## Module 10 Final Exam

## **Elevator Preventive Maintenance**

NAME (Print)								
		First	Middle Initia	l	Last			
	Empl	oyee Number _		Date				
INSTRUCTIONS:	Before starting, fill in your name, employee number and the date.							
	before point-	answering, read each question carefully. Read ALL answers selecting the answer that is <b>most correct</b> . Using ink or ball ben, circle the answer that indicates your choice. <b>Select only nswer</b> .						
	When words used such as; all, most, mostly, system, or any other similar word, they normally pertains to BART property.							
	When changing a previously selected answer, circle the ans you WANT and cross out your previous selection then initia MAKE CORRECTIONS OBVIOUS.							
EXAMPLE:	The third rail is electrified with?							
	a)	500 volts DC						
	b)	1000 volts DC						
	C)	500 volts AC						
	d)	1000 volts AC						

- 1. What would be the elevator speed when the manual lowering valve is opened?
  - a) Not to exceed 20 fpm.
  - b) Not to exceed 30 fpm.
  - c) Normal running speed.
  - d) It depends on the elevator location.
- 2. What is the most important key element in performing any PM and services on elevators and escalators?
  - a) Safety
  - b) Barricade
  - c) Tagout and lockout
  - d) Opening of circuit breaker.
- 3. What is the minimum clearance between the car platform sill to the landing sill of a side-post elevator?
  - a) ½ inch
  - b) <sup>3</sup>/<sub>4</sub> inch
  - c) 1 inch
  - d) No minimum required
- 4. All of the following statements are true before starting an elevator, except?
  - a) Inform the Station Agent
  - b) Make sure no bystanders have entered around safety barricades.
  - c) Notify all personnel working in or around the elevator that the unit is ready to start.
  - d) Wait for the reply of all personnel in or around the area before starting.

### 5. What should be the oil level inside the worm gear?

- a) 1/3 of the worm gear
- b) 2/3 of the worm gear
- c)  $\frac{1}{2}$  of the worm gear
- d) Above the worm gear

- How would you know if the door spirator closes the doors properly and smoothly? By \_\_\_\_.
  - a) Wedging the hall doors then let the doors go.
  - b) Closing hall door a foot away from the door jamb or between doors.
  - c) Disengaging the hall door from the car door and let the car doors go.
  - d) Closing hall door with hand fist in-between doors then let the doors go
- 7. What are the colors of the hall direction lantern lenses?
  - a) UP and DOWN are both red.
  - b) UP and DOWN are both green.
  - c) Green for UP and red for DOWN.
  - d) Green for DOWN and red for UP.
- 8. When steel fillings beneath the traction sheave are found, it's an indication of \_\_\_\_.
  - a) upthrust bearing wear.
  - b) machine being overused.
  - c) residue from work on the floor during installation.
  - d) slippage between the ropes and sheave or wear of wire ropes.
- 9. How often should you inspect the brushes and the commutator of a DC motor?
  - a) Monthly
  - b) Quarterly
  - c) Semi-annually
  - d) Annually
- 10. Passenger elevators and automatic operation freight elevators shall be provided with an emergency alarm system, operable from within the car, which will provide effective means for summoning assistance at all hours in case of emergency. This is a code requirement by \_\_\_\_\_.
  - a) BART OR&P Rule 5100
  - b) CCR Elevator Safety Orders §3041.
  - c) CCR, Elevator Safety Orders §3035
  - d) CCR, Title 8, Article 13 Safety Order 4015

- 11. How would you set the brush of a DC motor?
  - a) Use abrasive grit cloth (sandpaper) underneath the brush.
  - b) Shape the brush bottom with a knife to match the commutator curve.
  - c) Grind the brush to match the curve of the commutator before installing.
  - d) Run the motor with a load until the brush shapes with the commutator.
- 12. Unequal tension of wire ropes will show steel fillings beneath the sheave.
  - a) True
  - b) False
- 13. Match all the part name below with the numbers in figure 10-3e.
  - a) Centering screws
  - b) Split housing screws
  - c) Heel and toe adjustment \_
  - d) Spring adjustment screws \_\_\_\_

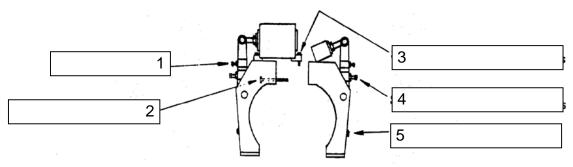


Figure 10-3e, Hollister-Whitney DC Brake, W10 Parking Elevators O&MM

- 14. You should replace the elevator brake pads if the lining is \_\_\_\_\_ or less than the original thickness.
  - a) ¼
  - b) 3/8
  - c) 1/3
  - d) ½

- 15. The passenger elevator Hall Chimes will chime \_\_\_\_\_.
  - a) the same for both UP and DOWN.
  - b) once for UP and trice for DOWN.
  - c) twice for UP and once for DOWN
  - d) once for UP and twice for DOWN.
- 16. BART passenger elevators are set to level at \_\_\_\_\_.
  - a) <sup>1</sup>/<sub>4</sub> inch or less
  - b) 3/8 inch or less
  - c) <sup>1</sup>/<sub>2</sub> inch or less
  - d) <sup>3</sup>/<sub>4</sub> inch or less
- **17.** What will happen to the elevator car light during test of emergency light switch? The rechargeable battery takes over the normal power supply and the light \_\_\_\_.
  - a) is not affected
  - b) should flicker but stays on.
  - c) stays on with no visual effect.
  - d) goes out for a period of 1 second then stays on.
- 18. When checking for wire rope seating depth, an indication of \_\_\_\_\_ inch can cause slippage and sheave wear?
  - a) 1/64
  - b) 1/16
  - c) 3/64
  - d) 3/16
- 19. What should you do if you found the brushes of a DC hoist motor to be 50% or less?
  - a) 50% is still acceptable.
  - b) Replace all brushes at the same time.
  - c) Replace the brushes in pairs per month or as necessary.
  - d) Make a report to your Supervisor to prepare the motor for overhaul.

- 20. When can you access the hoistway of an elevator for inspection?
  - a) After installing block underneath the car.
  - b) Only when you are working with someone.
  - c) Only when the pit stop switch is within reach.
  - d) When you have reliable method of controlling the car.
- 21. What should you look for while inside the elevator pit and at the cartop?
  - a) Light switch
  - b) Refuge area.
  - c) Safety switch
  - d) Control valve
- 22. What will happen if you actuate the elevator emergency stop switch? The car \_\_\_.
  - a) stops and a flashing signaling device is visible.
  - b) stops and an audible signaling device is heard.
  - c) stops at the nearest landing and an audible signaling device is heard.
  - d) will not stop until it reaches its destination then an audible signaling device is heard.
- 23. What is the runby clearance of the counterweight? The counterweight striking plate must be no less than \_\_\_\_ inch from the top of the shock absorber.
  - a) 5
  - b) 5.5
  - c) 6
  - d) 7
- 24. What causes the counterweight runby clearance to be less than the minimum required?
  - a) Counterweight frame maybe loose.
  - b) Guide rails are most likely out of alignment.
  - c) Shock absorber may have sprung a leak inside the cylinder.
  - d) Wire ropes and/or the drive sheave grooves are most likely worn

- 25. When inspecting the elevator spring buffers, they should be vertical and properly align with the \_\_\_\_?
  - a) Striker plates on the car.
  - b) Pit channel and the guide rails.
  - c) Crosshead and the pit channel.
  - d) Safety plank and the pit channel.
- 26. The vertical clearance between the pit floor and the lowest structure or mechanical part underneath the car platform except guide shoes or rollers, safety jaw assemblies, and aprons, or other equipment located within 12 inch (305mm) horizontally from the sides of the platform shall be?
  - a) Not less than 2 feet.
  - b) Not less than 3 feet.
  - c) Exactly within 2 feet
  - d) Not less than 2 <sup>1</sup>/<sub>2</sub> feet
- 27. What should you not do in the performance of oil buffer maintenance?
  - a) Never step on top of the buffer.
  - b) Do not clean the disconnect switch.
  - c) Do not attempt to disassemble an oil buffer.
  - d) Never land the elevator car on top of the buffer.
- 28. What should you be looking for when inspecting door pulleys?
  - a) The door open switch from the operating panel works.
  - b) Insure that the door closing and opening are properly timed.
  - c) Check for flat spot, loose tires, worn bearings, dry tires, and binding.
  - d) The door sensor should open the door when an object is between doors or door and doorjamb.
- 29. Is the 2 inch pre-opening of doors applicable to BART Station street and platform elevators?
  - a) No
  - b) Yes

- 30. What is the status of the car and hall doors against the doorjamb when fully closed for side opening doors?
  - a) Flushed
  - b) A clearance of 1/16 inch.
  - c) Closed but not too tight.
  - d) With a light visible from the other side.
- 31. As Code requirement, the door gib tab needs to be \_\_\_\_ before inserting under the bottom of the door panel.
  - a) up
  - b) down
  - c) removed
  - d) pointing out
- 32. Match the part name below with the part numbers in figure 10-8a?
  - a) Hanger track
  - b) Eccentric roller \_\_\_\_
  - c) Cam mounting screws
  - d) Track mounting screws and washers

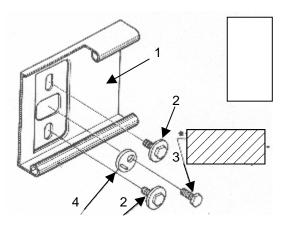
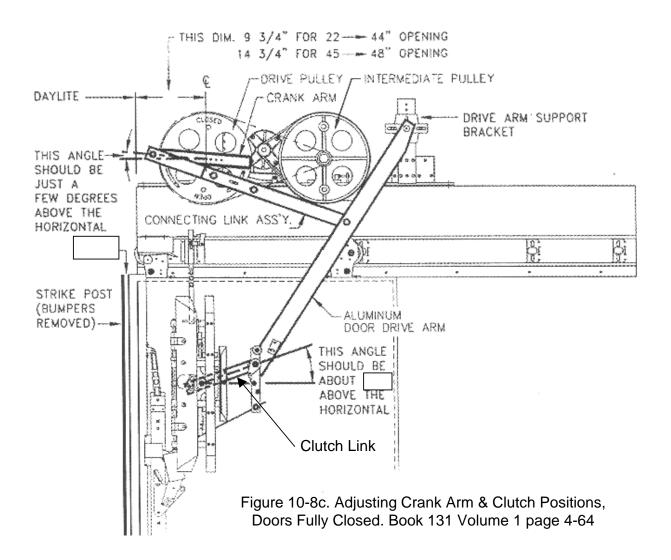


Figure 10-8a. Door Track Adjustment

- 33. To raise the door panel and to align the track, what must you do to part # 4?
  - a) Turn half way towards.
  - b) Turn to the right and up.
  - c) One full turn to the right.
  - d) Turn to the left and down towards the bottom.
- **34.** What is the probable cause of an inconsistent or "jerky" door movement? An indication that the \_\_\_\_
  - a) door gibs are misaligned.
  - b) door panels are out of plumb.
  - c) drive chain needs adjustment or the guide rollers are worn out.
  - d) door edges are not centered and the light beams are misaligned.

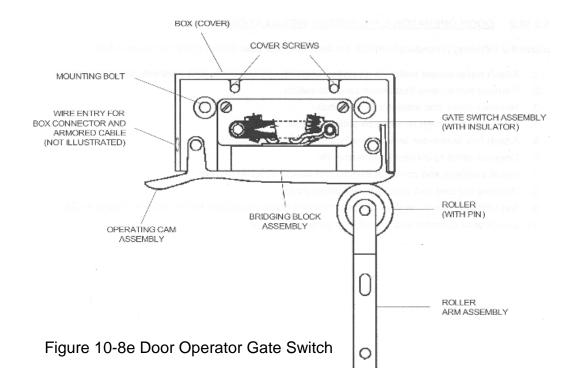
35. The clutch link in figure 10-8c is how many degrees above the horizontal?

- a) 15°
- b) 20°
- c) 25°
- d) 30°



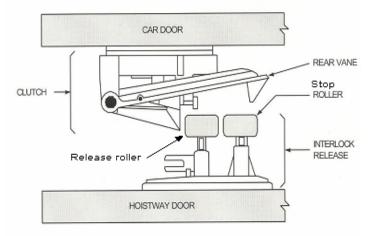
- 36. What should be the distance between the striking post and the door edge with the bumpers removed in figure 108-c?
  - a) 1/32 inch
  - b) 1/16 inch
  - c) 3/16 inch
  - d) 1/8 inc

- 37. The gate switch in figure 10-8e below should open when the car door \_\_\_\_.
  - a) starts to open.
  - b) is totally opened.
  - c) is open 1 inch or more
  - d) opens at 2 inch or more



- 38. What is the circuit status of the switch in figure 10-8e if you place an elevator car in inspection?
  - a) Isolated
  - b) Power ON
  - c) Power OFF
  - d) Power dropped to  $\frac{1}{2}$  its voltage.
- 39. How often should you inspect Car Operating Control panel?
  - a) Every visit
  - b) Monthly
  - c) Quarterly
  - d) Semi-annually

- 40. What is the margin between panels, under panels, and adjacent sections (headers, doorjamb, and cab entrance column) of car and hall doors?
  - a) A nominal ¼ inch or as required by the manufacturer.
  - b) You should see the light at the other side of the panel.
  - c) A nominal ½ inch or as required by the manufacturer.
  - d) The width of one finger or as required by the manufacturer.
- 41. The door closing torque is directly related to the closing speed, the faster the speed the higher the torque.
  - a) True
  - b) False
- 42. What is the clearance of the rear vane from the stop rollers in figure 10-8h when the car door is ½ inch from the striking post and hall door is fully closed?
  - a) 1/16 inch
  - b) 3/16 inch
  - c) 1/8 inch
  - d) 3/8 inch
- 43. What is the clearance of the clutch rear vane in figure 10-8h when the doors are fully open?
  - a) 1/8 inch
  - b) 3/8 inch
  - c) <sup>1</sup>/<sub>4</sub> inch
  - d) ½ inch



- Figure 10-8h. Clutch & Interlock Release
- 44. What will happen to the gate switch if the release roller in figure 10-8h will not engage the clutch during door opening cycle?
  - a) Remain closed
  - b) Remain opened
  - c) Closes partially
  - d) Opens partially

- **45.** What should you do if your finger wiped test in the sheave groove leaves the finger dry and formation of rust and deterioration between the strands is found?
  - a) No maintenance required.
  - b) Wire rope lubrication is necessary
  - c) Further inspection to all ropes is needed.
  - d) Inform your Foreworker to schedule wire rope replacement.
- 46. How far will the door retractable mechanical safety edge extends beyond the door edge during closing cycle?
  - a) 1 inch
  - b) 1 ¼ inch
  - c) 1 <sup>3</sup>/<sub>4</sub> inch
  - d) 2 inch
- 47. How wide can you open the car doors when the car is outside the unlocking zone?
  - a) Opens to less than 3 in. from inside the car.
  - b) Opens to less than 4 in. from inside the car.
  - c) Cannot open more than 3 in. from inside the car.
  - d) Cannot open more that 4 in. from inside the car.
- 48. How do you inspect the locking zone device operation? Insure that pressing the \_\_\_\_\_.
  - retiring bar assembly, the zone locking device unlocks and locks when retiring bar assembly is released.
  - retiring bar assembly, the zone locking device locks and unlocks when retiring bar assembly is released.
  - c) retracting arm assembly, the zone locking device unlocks and locks when retiring bar assembly is released.
  - d) Retracting arm assembly, the zone locking device locks and unlocks when retiring bar assembly is released.

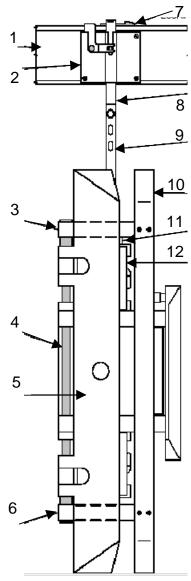


Figure 10-8j Door Clutch Assmebly

- 49. What may be the problem on the drive sheave grooves if a straight edge inspection does not contact all the wire ropes?
  - a) Worn grooves
  - b) Undersized groove.
  - c) Sheave not balanced.
  - d) Misaligned wire ropes.
- 50. Which part of the Car Top Tape Reader you should pay particular attention to for wear and tear during your inspection?
  - a) Part #1
  - b) Part #2
  - c) Part #3
  - d) The box
- 51. Where is the best place to access figure 10-6e?
  - a) At the top of the car.
  - b) At the bottom of the pit.
  - c) At the top most landing.
  - d) Inside the machine room.

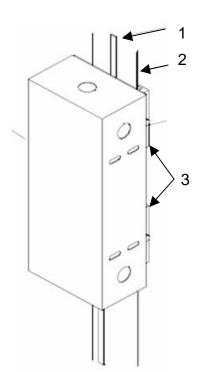


Figure 10-6e Car Top Tape Reader

- 52. Where sliding-type guide shoes are used, insure that rails are\_\_\_.
  - a) Free of lent and dirt and must be coated with a heavy grease.
  - b) Free of lubrication since sliding guide shoes are lubrication free.
  - c) Must be coated with a film of grease or oil but not excessively lubricated.
  - d) Free of lent and dirt, must be coated with a film of grease or oil but not excessively lubricated.
- 53. When Fire Operation is in the ON position, the elevator shall be on Phase II Emergency In-Car Operation, for use by whom?
  - a) Nobody.
  - b) Trapped passengers.
  - c) Emergency personnel only.
  - d) Maintenance personnel only.

- 54. When Phase I Emergency Recall Operation recall is initiated, all elevators will \_\_\_\_.
  - a) Disembark passengers at any landing and leave doors open.
  - b) Return nonstop to the designated level and park with the doors open.
  - c) Load passengers from upper floors and bring them to the designated level and park with doors open.
  - d) Unload passengers at the nearest landing then proceed to the designated level and park with doors open.
- 55. In the performance of preventive maintenance to the roller guides, all of the statement below are true, except?
  - a) Rail is lubricated.
  - b) Spring properly tensioned,
  - c) Roller surfaces against the rail evenly and evenly worn.
  - d) Bearings are quite when the car is travelling.
- 56. What will happen to an ascending hydraulic elevator car if you disconnect low oil level sensor wire from the controller? The controller \_\_\_\_\_.
  - a) losses control over the ascending elevator and the MLT elapsed takes over.
  - b) automatically send the car to the bottom landing after MLT elapsed, leave the doors opened, and takes the car out-of-service.
  - c) terminate the car from ascending and you have to manually lower it through the manual lowering valve.
  - d) brings the car to the nearest floor to unload the passengers, leave the doors opened, and take the car out-of-service.
- 57. What must you do when replacing pump drive belts in accordance with ANSI Rule 1200.4?
  - a) Drive belts must be replaced in matched set. When replacing a broken belt, replace all serviceable belts.
  - b) Drive belts must be replaced in pairs and spray belt dressing to the others.
  - c) Replace worn belts only and spray belt dressing to the other belts for traction.
  - d) If multiple drive belts in one pulley, you can pull worn belt and replace belt when more than one is worn.

- 58. While opening the Manual Lowering Valve to initiate a downward movement, the pump motor should start when or before the car exceeds \_\_\_\_\_.
  - a) 1 inch from the floor.
  - b) 2 inch from the floor.
  - c) no more than .5 inch from the floor.
  - d) no more than 2 inch from the floor.
- 59. What must you do before checking for belt tension between the motor and the pump pulleys?
  - a) Use one finger to push each belt for tension.
  - b) Trip the circuit breaker/quick disconnect only.
  - c) Always turn off and tagout circuit breaker/quick disconnect.
  - d) Inform the Station Agent to make sure no one uses the elevator.
- 60. If the Station Agent cannot acknowledge the call during elevator telephone system inspection, how many seconds before Central Control should acknowledge the test or an emergency call will register?
  - a) 60 seconds
  - b) 80 seconds
  - c) 90 seconds
  - d) 100 seconds

- B. Inspect Traction Elevator Brake (M): Manpower: one Mechanic, two Mechanics for brake located in the pit. Estimated Labor-hour: 0.5 hours
- CAUTION: Use special caution to avoid contact with any moving equipment while inspecting the brake.

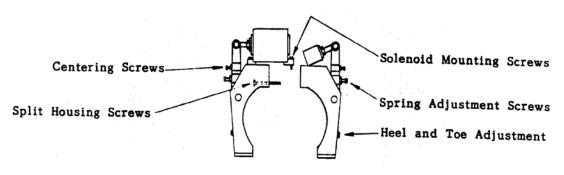
Avoid touching the brake drum when mainline disconnect switch is engaged.

The most common trouble encountered in a direct current brake is the **reluctance to set**. Number one cause of slow setting is due to **residual or circulating magnetism**. A worn thin plate between the cores, the brake may take a very long time to set. With weak springs, the brake may never set, but with strong springs it will set but have a varying delay. When a "soft-set" brake is used, the brake will set at a lower rate with the use of resistor whose value is less than three times the coil resistance.

- 1. Operate the unit to observe the operation of the **brake**.
  - a) The **brake should apply** smoothly and quite at each stop on or after completion of the slow down and leveling operation.
  - b) A brake that is slow in applying (car overshoots the floor) or noisy indicates that thorough maintenance is needed.
- 2. The brake lining clearances should be at minimum to permit free running without drag. Use a light to observe the clearances between the brake and the drum when the elevator is running. The light should go through the drum and the brake lining.
- 3. If the elevator has been operating, the **drum** will be hot but should not be uncomfortable to touch. A hot drum may indicate a dragging brake.
  - a) Make sure that there is approximately **1/32**" **between the centering screw** (figure 13 p34) and the housing when the solenoid is energized (i.e. brake plungers make contact and the car is traveling).
- **NOTE:** Do not use centering screws as stops to limit plunger travel.
  - b) Place the Relay Board Inspection switch to Inspect. Make sure that there are no passengers onboard. If another Mechanic is available to assist, run car on TEST at low speed to make proper adjustment. With one Mechanic, run car from top most to bottom most floors or

vice versa. With solenoid energized, tighten centering screws until centering screws touch main housing, back off 1/4 to 1/2 turn. BART O&MM Book 217 page 4-75.

c) Examine the **pins** for lubrication, looseness and conditions of retainers (figure 14 p36). Lubricate all **pivot pins** with drop of oil. Clean and wipe off any excess or spilled lubricants.



#### Figure 13, Hollister-Whitney DC Brake, Colma Station Parking Elevators O&MM

- 4. Open mainline disconnect, tag-out and lock-out the unit. Perform complete visual inspection on all sides of the brake pads and the drum. Make proper adjustment or correction as necessary.
  - Look a) for evidence of contamination on the drum and the brake pads that maybe caused by oil/grease. Look for scoring that may be caused by worn lining allowing the rivets to contact the drum. Replace worn and/or contaminated pads.



Figure 15a, Uneven Brake Pads Wear

- b) Carefully **inspect all moving parts** for looseness, misalignment, wear and evidence of overheating.
- c) **Inspect brake pads** and look for uneven wear due to misalignment or improper spring tension (figure 15a).

- d) Examine the **brake solenoid coil** for evidence of overheating or wear which may be indicated by accumulation of lubricant or powder around the plunger.
- C. Inspect Worm and Gear (Q): machinery located in the pit. Manpower: one Mechanic, two Mechanics for Estimated Labor-hour: 1.0 hours
  - 1. Open mainline disconnect, tag-out and lock out the elevator.
  - 2. Clean the machine top, inspection cover, and oil cap to avoid contaminants entry into the gearbox.
  - 3. Check the proper **oil level** of a geared machine (figure 15 p38). Lubricants must be in high-level mark shown on the gauge. In the absence of level gauge, it is important that **the oil level should be maintained at the center of the worm gear**.

Replacement of worm-gear lubricants should be done every three years for normal machine room environments.

The gear case should be drained, thoroughly washed out with suitable solvent and refilled with fresh lubricant at the first indication of abrasive dust, excessive condensation, excessive "frothing" (foaming), or breaking down of the oil.

Dispose used oil in proper disposal container/ area.

Wear in worm-gear drives is caused chiefly by metal-to-metal contact during starting and stopping.

- 4. Check for improper wear on **gear teeth**. Their teeth profile and the teeth
  - **top land** (figure 15a) should show even pattern of wear. The gear should also have a film of oil on the teeth and minimum foaming of the oil. Worn gear teeth maybe caused by lack of lubrication, worn bearings, or misaligned worm or ring gear.
- 5. Inspect gear oil for any **evidence of discoloration**, **metallic contamination**, or any form of contamination.

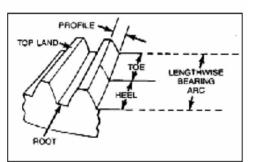
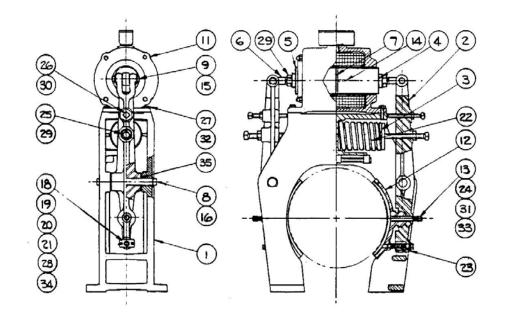


Figure 15a. Typical Gear Teeth

6. Look for **oil leaks** that may result in failure of the drive train or contaminate the brake, traction, commutator and other components.

7. Reinstall gear case inspection plate. Clean and wipe off any excess or spilled lubricants. Return the elevator to service. Inform the Station Agent and Central Control.



No.	DESCRIPTION	Qty	#90 (10" dia)	#100 (12" dia)	#110 (14" dia)	#120 (16" dia)
1	HOUSING	11	90-1	100-1	110-1	120-1
2	LEVER	2	90-3-A	90-3-A	110-3-A	120-3
3	CAP-SPRING	2	90-5	90-5	90-5	90-5
4	PLUNGER	1	90-6	90-6	90-6	120-6
5	PLUNGER	1	90-7	90-7	90-7	120-7
6	EYEBOLT	2	90-8	100-8	100-8	90-8
7	RING-PLUNGER	1	90-11	90-11	90-11	90-11
8	PIN-LEVER	2	90-12	100-12	110-12	120-12
9	PIN-PLUNGER	2	90-13	90-13	90-13	90-13
10						
11	SOLENOID ASSEMBLY	1	90-28	90-28	90-28	120-28
12	SHOE ASSEMBLY	2	90-29-A	100-29-A	110-29-A	120-29
13	NUT-NYLON		90-30	90-30	90-30	90-30
14	SCREW-DRIVE	1	90-31	90-31	90-31	90-31
15	RING-TRUARC	4	90-32	90-32	90-32	90-32
16	RING-TRUARC	4	90-33	90-33	90-33	90-33
17						
18	PLATE	2	90-36	90-36	90-36	90-36
19	BUSHING-OILITE	2	90-45	90-45	90-45	90-45
20	SCREW-HEX HEAD	2	90-38	90-38	110-38	110-38
21	WASHER	4	90-39	90-39	90-39	90-39
22	SPRING-LEVER	2	400-32	400-32	400-32	400-34
23	SPRING-SHOE	2	400-39	400-39	400-39	400-19
24	STUD-ALL THD.	2	500-23	500-23	500-23	500-23
25	SCREW-SQ HEAD SET	2	5/8"NC x 4"	5/8"NC x 43"	5/8"NC x 5"	5/8"NC x 4"
26	SCREW-SO HEAD SET	2	1/2"NC x 35"	1/2"NC x 35"	1/2"NC x 4"	1/2"NC x 5"
27	SCREW-HEX HEAD CAP	4	3/8"NC x 11"	3/8"NC x 11"	3/8"NC x 12"	3/8"NC x 13"
28	SCREW-ROUND HEAD	4	#10-32 x 3"	#10-32 x 3"	#10-32 x 5"	#10-32 x 5"
29	NUT-JAM	4	5/8" NC	5/8" NC	5/8" NC	5/8" NC
30	NUT-JAM	2	1/2" NC	1/2" NC	1/2" NC	1/2" NC
31	SPRING-PIVOT		400-70	400-70	400-70	400-70
32	WASHER-STANDARD	4	3/8"	3/8"	3/8"	3/8"
33	WASHER-STANDARD	4	5/16"	5/16"	5/16"	5/16"
34	WASHER-LOCK	4	#10-32	#10-32	#10-32	#10-32
35	BUSHING-LEVER	4	90-44	90-44	90-44	90-44

MRG:keg (7/88)

Figure 14 Traction Elevator Brake Parts Breakdown

**D.** Inspect Traction Sheave and its Bearings (Q); Manpower: two Mechanics for drive sheave located in the pit or in the hoistway. Estimated Labor-hour: 0.45 hours

You may ride the top-of-the car to access traction sheave located in hoistway.

- 1. Open the disconnect, tag-out and lock-out if applicable while inspecting for **unequal wear of traction sheave grooves and wire ropes**.
- 2. Inspect the traction sheave **mounting bolts**. Look for evidence of wear on side of sheave or under mounting bolts and nuts that may indicate looseness.
- 3. Inspect for steel fillings beneath the sheave as an **indication of slippage between the ropes and sheave or wear of wire ropes**. This may be caused by any or combination of the following:
  - Unequal tension in the rope;
  - Contamination of the ropes with gear lubricant or grease and dirt;
  - Unequal rope diameter;
  - Excessive lubricant;
  - Incorrect counterweight;
  - Overloading and hard breaking;
  - Improper fit between the rope and sheave;
  - Improperly aligned drive sheave.

Any or combination of the above probable problem may cause sound vibration and/or noise around the drive sheave.

Report found evidence of failure to your Foreworker.

- 4. Visually examine the sheaves to ensure they are tight on shafts. **Sound spokes and rim** with hammer to detect cracks.
- 5. Run the elevator and listen to any noise off the traction sheave **bearing**.
- 6. Open the disconnect switch, tag-out and lock-out the elevator for overhead traction machine. Mainline disconnect must be ON to inspect traction sheave bearings located in the hoistway.

a) Clean the zerk fittings on the **spider hub** traction side and on the gear housing (figure 15).

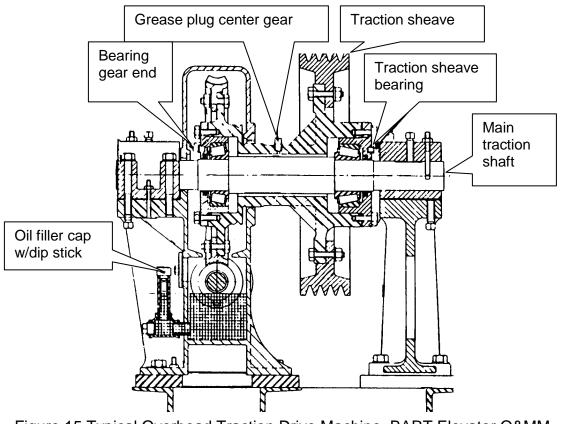


Figure 15 Typical Overhead Traction Drive Machine, BART Elevator O&MM

- b) Re-grease the bearings. Replace cover for the plug back and wipe off any excess or spilled lubricants.
- c) Clean and open pressure relief plug between the gear housing and traction sheave.
- 7. Return the elevator to service. Inform the Station Agent and Central Control.
- E. Inspect Sheaves of Counterweight, Deflector/Overhead, Overspeed Governor, and Car (Q): Manpower: two Mechanics. Estimated Labor-hour: 1.5 hour

One of the most important guarantors of safe operation in traction elevators is the friction between the traction sheave and the ropes. Friction changes as the result of;

- variations in groove wear,
- reductions in rope diameter,
- fluctuations in lubrications, and
- the differing tolerances produce by rope replacement and drive sheave regrooving.

#### CAUTION: Observe safety during inspection and maintenance.

**Inspect all sheaves;** car, counterweight, and overspeed as follows;

- 1. Operate the elevator in both directions and observe the sheaves, looking and listening for:
  - a) axial movement;
  - b) mounting or axle vibration;
  - c) bearing noise;
  - d) rope tracking;
  - e) vibration or wobble of the sheave or ropes.
- 2. Have access to the elevator pit to inspect car sheaves (split sheaves) for underslung elevators. Manually inspect car sheaves for axial movement or wobble of the sheave, mounting, ropes tracking, secured fastening, and minimum clearance of the rope anti-slack bar.
- 3. Clean bearing housing and grease fitting to lubricate bearings. Wipe off excess lubricants.
- 4. Verify that the sheaves are marked to indicate minimum bottom groove diameter.
- 5. Clean and inspect counterweight sheave for secure fastening. Clean the grease fitting to lubricate its bearings. Wipe off excess lubricants.
- 6. During inspection of counterweight sheave, inspect (Annually) its **frame**, **tie rods, and weights for cracks, secure fastening, and corrosion**.
- 7. Open the disconnect switch, lock-out and tag-out. Inspect the sheaves for **rope seating depth**, cracks, condition of sheave grooves, and proper lubrication. A sheave groove gauge may be used to check the rope setting depth if needed. A badly worn sheave may shorten wire rope life.
- 8. Repair, correct, or make a report to your Foreworker for assistance of any found discrepancy.
- 9. Return the elevator to service. Inform Station Agent and Power and Way.

- F. Inspect Governor, Overspeed Switch and Seal (Q), Vertical Centrifugal Overspeed Governors: Manpower: one Mechanic, Estimated Labor-hour: 0.5 hour
- WARNING: Do not check overspeed governor with power applied to the system.
- NOTE: Speed Governor Required and Locations: Counterweight safeties, where provided with rated speeds over 150 fpm (0.76 m/s), and car safeties, shall be actuated by separate speed governor. This is applicable to all BART parking garage traction elevators and Daly City Yard elevator.

W10/EL86, 87, 88, & 89 counterweights are equipped with overspeed governors.

Car Speed Governor Tripping Over Speed: The speed governors for car safeties shall be set to trip at no less than 115% of the rated car speed. CCR §3036.

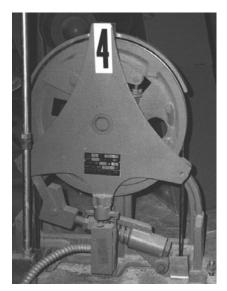


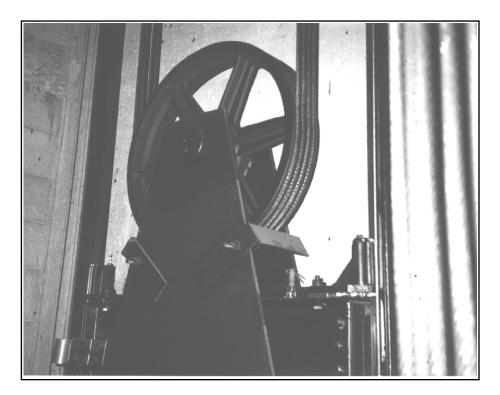
Figure 20, W20/EL89 Overspeed Governor Sheave machineroom mount

**Counterweight Speed Governors:** Speed governors, where provided for counterweight safeties, shall be set to trip at an overspeed greater than that at which the car speed governor is to trip, but no more than 10% higher. **CCR §3036**.

1. Open the mainline disconnect, lock out and tag-out the elevator with overhead machinery.

2. **Examine the car and counterweight governors**, for secure fastening and free running of the rope. The rope must not be rubbing against the governor jaws or other parts.

Figure 16, K10/EL23 Counterweight Sheave



- 3. **Examine all linkages, gears, pins, collars, bushings, latches**, and mechanisms for evidence of excessive wear and lost motion.
- 4. **Clean and check all moving parts** to insure that there are no restriction and corrosion.
- 5. **Hand trip the governor by lifting the weights** or other mechanisms to determine that there is ample room for movement of all parts with the governor rotation. Insure that the micro-switch lever resets to normal.
- 6. **Check all governor grip jaws** and rubbing surfaces to make sure that they are not worn and are free of paint.

CAUTION: DO NOT SPILL ANY LUBRICANTS ONTO THE GOVERNOR ROPE.

7. Lubricate all pivot pins with drop of oil. Lubricate bearing hubs, if

- equipped, with a pressure gun until old grease expelled at the hub. BART K10/EL23 in figure 21 is equipped with an **access cover cap behind the sheave for oil replenishing**. Wipe off any excess or spilled lubricants.
- 8. PM must be perform for elevators with machinery in the pit level or in the hoistway as follows:
  - With the power ON, ride on top-of-the-car to the highest platform. Turn top-of-the-car inspection switch to STOP, perform PM on the governor mechanism.

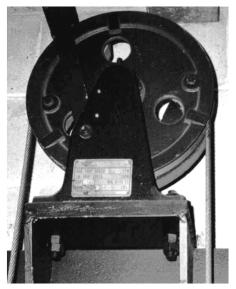
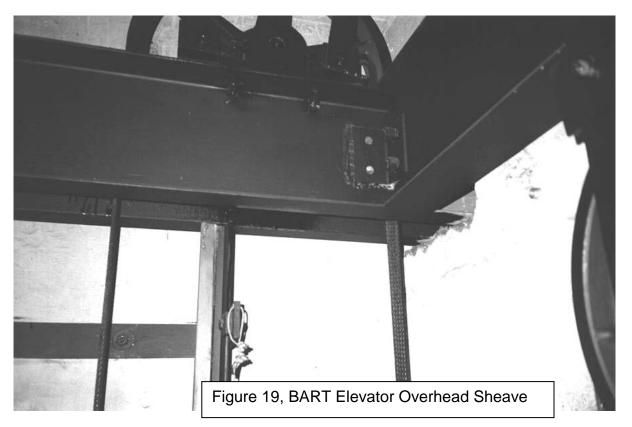


Figure 21, K10/EL 23 Overspeed Governor Sheave hoistway overhead mount

- b) Run the elevator to the lowest platform to perform PM on the governor overspeed switch located under the car safety plank.
- c) **Inspect switch** mechanism of Governor Overspeed and Anti-slack Cable Safety (figure 23 p44). Turn power off. Open switch cover and check for corrosion, tightness of screws, and proper operation of the switch.
- 9. **Examine the test tag** attached to the governor and note the date that the next five years test is due.
- **NOTE:** An authorized representative of the DIS shall witness this test, or the division may accept reports of witnesses recognized as competent by the division. A metal data tag attached to the governor fastening must bear the following wire rope data as per CCR §3036:
  - the diameter in inches;
  - the manufacturer's rated breaking strength;
  - the grade of material used;
  - the month and year the rope was installed;
  - whether non-preformed or preformed;
  - construction classification;

- name of the person or firm who installed the rope;
- name of the manufacturer of the rope.
- 10. Return the elevator to service. Inform the Station Agent and Central Control.



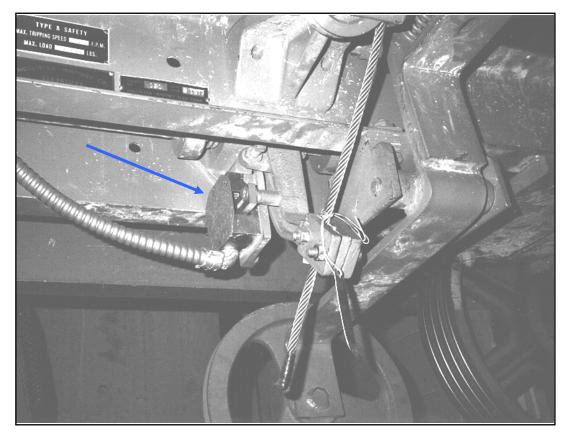


Figure 22, K10/EL23 Governor & Anti-slack Cable Safety Switch (w/arrow)

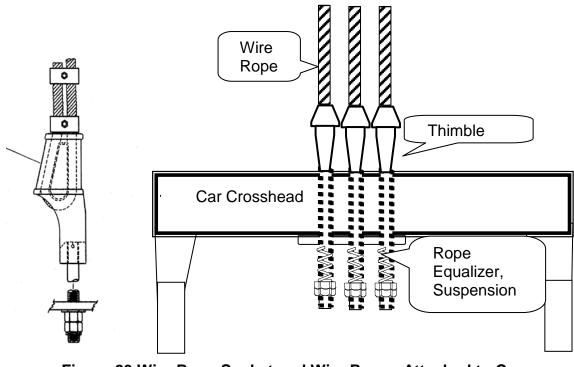


Figure 23 Wire Rope Socket and Wire Ropes Attached to Car

- **G.** Clean, Inspect, and Lubricate Governor Tension Return/Sheave (Q): Manpower: two Mechanics, Estimated Labor-hour: 0.25 hour
  - 1. Place the elevator on inspection at the lowest landing and have access to the pit.

# CAUTION: Look for refuge area and stay away from the counterweight while running the car.

- 2. Clean dust shield and examine **governor tension sheave** and its rail fastening for corrosion, obstruction and that they are clean and secured.
- 3. Run the elevator in inspection mode, listen for **bearing noise and examine sheave movement and vibration**. Insure it does not wobble.
- 4. Stop the elevator, **lubricate bearings and pivot pins**. Wipe off any excess or spilled lubricants.
- 5. Return the elevator to service. Inform the Station Agent and Central Control.
- H. Clean, Inspect, Lubricate Safety Linkage (Q), and Safety for Traction Elevator (Annually), CCR §3035 Safeties; Inspect wire rope for stretch in the pit; Manpower: two Mechanics, Estimated Labor-hour: 0.5 hour
  - 1. Place the elevator on inspection or independent service at the lowest landing to inspect **safety linkages** located under the car. These safety linkages maybe part of the **governor overspeed**, or **the wire rope anti-slack devices** (figure 22 p44) that are currently applicable to the BART elevators: EL23, EL25, EL53, EL55, EL57, L34, EL36, EL37, and EL45.
  - 2. If governor-actuated safety linkages are located on or near the top-of-thecar, have access to the cartop. This may be applicable to parking garage and Daly City Yard elevators.
  - 3. Clean and inspect **links and pins** of governor-actuated safety gear for freedom of movement.
  - 4. Lubricate all **pivot points** with a few drops of oil. Wipe off excess oil.
  - 5. Clean and **inspect safety mechanism** for corrosion and any obstruction. Lubricate all pivot points. Wipe off excess oil.

### CAUTION: DO NOT OVER LUBRICATE ANY MECHANISM AROUND THE RAIL.

6. Insure that the metal **safety marking plate(s)** is attached to each safety so as to be readily visible, and shall be marked in a legible and permanent

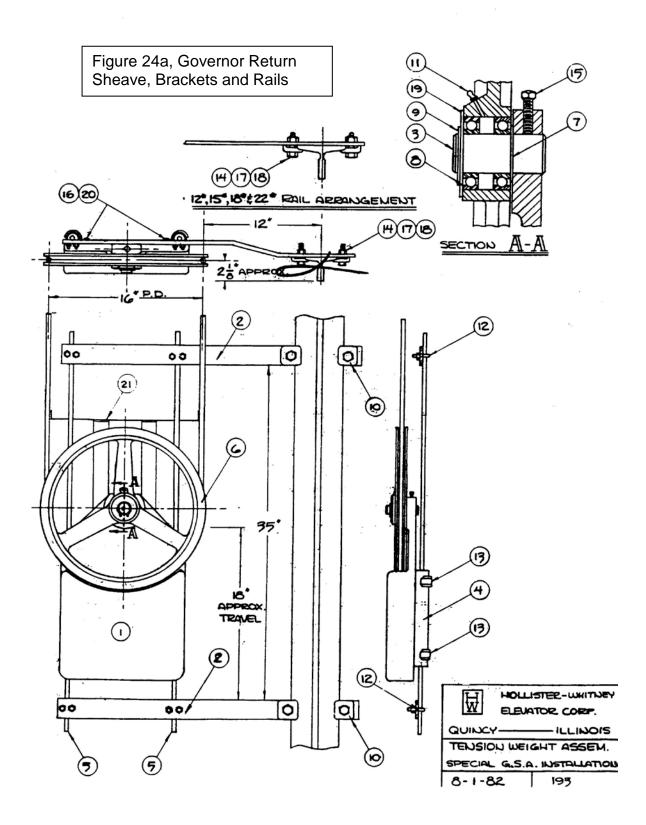
manner with letters and figures not less than 1/4 inch in height indicating the following:

- type of safety;
- maximum tripping speed in feet per minute for which the safety is designed to be used;
- maximum weight in pounds for which the safety is designed to be used with the car frame in which it is installed;
- name of the manufacturer and the identifying number of the safety;
- date of the initial safety test required by CCR section 3035[a] witnessed by a representative of the division.
- 7. Check clearance between **rail and gripping face of wedges and jaws** (figure 24a p47from Book 217 p4-77 & 78).

# NOTE: As per CCR §3035 for Minimum Permissible Clearance between Rail Gripping Faces of Safety Parts:

In the normally retracted position of the safety, the distance between the rail-gripping faces of the safety parts shall be not less than the thickness of the guide rail plus **9/64 inch** (3.6mm). The clearance on any side between the gripping face and the guide rail shall be not less than **1/16 inch** (1.6mm) as measured on the side of the rail toward which the car frame is pressed with sufficient force to take up all clearances in the guide shoe assembly. Safety jaws, while in the retracted position, shall be so restrained as to prevent a reduction of this minimum clearance.

- 8. Inspect the portion of the car accessible from the pit. Determine whether all fastenings, including those between the car frame and the platform, are securely in place and that the frame is not distorted.
- 9. Clean and check the **platform toe guards and aprons** to insure they are securely fastened and not corroded.



- 10. Perform **wire rope inspections** (annually) at the bottom of the elevator pit. Two mechanics required;
  - a) Run the elevator at the top most landing to a floor level.
  - b) Inspect the **runby clearance** of the counterweight (figure 24b). **The counterweight striking plate must be no less than six inches from the top of the shock absorber**.

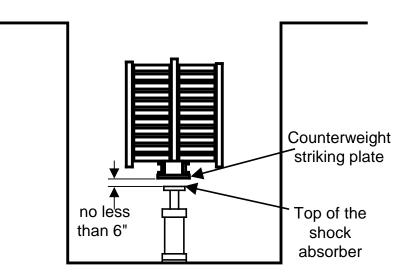


Figure 24b, Bottom Runby Clearance of Counterweight

- c) If found to be less than six inches, make a report to your Foreworker for **stretched wire rope**.
- 11. Clean the bottom floor rear of **sills** while at the pit.
- 12. Check **pit lights**. Replace lamps as required.
- 13. Clean and check all **fasteners** of the **pit channels**, **guide rails**, and **spring buffers.** They should be secured and free of corrosion.
- 14. Return the elevator to service. Inform the Station Agent and Central Control.

San Francisco Bay Area Rapid Transit District

Elevator & Escalator Mechanic Apprenticeship Program



Performance-Based Learning Series

Module 10: Elevator PM

San Francisco Bay Area Rapid Transit District 300 Lakeside Drive, Oakland, CA 94612 Copyright 2008

Module 10: Elevator Preventative Maintenance (PM)

## About this Module

Elevator PM goal is to prevent the failure of equipment before it actually occurs. PM is a schedule of planned maintenance actions aimed at prevention of breakdowns and failures. PM is designed to preserve and to enhance equipment reliability by inspecting, adjusting, lubricating and replacing worn parts before they fail.

### Why you need to know?

As an elevator / escalator mechanic, it is critical that you develop your expertise relating to Preventative Maintenance. You will need to correctly perform the established procedures to complete scheduled periodic maintenance.

## Module Objective

Upon completion of this unit, participants will be able to:

- 1. Apply all safety procedures while performing PM on elevators.
- 2. Inspect, adjust, lubricate and replace worn components while performing scheduled maintenance procedures.
- 3. Accurately complete all appropriate documents that confirm the completion of scheduled PM.
- 4. Apply all code requirements relating to maintaining elevators and their component.

## Module Resources

In the performance of the above objectives, participants will be given the following resources:

- BART PM Card
- BART Elevator/Escalator Maintenance Information Sheet
- Standard Issue Elevator/Escalator Tools and Replacement Parts
- Elevator scheduled for PM
- Elevator Simulator or Test Bench
- Most recent publications of the BART Operations Rules & Procedures (OR&P), Mechanical & Electrical (M&E) Safety Manual Book #343, the Elevator Industry Field Employee's Safety Handbook, and American Society of Mechanical Engineers.

This content of this module is based on information available at the time of its publication. It is not a maintenance procedure instruction for action; it is a training material for elevator preventive maintenance. This handout is not intended to replace any designed Operations and Maintenance Manual (O&MM) or Operations and Equipment Manual (OEM) Specifications for BART elevators nor adequately designed to describe the entire maintenance system of an elevator. Some drawings and/or pictures attached are copied from BART O&MM and pictures taken from BART elevators.

The Elevator PM, BART basics was developed to assist Elevator/Escalator Training Program for new Trainees and maintenance personnel the necessary fundamentals training to ensure a basic understanding of the elevator preventive maintenance. When words used such as; all, most, mostly, system, or any other similar word, they normally pertains to BART property.

### **Table of Contents**

Unit 1: Safety Practices Unit 2: About Preventive Maintenance Unit 3: Traction Machine Room & Equipment Unit 4: Hydraulic Machine Room Equipment Unit 5: Hydraulic Elevator Pit Equipment Unit 6: Hoistway Equipment Unit 6: Hoistway Equipment Unit 7: Car and Counterweight Unit 8: Hall and Car Doors Unit 9: Inspect Car & Car Operating Controls

# Module 10 Final Exam

# **Elevator Preventive Maintenance**

NAME (Print)										
( )		First	Middle Initia	al	Last					
	Empl	oyee Number _		Date						
INSTRUCTIONS:	Befor	e starting, fill in y	our name, employ	/ee number a	nd the date.					
	before point-	e selecting the a	l each question c nswer that is <b>mo</b> nswer that indicat	st correct. Us	sing ink or ball					
	When words used such as; all, most, mostly, system, or any other similar word, they normally pertains to BART property.									
	you V		eviously selected s out your previo S OBVIOUS.							
EXAMPLE:	The th	nird rail is electrifi	ed with?							
	e)	500 volts DC								
	f)	1000 volts DC								
	g)	500 volts AC								
	h)	1000 volts AC								

- 61. What would be the elevator speed when the manual lowering valve is opened?
  - a) Not to exceed 20 fpm.
  - b) Not to exceed 30 fpm.
  - c) Normal running speed.
  - d) It depends on the elevator location.
- 62. What is the most important key element in performing any PM and services on elevators and escalators?
  - a) <u>Safety</u>
  - b) Barricade
  - c) Tagout and lockout
  - d) Opening of circuit breaker.
- 63. What is the minimum clearance between the car platform sill to the landing sill of a side-post elevator?
  - a) <u>½ inch</u>
  - b) <sup>3</sup>/<sub>4</sub> inch
  - c) 1 inch
  - d) No minimum required
- 64. All of the following statements are true before starting an elevator, except?
  - a) Inform the Station Agent
  - b) Make sure no bystanders have entered around safety barricades.
  - c) Notify all personnel working in or around the elevator that the unit is ready to start.
  - d) Wait for the reply of all personnel in or around the area before starting.

#### 65. What should be the oil level inside the worm gear?

- a) 1/3 of the worm gear
- b) <u>2/3 of the worm gear</u>
- c)  $\frac{1}{2}$  of the worm gear
- d) Above the worm gear

- 66. How would you know if the door spirator closes the doors properly and smoothly? By \_\_\_\_.
  - a) Wedging the hall doors then let the doors go.
  - b) Closing hall door a foot away from the door jamb or between doors.
  - c) Disengaging the hall door from the car door and let the car doors go.
  - d) <u>Closing hall door with hand fist in-between doors then let the doors go</u>
- 67. What are the colors of the hall direction lantern lenses?
  - a) UP and DOWN are both red.
  - b) UP and DOWN are both green.
  - c) <u>Green for UP and red for DOWN.</u>
  - d) Green for DOWN and red for UP.
- 68. When steel fillings beneath the traction sheave are found, it's an indication of \_\_\_\_.
  - a) upthrust bearing wear.
  - b) machine being overused.
  - c) residue from work on the floor during installation.
  - d) <u>slippage between the ropes and sheave or wear of wire ropes.</u>
- 69. How often should you inspect the brushes and the commutator of a DC motor?
  - a) <u>Monthly</u>
  - b) Quarterly
  - c) Semi-annually
  - d) Annually
- 70. Passenger elevators and automatic operation freight elevators shall be provided with an emergency alarm system, operable from within the car, which will provide effective means for summoning assistance at all hours in case of emergency. This is a code requirement by \_\_\_\_\_.
  - a) BART OR&P Rule 5100
  - b) <u>CCR Elevator Safety Orders §3041.</u>
  - c) CCR, Elevator Safety Orders §3035
  - d) CCR, Title 8, Article 13 Safety Order 4015

- 71. How would you set the brush of a DC motor?
  - a) <u>Use abrasive grit cloth (sandpaper) underneath the brush.</u>
  - b) Shape the brush bottom with a knife to match the commutator curve.
  - c) Grind the brush to match the curve of the commutator before installing.
  - d) Run the motor with a load until the brush shapes with the commutator.
- 72. Unequal tension of wire ropes will show steel fillings beneath the sheave.
  - a) <u>True</u>
  - b) False
- 73. Match all the part name below with the numbers in figure 10-3e.
  - a) Centering screws
  - b) Split housing screws
  - c) Heel and toe adjustment \_
  - d) Spring adjustment screws \_\_\_\_

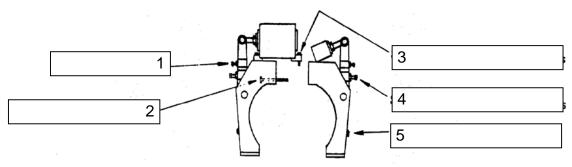


Figure 10-3e, Hollister-Whitney DC Brake, W10 Parking Elevators O&MM

- 74. You should replace the elevator brake pads if the lining is \_\_\_\_\_ or less than the original thickness.
  - a) ¼
  - b) 3/8
  - c) <u>1/3</u>
  - d) ½

- 75. The passenger elevator Hall Chimes will chime \_\_\_\_\_.
  - a) the same for both UP and DOWN.
  - b) once for UP and trice for DOWN.
  - c) twice for UP and once for DOWN
  - d) <u>once for UP and twice for DOWN.</u>
- 76. BART passenger elevators are set to level at \_\_\_\_\_.
  - a) <sup>1</sup>/<sub>4</sub> inch or less
  - b) 3/8 inch or less
  - c) <sup>1</sup>/<sub>2</sub> inch or less
  - d) <sup>3</sup>/<sub>4</sub> inch or less
- 77. What will happen to the elevator car light during test of emergency light switch? The rechargeable battery takes over the normal power supply and the light \_\_\_\_\_.
  - a) is not affected
  - b) <u>should flicker but stays on.</u>
  - c) stays on with no visual effect.
  - d) goes out for a period of 1 second then stays on.
- 78. When checking for wire rope seating depth, an indication of \_\_\_\_\_ inch can cause slippage and sheave wear?
  - a) <u>1/64</u>
  - b) 1/16
  - c) 3/64
  - d) 3/16
- **79.** What should you do if you found the brushes of a DC hoist motor to be 50% or less?
  - a) 50% is still acceptable.
  - b) Replace all brushes at the same time.
  - c) Replace the brushes in pairs per month or as necessary.
  - d) Make a report to your Supervisor to prepare the motor for overhaul.

- 80. When can you access the hoistway of an elevator for inspection?
  - a) After installing block underneath the car.
  - b) Only when you are working with someone.
  - c) Only when the pit stop switch is within reach.
  - d) When you have reliable method of controlling the car.
- 81. What should you look for while inside the elevator pit and at the cartop?
  - a) Light switch
  - b) <u>Refuge area.</u>
  - c) Safety switch
  - d) Control valve
- 82. What will happen if you actuate the elevator emergency stop switch? The car \_\_\_.
  - a) stops and a flashing signaling device is visible.
  - b) stops and an audible signaling device is heard.
  - c) stops at the nearest landing and an audible signaling device is heard.
  - d) will not stop until it reaches its destination then an audible signaling device is heard.
- 83. What is the runby clearance of the counterweight? The counterweight striking plate must be no less than \_\_\_\_ inch from the top of the shock absorber.
  - a) 5
  - b) 5.5
  - c) <u>6</u>
  - d) 7
- 84. What causes the counterweight runby clearance to be less than the minimum required?
  - a) Counterweight frame maybe loose.
  - b) Guide rails are most likely out of alignment.
  - c) Shock absorber may have sprung a leak inside the cylinder.
  - d) <u>Wire ropes and/or the drive sheave grooves are most likely worn</u>

- 85. When inspecting the elevator spring buffers, they should be vertical and properly align with the \_\_\_\_?
  - a) <u>Striker plates on the car.</u>
  - b) Pit channel and the guide rails.
  - c) Crosshead and the pit channel.
  - d) Safety plank and the pit channel.
- 86. The vertical clearance between the pit floor and the lowest structure or mechanical part underneath the car platform except guide shoes or rollers, safety jaw assemblies, and aprons, or other equipment located within 12 inch (305mm) horizontally from the sides of the platform shall be?
  - a) Not less than 2 feet.
  - b) Not less than 3 feet.
  - c) Exactly within 2 feet
  - d) Not less than 2 <sup>1</sup>/<sub>2</sub> feet
- 87. What should you **not do** in the performance of oil buffer maintenance?
  - a) Never step on top of the buffer.
  - b) Do not clean the disconnect switch.
  - c) <u>Do not attempt to disassemble an oil buffer.</u>
  - d) Never land the elevator car on top of the buffer.
- 88. What should you be looking for when inspecting door pulleys?
  - a) The door open switch from the operating panel works.
  - b) Insure that the door closing and opening are properly timed.
  - c) <u>Check for flat spot, loose tires, worn bearings, dry tires, and binding.</u>
  - d) The door sensor should open the door when an object is between doors or door and doorjamb.
- 89. Is the 2 inch pre-opening of doors applicable to BART Station street and platform elevators?
  - a) <u>No</u>
  - b) Yes

- 90. What is the status of the car and hall doors against the doorjamb when fully closed for side opening doors?
  - a) <u>Flushed</u>
  - b) A clearance of 1/16 inch.
  - c) Closed but not too tight.
  - d) With a light visible from the other side.
- 91. As Code requirement, the door gib tab needs to be \_\_\_\_ before inserting under the bottom of the door panel.
  - a) up
  - b) <u>down</u>
  - c) removed
  - d) pointing out
- 92. Match the part name below with the part numbers in figure 10-8a?
  - a) Hanger track
  - b) Eccentric roller \_\_\_\_
  - c) Cam mounting screws
  - d) Track mounting screws and washers

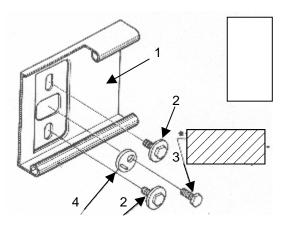
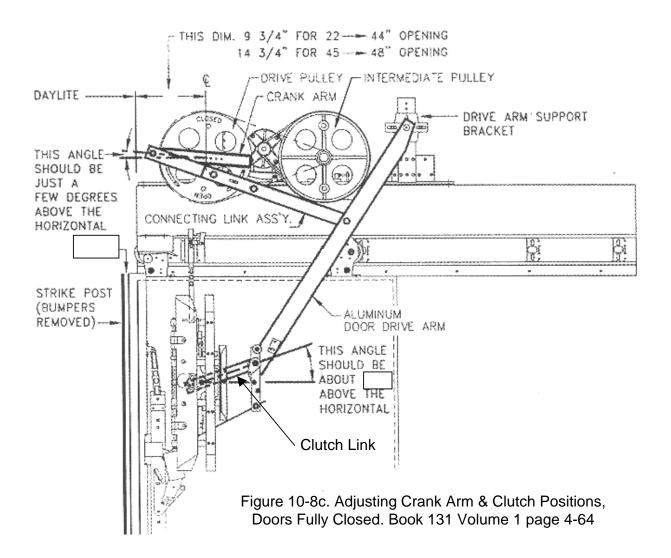


Figure 10-8a. Door Track Adjustment

- 93. To raise the door panel and to align the track, what must you do to part # 4?
  - a) Turn half way towards.
  - b) Turn to the right and up.
  - c) One full turn to the right.
  - d) <u>Turn to the left and down towards the bottom.</u>
- 94. What is the probable cause of an inconsistent or "jerky" door movement? An indication that the \_\_\_\_
  - a) door gibs are misaligned.
  - b) door panels are out of plumb.
  - c) drive chain needs adjustment or the guide rollers are worn out.
  - d) door edges are not centered and the light beams are misaligned.

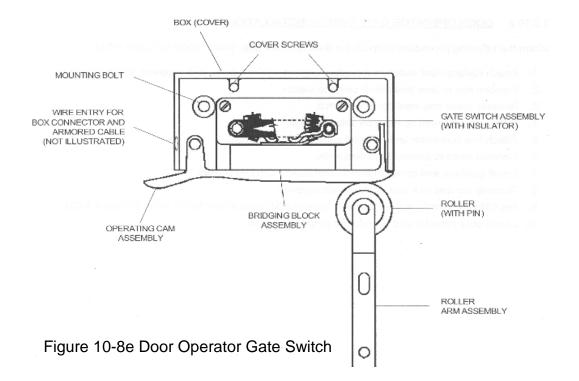
95. The clutch link in figure 10-8c is how many degrees above the horizontal?

- a) 15°
- b) <u>20°</u>
- c) 25°
- d) 30°



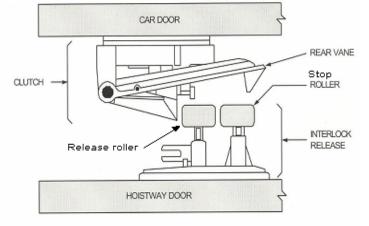
- 96. What should be the distance between the striking post and the door edge with the bumpers removed in figure 108-c?
  - a) 1/32 inch
  - b) <u>1/16 inch</u>
  - c) 3/16 inch
  - d) 1/8 inch

- 97. The gate switch in figure 10-8e below should open when the car door \_\_\_\_.
  - a) starts to open.
  - b) is totally opened.
  - c) is open 1 inch or more
  - d) opens at 2 inch or more



- 98. What is the circuit status of the switch in figure 10-8e if you place an elevator car in inspection?
  - a) Isolated
  - b) <u>Power ON</u>
  - c) Power OFF
  - d) Power dropped to  $\frac{1}{2}$  its voltage.
- 99. How often should you inspect Car Operating Control panel?
  - a) <u>Every visit</u>
  - b) Monthly
  - c) Quarterly
  - d) Semi-annually

- **100.** What is the margin between panels, under panels, and adjacent sections (headers, doorjamb, and cab entrance column) of car and hall doors?
  - a) <u>A nominal ¼ inch or as required by the manufacturer.</u>
  - b) You should see the light at the other side of the panel.
  - c) A nominal ½ inch or as required by the manufacturer.
  - d) The width of one finger or as required by the manufacturer.
- **101.** The door closing torque is directly related to the closing speed, the faster the speed the higher the torque.
  - a) <u>True</u>
  - b) False
- 102. What is the clearance of the rear vane from the stop rollers in figure 10-8h when the car door is  $\frac{1}{2}$  inch from the striking post and hall door is fully closed?
  - a) 1/16 inch
  - b) 3/16 inch
  - c) <u>1/8 inch</u>
  - d) 3/8"
- 103. What is the clearance of the clutch rear vane in figure 10-8h when the doors are fully open?
  - a) 1/8 inch
  - b) 3/8 inch
  - c) <sup>1</sup>/<sub>4</sub> inch
  - d) <u>½ inch</u>



- Figure 10-8h. Clutch & Interlock Release
- 104. What will happen to the gate switch if the release roller in figure 10-8h will not engage the clutch during door opening cycle?
  - a) <u>Remain closed</u>
  - b) Remain opened
  - c) Closes partially
  - d) Opens partially

- **105.** What should you do if your finger wiped test in the sheave groove leaves the finger dry and formation of rust and deterioration between the strands is found?
  - a) No maintenance required.
  - b) <u>Wire rope lubrication is necessary</u>
  - c) Further inspection to all ropes is needed.
  - d) Inform your Foreworker to schedule wire rope replacement.
- 106. How far will the door retractable mechanical safety edge extends beyond the door edge during closing cycle?
  - a) 1 inch
  - b) 1 ¼ inch
  - c) <u>1 ¾ inch</u>
  - d) 2 inch
- 107. How wide can you open the car doors when the car is outside the unlocking zone?
  - a) Opens to less than 3 in. from inside the car.
  - b) Opens to less than 4 in. from inside the car.
  - c) Cannot open more than 3 in. from inside the car.
  - d) <u>Cannot open more that 4 in. from inside the</u> <u>car.</u>
- 108. How do you inspect the locking zone device operation? Insure that pressing the \_\_\_\_\_.
  - a) <u>retiring bar assembly, the zone locking</u> <u>device unlocks and locks when retiring bar</u> <u>assembly is released.</u>
  - retiring bar assembly, the zone locking device locks and unlocks when retiring bar assembly is released.
  - c) retracting arm assembly, the zone locking device unlocks and locks when retiring bar assembly is released.
  - d) Retracting arm assembly, the zone locking device locks and unlocks when retiring bar assembly is released.

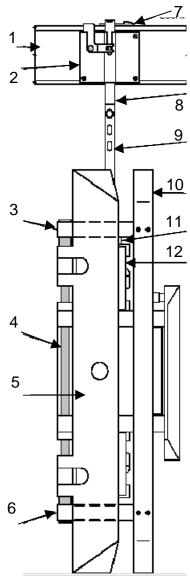


Figure 10-8j Door Clutch Assmebly

- 109. What may be the problem on the drive sheave grooves if a straight edge inspection does not contact all the wire ropes?
  - a) <u>Worn grooves</u>
  - b) Undersized groove.
  - c) Sheave not balanced.
  - d) Misaligned wire ropes.
- 110. Which part of the Car Top Tape Reader you should pay particular attention to for wear and tear during your inspection?
  - a) Part #1
  - b) Part #2
  - c) <u>Part #3</u>
  - d) The box
- 111. Where is the best place to access figure 10-6e?
  - a) At the top of the car.
  - b) At the bottom of the pit.
  - c) At the top most landing.
  - d) Inside the machine room.

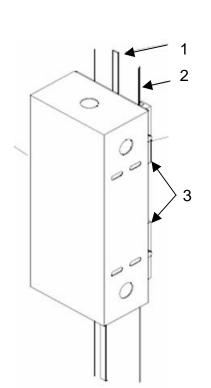


Figure 10-6e Car Top Tape Reader

- 112. Where sliding-type guide shoes are used, insure that rails are\_\_\_.
  - a) Free of lent and dirt and must be coated with a heavy grease.
  - b) Free of lubrication since sliding guide shoes are lubrication free.
  - c) Must be coated with a film of grease or oil but not excessively lubricated.
  - d) Free of lent and dirt, must be coated with a film of grease or oil but not excessively lubricated.
- **113.** When Fire Operation is in the ON position, the elevator shall be on Phase II Emergency In-Car Operation, for use by whom?
  - a) Nobody.
  - b) Trapped passengers.
  - c) <u>Emergency personnel only.</u>
  - d) Maintenance personnel only.

- 114. When Phase I Emergency Recall Operation recall is initiated, all elevators will \_\_\_\_.
  - a) Disembark passengers at any landing and leave doors open.
  - b) Return nonstop to the designated level and park with the doors open.
  - c) Load passengers from upper floors and bring them to the designated level and park with doors open.
  - d) Unload passengers at the nearest landing then proceed to the designated level and park with doors open.
- 115. In the performance of preventive maintenance to the roller guides, all of the statement below are true, except?
  - a) <u>Rail is lubricated.</u>
  - b) Spring properly tensioned,
  - c) Roller surfaces against the rail evenly and evenly worn.
  - d) Bearings are quite when the car is travelling.
- **116.** What will happen to an ascending hydraulic elevator car if you disconnect low oil level sensor wire from the controller? The controller \_\_\_\_\_.
  - a) losses control over the ascending elevator and the MLT elapsed takes over.
  - b) <u>automatically send the car to the bottom landing after MLT elapsed,</u> <u>leave the doors opened, and takes the car out-of-service.</u>
  - c) terminate the car from ascending and you have to manually lower it through the manual lowering valve.
  - d) brings the car to the nearest floor to unload the passengers, leave the doors opened, and take the car out-of-service.
- 117. What must you do when replacing pump drive belts in accordance with ANSI Rule 1200.4?
  - a) Drive belts must be replaced in matched set. When replacing a broken belt, replace all serviceable belts.
  - b) Drive belts must be replaced in pairs and spray belt dressing to the others.
  - c) Replace worn belts only and spray belt dressing to the other belts for traction.
  - d) If multiple drive belts in one pulley, you can pull worn belt and replace belt when more than one is worn.

- **118.** While opening the Manual Lowering Valve to initiate a downward movement, the pump motor should start when or before the car exceeds \_\_\_\_\_.
  - a) <u>1 inch from the floor.</u>
  - b) 2 inch from the floor.
  - c) no more than .5 inch from the floor.
  - d) no more than 2 inch from the floor.
- 119. What must you do before checking for belt tension between the motor and the pump pulleys?
  - a) Use one finger to push each belt for tension.
  - b) Trip the circuit breaker/quick disconnect only.
  - c) <u>Always turn off and tagout circuit breaker/quick disconnect.</u>
  - d) Inform the Station Agent to make sure no one uses the elevator.
- 120. If the Station Agent cannot acknowledge the call during elevator telephone system inspection, how many seconds before Central Control should acknowledge the test or an emergency call will register?
  - a) 60 seconds
  - b) 80 seconds
  - c) <u>90 seconds</u>
  - d) 100 seconds

# Unit 1: Elevator Maintenance, Safety Practices

This page is intentionally left blank.

## Safety Practices

# Objective: Upon completion of this module, an Elevator/Escalator Trainee should be able to;

- Understand all safety practices involved when accessing an elevator; top of-the-car, cab, pit, machine room, and the hoistway.
- Know how to work around electrical circuits.

#### A. General Safety. Safety is the most important key element in performing any PM and services on elevators and escalators.

- 1. It is everybody's responsibility to insure that safety practices are adhered to the maximum to prevent personnel injury and equipment failure.
- 2. Safety Definitions and Requirements found in OR&P and O&MM are designed to provide valuable source for safety. Use them to prevent injuries and illnesses resulting from unsafe acts or unsafe conditions.
- 3. The service technician must understand the operation of the equipment and the safety measures required to service this equipment.
- 4. Do not work on any equipment unless you understand how the equipment functions and you have been informed of potential hazards.
- 5. Make sure that the Station Agent and Central Control are notified that a PM or a service will be perform in an elevator in the station.
- 6. Barricades are to be use around the exits and entrances of an elevator where a service will be perform, and/or place Out-of-Service signs in a prominent position to notify all persons that use of the elevator is prohibited.
- NOTE: Not posting Out-Of-Service signs and barriers while performing PM and service is a violation of BART Safety Definitions and Requirements, Book 217 page A-4 or the latest revision/ edition.

# 7. Dirty, oily, and watery pits or machine rooms are safety hazards. They must be clean before performing any PM or service.

8. Before starting an elevator, make sure no bystanders have entered around safety barricades. Notify all personnel working in or around the elevator that the unit is ready to start. Wait for their reply before starting.

- 9. Ensure that there is adequate lighting in the machinery rooms and pits and especially around moving machinery.
- 10. Loose fitting clothing, neck chains, rings and watches that may become entangled in moving equipment should not be worn.
- 11. Eye, ear and respiratory protection should be worn as appropriate for the type of work being performed. Safety shoes must be worn

### B. Electrical

- 1. Lockout and tag-out of the main disconnect switch must be perform. After the work has been completed, the lock and tag or tags shall be remove by the same person whose name appears on the tag.
- 2. Extreme caution should be exercised when doing any electrical work. Less than one (1) ampere or as low as twelve (12) volts can kill.
- 3. Prior to working on any electrical circuits, check for live voltage.
- 4. All electrical circuits must always be treated as live. All voltages can be dangerous. Contact with even low voltages can result in serious injury.
- 5. To check a circuit, test the live side with a voltage tester set on a higher range, then test the dead side and retest the live side again. This action ensures the good condition of the voltage tester.
- 6. As a general rule, use only one hand for switching. Keep the other hand clear. Before closing a switch, make sure that a circuit is ready and all moving parts are free, personnel near moving parts are notified that the circuit is to be energized and proper fuses are installed.
- 7. When using a temporary circuit jumper, make sure that you understand what effect the jumper have on the elevator. Always remove your jumper when job is finished or before living the job site.

**Review Questions:** Write your name and answer in separate paper.

- 1. What would you do before starting an elevator after performing service?
  - a) Lockout and tagout.

- b) Make sure the circuit breaker is off.
- c) Inform the Station Agent and your Foreworker.
- d) Make sure no bystanders have entered around safety barricades.
- 2. Who is responsible in removing the temporary circuit jumper you used?
  - a) Your Foreworker.
  - b) You before living the job site.
  - c) The person who finishes the job.
  - d) Whenever the equipment operational.
- 3. What will happen if you come in contact with 120 VAC with a .9 ampere current?
  - a) Fatal injury.
  - b) Maybe a temporary shock.
  - c) Has no effect since it's less than 1 ampere.
  - d) Has no effect since you are insulated from the ground.

This page is intentionally left blank.

Unit 2: About Preventive Maintenance

This page is intentionally left blank

#### Preventive Maintenance

#### A. What is PM?

- 1. PM is the most efficient management of materials and equipment exercised to achieve the one overriding consideration in the District establishment --- "The equipment readiness to serve the riding public."
- 2. When performed properly, PM prolongs the life of the equipment and minimizes the unsafe condition that may occur due to parts breakdown. PM also minimize the wear and tear and failure of the equipment.
- 3. The old saying "if ain't broke, don't fix it" is not acceptable procedure for the PM. Scheduled periodicity must be performed to attend best equipment performance.
- 4. PM reduces complex maintenance to simplified procedures, plans manpower and material requirements, and detects areas requiring additional emphasis on training and techniques.
- B. What are the Types of PM?
  - Full maintenance or full service is required on each elevator. The periodicity of each visit (EV, not in the PM card), every two weeks (Bi-wk), monthly (Mo), every three months (Q), semi-annually (SA), and annually (A), or as recommended by the manufacturer must be perform. These can be accomplish by three inspection method:
    - a) Visual awareness review;
    - b) Manual inspection and repair;
    - c) Mid-used or failed part replacement.
  - 2. "Oil & Lube, Oil & Grease, or Clean & Lube" are just periodic PM to do necessary lubrication and conduct minor cleaning & inspection. This does not maintain the equipment in a safe operating condition and often result in equipment failure and increase in maintenance cost. All three of the above inspection method (1. a to c) has to be performed in addition to any adjustment parameter set by manufacturer.

## C. What are the Goals of PM?

- 1. To minimize personnel injuries. Many injuries and some death come about when an elevator fails due to an improper/ lack of PM.
- 2. To minimize the cause of failure, therefore it extends the life of the equipment.
- 3. PM provides the means of gathering information on expenditure of resources in the maintenance of the equipment, failure data, and other data related to the maintenance. Collected data can be displayed and analyzed to show the direct relationship of corrective (repair) maintenance to PM. The elevator/escalator personnel can use this data to improve their maintenance effort.
- 4. The equipment can provide a reliable and continuous service as required by the users.
- 5. PM Overall benefits are:
  - Increased reliability. PM increases reliability by substituting PM for corrective maintenance.
  - Increased Economy. PM reduces casualties and saves the cost of major repairs.
  - Better Records. PM records contain more data that can be useful to the maintenance manager.
  - Better Planning. PM facilitates the efficient and convenient programming of work by advance planning. Inevitable changes in personnel assignments can be easily accommodated.
  - Improved Leadership and Management. The increased clarity and convenience of the system, as well as the reduction in frustrating breakdowns and irregular hours of work, help prevent "moral breakdowns." PM also enhances the feeling of effectiveness on the part of the crew and the managers.

## D. Objectives of PM

PM is developed to provide the department and its supervisors with effective means to plan, schedule, and control elevator maintenance. PM is designed to:

- 1. Reduce the complex maintenance of equipment to simplified procedures that are easily identified and managed.
- 2. Defined the PM required, schedule and control its performance, describe the methods and tools to be used, and provide for the detection and prevention of impending casualties.
- 3. Forecast and plan manpower and material requirements.
- 4. Plan and schedule maintenance tasks.
- 5. Estimate and evaluate repair parts readiness.
- 6. Detect areas needing improved personnel training and improve maintenance techniques
- E. What Type of Lubricants are we suppose to use and why?
  - 1. Proper lubrication is perhaps the most important part of any maintenance program. Lubrication is an important factor in sustaining production, reducing delays, and lowering maintenance cost.
  - 2. Lubricants reduces **FRICTION** and **WEAR**, carry away **HEAT** from bearings and running parts, aid in sealing against **DIRT**, and protect metal surfaces against **RUST** and **CORROSION**.
  - 3. The wrong lube used or incorrectly applied, the results can often be worse than doing nothing.
  - 4. Viscosity is probably the most important property of oil. Viscosity is a measure of the thickness of oil. The higher the viscosity numbers the thicker the oil. Proper lubrication requires:
    - Applying the lubricant in a proper lubricating manner and right quantity.
    - Using correct lubricant
    - Checking at the proper intervals.

**BART Elevator Maintenance Schedule** (p7-8). The maintenance schedule card may not list all system, sub-system, and component that require PM. It is important to use the O&MM for specifics equipment PM.

- NOTE: BART Elevator Maintenance Schedule may change from time to time to conform to the O&MM and/or the District requirements.
- A 17x11 Maintenance Schedule card posted in each elevator machinery room will be used in the performance of PM. The card covers; Location, Unit, District #; all to be filled by the maintenance person.

Actions to be taken are as follows;

- 1. Item list most typical component names of an elevator. This may not list the entire component of a particular type and model of an elevator. It is important to use the O&M manual of certain elevator for specific parameters, procedures, or any additional PM to be accomplished.
- Inspection the PM actions to be perform on each listed item such as check, inspect, listened, or any of similar use of sensory. Inspection column may suggest additional detailed information in the O&MM. Example; item number 25 says, "Refer to O.E.M."
- 3. Lubricant lists of elevator parts manufacturer recommended lubricants. If a substitute lubricant is to be used, it must be compatible with the manufacturer's recommended lubricant.
- 4. Method lists all the required PM actions to be accomplished.
- CYC or Periodicity is cycle or how often each scheduled PM performed. CYC is used to monitor the wear and tear, the length of time before a part or parts will break. The codes are; Bi-Wk – every 2 weeks, Mo – monthly, Q – every 3 months, SA – semi-annually, A – annually.
- 6. Months list all the months with blank spaces below them for date entry of PM accomplished. Enter N/A if PM is not applicable.

The maintenance person must report all accomplished PM to his/her Foreworker before the end of each shift. It is important to know that a completion of PM can be reported when a part or a component is found to be partially worn-out or defective but does not constitute to an unsafe condition of the unit. A "Speedy Memo" must be submitted to your Foreworker for corrective action if the repair or replacement of part will take more than two hours.

# BART Elevator Maintenance Schedule 2006; LOCATION: \_\_\_\_ UNIT: \_\_\_\_ DIS #\_\_\_\_

Employee Name: For Training Use Only Enter the date when each item is completed

	ITEM	INSPECTION	LUB	METHOD	C Y C	J A N	FЕВ	M A R	A P R	M A Y	J U N	J U L	A U G	S E P	0 C T	N O V	D E C
1	Emergency Phone	Check for proper operation.		Insure phone rings in station booth & rolls over to OCC when not picked up by Agent.	B W												
2	Shaft and Car Door	Clean sills. inspect gibs, hanger & eccentric rollers for alignment & wear. Check for loose hardware. Lubricate as necessary.	Texaco Alcaid Oil	Keep felt oilers saturated. Clean tracks. Replace bottom guides if worn. Check doors for alignment.	B W												
3	Contactor & auxiliary relay	Inspect coil insulation and contacts for pitting. Inspect pivots for wear.		Do not lubricate any parts of contactors. Check for smooth operation & overheating.	B W												
4	Controller General	Check all relays for freedom of movement, dust, dirt, contact pitting or burning and loose connections. Check ribbon connectors and terminal strips.		Clean controller. Insure all relays, boards, ribbon connectors and terminal strips are securely fastened. Check for burned components.	B W												
5	Car & Hall Key Switches & Pushbuttons	Check for broken buttons, burned out lamps, key switches, overhead lighting, emergency stop button & bell. Check ceiling fan operation.		Check for proper operation of all buttons, lamps, key switches, gongs, overhead lighting, emergency lighting and overhead ceiling fan.	B W												
6	Machine Room	General Cleanliness, Ventilation windows etc.	Texaco	Clean and/or replace AC or controller vent filter.	Μ												
7	Machine & Generator Motor	Check oil level in bearing reservoir. Feel motor for overheating. Check for excessive noise. Examine commutator for high mica. Undercut if necessary. Do not use brush-seating stone.	Texaco Alcaid oil Regal AFB #2	Sleeve bearing - fill oil level. Ball bearings - open relief plugs & remove hardened grease, add grease to running motor until expelled through relief hole, run for 20 minutes.	Μ												
8	it, Note: Piston (Ram)	Check oil tank level with car at bottom Check for sufficient oil with car at top Check motor belt tension Check air filter (if provided) Check control valve filters (only if erratic) Check for leaks, empty machine drip pan. Record amount of hydraulic oil added to tank Check piston packing head for excessive leak	Mobil Vactra light 150SSU	Fill to level shown on dipstick. Tightened to 1/64 slack per inch of pulley diameter. Replace "O" rings or gaskets as required. Replace packing if necessary.	M M M M M												
9	Brake	Check lining for wear and glazing. Check stopping distance. And adjust as necessary.	Texaco Alcaid Oil	Stop unit and measure stopping distance. Drop of oil pivot in holes provided.	Μ												
1 0	Cables; Car Comp. & Governor	Inspect for worn or broken strands, dryness and rust spots. Inspect shackles and spring for cracks. Check cables for equal tension.	Columbia special platinum	If cables are dry, apply a thin coat of lubricant. Remove excessive rust deposits. NOTE: Do not lubricate governor cables.	Μ												
1 1	Interlocks, Pick up rollers & Gate Switches	Check contacts for pits & oxidation. Check linkage for tightness. Adjust locks for proper clearances. Inspect rollers.	Texaco Alcaid Oil	Lubricate and wipe dry all pivot surfaces. Check each landing for proper operation.	Μ												

			<u> </u>		<b></b>	 -	 	1	r r	- 1	п
1 2	Car Door Operator, Motor, Linkage Belts Etc.	Inspect for cleanliness and loose hardware. Inspect control contacts for pitting, wear & tear. Check for smooth operation.	Texaco Alcaid Oil Spcl W/G	Adjust door opening and closing for smooth operation. Check linkage and lubricate all bushings as necessary. Check belt tension	Μ						
1 3	Car Door Clutch, Detectors, Saf-T-Edge	Inspect retraction rollers and cables for wear, inspect pivots for wear. Check detector edges for proper operation.	Texaco Alcaid Oil	Clean and lubricate all pivots & pins. Check door detector with obstruction to verify proper operation.	Μ						
1 4	Car & Cwt. Rollers or Shoes	Inspect shoes for wear and proper lubrication. Inspect rollers for wear, tension & clearance.		Wipe clean & adjust for proper tension & clearance. Replace worn gibs & rollers.	Μ						
1 5	Camera Equipment	Check if camera and enclosure equipment is intact.		Inspect camera enclosure and window. Report any damages.	Μ						
1 6	Elevator Pit	Clean & inspect pit floor. Check drain sump & oil scavenger for operation.	>>>>>	Remove debris & check oil absorbent pads. Verify sump operation with 5 gal of water.	Μ						
1 7	Governor & Tension Sheave	Check for corrosion, obstructions and for bearing noise. Check linkage for binding.	Texaco Alcaid Oil	Grease with pressure gun until expelled at hub. Drop oil at pivot pins in holes provided.	Q						
1 8	Safety linkage	Inspect links and pins for freedom of movement.	Texaco Alcaid Oil	Lubricate all pivot points with a few drops of oil.	Q						
1 9	Traction Sheaves and Bearings	Check for noise or vibration and sufficient lubrication. Inspect drive sheave grooves for unequal wear.	Texaco Alcaid Oil	8 Strokes of pressure gun in fitting under swing cover in housing & in sheave bearing cap. Remove relief plug in spider hub.	Q						
2 0	Gearbox	Check oil level & backlash of rotor shaft. Inspect ring gear for wear, gaskets and seals for leaks.	Texaco 650-T	Fill oil to center of worm. Add 4 to 5 drops of Dow-Corning anti- "Q" compound for excessive foaming	Q						
2 1	Deflector Sheaves Car & Cwt.	Check for noise or vibration and sufficient lubrication.	Texaco Alcaid Oil	8 Strokes of pressure gun to shaft fitting or 2/3 of oil through hubcap.	Q						
2 2	Shaft Limit Switches	Inspect contacts for pits & oxidation. Check for smooth operation.	Texaco Alcaid Oil	Drop of oil on pivot & roller pins.	S A						
2 3	Rails	Inspect splice plates for loose bolts. Inspect rails for nicks & burns and joints for smoothness.	Texaco Alcaid Oil or SLIPIT	Fill rail lubricators or brush on slip-it. Do not lubricate roller guides. Inspect for alignment & smoothness. File as necessary.	S A						
2 4	Trail Cables	Inspect for breaks & scuff spots.			S A						
2 5	Safety, Traction	Check clearances between rail & gripping face of wedges or jaws. Refer to O.E.M.	Texaco Alcaid Oil	Lubricate all pivots with a few drops of oil.	А						
2 6	Gearbox Oil	Inspect for contamination		Drain, clean gearbox and replace oil.	А						
2 7	Counterweig ht	Inspect for loose or broken weights. Check runby.		Tighten clamp, replace broken weights.	А						
2 8	Landing System	Inspect landing system guides, tape and magnets. Measure runby.	Grainger 3599/ 5H885	Clean & apply dry lubricant on tape. Inspect system guide shoes & tape brackets.	A						

**Review Questions**: Use separate piece of paper and write your name on top.

- 1. What is the first thing you should do before performing any scheduled service or maintenance on an elevator in the station?
  - a) Install a barricade
  - b) Call your supervisor
  - c) Tagout and lockout the circuit breaker
  - d) Inform the Station Agent and Central Control.
- 2. \_\_\_\_\_ kills an electrocuted person.
  - a) Voltage
  - b) Current
  - c) Resistance
  - d) Horsepower
- 3. Elevator proper maintenance and use depends mainly on \_\_\_\_\_?
  - a) safety
  - b) repair
  - c) corrective maintenance
  - d) preventive maintenance
- 4. What are the three inspection methods for full elevator maintenance?
  - a) Visual, audio, and smell awareness
  - b) Visual inspection every two weeks, monthly, and quarterly
  - c) Visual awareness review, manual inspection and repair, and mid-used or failed part replacement
  - d) Applying proper lubricant, using correct lubricant, and checking at the proper intervals
- 5. All of the following are goals of preventive maintenance except?
  - a) Minimize personnel injuries.
  - b) Minimize the cause of failure.
  - c) Forecast and plan manpower and material requirements
  - d) Gather information on expenditure of resources in the maintenance of the equipment

- 6. All of the following are true concerning the importance of the use of proper lubricants in any equipment maintenance, except \_\_\_\_\_?
  - a) reduces friction
  - b) reduces wear
  - c) carry away heat
  - d) protect metal surfaces against unwanted electrical current
- 7. What column(s) in the maintenance schedule are the PM actions to be accomplished?
  - a) Item & Inspection
  - b) Inspection and Lubrication
  - c) Inspection and Method
  - d) Lubrication and Method
- 8. How often do you check the brake lining for wear and glazing/
  - a) Weekly
  - b) Monthly
  - c) Quarterly
  - d) Semi-annually
- 9. When are you going to replace the cylinder packing as per the PM card?
  - a) Every month
  - b) When the elevator is idle.
  - c) Only when ordered by your Foreworker
  - d) Piston packing head has an excessive leak.
- 10. What is the method to follow when performing BW maintenance on shaftway and car doors?
  - a) Clean & apply dry lubricant on tape, inspect system guide shoes & tape brackets.
  - b) Keep felt oiler saturated, clean tracks, replace bottom guides if worn, and check doors for alignment.
  - c) Stop the unit and measure the stopping distance, drop oil pivot in holes provided.
  - d) Clean sills, lubricate, check for loose hardware, and inspect gibs, hanger & eccentric rollers for alignment & wear.

Unit 3: Traction Machine Room & Equipment

#### SAFETY REMINDER

Avoid using bare hand in picking dirt or debris. Dispose all debris and hazardous materials in the proper disposal area or container.

Avoid contact with any moving or rotating machinery.

Do not use any abrasive tools or solvents around the motor windings and commutator. Protect any electrical wire insulations from scratches or cuts.

The elevator must be declared out of service by placing a sign or placard on the controller;

ELEVATOR IS UNDER THE CONTROL OF A MECHANIC – DO NOT OPERATE

# Traction Machine Room and Equipment

**Objective:** Upon completion of this module, an Elevator/Escalator Trainee should be able to;

- Clean, inspect and lubricate hoist drive motor.
- Clean, inspect, replace and set DC motor brushes.
- A. Machine Room, Clean & Inspect
- **NOTE**: If you plan to operate the elevator from the machine room, insure that no passenger is inside the elevator. Place machine room Independent Service switch to TEST to disable elevator Door Open. The MP diagnostics will display TEST message.
  - 1. Check the floor area for cleanliness; note any accumulation of oil, grease or dirt and take action as needed.
  - 2. Clean all exposed surfaces of the machinery from top to bottom. Avoid any dirt, debris, water, or any contaminant getting into the tank of hydraulic elevators, in gearboxes, around motor commutator and windings, and all wire ropes.
  - 3. Do not store any flammable materials such as lubricant, solvent or oily rags inside the machinery room.
  - 4. Do not store any items in the machine space that are unrelated to elevator maintenance and operation.
  - 5. Insure that mechanical ventilation and/or air conditioning to the control cabinets are in operating condition. Check that natural machine room ventilation is open and functioning. Clean any obstruction and dirt accumulation to the machine room ventilation grills and filters. Replace filters to the room and the control cabinet when found to be dirty.
  - 6. Where the machinery of more than one elevator is in a single machine room, check that the number for each car has been securely attached or painted to the drive machine, controller, and disconnect switch.
  - 7. Insure that a class "C" fire extinguisher is mounted convenient to machine room access door. The extinguisher should be tagged to indicate monthly check and requires annual maintenance. **Un-mount extinguisher every month, turn it upside down and shake** to loosen the CO2.

## B. Traction Elevator Hoist/Drive Motor; Clean, Inspect & Lubricate

#### CAUTION: Open mainline disconnect switch, tagout and lockout the elevator.

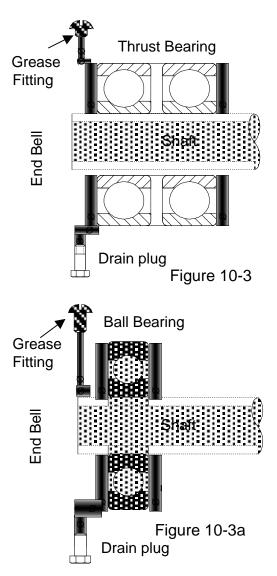
#### DO NOT OVER LUBRICATE.

It is very important to avoid grease under pressure to force its way through the housing seals onto the commutator and other motor parts. Grease MG-set bearing in small amount with the motor running.

**Oil/grease slinger** if installed around motor shaft between the motor and the brake must be maintained to protect the motor insulation and the brake from oil contamination.

- 1. Place the elevator on inspection or independent service. Inspect motor and controller ground cables to the building ground to be secured and corrosion free.
- 2. Check and clean for unusual amount of dust, chips or lint on/or about the motor. Clean and inspect exposed motor windings for grease/oil contaminants.
- 3. Operate the elevator by making several stops to check the **bearings** for excessive heat, the **motor mount** and coupling for tightness and vibration. Re-tighten all hardware.
- 4. Check the **hoist motor bearings** with a bearing stethoscope. A metallic grinding, a rattling noise or an excessive vibration may be an indication of bad bearing or an unbalance rotor and rotor shaft.
- 5. During the operation, inspect motor **reduction gear** fastening for evidence of movement indicating improper tightness. Secure fasteners.
- 6. Check hoist **motor oil level** bearings for Station Platform elevators, if equipped. Oil level should be no more than 2/3 of the bearing.
- Observed/correct excessive backlash of the rotor shaft (figures 10-3 & 10-3a p5) which maybe cause by:
  - **Thrust Bearing** "Thrust Play" is easily detected by watching the movement of the worm shaft. If the horizontal movement is excessive, the thrust bearing should be adjusted or replaced

- Worm Wear: Check for wear of worm gear sprockets. During gear oil change, check the lock key between the gear and the motor shaft to be secured and not worn.
- Gear Wear: Worn out gears may cause an indication of metallic contaminants in the gear oil. When an excessive wear is detected on the teeth of the gear, the gear must be replaced.
- Clean bearing grease fittings and remove grease refill and drain plugs. Add recommended quantity of grease with a pressure gun to the bearing housing. Use a handoperated grease gun only.
- Remove the hardened lubricant that has accumulated around the refill or the relief plug with a plastic stick.
- Re-grease motor or generator bearings with a low pressure grease gun while the motor is at standstill.
- Run the motor for 20 minutes after re-greasing until the new grease flows from the drain plug. For optimum operation, the bearing chamber should be **2/3 full** of grease.



- Replace grease refill and drain plugs. Clean and wipe off any excess or spilled lubricants. Clean grease around the shaft towards the commutator or the windings and the brake assembly.
- Check sleeve bearing for proper lubrication. They may be oil-lubricated and usually have an oil well or a carrier.
- **NOTE:** Imperial electric motors are properly lubricated and thus do not require lubrication when installed.

Use the table below for re-lubricating guide in months for ball bearings.

# Motors operating in ambient temperature of 0° to 100° F ball bearing re-lubricating guide in months.

Condition	Motor RPM		
Condition	1800 RPM	3600 RPM	
1	12 mo.	6 mo.	
2	6 mo.	3 mo.	
3	3 mo.	3 mo.	

Condition Description:

- 1. **Normal** Eight hours per day, normal loading, clean environment, 100°F maximum ambient.
- 2. **Severe** Twenty hours per day operation, or shock vibration loading, dirt or dust environment, 100 to 105°F ambient.
- 3. Extreme Heavy shock or vibration, harsh environment.

NOTE: Do not use silicon arease on direct current equipment.

**Origins of Bearing Failures and Deficiencies**. The general classifications of failure and deficiencies requiring bearing removal are:

- a) **Overheating;** a) inadequate or excessive lubrication, b) grease liquefaction or aeration, c) oil foaming, d) abrasive or corrosive due to contaminants in beating and improper handling, e) distortion of housing due to warping, or out-of-round, f) seal rubbing or failure, g) inadequate or blocked scavenge oil passages, h) inadequate beating-clearance or bearing-preload, i) cage wear.
- b) Vibration; a) dirt of chips in bearing, b) fatigued race or rolling elements, c) race turning, d) rotor unbalance, e) out-of-round shaft, f) race misalignment, g) housing resonance, h) cage wear, i) flats on races or rolling elements, j) excessive clearance, k) corrosion, l) false-brinelling or indentation of races, m) electrical discharge (similar to corrosive effects), n) mixed rolling element diameters.
- c) **Noisy Bearing;** a) lubrication breakdown, inadequate lubrication, stiff grease, b) contamination, c) pinched beating, d) seal rubbing, e) loss of clearance and pre-loading, f) bearing slipping on shaft of in housing, g) flatted roller or ball, h) brinelling due to assembly abuse, handling, or shock loads, i) vibration in size of rolling elements.
- C. Worm and Gear, Inspect (figure 10-3b)

- 1. Open mainline disconnect, tag-out and lock out the elevator.
- 2. Clean the machine top, inspection cover, and oil cap to avoid contaminants entry into the gearbox.
- 3. Check the proper **oil level** of a geared machine. Lubricants must be in high-level mark shown on the gauge. In the absence of level gauge, it is important that **the oil level should be maintained 2/3 of the worm gear**.

Worm-gear lubricants replacement should be done every three years for normal machine room environments.

The gear case should be drained, thoroughly washed out with suitable solvent and refilled with fresh lubricant at the first indication of abrasive dust, excessive condensation, excessive "frothing" (foaming), or

breaking down of the oil. Dispose used oil in proper disposal container/ area.

Check for improper wear on **gear teeth**. Wear in worm-gear drives is caused chiefly by metal-tometal contact during starting and stopping. The gear should also have a film of oil on the teeth and minimum foaming of the oil.

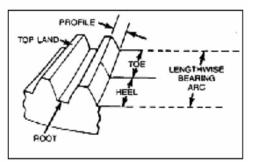


Figure 10-3b Typical Gear Teeth

- The gear teeth profile and the teeth top land (figure 10-3b) should show even pattern of wear. Gear teeth wear maybe caused by lack of lubrication, worn bearings, or misaligned worm or ring gear
- 5. Inspect gear oil for any evidence of discoloration, metallic contamination, or any form of contamination.
- 6. Look for **oil leaks** that may result in failure of the drive train or contaminate the brake, traction, commutator and other parts.
- 7. Reinstall gear case inspection plate. Clean and wipe off any excess or spilled lubricants.
- D. DC Hoist Motor Brushes, Commutator and Field Windings, MG Set DC Generator and Slip Rings; Clean & Inspect

#### 1. **During normal operation**;

• Listen to the brushes that tend to squeal at light loads but quite down as the load increases. Possible causes of squealing are:

Brushes holder may be too far from the commutator.

Insufficient brush pressure. Modern designs of mg sets are equipped with constant tension brush springs designed for about 4 pounds per square inch brush pressure.

Average brush density maybe too low. Electrographitic brushes operate better at moderate high brush density (500 to 80A/in<sup>2</sup>).

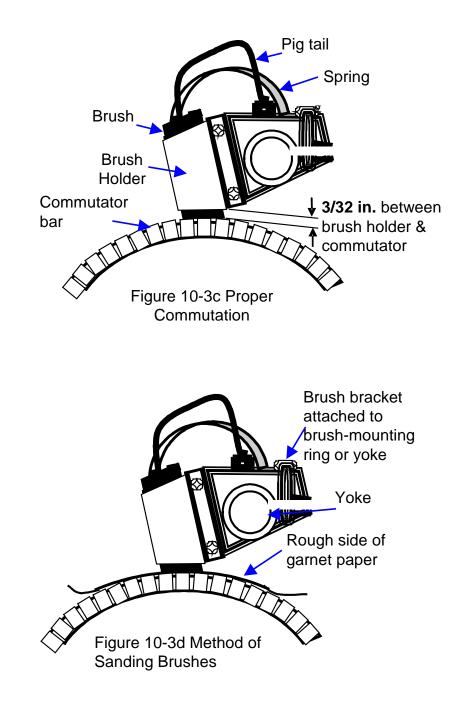
The presence of some visible sparking is not necessarily evidence of unsuccessful commutation. Moist in the air or dirt and low relative humidity may cause sparking.

#### 2. Open mainline disconnect switch, tagout and lockout the elevator.

- Remove inspection plates of the MG set dc generator and the dc hoist motor.
- Clean and inspect dc generator and dc hoist motor; brushes, commutator, field windings, and the slip rings of an ac motor. Use non-metallic sash brush, a vacuum cleaner and clean lint-free cloth.
- Clean the commutator with canvas pad to improve the condition of the commutator film and to improve the reliability of the brushes.
- Clean accumulation of carbon or copper dust in between slots of the commutator, inside the brush holders and its brackets, and around the windings. Insure that the commutator must be oil free.
- Use a blower attachment to remove dirt that cannot be reached by the vacuum. Leave the machine room door open during this operation so that the dust will not settle on the commutator.
- 3. **Inspect the Commutator** (figures 10-3c & 3d p10)
  - Check for uneven wear of the commutator. See attached pages at the back of this handout for the Aspects of Commutator Films.

- A worn out commutator will show high mica and the insulation between the commutator bars will protrude that normally causes sparking and burns. Undercutting high mica should be performed by an outside contract.
- Inspect for shorts between bars and for solders that may be thrown out of the riser. Shorted bars usually become hot and discolored.
- If excessive sparking has occurred, the surface of the commutator will appear dull and black. In this case it should be clean with a fine commutator stone or No. 0000 sandpaper. Do not use an emery cloth.
- Should the commutator become so rough and grooved due to excessive sparking or long usage that dressing with a commutator stone or sandpaper is no longer effective the armature should be removed and repaired.
- 4. **Inspect the Brushes** (figures 10-3c & 3d p10)
  - Inspect the length and wear pattern of the brushes.
  - New brushes should be installed after their length has been reduced to **50% or less**.
  - Replace worn brushes with new ones of the same size and grade. In a normal operation, the brushes will last from 8 months to a year before they wear out and must be replaced.
  - If unsure, follow the equipment manufacturer OEM which usually specifies types and grade of brushes and related clearances.
  - Do not replace all brushes at the same time. If found to be worn or need replacement, replace them in pairs per month or as necessary.
  - Ensure that brushes are free in their holders and should slide in and out without obstruction.

• All brush holders must have the same distance from the commutator; not over **3/32 inch and no less than 1/16 inch** for best operation.



• Set Brushes (figure 10-3d) – use Cloth (sandpaper), Abrasive Grit, Garnet Paper 150 grit, 5 x 50 yard. BART Stock No. 53-50-6100.

- 5. **Installing New Brushes** (figures 10-3c & 3d p10)
  - When installing new brushes that are not shaped to the curve of the commutator;

Slide No. 0000 sandpaper between the commutator and the brush with the brush resting on the abrasive side of the paper (figure 10-3c p9).

With the spring tension on the brush, move the paper back and forth until the curvature of the brush fits the commutator.

Thoroughly clean all abrasive particles and contaminants around the commutator and in-between the slots.

- Make certain that the brushes rest firmly on the commutator and that all brushes are held firmly by the same pressure. A pressure of about 2-4 pounds per square inch of surface of each brush is proper.
- If applicable, attach a spring scale to the pigtail and pull very straight on the lead so that the brush will not bind.

Pull the brush all the way to the top, and then let it return about 1/16" to 1/8". Observe spring tension for accuracy. Do not observe spring tension as the brush is moving out.

- Check all brushes pigtails and their holders for secured fasteners. Insure that the holders/springs are not resting against the pigtails.
- Inspect the toes of all brushes on each brush holder. The brushes:

must line up with each other and with the edge of one commutator segment (bar).

should be evenly spaced around the commutator.

- Avoid hard snapping of the brushes springs while cleaning or reinstalling. Do not use a brush seating stone to seat brushes.
- Reinstall inspection covers.
- Clean and vacuum vent filters of an AC hoist motor, if equipped.
- Clean motor windings with lent free rags and vacuum if accessible.

### **C.** Elevator Brake, Clean and Inspect

# CAUTION: Use special caution to avoid contact with any moving equipment while inspecting the brake.

Avoid touching the brake drum when mainline disconnect switch is engaged.

The most common trouble encountered in a direct current brake is the **reluctance to set**. Number one cause of slow setting is due to **residual or circulating magnetism**. A worn thin plate between the cores, the brake may take a very long time to set. With weak springs, the brake may never set, but with strong springs it will set but have a varying delay.

- 5. Operate the unit to observe the operation of the **brake**.
  - The **brake should apply** smoothly and quite at each stop on or after completion of the slow down and leveling operation.
  - A brake that is slow in applying (car overshoots the floor) or noisy indicates that thorough maintenance is needed.
- 6. The brake lining clearances should be at minimum to permit free running without drag. Use a light to observe the clearances between the brake and the drum when the elevator is running. The light should go through the drum and the brake lining.
- 7. If the elevator has been operating, the **drum** will be hot but should not be uncomfortable to touch. A hot drum may indicate a dragging brake.
  - Place the Relay Board Inspection switch to Inspect. Make sure that there are no passengers onboard. If another Mechanic is available to assist, run car on TEST at low speed to make proper adjustment. With one Mechanic, run car from top most to bottom most floors or vice versa. With solenoid energized, tighten centering screws until centering screws touch main housing, back off ¼ to ½ turn, BART O&MM Book 217 page 4-75.
  - Insure that there is approximately **1/32 inch between the centering screw** (figure 10-3e) and the housing when the solenoid is energized (i.e. brake plungers make contact).
- **NOTE:** Do not use centering screws as stops to limit plunger travel.

• Examine **pins** for lubrication, looseness and conditions of retainers. **Lubricate all pivot pins** and bushings (brake parts breakdown p14) with drop of oil. Clean and wipe off spilled lubricants.

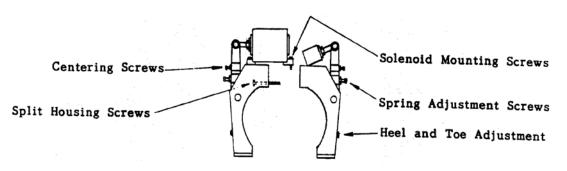


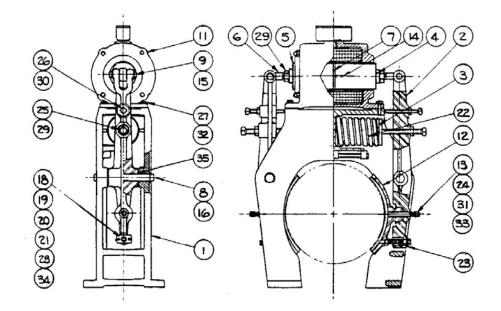
Figure 10-3e, Hollister-Whitney DC Brake, W10 Parking Elevators O&MM

- 8. Open mainline disconnect, tagout and lockout the unit. Perform complete visual inspection on all sides of the brake pads and the drum. Make proper adjustment or correction as necessary.
  - Look for **evidence of contamination** on the drum and the brake pads that maybe caused by oil/grease. Look for scoring that may be caused by worn lining allowing the rivets to contact the drum. Replace worn and/or contaminated pads.
  - Carefully inspect all moving parts for looseness, evidence of overheating, wear and misalignment.
  - Inspect brake pads and look for uneven wear due to misalignment or improper spring tension. Replace the pads if the lining is 1/3 or less than the original thickness



Figure 10-3f, Uneven Brake Pads Wear

- Examine the **brake solenoid coil** for evidence of overheating or wear which may be indicated by accumulation of lubricant or powder around the plunger.
- Inspect electrical control wires of the brake solenoid to be secured. Check to make sure all fasteners are secured.



No.	DESCRIPTION	Qty	#90 (10° dia)	#100 (12" dia)	#110 (14" dia)	#120 (16" dia)
1	HOUSING	1	90-1	100-1	110-1	120-1
2	LEVER	2	90-3-A	90-3-A	110-3-A	120-3
3	CAP-SPRING	2	90~5	90-5	90-5	90-5
4	PLUNGER	1	90-6	90-6	90-6	120-6
5	PLUNGER	1	90-7	90-7	90-7	120-7
6	EYEBOLT	2	90-8	100-8	100-8	90-8
7	RING-PLUNGER	1	90-11	90-11	90-11	90-11
8	PIN-LEVER	2	90-12	100-12	110-12	120-12
9	PIN-PLUNGER	2	90-13	90-13	90-13	90-13
10						
11	SOLENOID ASSEMBLY	1	90-28	90-28	90-28	120-28
12	SHOE ASSEMBLY	2	90-29-A	100-29-A	110-29-A	120-29
13	NUT-NYLON	2	90-30	90-30	90-30	90-30
14	SCREW-DRIVE	1	90-31	90-31	90-31	90-31
15	RING-TRUARC	4	90-32	90-32	90-32	90-32
16	RING-TRUARC	4	90-33	90-33	90-33	90-33
17		-				
18	PLATE	2	90-36	90-36	90-36	90-36
19	BUSHING-OILITE	2	90-45	90-45	90-45	90-45
20	SCREW-HEX HEAD	2	90-38	90-38	110-38	110-38
21	WASHER	4	90-39	90-39	90-39	90-39
22	SPRING-LEVER	2	400-32	400-32	400-32	400-34
23	SPRING-SHOE	2	400-39	400-39	400-39	400-19
24	STUD-ALL THD.	2	500-23	500-23	500-23	500-23
25	SCREW-SQ HEAD SET	2	5/8"NC x 4"	5/8"NC x 45"	5/8"NC x 5"	5/8"NC x 4"
26	SCREW-SO HEAD SET	2	1/2"NC x 33"	1/2"NC x 35"	1/2"NC x 4"	1/2"NC x 5"
27_	SCREW-HEX HEAD CAP	4	3/8"NC x 12"	3/8"NC x 11/4"	3/8"NC x 11/2"	3/8"NC x 13"
28	SCREW-ROUND HEAD	4	#10-32 x 3"	#10-32 x 3"	#10-32 x 5"	#10-32 x 3"
29	NUT-JAM	4	5/8" NC	5/8" NC	5/8" NC	5/8" NC
30	NUT-JAM	2	1/2" NC	1/2" NC	1/2" NC	1/2" NC
31	SPRING-PIVOT		400-70	400-70	400-70	400-70
32	WASHER-STANDARD	4	3/8"	3/8"	3/8"	3/8"
33	WASHER-STANDARD	4	5/16"	5/16"	5/16"	5/16"
34	WASHER-LOCK	4	#10-32	#10-32	#10-32	#10-32
35	BUSHING-LEVER	4	90-44	90-44	90-44	90-44
						MRG:keg (7/88)

MRG:keg (7/88)

#### Brake Parts Breakdown

#### G. Traction Sheave and its Bearings, Clean, Inspect and Lubricate

You may ride the top-of-the car to access traction sheave located in hoistway.

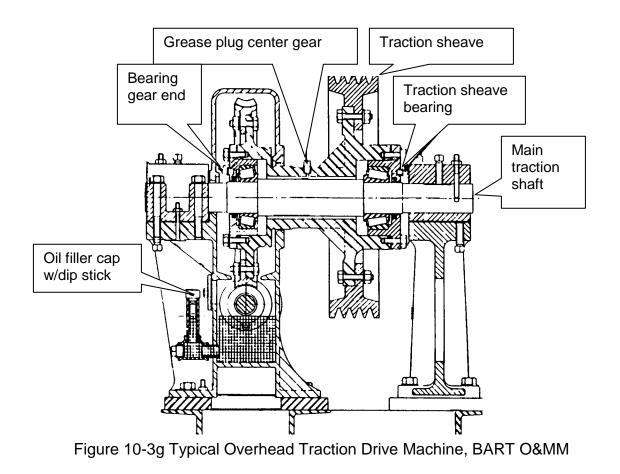
- 1. Open the disconnect, tagout and lockout if applicable while inspecting for **unequal wear of traction sheave grooves and wire ropes**.
- 2. Inspect the traction sheave **mounting bolts**. Look for evidence of wear on side of sheave or under mounting bolts and nuts that may indicate looseness.
- 3. Inspect for steel fillings beneath the sheave as an **indication of slippage between the ropes and sheave or wear of wire ropes**. This may be caused by any or combination of the following:
  - Unequal tension in the rope;
  - Contamination of the ropes with gear lubricant or grease and dirt;
  - Unequal rope diameter;
  - Excessive lubricant;
  - Incorrect counterweight;
  - Overloading and hard breaking;
  - Improper fit between the rope and sheave;
  - Improperly aligned drive sheave.

Any or combination of the above probable problem may cause sound vibration and/or noise around the drive sheave.

Report found evidence of failure to your Foreworker.

- 4. Visually examine the sheaves to ensure they are tight on shafts. **Sound spokes and rim** with hammer to detect cracks.
- 5. Run the elevator and listen to any noise off the traction sheave **bearing**.
- 6. Open the disconnect switch, tagout and lockout the elevator for overhead traction machine. Mainline disconnect must be ON to inspect traction sheave bearings located in the hoistway.

• Clean the grease fittings on the **spider hub** traction side and on the gear housing (figure 10-3g).



- Clean and open pressure relief plug between the gear housing and traction sheave.
- Re-grease the bearings.
- 7. Replace cover for the plug back and wipe off any excess or spilled lubricants.
- G. Controller in General, Clean and Inspect
- CAUTION: Check all circuits to ground for live voltage. Avoid contact with any capacitor terminals.

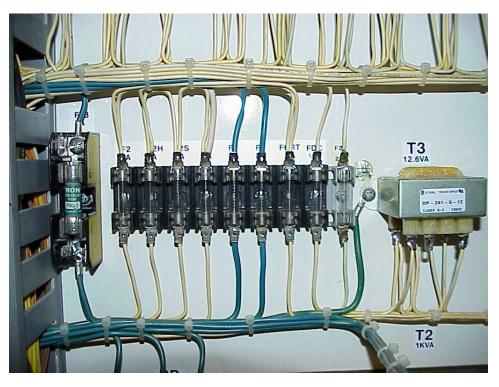
Tagout and Lockout the circuit breaker in the distribution panel before performing any PM for the mainline disconnect switch.

Where electronic circuits are present, avoid touching printed circuit board (PCB) without proper body grounding.

Avoid prolonged exposure to any cleaning solvent and positive ventilation must be available.

- 1. Clean and inspect controller ground cable to the building ground for corrosion and secured fastening.
- 2. Clean and inspect **mainline disconnect** switch to insure that it is in good working order and securely mounted.
  - Insure that all arc shields, if equipped, are clean and properly in place.
- 3. Check for oil or water leak from controller top. Insure that covers are installed properly to avoid water or any contaminant entry.
- 4. Clean controllers with vacuum and inspect all **relays**, **switches**, **contactors**, **control circuit rectifiers**, **transformer**, **capacitors**, **resistors**, **PCB**, **reverse phase relay**, and etc.
  - Inspect for excessively worn or burned contact, broken connectors, broken or cracked resistance grids or resistance tubes.
  - Use a non-metallic brush to **clean off dust** or other foreign matter from the rheostat windings or wire wound resistors, being careful not to disturb the rheostat settings.
  - **Clean the pitted contacts** with lint-free rags. Replace contacts in set when excessively pitted or burned. Never use emery board, sandpaper, or other abrasive material to clean contacts, since this may destroy contact plating. Contacts must be properly seated to avoid sparking. Observe seating of contacts to be flush against each other during normal operation. If cleaning solvent is to be used, insure that solvent is wipe off immediately and dried
  - Check for proper fuse type and rating and that no fuse should be jumped or shorted.

• Securely fastened any jumper wires or temporary wiring changes, controller connections, wire terminals and screws.



Picture of L10/EL95 Control Fuses

- 5. **Replace cracked or broken resistance** grid and resistor tube. Insure that the same size and rating of resistor must be used.
- 6. Remove tagout and lockout. Close the circuit breaker and disconnect switch.
  - Run the elevator and observe the operation of the control equipment when the elevator is running in each direction.
  - Note any arcing of contacts, excessive heating of coils or resistors, and misalignment of relays, contactors, and switches.

**Review Questions:** Write your name and answer in a separate paper.

- 1. Which of the following is an indication of an excessive horizontal movement of the motor shaft?
  - a) worn gear mount
  - b) worn motor mount
  - c) excessive backlash of the stator
  - d) excessive backlash of the rotor shaft
- 2. Steel fillings beneath the sheave is an indication of unequal tension in the ropes?
  - a) True
  - b) False
- 3. When should you replace normally worn brushes of a dc hoist motor?
  - a) after 3 years of service
  - b) after 5 years of service
  - c) length has been reduced to 50%
  - d) length has been reduced to 80%
- 4. The distance of the brush holder from the commutator should be not over \_\_\_\_\_\_\_\_ inch and no less than \_\_\_\_\_ inch for best operation.
  - a) 1/32, 1/16
  - b) 3/32, 1/16
  - c) 1/32, 3/16
  - d) 1/16, 3/32
- 5. Normally, what indication you will see when the commutator is worn out?
  - a) high commutator bars
  - b) high stator bars
  - c) low mica
  - d) high mica
- 6. What is the proper way of re-greasing motor or generator? Re-grease while the motor is/in \_\_\_\_\_?

- a) running.
- b) standby
- c) standstill
- d) operational
- 7. What effect does an improper brake spring tension do to the brake pads?
  - a) nothing
  - b) effective braking
  - c) even pads wear
  - d) uneven pads wear
- 8. Where should be the level of the gear oil in the absence of gear oil gauge?
  - a) Above the worm gear
  - b) Below the worm gear
  - c) At mid-level of the bronze gear
  - d) At the center of the worm gear.
- 9. How do you replace worn brushes? Replace them \_\_\_\_\_.
  - a) in pair per month
  - b) one at a time per week
  - c) all at the same time
  - d) in set per week
- 10. Which of the following steps you should do to service an elevator?
  - a) Inform the Station Agent & Central Control, place barricades, trip & tagout circuit breaker or quick disconnect.
  - b) Inform the Station Agent & Central Control, trip & tagout circuit breaker or quick disconnect, place barricades.
  - c) Place barricades, inform the station Agent & central Control, trip & tagout the circuit breaker or quick disconnect.
  - d) Trip circuit breaker or quick disconnect, p[lace barricades, inform the Station Agent & Central Control.

#### FIELD PRACTICAL SKILL TEST, Perform;

Inform the Station Agent and Central Control that elevator \_\_\_\_\_ will be use for training and is available for passenger.

- 1. Perform greasing of dc hoist motor bearings.
- 2. Clean, inspect commutator and replace hoist motor brushes.
- 3. Clean and inspect condition of brake pads.

Inform the Station Agent and Central Control that training is finished on elevator \_\_\_\_\_\_.

This page is intentionally left blank.

Unit 4: Hydraulic Elevator Machine Room and Equipment

#### SAFETY REMINDER

Always ensure that the circuit breaker is off before placing hand around the pump, the motor bearings, and drive belts.

Avoid stepping on pipes, fittings, and solenoid boxes in the pit.

Locate a safe refuge area inside the pit.

Before Entering Elevator Pit during inspection and maintenance;

The elevator must be declared out of service by placing a sign or placard on the controller;

ELEVATOR IS UNDER THE CONTROL OF A MECHANIC – DO NOT OPERATE

Hydraulic elevator Machine Room and Equipment

Objective: Upon completion of this module, an Elevator/Escalator Trainee should be able to;

- Inspect oil level and oil condition in the tank.
- Inspect reservoir condition.
- Test operate float switch and reset controller.
- Inspect drive motor and pump bearings.
- Inspect drive belt tensions and pulleys alignment.
- Test and inspect manual lowering valve.
- Inspect supply line, control valve, victaulic couplings, connecting pipes and hoses.
- **NOTE:** Dirty oil causes the highest percentage of problem in a hydraulic system.

Mixing of different oil grade or different oil compositions may cause a byproduct that may contaminate the oil.

Place controller relay panel Inspection Switch to ON in the performance of Machine Room Equipment Maintenance. Insure that no passenger is inside the elevator.

- A. Inspect Oil and Tank Condition
  - 1. Check Oil Level and Condition in the tank/reservoir.
    - Clean tank cover to avoid spillage of contaminants into the tank.
    - Check oil level with the use of dipstick or any level markings;

**Car is at top landing.** The reservoir oil level should be two inch over a submerged baffle or the oil must cover the pump suction intake to prevent cavitation for non-submersible pump.

**Car is at the bottom landing.** The oil level should be at the level "high" marker or similar indicator.

- Visually check the oil for large amounts of bubbles or milkiness caused by an excessive air.
- Remove any visible contaminants from the oil.
- Take sample of hydraulic fluid (Annually) and have it tested by a certified laboratory for viscosity, color, contamination, foaming, and other properties specified by the manufacturer.
- Drain and replace fluid if it fails to meet manufacturer's specified properties.
- 2. Inspect tank and baffle for corrosion, leaks, any indication of cracking or failure of the metal and secured fastening.
  - Never paint the inside of the tank or any part inside it.
  - Inspect tank cover underside for corrosion. Tank covers must be reinstalled after inspection to avoid any contaminant entry.
- 3. Insure that the **low oil level sensor switch** in the reservoir will shut off the controller when oil level is low by;
  - With the car ascending, manually test operate low oil sensor switch by disconnecting low oil level sensor wire from the controller.
  - Observe that the controller will automatically sends the car to the bottom landing after Motor Limit Timer elapsed (3 minutes), leave the doors opened, and takes the car out-of-service.
  - Reinstall wire back to the terminal and reset the controller through the RESET switch in the Controller.
- B. Inspect Power System
  - Inspect ac motor and pump bearings, relief valve, control valve, fittings, victaulic couplings and connecting pipes under the tank (figures 10-3 & 10-4a p5).
    - Trip controller circuit breaker to remove cover for the ac motor, pump and belt.

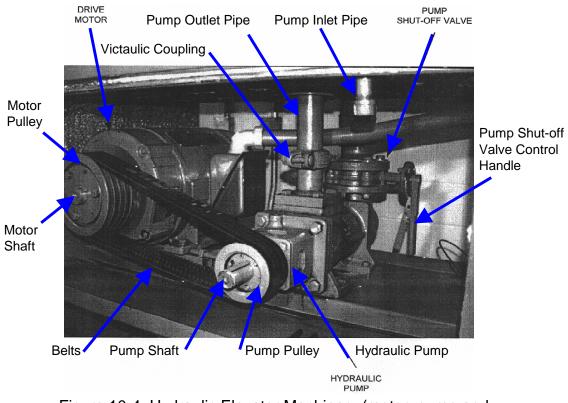


Figure 10-4. Hydraulic Elevator Machinery (motor, pump and belt cover removed), BART 1993 Extension Stations

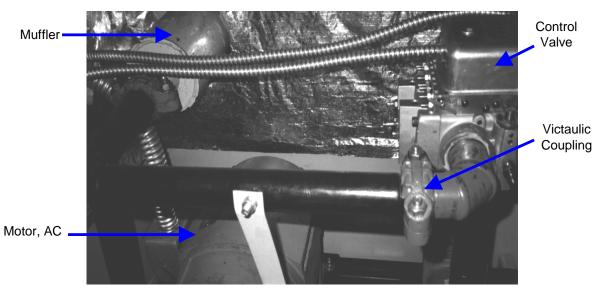


Figure 10-4a K10/EL22 Valve Control, Victaulic Coupling and Muffler

- Turn on controller circuit breaker to operate the motor and the pump.
- Check the bearings and listen to a metallic grinding, a rattling noise or an excessive vibration that may be an indication of bad bearing or an unbalance rotor or a cooling fan (motor impeller).
- Observe any looseness or excessive backlash of the rotor shaft, any excessive noise, misalignment, and loose mounting.
- 2. Check pump (figure 10-4 p5) for unusual noise that may be caused by;
  - Air entrapment or cavitation, or leaks in suction line.
  - Vortexing or low oil level in reservoir.
  - Incorrect alignment of pump and motor, worn shaft key and/or keyway.
  - Restriction in suction line or clogged strainer.
  - Loose motor, pump, bracket, or power system component.
  - Excessive belt tension, unmatched belt set, or an unbalanced sheave.
  - Damage or unbalanced motor.
  - Pump suction capability exceeded oil too cold or pump speed excessive.
- Exception: Elevator with submerged motor and pump are directly coupled. Check and listen to any noise and vibration from the tank.
  - 3. If the elevator will not ascend or very slow ascending, investigate the lack of oil flow or low pressure to the piston:
    - Belts slipping.
    - Incorrect motor rotation.
    - Low oil in reservoir.
    - Restricted pump suction.
    - Excessively cold and viscous oil.
    - Up control valve and solenoid may be damaged or malfunctioning.
    - Worn or damaged pump.
    - Pump leaks around the shaft.

- 4. Inspect couplings, connecting pipe, shut off valve and oil return line for leaks, secured support and fasteners (figure 10-4b).
- 5. Inspect the hoses from the tank to the pump and from the return line to the tank for deterioration or evidence of contracting or collapsing. Check the security of the clamps. Replace and/or adjust as necessary
- 6. Check the Pressure Gauge (Annually). Have an inspector pressure gauge installed in the system (requires two Mechanics). The working pressure must be on a plate mounted on the power unit.
- 7. Examine the relief valve and verify that the seal is properly attached to prevent changing of setting. The relief valve must be tested and re-sealed if the seal is broken or not in place.

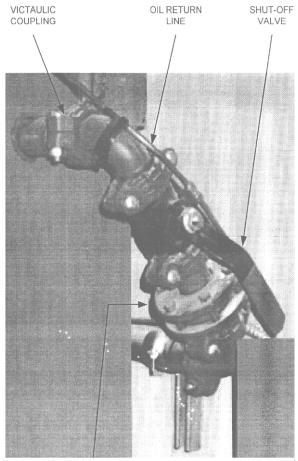


Figure 10-4b Machine Room Component, BART Stations C60, C70, L10, & W10.

Use the specific O&MM for other types of control valve where applicable.

• Test the relief valve by inching (raising) the car at slow speed against the stop ring, then set the controls to attempt to run the car at full speed and read the gauge. The up over-travel limit switch is bypassed.

Elevator	Working Pressure	Relief Pressure
62 & 63	290 psi	360 psi @ 125%
Extension	363 psi	450 psi @ 125%
Intermodal EL70 & EL71	425 psi	475 psi @ 125%

he full output of the pump should bypass at a gauge reading 150% or less of the working pressure.

- NOTE: CCR §3068(b)(B), Elevator Safety Order; The relief valve shall be preset to open at a pressure not greater than that necessary to maintain 125% of the working pressure.
  - After the test, check the car for proper operation and visually inspect the system for leaks.
  - After this test, the means of adjustment must be sealed. The annual test of flexible hydraulic hoses (if equipped) and fitting assemblies may be conducted concurrently with this test.
  - 8. Visually examine the flexible hydraulic hoses (if equipped), fittings assemblies, and flexible couplings for:
    - Evidence of leakage and slippage of hose fittings;
    - Damage to outer hose covering sufficient to expose reinforcement or cause distortion or bulging of hose body;
    - Note any leaks from the valves and the air filter (muffler).
    - Permanent marking with:

SAE 100 R2 type hose;

Required replacement date;

A metal tag indicating the date of the annual pressure test and the person or firm that conducted the test.

- NOTE: Hoses between the suction side of the pump and the tank are not considered pressure hoses but they must be inspected for leaks, bulging or other signs of damage.
  - 9. Check Drive Belt and Pulleys for proper alignment and secured fastening. Visually check pump drive belts for cracks, wear, contamination, correct size as follows;
    - Open the disconnect switch, tagout and lockout the elevator.
    - Twist and check each belt for cracks which will normally be seen on the inside "V" portion of the belt and extend all the way to the cords. This will cause increased slipping and accelerated wear.

- A worn out belt will show an outer cords, covering or strips of rubber separating from the belt. It may also show a different tension or over-stretched compared to the other sets.
- Verify that all belts widths are all correct;

A belt that is too wide for the groove rides high and losses traction.

A belt that is too narrow for the groove rides on the bottom, severely affecting traction and belt life.

All belts must have the same depth into the grooves.

## CAUTION: Always turn off and tagout circuit breaker/quick disconnect before checking for belt tension.

- 10. Check belt tension (figure 10-4c) by applying pressure (force) at the center of the belt non-taut side. All the belts should have similar tension and be tightened to about **1/64 inch** slack per inch of pulley or sheave span. The side of the belt being pulled by the motor pulley is the taut side.
  - The pulley span is from the center of the motor pulley to the center of the pump pulley. A rule of thumb is, "Belts should be tensioned when there is more than **1/2 inch** slack at the middle of non-taut side." Place the end of the extended measuring tape against the taut side and measure the slack by flexing the non-taut belt.

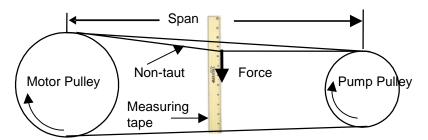


Figure 10-4c Checking Pump Belt Tension

- NOTE: It is important to know that drive belts must be replaced in matched set. When replacing a broken belt, replace all serviceable belts. ANSI Rule 1200.4.
  - New belts should be operated for 30 minutes and then set to two times the minimum tension to allow for initial stretch and wear. The tension should be re-checked after two or three weeks of operation.

11. Test and inspect **manual lowering valve** (figure 10-4d), and anti-creep devices. Two Mechanics required.

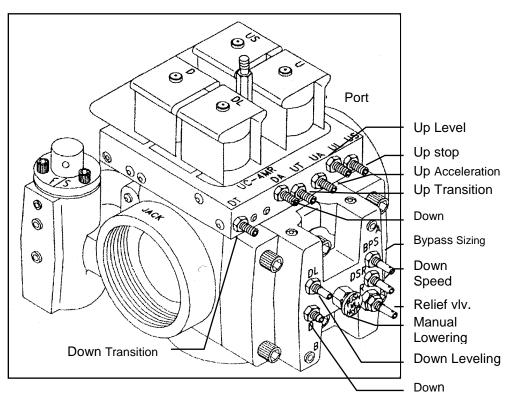


Figure 10-4d UC-4MR Hydraulic Control Valve

**Manual Lowering Valve.** A manually operated valve, located on or adjacent to the control valves, shall be provided and identified, which permits lowering the car at a speed not exceeding 20 fpm.

- Close the mainline disconnect to run the elevator.
- Position the car at a landing in response to operation by the normal landing device and in normal operation.
- Lower the car by opening the Manual Lowering Valve to initiate a downward movement. The pump motor should start when or before the car exceeds 1 inch from the floor.
- Close the manual lowering valve, the car should be within 1 inch or less of the floor when the pump motor stops.

Review Questions. Use separate piece of paper and write your name on top.

- 1. If you observe an excessive horizontal movement of the motor shaft, it is an indication of \_\_\_\_\_?
  - a) worn gear mount
  - b) worn motor mount
  - c) excessive backlash of the stator
  - d) excessive backlash of the rotor shaft
- 5. What is the first precautionary measure you should do before servicing any hydraulic pump belt?
  - a) Full control fuse
  - b) Inform the Station Agent
  - c) Remove belt and motor cover
  - d) Tagout and lockout the circuit breaker
- 6. What causes the most common problem in a hydraulic system?
  - a) dirty oil
  - b) oil level
  - c) burnt oil
  - d) low oil float switch
- 4. Which of the following is true statement that there is an excessive air mixture in the hydraulic oil?
  - a) Sound cavitation of the pump.
  - b) A large amount of oil flow above the cylinder gasket.
  - c) A smell of burnt oil caused by friction in the pump.
  - d) Very smooth hydraulic system operation.

- 5. What is the elapse time of the Motor Limit Timer (MLT) of a three rise elevator?
  - a) 2
  - b) 3
  - c) 3.5
  - d) 4
- 6. How would you return an elevator to service that went out due to low oil level? After correcting the problem you should \_\_\_\_\_.
  - a) turn on any push button switch
  - b) remove it form inspection access
  - c) turn on the controller reset switch
  - d) turn on the quick disconnect switch.
- 7. Opening of the manual lowering valve will lower the car not exceeding?
  - a) The size of valve orifice
  - b) Normal running speed
  - c) 20 fpm
  - d) 30 fpm
- 8. As per ANSI Rule, when replacing a broken drive belt, replace belts;
  - a) in pair
  - b) individually
  - c) in match set
  - d) all serviceable belts

FIELD PRACTICAL SKILL TEST, Perform;

Inform the Station Agent and Central Control that elevator \_\_\_\_\_ will be use for training and is available for passenger.

- 1. Inspect hydraulic oil level and for contamination.
- 2. Inspect pump drive belts for wear and tension.
- 3. Lower elevator using Manually Lowering Valve.

Inform the Station Agent and Central Control that training is finished on elevator \_\_\_\_\_\_.

.

## Unit 5: Hydraulic Elevator Pit Equipment

#### SAFETY REMINDER

Avoid stepping on pipes, fittings, and solenoid boxes in the pit.

Locate a safe refuge area inside the pit.

Before Entering Elevator Pit during inspection and maintenance;

The elevator must be declared out of service by placing a sign or placard on the controller;

ELEVATOR IS UNDER THE CONTROL OF A MECHANIC – DO NOT OPERATE

### Hydraulic Elevator Pit Equipment Maintenance

**Objective:** Upon completion of this unit, an Elevator/Escalator Trainee should be able;

- Understand all safeties involved when accessing the elevator pit.
- Inspect damage around the piston. Clean, inspect and smooth piston surfaces from pitting, scoring and corrosion.
- Inspect plunger fastening for oil leak. Tighten packing seal to correct oil leak and test elevator for normal operation.
- Inspect operation of the scavenger and recovery tank.
- Inspect supply line, control valve, couplings, and connecting pipes.
- Inspect overspeed/pipe rupture valve.
- Inspect and clean Y gate strainer/oil filter.
- A. Elevator Pit Equipment, Clean and Inspect
  - 1. Inspect elevator pit. Insure that;
    - The pit stop switch works by turning it OFF;

Push hall calls switches. The car must not respond to hall calls.

Attempt to raise and lower the elevator with the Hoistway Access (key switch). The car must not travel in any direction.

- Pit lights should properly operate and be protected by guards.
- Pit ladders should be vertically fixed and made of noncombustible material.
- It is dry and free from rubbish or lubricants. **No stored** material.
- Pit channels, guide rail fasteners, and spring buffers should be clean, painted and free of corrosion.
- B. Inspect Piston and Adjust Packing

- 1. Ride the car and listen to unusual noise. Observe its operation and check for noticeable drop/slips below floor level. If the car slips ½ inch or more, the packing may be loose or worn.
- 2. Barricade entrances to the elevator.
- 3. Prepare to access the elevator pit. Place the elevator on inspection or independent service. Open the bottom landing hoistway door.
- 4. Raise the car and visually check the amount of oil around the piston for an indication of an excessive **oil leak from the packing** gland (figure 3-2).

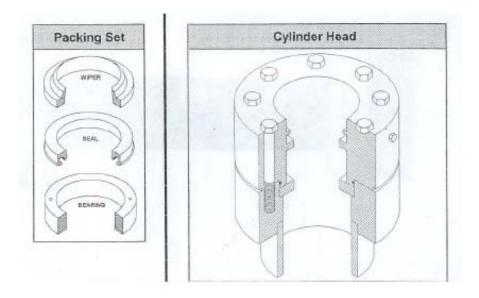


Figure 3-2 Cylinder Head and Packing Seal

If excess oil carry through the piston is present:

- Position the car sufficiently high to safely enter and exit the pit.
- Turn OFF the pit stop switch.
- Note the location of the oil leak around the piston.
- Access the pit and **blocked car up or tied off** to prevent unexpected movement from the release of hydraulic pressure.

- Examine the piston for pitting, scoring, or corrosion that may cause excess oil leakage and create safety hazard.
- Cover piston well with clean lent free rugs to prevent contaminants entry.
- If pitting, scoring, or corrosion is present, smooth piston surfaces with sandpaper. Clean contaminants from piston and piston well after sanding.
- If the leak is caused by loose or partially worn packing set, gradually tighten each bolt in equal amount of turn alternately (crisscross method).

#### CAUTION: DO NOT OVERTIGHTEN THE CYLINDER HEAD PACKING.

- Place a level gauge above the cylinder head flange to insure that the packing set sets evenly.
- 5. Turn the pit stop switch ON, raise the car to unblock or untie, remove rug around the piston well, test operate elevator with the access key switch.
  - Insure that the elevator travels freely without snag or lag from the time the pump starts, and the oil leak is resolved after two or three up travel test.
  - If noticeable lag time occurs between the pump start and the elevator up travel, recheck the cylinder head packing and readjust if necessary.
- NOTE: The elevator will normally lag from the pump start on its first up travel.
  - Run the elevator up and down to check if the excess oil leak was cleared. If not, make a report to your Foreworker, the packing set needs replacement.
  - 6. Add oil to the reservoir as required. Record amount added.

- C. Scavenger and Recovery Tank, Clean and Inspect
  - 1. Inspect piston well and drip line to the reclaiming container to be unclogged and free of any contaminants.

- Note the amount of oil in a non-automatic scavenger. Non-automatic scavenger or recovery tank (figure 10-5) must not reclaim more than five (5) gallons of oil per bi-weekly visit.
  - Insure that the **high oil level sensor switch** if installed inside the recovery tank will shut off the controller by adding oil inside the tank.

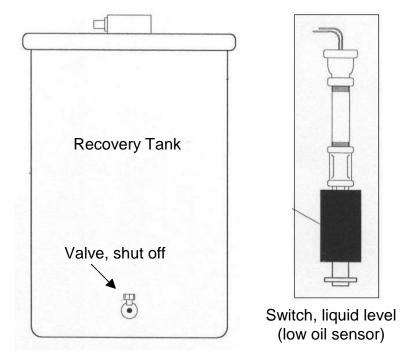
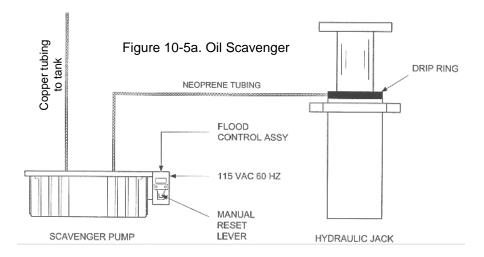


Figure 10-5. Oil Recovery System

- If the bucket or the recovery tank has to be emptied often after tightening of cylinder head or cleaning of piston rough surfaces, replace the cylinder head seal.
- 3. Ensure that the **scavenger** (figure 10-5a p7) is covered, operates, and cleared of any contaminants. If found to be contaminated, empty and clean container to avoid system oil contamination.
  - Clean scavenger filter. Ensure that power is off.
- Test operate flood control assembly sensor. Ensure that the presence of water in the pit will shuts off the scavenger pump to prevent water or contaminated oil from being pumped back to the oil reservoir.

When water is no longer present and the system is clean, the pump **manual reset lever** must be reset manually to resume scavenger pump normal operation.

• Test operate the scavenger by moving the float handle to actuate the switch. The pump should run, if not perform failure inspection.



- D. Inspect Supply Line, Couplings and Pipe Rupture Valve
  - 1. Clean and inspect pit **supply line and victaulic couplings** (figure 10-5b) for leaks, adequate support, vibration, loose fasteners or other evidence of damage. Correct problem if found.

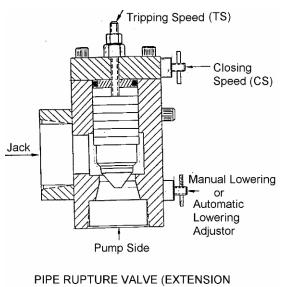
If unable to perform corrective maintenance, report to your Foreworker.



Figure 10-5b Victaulic Coupling Courtesy of Wikipedia 2008

 Ensure that the seal of the overspeed/pipe rupture valve (figure 10-5c) located between the jack and the shut off valve in the pit is intact and not tampered. To test for proper operation use, Book 105 Vol. 2 Appendix A, O&M manual.

- Raise the car midway the shaft to test the overspeed device. Open the manual lowering valve to simulate rupture in the system line. The tripping speed sensor should trip and stop the down travel at 130% of the car speed. A speed of 50 fpm will trip at 56.5 fpm.
- If **pipe rupture valve fails**, the car may stop abruptly. Manually operate elevator from the controller with the Inspection Switch to **raise car only**.



STATIONS ELEVATORS) Figure 10-5c

- 6. **Test Pressure Switch.** Performed during elevator load test (Annually);
  - Place the car at any landing except the bottom landing.
  - Visually inspect pressure switch for condition and damage.
  - Remove one electrical lead from the pressure switch and try to run the car in the down direction. If the car will not run by normal means, open the mainline disconnect switch. Connect a circuit continuity tester, such as ohmmeter, across the pressure switch and lower the car on the buffer with the Manual Lowering Valve.
  - The ohmmeter should indicate that the pressure switch is open when the car comes to rest on the buffer.
- **NOTE:** A pressure switch is required if the top of the cylinder is above the storage tank. The switch is to prevent operation of the valve if there is no pressure in the line between the down valve and the cylinder.
- 7. Test Hydraulic Cylinders (Annually). Test must be performed after the relief valve test was performed. Open the disconnect switch at the machine room and observe the car for 15 minutes. Note the position of the car platform with respect to the reference mark.
  - A change in a car position that can not be accounted for by visible oil leakage, valve leakage, or temperature change of the oil indicates a leak of the

cylinder or in the underground piping and a need for further inspection, tests, or repairs.

- 8. Examine (Annually) the **plunger fastening** to the carframe to verify that it is secured and adequately fastened.
- 9. Clean and inspect "Y" Gate strainer (figure 10-5d). Require two manpower (Annually). Clean all work areas to avoid oil contamination.
  - Insure that the car is at the bottom landing resting on its spring or buffer with the down **final limit switch bypassed** in the controller.
  - Isolate strainer by closing gate valves, and/or capped off inlet and outlet oil lines in the reservoir.
  - Use an oil collector under the "Y" strainer to avoid spillage.
  - Remove strainer cap screws. Gently unscrew strainer cap to bleed off any pressure.
  - Remove, clean, and flush debris off the strainer. Replace gasket.

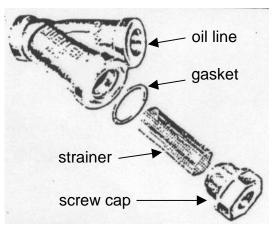


Figure 10-5d. "Y" Type Screwed End Strainer

- Reinstall filter and check for leak after turning on gate valves. Remove final limit switch bypass and raise elevator to the floor level.
- 10. Empty and clean **drip pans** from under the tank and discard contaminated oil in a proper container. Check the amount of oil spill, if any, look for the source.
  - Make sure to replace all covers and that they are securely in place to avoid contaminants from entering the hydraulic system.

**Review Questions:** Answer in separate piece of paper and write your name.

- 1. How do you tighten the piston packing gland? Tighten bolt alternately \_\_\_\_\_
  - a) one full turn
  - b) two full turns
  - c) gradual turns

- d) one and a half turns
- 2. What preparation should you do before opening "Y" gate strainer?
  - a) Warm up the oil by running the elevator.
  - b) Open the screw cap from the strainer and drain oil.
  - c) Bring the elevator to its spring and close the valve from the tank.
  - d) Bring down the elevator to its spring and empty the oil off the tank.
- 3. What component is used by the pit scavenger to avoid oil contamination in the tank?
  - a) Use of collection tank.
  - b) Use of flood control assembly.
  - c) Electric pump constant pressure.
  - d) Oil/water separator inside the scavenger.
- 4. An actuated high liquid level sensor inside the recovery tank indicates \_\_\_\_?
  - a) high oil level in the reservoir.
  - b) low oil level in the reservoir.
  - c) high oil level both in the reservoir and the recovery tank.
  - d) low oil level both in the reservoir and the recovery tank.
- 5. What should you do if the oil leak still exists after clearing piston rough surfaces and adjusting the packing?
  - a) Hammer the flange to set the packing.
  - b) Tighten the packing gland again.
  - c) Drain the oil from the wiper ring.
  - d) Replace the packing.

## FIELD PRACTICAL SKILL TEST, Perform

Inform the Station Agent and Central Control that elevator \_\_\_\_\_ will be use for training and is available for passenger.

- 1. Inspect piston for excess oil leak caused by pitting, scoring, or rust.
- 2. Clean and resurface damaged piston surfaces with sandpaper.
- 3. Inspect piston for loose or worn packing set.
- 4. Adjust piston packing gland.
- 5. Test run elevator.

Inform the Station Agent and Central Control that training is finished on elevator \_\_\_\_\_\_.

This page is intentionally left blank.

# Unit 6: Hoistway Equipment Maintenance

## SAFETY REMINDER

Never clean or lubricate rope surfaces while the car is moving. Look for overhead obstructions and locate a safe refuge area while at the-car-top and inside the elevator pit.

Before entering the elevator hoistway during inspection and maintenance, the elevator must be declared out of service by placing barricades in all entrances and a sign or placard on the controller. Hoistway Ropes, Guides Rails, Guide Shoe/Rollers, Landing System and Earthquake Sensor Maintenance

- **Objective:** Upon completion of this module, an Elevator/Escalator Trainee should be able to;
  - Understand all safeties involved when accessing the elevator hoistway.
  - Understand all safeties involved while at the car top.
  - Inspect car, governor, and compensating ropes fastening to be secured. Lubricate only as required.
  - Inspect car and counterweight rails and bracket fastening to be secured.
  - Inspect car and counterweight sliding guide shoe inserts for wear and fastening to be secured.
  - Inspect car and counterweight guide rollers wear, springs tension, and fastening to be secured.
- **NOTES:** Solvents must never be used to clean the ropes. It will remove lubricants.

**CCR §3042:** When hoisting or counterweight ropes are renewed, the entire set shall be renewed. A set of rope in this case shall mean all of the hoisting ropes, or all of the car counterweight ropes. Suspension or compensating wire ropes shall NOT be lengthened or repaired by splicing.

It is important to know that the **grooves are used to transmit power**. Make sure that sufficient traction must be provided between the rope and the groove.

**Governor ropes must NEVER be lubricated** after installation since the lubricant may interfere with the operation of the governor. If the governor ropes need lubricant, they must be replaced.

**Misalignment of the sheave** will cause rapid wear of the rope and sheaves. Worn sheave bearings and bushings causing sheave wobble also results in rapid wear. A. Car, Governor, Compensating Ropes & Rope Fasteners; Clean and Inspect

## 1. **Inspect wire ropes**

- Ride the elevator and listen to **vibration or rope chatter** that will be emitted throughout the elevator system. Size difference between the rope and sheave groove is the most common reason for vibration.
- Detect the differences in tension, **feel the resistance** of each rope to a horizontal pull or by plucking each rope and observe the vibrations.
- Mark the ropes with chalk to indicate the portions inspected.

The examiner is stationed on top-of-the-car and the car is **moved 2 to 3** feet at a time in the down direction. At each stop, wipe the excess grease and dirt from the ropes to do proper inspection.

- Use strong light, rope-cleaning compound, mirror, and magnifying glass to inspect for broken wire.
- Inspect for worn or broken strands (figure 10-6), excessive dryness and rust spots. Check for ruptures in strands and internal damage in rope valleys, dangerous slack in spots from excessive wear. Check for rouging - a form of corrosion found in stainless steel due to iron contamination of the stainless steel surface due to welding of ferrous.



#1. Wire rope per lay is one complete turn of the rope strands around the core from point "A" to point "B" (Right Regular Lay)



#2. Broken wire strands.

Figure 10-6. Wire Ropes; #1 good wire strands, #2 broken strands

When broken wires begin to appear, frequent interval of inspection is required to determine the rate of increase in the number of broken wires.

Those having **cracked wires must be examined closely**. Count the number of broken wires in a rope lay. If section of rope has developed six or more broken wires per lay, the rope must be replaced. Ropes that are new or have no cracked wires do not require close inspection.

- Take a close **look for any metal dust**. Examine ropes for metal chips that indicate broken wires, black dust is normal.
- **Inspect core damage or severe internal wire breaks** often indicated by increase or decrease (flattened appearance) in rope. If the fibre core is allowed to reach a state of dryness, an abrasive wearing action begins between the wire strands and the core with minute particles being worn from the wires.
- Visually **examine all ropes and fastenings** where they are likely to show signs of wear or bent over short radius.

### 2. Lubricate car, counterweight and compensating ropes as required

- Remove excessive rust deposits with wire brush first before lubricating.
- Lubricate wire ropes by using a paintbrush and only an elevator rope lubricant is applied. Oil viscosity recommended is between 34 & 38 SSU at 210 degrees Fahrenheit. If an automatic lubricator is installed, refill container every month.

A practical guide to the need for re-lubrication, a finger wiped in a sheave groove should show a faint smudge and have a **slight oily "feel."** If this test leaves the finger dry and formation of rust and deterioration between the strands and the core is visible, lubrication is necessary.

 Lubricate the whole rope but **Do Not Over-lubricate**. Over lubrication will cause wire rope slippage on the sheave grooves. Wipe off any excess or spilled lubricants.

**Periodic re-lubrication** is needed to obtain optimum hoist rope service life. Proper lubrication of the wire rope reduces internal friction by interposing a film of lubricant between the moving parts. The lubricant offers protection against corrosion and retards surface wear on both the rope and the grooves of sheaves and drums.

### Ways of lubricating wire ropes;

**Continuous Bath.** Operating is run through a specially constructed casing that has been packed with swabbing and loaded with lubricant to provide continuous lubrication.

**Dripping.** A container is placed above the sheave so that a spigot can be opened to lubricate the ropes as it bends along the grooves.

**Swabbing and Painting.** Two quick methods are swabbing on lubricant with rags or painting it on with a brush.

**Spraying.** Light lubricants can be directed by a properly directed spraynozzle. New aerosol cans are also proving useful.

- 3. Visually examine each counterweight rope.
  - Wire ropes that end at the counterweight top, check tension of each rope to determine if they should be shortened or equalized.
  - Unequal tension can result from unequal sheave grooves depth or improper adjustment at the attachments. Inspect counterweight sheave grooves for wear. Inspect the sheave fasteners to be secured
  - Lay a straight edge above the wire ropes laying on the sheave. Insure that all ropes have same depth into the grooves. Observed a variation of rope seating depth. As little as **1/64 inch can cause slippage** and sheave wear or an indication of unequal rope tension.
- 4. Inspect car and counterweight **shackles**, **rope sockets**, **condition of lock nuts and cotter pins**, **springs and all wire rope-fastening devices** (figure 10-6b) for breaks and signs of deterioration. Inspect dead-end hitches, compensating spring conditions, lock nuts and cotter pins for



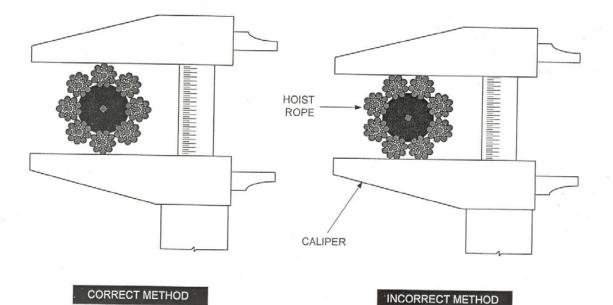
Figurigula-6b-66ire 1000023006etmendvErguralisteent CarRopeshead

secured fastening.

- Visually **examine ropes** for worn grooves on the drive and deflector sheaves and determine that all ropes seat to exactly the same depth by using a **straight edge** along the top of the ropes. If the straight edge does not contact all wire ropes, unequal groove depth is indicated.
- Observed a variation of rope seating depth. As little as **1/64 inch can cause slippage** and sheave wear. It may also be an indication of unequal rope tension.
- Visually check the position of the governor sheaves and the tension of its rope to determine if the rope needs shortening.
- Secure all fasteners.

Rope No.	Diameter with Car at BART Landing	Diameter with Car at MUNI Landing	Diameter with Car at Concourse Landing
1			
2			
3			
4			
5			
6			

# Table 6-3. Record of Hoist Rope Diameter Measurements



E.

MEASURE FROM TOP OF STRAND TO TOP OF OPPOSITE STRAND. DO NOT MEASURE

ACROSS FLATS.

Figure 6-2. Hoist and Governor Rope Diameter Measurement

#### Rev. Jan/03

#### Book 279

• **Measure wire ropes** (figure 6-2) at different locations in the hoistway, records each measurements and compare to see if there are any flat areas.

B. Car & Counterweight Guide Rails & Support Brackets; Clean, Inspect and Lubricate

Where roller guides are used, **lubricant is not required and must not** be used since it may interfere with the safety of operation.

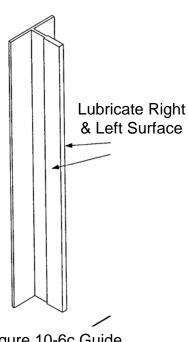
If an automatic rail lubricator is installed, the reservoir of the lubricator must be check periodically. Avoid using excessive lubricants that may interfere with normal operation. Rust-preventive compounds such as paints, mixtures of graphite and oil or similar coatings shall not be used as they may interfere with the proper operation of the car safety.

- CAUTION: When moving the car, make sure to have a firm holds on the crosshead or other parts of the car structure. NEVER hold onto the ropes. Always keep inside the limits of the car when moving to avoid the counterweight and any other ropes.
  - 1. Have access to the top-of-the-car at the top most landing. Place the elevator on inspection or independent service.
  - 2. Run the car in the down direction three to four feet at a time.

Inspect guide rails and brackets to be clean and free of rust, sound and tight, and there is no missing bolt or guide clips, all fastening secured.

Inspect guide rails for proper alignment, rough or damaged joints. Clean dirt accumulation.

Lubricate guide rails on both sides with manufacturer recommended lubricants. Wipe off excess lubricants.



**Brackets** are properly secured to building structure and to guide rails.

Figure 10-6c Guide Rail Lubrication

Fishplate bolts and nuts should be properly aligned and fastened.

- C. Landing System, Clean and Inspect
  - 1. Inspect landing system top and bottom support brackets (figure 10-6d), steel tape, fastenings, and magnets for rust, corrosion, wear and tear.

Clean and inspect all fasteners to be secured.

 Clean landing tape and apply proper lubricant as per manufacturer (figure 4-29 p11).

Insure that the magnets are securely fastened and not worn out.

If steel tape is perforated, insure that holes are cleaned, free from any debris or obstructions.

Never use lubricant on the perforated tabs. Lubricant may be shinny that will indicate false reading on the sensor digital position.

3. **Inspect car top reader box and tape guides** of the landing system (figure 10-6e).

The guides must not show excessive wear and tear and are securely fastened.

Pay particular attention to the wear of the tape guides. Replace tape guide in sets. Tighten all hardware.

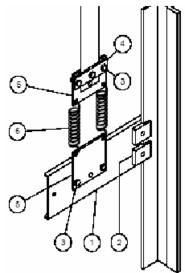


Figure 10-6d Landing Sys Tape Support Assembly

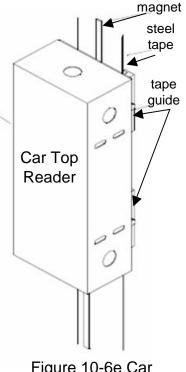


Figure 10-6e Car Top Tape Reader

4. While at the cartop, clean all **rear of landing door sills**.

#### 4-6-2-3 LANDING SYSTEM TAPE

Perform the following procedure to lubricate a landing system tape:

TASK PREPARATION			
REQUIREMENT	DESCRIPTION		
Workhours	1 hour		
Special Tools	None required		
Test Equipment	None required		
Consumable Materials	Alcohol Dry lubricant Clean cloth		
Parts and Hardware	None required		

CAUTION: DO NOT USE GREASE OR OIL TO LUBRICATE THE LANDING SYSTEM TAPE. GREASE OR OIL CAN CAUSE DETERIORATION OF THE ADHESIVE USED TO ATTACH MAGNETS TO THE TAPE AND CAN ALSO CONTAMINATE THE LANDING SYSTEM MAGNETIC SENSORS.

- 1. Use clean cloth and alcohol to clean tape (see Figure 4-29). Do not allow alcohol to come in contact with magnets.
- 2. Spray dry lubricant on clean cloth and apply lightly to sides and edges of tape.

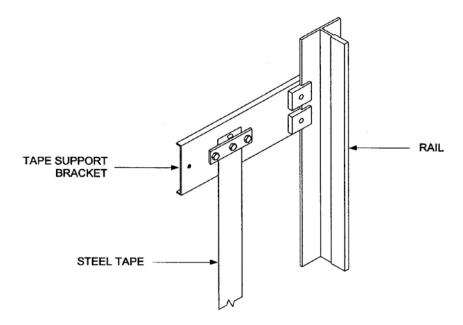


Figure 4-29. Landing System Tape Lubrication

- D. Car & Counterweight Guide Shoes or Guide Rollers; Clean and Inspect
  - 1. Visually inspect car and counterweight guide shoes for proper clearance, wear and tear, and secured fastening.
  - 2. Where **sliding-type guide shoes** are used, insure that rails are free of lent and dirt. The rail must be coated with a film of grease or oil but not excessively lubricated. Lack of proper rail lubrication causes vibration and noise and wear of guide shoe inserts or gibs due to friction against the rail.
  - 3. When fitted with guide rail lubricators, they are located either at the top of the guide rails or on the elevator car. Check and **refill lubricator** when low.
  - 4. **Refill lubrication fitting** (figure 10-6f & 6g) of guide shoe spring.
  - 5. Sliding guide shoes should be snugly fitted to the rail with approximately **1/32 inch** clearance against the rail face.

Check the wear of the insert inside the guide shoe. Replace as necessary. Insure that all fastening are secured.

Side to side shifting (rocking) of elevator cab while ascending or descending is an indication of worn out inserts.

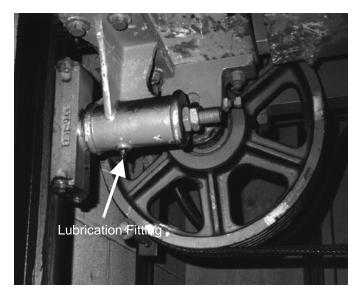


Figure 10-6f Guide Shoe and Sheave, Underslung Elevator

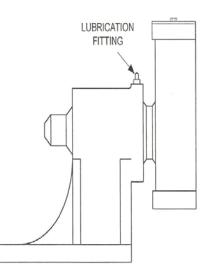


Figure 10-6g Guide Shoe lubrication fitting for the shaft inside stand

6. Where roller quides are used, rails should be clean and drv without lubricants. Insure that roller quide fasteners are secured. springs properly are tensioned. roller surfaces against the rail and evenly worn, bearings are quite and thev don't wobble.

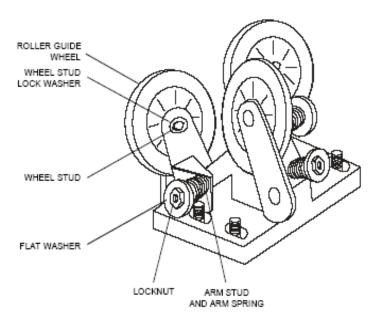


Figure 2-83 Car Roller Guides

- 7. Inspect **counterweight for loose or broken weights**. Insure the weights and fasteners are securely fastened.
- E. Counterweight Derailment "Ring-on-a-String" and Seismic Sensor Devices; Clean and Inspect
- CAUTION: AVOID CONTACT WITH LIVE CIRCUIT (the string).
- NOTE: Periodic calibration nor maintenance not required for Seismic Switch.
  - 1. Place the elevator in inspection.

Test to operate the **seismic** or earthquake sensor (EQ). The elevator should not operate normally until after reset switch is activated. With the car top in level with the counterweight derailment ring, shut the power off to **clean** and to inspect the derailment ring and string



for oxidation or corrosion and secure fastening.

**Review Questions:** Use separate piece of paper and write your name.

- 1. What is the most common reason for elevator wire rope vibration?
  - a) Worn wire ropes.
  - b) Misaligned drive sheave.
  - c) Over greased wire ropes.
  - d) Size difference between the rope and the sheave groove.
- 2. How many broken wires developed per lay would you consider rope replacement is needed?
  - a) Two
  - b) Four
  - c) Six
  - d) Eight
- 3. Lack of proper rail lubrication causes?
  - a) no effect.
  - b) vibration and noise.
  - c) earthquake sensor to actuate.
  - d) formation of lubricant at the bottom of the rails.
- 4. What is the clearance of the sliding guide shoes against the rail face?
  - a) 1/16 inch
  - b) 3/16 inch
  - c) 1/32 inch
  - d) 3/32 inch
- 5. How would you determine if the hoist rope needs re-lubrication?
  - a) Newly installed.
  - b) Shinny rope surfaces.
  - c) A faint smudge and have a slightly oil "feel".
  - d) Formation of rust and deterioration between strands.

### FIELD PRACTICAL SKILL TEST, Perform;

Inform the Station Agent and Central Control that elevator \_\_\_\_\_ will be use for training and is available for passenger.

- 1. Inspect wire rope for wear and breaks.
- 2. Inspect wire ropes for wear against the drive sheave.
- 3. Clean & inspect Landing System guides.
- 4. Clean & inspect guide shoes for wear.

Inform the Station Agent and Central Control that training is finished on elevator \_\_\_\_\_\_.

This page is intentionally left blank.

Unit 7: Car, Counterweight, Buffers, Springs and Bumpers; Clean and Inspect

# Safety Reminder

NEVER access the hoistway unless you have reliable method of controlling the car.

Stay clear of the counterweights and look for refuge area the elevator pit.

# Warning

DO NOT attempt to disassemble an oil buffer. These buffers are factory assembled with a spring or series of springs which can be dangerous if an attempt is made to disassemble them. Car, Counterweight, Buffers, Springs and Bumpers; Clean and Inspect

**Objective:** Upon completion of this module, an Elevator/Escalator Trainee should be able to;

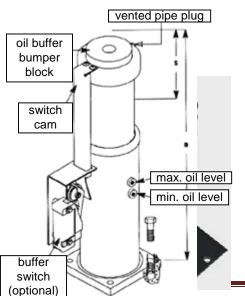
- Understand all safeties involved when accessing the elevator hoistway.
- Understand all safeties involved while at the car top.
- Inspect car, counterweight, buffers, springs and bumper fastening and brackets to be secured.
- Inspect car and counterweight bottom clearances and runby.
- A. Oil Buffer (figure 10-7), Clean & Inspect

Before entering elevator hoistway during inspection and maintenance, the elevator must be declared out of service by placing a sign or placard on the controller and at all entrances.

- 1. Place the elevator on inspection or independent service at the lowest landing and have access to the pit floor.
- 2. **Clean and inspect solid bumpers** and insure that their support are securely fastened, no damage or deterioration exists, and they are vertical and in alignment with the striker plates on the car.
- 3. Clean and inspect **oil buffer fastenings**. Inspect for any sign of corrosion and oil leaks.
- 4. Apply an anti-rust compound to the piston if needed but do not coat or paint with any substance that will interfere with their operation.

190

- 5. Check car and counterweight buffers oil level. The grade of oil to be used if required must be as indicated on the buffer marking plate.
- 6. Clean and inspect **oil buffer safety switch**, if equipped, check for corrosion and secured fastening.



Figutepfiog7BOffeBsffer

- 7. Clean and inspect spring buffers to determine that:
  - Their supports are securely fastened,
  - They are vertical and properly align with the striker plates on the car, and the counterweight if applicable,
  - Springs are properly seated on the cup or other mounting provided,
  - Springs have not been deformed, obviously weakened, or damage,
  - Buffer-marking plate is in place and contains all the required information. The number of springs be indicated on the marking place in addition to the other data.
- 8. Check the **clearance around the side and bottom of the elevator car** (Annually, Mechanic: 2 required) to insure that the car platform will not strike any pit components when run down onto the buffer.

Slowly run the car down onto the buffer until the buffer is fully compressed. Raise the car rapidly and time the buffer's return to its normal position. The buffer should return within 90 seconds. If it doesn't, appropriate repairs must be made.

- 9. Perform a similar test on the counterweight buffer, if equipped.
- B. Check Car & Counterweight Bottom Clearance and Runby, CCR §3018
  - 1. **Inspect bottom car clearances.** When the car rest on its fully compressed buffer;
    - There shall be vertical clearance of **not less than 2 feet** (610mm) between the pit floor and the lowest structure or mechanical part, equipment, or device installed underneath the car platform except guide shoes or rollers, safety jaw assemblies, and platform aprons, guards, or other equipment located within **12 inch** (305mm) horizontally from the sides of the platform.
    - No part of the car or any equipment attached thereto shall strike any part of the pit or any part located therein.
  - 2. Inspect bottom runby for counterweighted elevators.

- The bottom runby of cars and counterweight shall be not less than where oil buffers are used, **6 inch** (152mm). Refer to CCR 3017 for exceptions.
- 3. It is important to know that **if counterweight runby is less than 6 inch**, the wire ropes and/or the drive sheave grooves are most likely worn.
- 4. Report any unusual findings to your Foreworker.
- C. Check Horizontal Car and Counterweight Clearances. CCR §3018.
  - 1. Operate the car from the top-of-the-car, making stops in every floor and observe the clearances between the:
    - Car and hoistway enclosure, or any projection in the hoistway shall not be less than **1 inch** (25mm). If found to be less than 1 inch the guide rail sliding shoe insert may be worn, guide roller(s) out of adjustment.
    - Car and the counterweight shall not be less than 20mm (0.75 inch). The clearance between the counterweight and the counterweight screen and between the counterweight and the hoistway enclosure or any projection in the hoistway shall not be less than <sup>3</sup>/<sub>4</sub> **inch** (20mm).
    - Car platform sill and the hoistway edge of any landing sill, or the hoistway side of any vertically sliding counterweighted hoistway door or of any vertically sliding counterbalanced bi-parting hoistway door, shall not be less than 13mm (½ inch) where side steel guide are used, and not less than ¾ inch where corner steel guides are used. The maximum clearance shall be no more than 38mm (1.5 inch).
    - Car running clearances and any equipment attached thereto, of elevator operating in multiple hoistway, shall not be no less than **2 inch** (51mm).
  - 2. Clean and examine fastening and clearances of car leveling devices, including cams and vanes located in the hoistway.
    - Place the car in inspection and lower it slightly more than 1 inch below the lowest platform, landing sill.
    - Return the car to normal operation and observe that it levels within 0.5 inch (12.5mm) of the floor level for BART Specs.

- NOTE: Traction Elevator Leveling Problem. If the elevator leveling operation is common to all floors, the problem maybe from the brake or the leveling sensor on-the-car top.
- D. Inspect Car Top Clearances for Counterweighted and Not Counterweighted Elevators, CCR §3017
  - 1. The **Car Top Clearance** shall be no less than the sum of the following;
    - The bottom counterweight runby.
    - The stroke of the counterweight buffer used.
    - 2 feet or the distance which any sheave or any other equipment mounted in or on the car crosshead projects above the top of the car crosshead, whichever is greater.
    - One-half the gravity stopping distance based on;

115% of rated speed where counterweight oil buffers are used. Where provision is made to prevent the jump of the car at counterweight buffer engagement, this figure need not be more than 18 inch (457mm) where the gravity slow down distance is greater than 36 inch (914mm).

Governor tripping speed where counterweight spring buffers are used.

- 2. **Car Top Clearance for Not Counterweighted Elevators.** The car top clearance shall be no less than the greater of the following;
  - **36 inch** (914mm).
  - **12 inch** (305mm) plus the amount which any equipment mounted on the car crosshead, or above the car top when no crosshead is provided, projects vertically more than 2 feet (610mm) above the crosshead or top.
- H. Inspect Clearance Between Cars and Landing Sills and Car Leveling
  - 1. Operate the car, making stops in every floor.

• Observe the relationship of the car platform sill to the landing sill. The clearances must be;

A side-post construction must be **1.5 inch maximum and** <sup>1</sup>/<sub>2</sub> **inch minimum**.

A corner-post construction must be at **1.5 inch maximum and** <sup>3</sup>/<sub>4</sub> **inch minimum**.

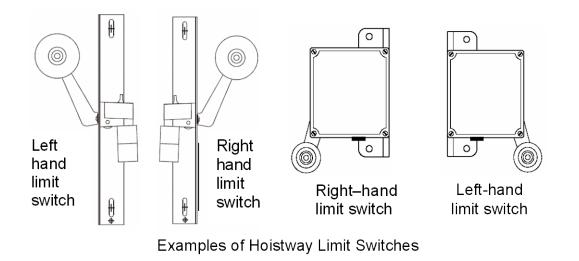
- If clearances are not within range, inspect wear of guide shoe insert and or guide rollers adjustments.
- 2. Clean and examine fastening and clearances of car leveling devices, including cams and vanes located in the hoistway.
  - Place the car in inspection and lower it slightly to more than 1 inch below the lowest platform landing sill.
  - Return the car to normal operation and observe that it levels within 1 inch (25mm) on the floor level for the elevators.
  - BART elevators levels at <sup>1</sup>/<sub>2</sub> inch or less.
- F. Normal Terminal Stopping Devices; Clean and Inspect

**Terminal Stopping** devices are used to slow down and to stop the car automatically, at or near the top and bottom terminal landing, with any load up to and including rated load in the car and from any speed attained in normal operation.

# CAUTION: Always place car-top inspection switch to STOP after each stop and during inspection of stopping devices/hoistway component.

- 1. Ride on top of-the-car and run the car up on inspection.
- 2. **Determine that normal stopping switches and cams** are in correct alignment, clean, operational and are securely fastened.
- 3. Stop the car near the top terminal and **sight the alignment of the cam and switch roller** of the Top Terminal Stopping Device. The switch roller should strike the bevel of the cam.

4. **Check the condition of the limit switch rollers**, as reduction of the effective roller diameter due to either wear or loss of roller may interfere with or prevent proper switch operation.



- 5. Insure that proximity switches if installed are maintained at **1/8 inch from the vane**. All foreign matter must be cleaned from the switches and insure that they are securely fastened with their covers properly in placed. Ferrous matter will interfere with normal operation.
- 6. Inspect the **Emergency Exit Panel** while on the car-top. Insure it is not obstructed and it is operational. Check the emergency exit panel access cover switch if equipped. The elevator should stop or will not run upon opening of the access cover.
- 7. Insure that **top limit is open if counterweight buffers are fully engaged**. Check the cam on the car to switch for proper engagement.
- 8. Perform similar steps above for the bottom terminal safety switches.
- G. Clean/Inspect Shaftway and Car Limit Switches not Mentioned as Normal Stopping Devices
- NOTE: The combinations of excessively worn car guide shoes or guide rollers and limit switch rollers, may cause elevator to malfunction.

- 1. Place the elevator in inspection service and have access to cartop. Before accessing the cartop turn off the fan switch from the COP to;
  - Clean the filter or wire mesh and the fan blades. Insure that the car ventilation is operational. Check for corrosion and secured fasteners.
  - Insure that the impeller does not wobble and the fan screen is installed and securely fastened.
  - Inspect and lubricate motor bearings.
- 2. Clean and inspect shaft **limit switches** or mechanical limit switches or may be an inductor switches of the magnetic type.
- 3. **Clean limit switch box surfaces and visually inspect** cam-operated roller for deterioration and cracks.
  - Determine if there is an evidence of corrosion and water inside the box.
  - Inspect control switches for corrosion, loose mounting, binding or excessive wear.
  - Insure that control limit switches covers are properly secured for **watertight integrity** when opened.
  - Correct problem as you found them.
- 4. **Visually check & manually operate** roller to ensure that the arm is not bent, loose or misalign and that they will return back to normal position when actuated. Insure that mechanical rollers are aligned with the cam.
- 5. **Clean and inspect all magnetic switches** for loose mounting, clearance, and foreign matter (ferrous).
- 6. Clean and inspect **inductor switches** for corrosion or misalignment.
- 7. Activate the LED of an inductor switch by covering the target area with a metal plate in front of the inductor. LED should turn on and illuminate.
- H. Traveling Cables and Junction Boxes, Clean and Inspect

CAUTION: Never use the traveling cable as a means of transporting personnel and equipment to and from the pit.

- 1. Place elevator in inspection and have access to the bottom pit. Examine the supporting means of the **cable at the connection points**. Insure all fasteners are secured.
- 2. Where a steel member is used to support the traveling cable, examine its attachment to the hoistway or car connection point and determined that it is securely fastened.
- 3. Examine for any evidence of wear or breaks in the steel **supporting fillers** which may damage the insulation of the conductors or cause the traveling cable to release, causing strain or breakage to the conductors at the terminal lugs.
- 4. Examine the **traveling cables** for:
  - excessive twist or kink, damage due to chafing, and intertwining of multiple cables;
  - clearance from hoistway equipment such as buffers, plungers, brackets, beams, etc.
- 6. Clean and inspect junction boxes for corrosion and evidence of water or any contaminant entry.
- 7. Inspect for water integrity. Secure all fasteners.

- I. Inspect Clearance Between Cars & Landing Sills and Car Leveling
  - 1. Operate the car, making stops in every floor. Observe the relationship of the car platform sill to the landing sill. The clearances must be;
    - A side-post construction must be 1.5 inch maximum and  $\frac{1}{2}$  inch minimum.

- A corner-post construction must be at 1.5 inch maximum and <sup>3</sup>/<sub>4</sub> inch minimum.
- 2. Clean and examine fastening and clearances of car leveling devices, including cams and vanes located in the hoistway.
  - Place the car in inspection and lower it slightly to more than 1 inch below the lowest platform landing sill.
  - Return the car to normal operation. Observe leveling within 1 inch (25mm) on the floor level.
  - BART elevators will level the floor within .5 inch.
- 3. Clean and examine fastening and clearances of car leveling devices, including cams and vanes located in the hoistway.
  - Place the car in inspection and lower it slightly to more than **1 inch** below the lowest platform, landing sill.
  - Return the car to normal operation and observe that it levels within **0.5 inch** (12.5mm) of the floor level for BART Specs.
- NOTE: Traction Elevator Leveling Problem. If the elevator leveling operation is common to all floors, the problem maybe from the brake or the leveling sensor on-the-car top.

Review Questions. Answer in separate piece of paper and write your name.

- 1. What indication is most likely the cause of counterweight runby to be less than 6 inch?
  - a) Worn guide rails.
  - b) Worn guide shoes.
  - c) Improperly installed buffer.

- d) Worn wire ropes and sheave grooves.
- 2. What is the car vertical clearance at rest between the pit floor and the lowest structure underneath the car with fully compressed buffer? \_\_\_\_ inch.
  - a) 3
  - b) 6
  - c) 9
  - d) 12
- 3. The switch roller of the terminal stopping devices should only strike the top and bottom edge of the cam.
  - a) True
  - b) False
- 4. Corroded contacts inside hoistway switch boxes is an indication of \_\_\_\_\_?
  - a) oil leak from the reservoir.
  - b) moisture from the elevator pit.
  - c) water spray from street cleaner.
  - d) improperly secured watertight integrity.
- 5. Leveling of BART elevator cars is within \_\_\_\_ inch?
  - a) 0.25
  - b) 0.5
  - c) 0.75
  - d) 1.0

FIELD PRACTICAL SKILL TEST, Perform;

Inform the Station Agent and Central Control that elevator \_\_\_\_\_ will be use for training and is available for passenger.

- 1. Inspect counterweight and car runby to determine if wire ropes and or sheave grooves are worn.
- 2. Inspect hoistway limit switches for roller alignment against the cam.

Inform the Station Agent and Central Control that training is finished on elevator \_\_\_\_\_\_.

This page is intentionally left blank.

# Unit 8: Hoistway and Car Doors, Clean and Inspect

# SAFETY REMINDER

NEVER ACCESS THE HOISTWAY UNLESS YOU HAVE RELIABLE METHOD OF CONTROLLING THE CAR.

STAY CLEAR OF THE COUNTERWEIGHTS AND LOOK FOR REFUGE AREA WHILE INSIDE THE ELEVATOR PIT AND AT THE CARTOP.

# Hoistway/ Hall and Car Doors Maintenance

**Objective:** Upon completion of this module, an Elevator/Escalator Trainee should be able to;

- Understand all safeties involved when accessing the elevator hoistway.
- Understand all safeties involved while at the car top.
- Inspect car doors alignment.
- Inspect hoistway doors alignment.
- Clean and inspect bottom guides and door gibs.
- Clean and inspect door interlock gate switches.
- Clean and adjust cable reel and spring closer.
- Inspect and adjust release rollers.
- A. Hall and Car Doors, Clean, Inspect and Adjust
  - 1. Place the elevator in inspection or independent service.
  - 2. Inspect running clearance of door panels.
    - Running clearance margins should be maintained with **door panels plumb** (figure 10-8 p4).
    - Margins between panels, under panels, and adjacent sections (headers, doorjamb, and cab entrance column) should be a **nominal** ¼ **inch or as required by manufacturer.**
  - 3. Adjust door track eccentric cam (figure 10-8a) to achieve <sup>1</sup>/<sub>4</sub> **inch** required for door bottom clearance if required.
    - Ensure that the door **hanger track** (item 1 figure 10-8b p5) is horizontally in plane. Use level to check and to adjust if necessary.
    - Install ¼ inch wedges under the door panel bottom edges before loosening track mounting screws for adjustment.

- Loosen but do not remove all tracks and eccentric mounting screws.
- Rotate eccentric cam to raise or lower door. Check for correct door panel plumbing (figures 10-8 & 10-8a below).
- Tighten all screws and recheck door panel plumbing and the door is free to horizontally slide along its track.
- Any door panel that cannot be plumb after adjusting the track, add or remove shims under the door panel sheave assembly (figure 10-8).
- 4. Clean and inspect car door or gate **hangers**, **tracks**, **guides**, **cables and tension pulley assembly** (figure 10-8b p5) to determine they are securely fastened in place and rust free.
  - Lubricate bushing of pulleys (item 6B figure 10-8b) with a drop of oil. Replace worn parts.
  - Inspect bushing and/or bearings and that the pulleys do not wobble.
  - Clean and insure all hanger, track, and guide fasteners to be secured and not corroded.
  - Check for wear and tear, flat spot, loose tires, worn bearings, dry tires, and binding. They must smooth and be free to spin.

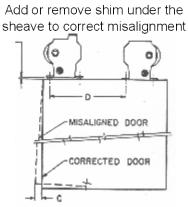
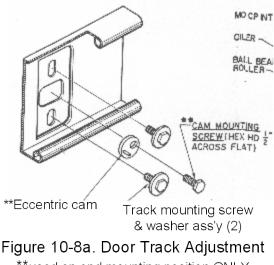
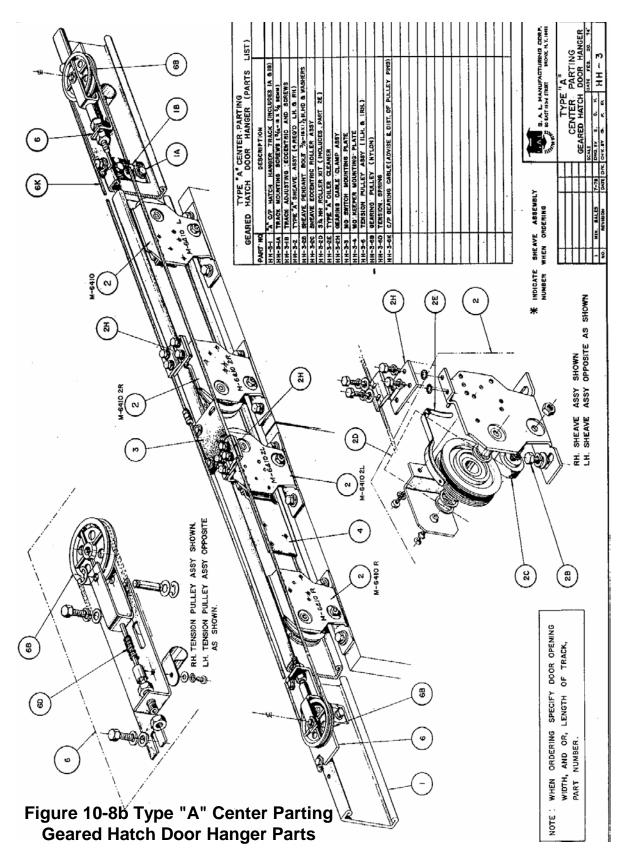


Figure 10-8. Door Plumbing



\*\*used on end mounting position ONLY



Replace wiper or felt oiler (item 2E) for the hanger roller if found to be dried.

- 5. Clean and inspect **hanger rollers** (item 2D figure 10-8b);
  - Lightly lubricate eccentric rollers bearings. Adjust **eccentric rollers** (upthrust) to 1/64 inch (item 2C) against the track. Use slotted screw driver to hold the upthrust while tightening the nut of the assembly.
  - There should be no friction from the gibs (figure 7-30) against the door sill. The upthrust and the door panel rolls smooth in opening/closing.
  - It is crucial to adjust and lubricate every hanger roller assembly.
- 6. Inspect bottom guides/door gibs for wear and tear, securely fastened, and properly aligned. Replace and/or adjust if necessary.
  - Insure that door gibs have **metal tabs (fire stop)**, the secondary retainer required by code. The tab needs to be down before the gib is inserted under the bottom of the door panel.
  - Insure that each end of the nylon runner is centered onto the sill.
  - Secure all fasteners.
- 7. Clean door sill guide grooves from end to end. Insure that sills are securely fastened, do not bounce when stepped on, and not corroded.

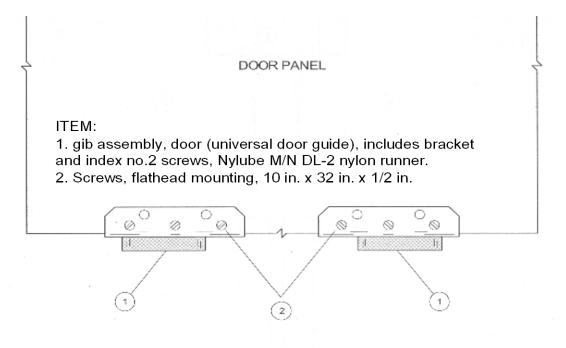


Figure 7-30 Door Gibs

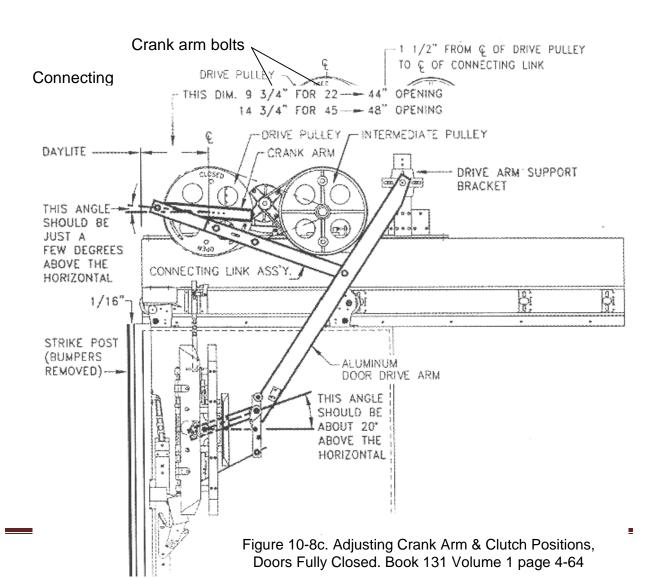
8. Inspect door crank arm and clutch link (figures 10-8c) positions. Adjust to avoid slamming and roll back during closing. The car and hall doors should be flushed against the doorjamb when fully closed for side opening doors.

If required, adjust the crank arm and link position as follows;

- Close the door.
- Loosen two connecting link bolts and two crank arm bolts.
- Adjust link arm to proper position.
- Tighten all four bolts. Check the operation.

**Doors fully closed**; the crank arm should be just a few degrees above the horizontal and the clutch link is about 20 degrees above the horizontal. This setting will help prevent slamming and roll back of the doors, allow manual opening of the doors when the car is stopped at the landing during power failure.

With doors fully closed, the connecting link should be about 1.5 inch from the horizontal centerline of the pulley. The clutch should be about 20 degrees above the horizontal as shown in figure 10-8d above.



Check clearance of the interlock release roller and the clutch rear vane (figure 2C p13) after adjusting crank arm and clutch link. Adjust roller if necessary.

A door is considered to be in the closed position when the clear open space between the leading edge of the door and the nearest face of the jamb **does not exceed 2 inch** (51 mm) or, in the case of bi-parting doors, when the **door panels are within 2 inch** of contact with each other.

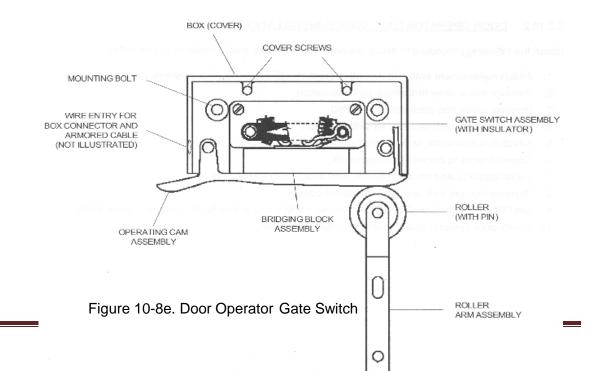
BART Elevators; The 2 inch pre-opening of doors are mostly for high speed high rise. Stations street and platform elevator doors are fully closed before the car travels and the car is fully stopped before door opening.

B. Inspect Door Interlocks and Gate Switches

## SAFETY REMINDER

## AVOID CONTACT WITH LIVE ELECTRICAL CIRCUIT.

- 1. Test the gate switch (figure 10-8e). Gate switch electrical contact should be **open when the car door opens at 2 inch or more**.
  - Place the elevator in inspection at the COP. Open car door to <sup>3</sup>/<sub>4</sub> inch and hold.
  - Return the INSPECTION switch to NORMAL Run and try to send the car to a different floor. The elevator should not move.
  - If the elevator moves, the switch contacts did not open. Check and



adjust roller arm assembly.

- 2. Clean and check **locking and contact devices**, **bridging block** and all related operating mechanisms.
  - Insure that the operating arm is correctly aligned with the roller arm of the interlock or the door operating mechanism. The roller travel is sufficient to insure proper operation of the interlocks or door operator.
  - Clean contacts pitting and oxidation if present. Secure all fasteners.
- 3. Where the locking members of door interlocks and gate switches are operated by car cams (door clutch), perform the following;
  - Place the elevator in INSPECTION and have access to the cartop.
  - Place the door or gate in the fully closed position and move the car to a sufficient distance away from the floor to permit the locking member to lock the door or gate.
  - Try to manually open the hall door panel(s), it should be held closed by the lock. Insure that the hall door cannot open more than **3/8 inch**.
  - When the car is outside the unlocking zone, the car doors shall be so arranged that it cannot be open more that **4 inch** from inside the car. The Door Zone locking device (figure 10-8d p8) must engage.
- 4. Open interlock or switch box assembly (figure 10-8f p11).
  - **Manually compress release rollers** together from the release roller assembly to open the hall door.
  - Check the **distance between the keeper bridging (shorting) block** (item 5) **from switch box bumper**. The shorting block must clear the bumper both in opening and in closing operations.
  - Adjust the release link (item 6) if necessary to clear the shorting block from hitting the bumper but to maintain a positive pressure between the shorting block and the contacts inside the switch box.
  - Clean and inspect keeper bridging contacts for pitting, oxidation, corrosion, and wear. Replace contacts if unable to correct wear.

- Check all the assemblies of the keeper, the switch block, and the release roller for secured fastenings and no breaks or cracks.
- Clean and lubricate all pivot points and bushings with a drop of oil. Wipe off excess oil.

NEVER use cleaning solvent WD40 to clean the contacts as per G.A.L. manufacturing.

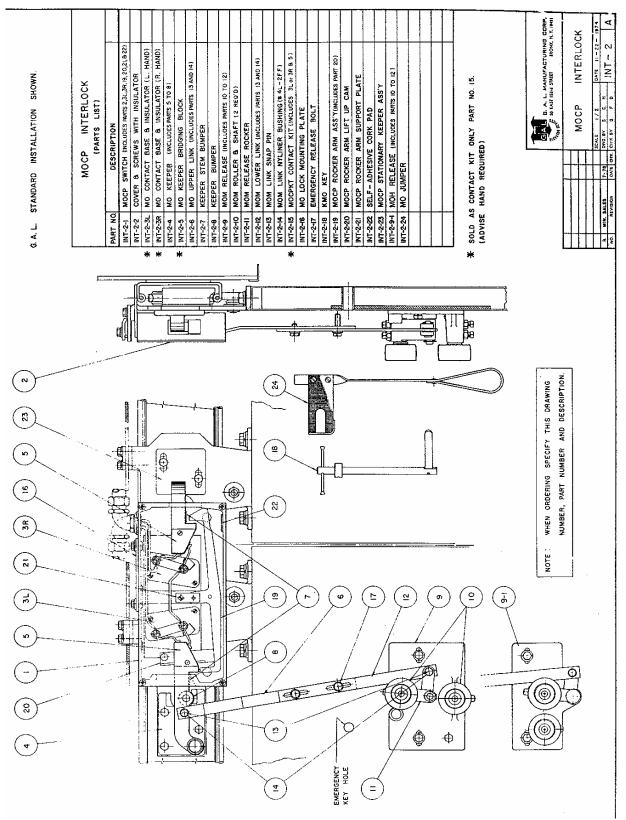


Figure 10-8f. GAL Door Interlock Parts Breakdown

5. Clean, inspect, lubricate and secure fastening of **cable-reel** (spirator) or **spring closer linkage assembly** (figure 10-8g below).

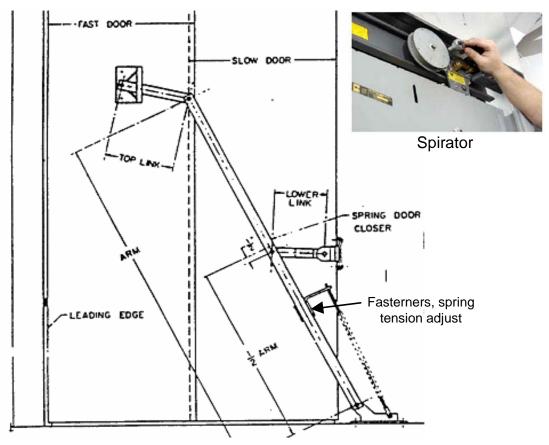


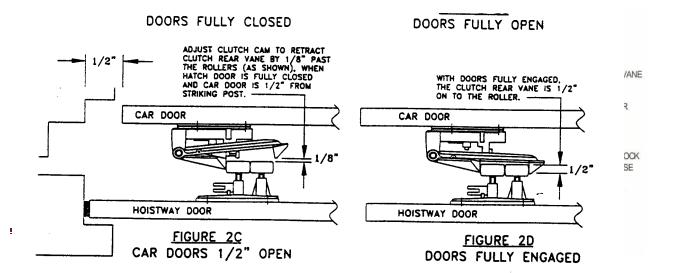
Figure 10-8g. Door Spring Closure Linkage and Spirator

- Clean and lubricate all pivot points and bushings of door spring closure and spirator with a drop of oil. Wipe off excess lubricants.
- Check door spring closer and spirator tension.
- Release hall door from car door clutch.
- Close hall door with hand fist in-between doors then let the doors go. Doors should close smoothly.
- If door closing is weak for door spring closure, leave hall doors closed and adjust spring fasteners at the arm to increase tension.
- The door spirator relating cables should be sufficiently taut to keep the doors operating smoothly, but not so taut that they cut into door relating cable reel.

• If hall door closing tension is strong, hold relating cable reel to un-spool. Release cable one turn at a time.

# CAUTION: Always maintain a strong grip on the relating cable reel.

- If door closing is weak, reel-in relating cable and retest operation.
- Replace any damaged parts of the spirator or spring closer linkage.
- C. Clean, Inspect, and Adjust Stop Roller, Release Roller & Clutch
  - 1. Inspect hall door interlock rollers for wear and secure all fasteners. Replace worn rollers in pairs.
  - 2. Clutch and interlock release should be adjusted so that the hall door will properly engage the clutch, both car and hall doors move together.
    - When doors are fully engaged, the clutch rear vane is 1/2 **inch** on to the roller (figure 2D below).
    - When doors are fully closed (figure 2C), the rear vane is off the rollers (figure 10-8h). Observed the clutch rear vane clearance from the cartop to be **1/8 inch** (figure 2C) past the rollers with car door ½ inch from the striking post and hall doors fully closed
    - Adjust rollers in/out for specific clearance by loosening a locknut at the roller base mount.
    - The clutch cam (rear vane) retracts as late as possible in the closing cycle. Adjust if necessary
    - Mark the base plate of the interlock release before replacement of the assembly.

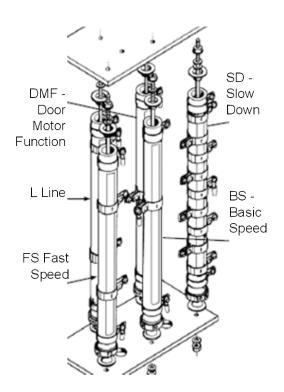


- Secure all fasteners.
- D. Inspect Car Door Operator, Motor, Gears, Cams, Resistor Tubes, Pulleys, Belts, & Chains (figures 10-8i below & 38 p16).

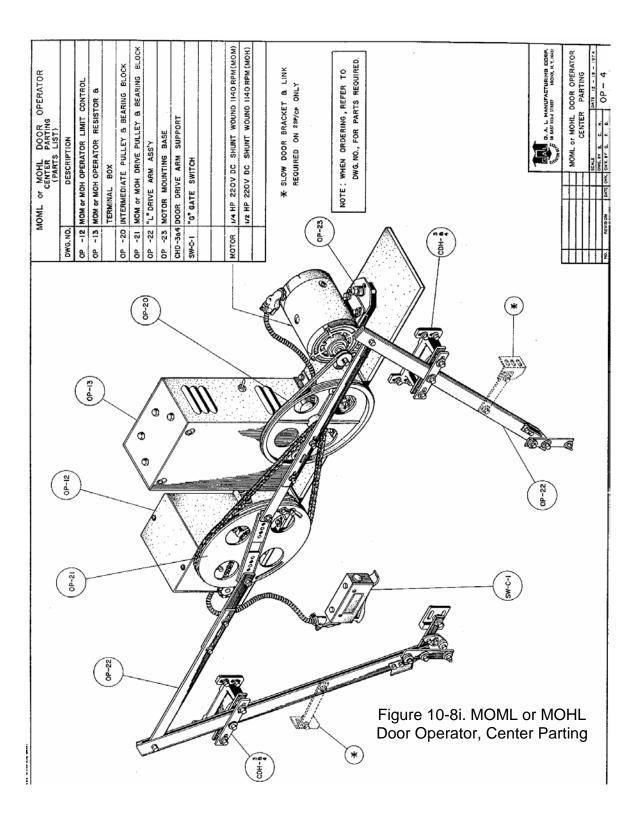
### CAUTION: Avoid contact with live electrical circuit. Remove Door Operator fuse.

- 1. Place the elevator in INSPECTION and have access to cartop.
- 2. Open Resistor Tube box.

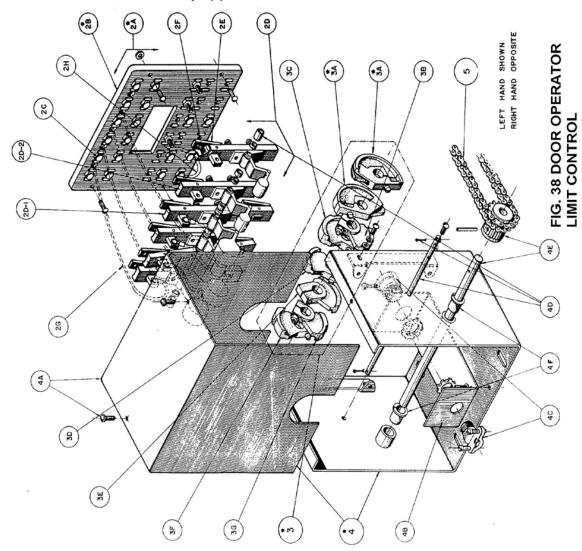
Clean and check resistor tubes for corrosion or burnt wire and wire terminals. Secure all fasteners and terminals around the resistor tubes.



Door Operator Resistor Tubes



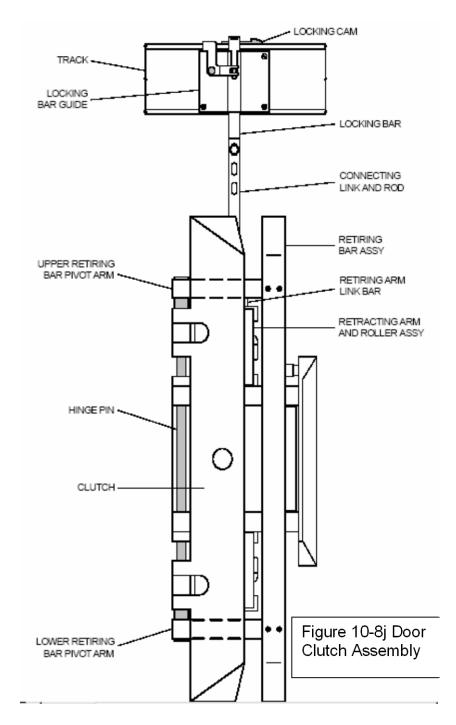
- 3. Open door operator **limit control box** (figure 38 p17).
  - Clean and inspect cams (item 3) for secure fastening and evidence of misalignment or cracks. Insure all fasteners are secured.
  - Clean and inspect contacts for pitting and oxidation.
  - Lubricate all bushings (item 4f) with drop of oil. Wipe excess oil.
- 4. Clean door operator **dc motor brushes** and inspect for wear.
  - The brush length must **not be less than 50% of its original**. They normally last very long and wear is less than the hoist motor brushes.
  - Inspect brushes pigtail condition for broken wires.
  - Lubricate dc motor bushings or bearings. Wipe off excess oil
- 5. Check for inconsistent or "**jerky**" **door movement** as an indication that the drive chain needs adjustment or the guide rollers are worn out.
- 6. Inspect **belts** for cracks and deterioration. Adjust/replace if necessary.
- 7. Examine relating **chains and sprockets** for proper tension and note any excessive sprocket teeth wear.
  - Apply moderate pressure on the chain. A deflection of approximately <sup>1</sup>/<sub>2</sub> inch at the non-taut end is acceptable.
  - Maintain a **thin coat of oil on all the chains** and lubricate bushings and all pivot points. Wipe off any excess lubricants.
- 8. Inspect all **sheaves and pulleys** for secure fastening and they don't wobble and are properly aligned.
  - If equipped, inspect **rubber suppressor** around the drive pulley for wear, tear, and elongation. Replace if necessary.
- 9. If grease or oil fittings are provided for the motor and pulleys, clean fittings and lubricate **bearings and sleeves**.



NOTES: AWHEN REPLACING ANY OLD CANVAS BAKELITE ACTIVATING CAMS. THE ENTIRE EXTIMUST BE ACTIVATING CAMS. THE ENTIRE FOR DEC ACTIVATING CAMS (OP-I2-3).SEE SV BUL.1215.77-A

# \*SPECIFY LEFT OR RIGHT HAND





Car Door Clutch Assembly (figure 10-8j above), clean and inspect.

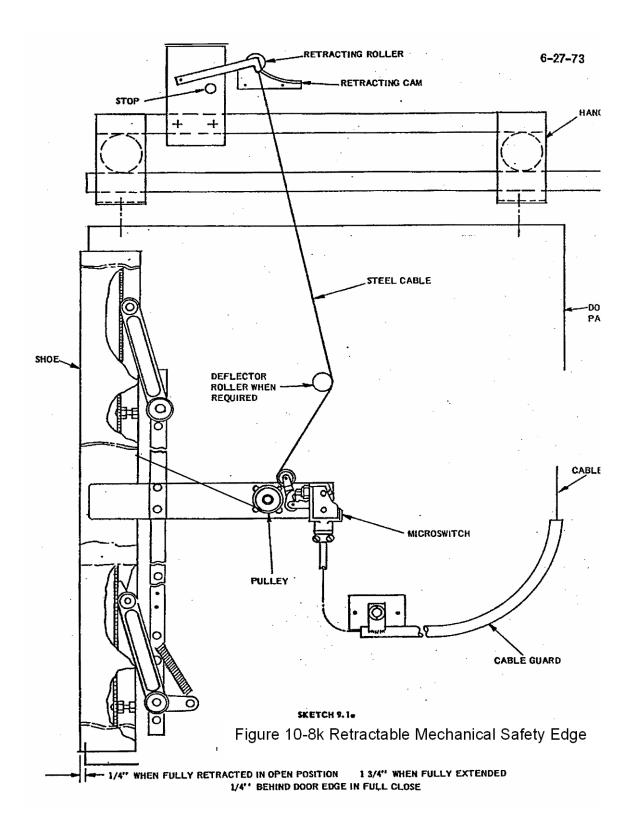
Open hall door and close car door fully to expose door clutch assembly. Insure that pressing the retiring bar assembly, the zone locking device unlocks and locks when retiring bar assembly is released. Lubricate all pivot surfaces and wipe off excess oil. Secure all fasteners, replace and/or adjust worn parts if necessary.

Insure that when the car is outside the unlocking zone, the car doors cannot open more that **4 inch** from inside the car.

- E. Clean, Test, and Inspect Door Safety Edge, Retractable Mechanical and Door Closing Force
  - 1. Place the elevator in inspection or independent service.
  - 2. **Clean all optical surfaces** of an electronic safety door edge or electronic door edges (EDE).
    - Inspect optical surfaces for cracks and/or damages. Repair/replace as necessary.
    - Insure that optical surfaces are dirt or grease free. Dirty optical surfaces can interrupt the transfer of a light ray enough to leave the door opened.
    - Receiver (RX) and transmitter (TX) cables should be securely fastened to the car door and car top and not to dangle.
    - For passenger safety, sensitivity should be adjusted to initiate reopen operation when the light beam is interrupted.
  - 3. **Place an obstruction between the safety edges** anywhere from the bottom edges to the height of 6 feet.
    - Check that the nudging beeper sounds and red (fault) trigger LED is illuminated.
    - If the doors are powered, they should retract or remain held open while the obstruction is in place. The **Nudging timer** starts when the regular default time of 40 seconds elapses.
    - If elevator normal operation stops after nudging, **reset Inspection Switch** from the controller.
  - 4. Return the elevator to automatic service. Activate door safety edge during the closing cycle at/or before midrange of travel to test for automatic reopening. The door should reopen.

# CAUTION: If door does not reverses its direction of travel during closing cycle, move obstruction object out to avoid accident.

5. Inspect **astragal/rubber bumper** if equipped at the leading edge of the doors for wear and tear. Adjust astragal to the center of door channel.



- 6. Inspect **retractable mechanical safety edge** (figure 10-8k p20).
  - Clean, lubricate all pivot points and inspect all parts for wear and secured fastening.

- Clean and inspect guide shoe, steel cable, cable pulley, switch roller, deflector roller, and retracting roller. Replace worn parts and adjust the steel cable if necessary to attain correct safety edge travel.
- Insure that the retracting roller will pull the steel cable to retract the safety shoe by 1/4 **inch** behind door edge when the door is fully opened or when fully closed.
- Insure that the safety edge will extend to 1<sup>3</sup>/<sub>4</sub> inch beyond the door edge during closing cycle. This will allow passengers to push the door back and to trigger the switch for the door to retract from closing.
- 7. **Test door closing force** (Annually) for power operated car doors. Use a Door Thrust Gauge, P/N MT-122027.
  - Park the car at floor level and start the doors in the closing direction.
  - Allow the doors to close between **1/3 to 2/3** of their normal travel.
  - Press the test scale on the **leading edge of the hoistway door** (reads over 30 lbs.).
  - Do not allow the door to strike the scale with impact. Be careful that you do not interfere with safety shoe, light ray, detector, or other reversal device.
  - Release the door and read the force as indicated on the scale. The **force must not exceed 30 lbf.** ASME A17.1.

# NOTE: The closing torque is directly related to the closing speed, the faster the speed the higher the torque.

- Adjust door speed if necessary to attain correct torque. Use MOML/MOHL Door Operator Installation and Manual Adjusting by G.A.L Manufacturing Corporation 5/20/98.
- F. Check Door Operating Speed & Locking Device (GAL MOML/MOHL Door Operator Installation & Adjusting Manual, BART Training Contract).

- **NOTE:** The operator cams have been factory preset. If necessary, speed adjustment should be made primarily with the resistor tubes. Cams should be adjusted only after resistor tube adjustment is exhausted.
  - 1. Observe door operating speed.
    - Doors should open within **2.2 to 2.5 seconds**.
    - Maximum door closing speed should not exceed an average of **1 ft/sec.** (304.8 mm/sec).
  - 2. Check for smooth and quite door opening and closing with no marked speed change.
    - Doors will start to open in slow start zone, then accelerate to high speed. After high-speed zone, there will be four steps of slowdown.
    - The last slowdown decelerates the doors to the final opening. Speed changes of the door(s) may not be noticeable.
  - 3. **Test car door switch or closed position of hoistway door** where hoistway door is equipped with mechanical locks and electric contacts. A second person is inside the car to run it during the test.
    - Insure that the **gate switch electrical contact** should be OPEN when the car door opens more than **2 inch**.
    - With the car door in the closed position and the hoistway door fully opened, close the hoistway door slowly from the landing side until the maximum clear opening is reached at which the actuation of the door switch will cause the car to start.
    - **Measure the distance** from the nearest face of the doorjamb to the nearest edge of the door, or between the meeting edges of bi-parting doors. Determine from this position, the door cannot be reopened from the landing side.
    - **Center-parting doors** should be no more than **1/16 inch** apart when the doors are fully closed.

If doors are found to be more than 1/16 inch apart, adjust Connecting Link Assembly (figure 10-8d p8). Set center parting doors at centerline of the drive pulley.

4. **Test hoistway door locking device** (figure 10-8f Door Interlock p11).

- Place car in inspection and run it near and above each landing so that the automatic unlocking device on the car cannot release the interlock.
- Raise and ride inside the car, and close the hoistway door.
- With the car away from the landing and its doors opened, try to open the hoistway door by hand at the doorjamb or center of bi-parting doors. It should not be possible to open the door beyond the closed position if the door gate is locked.
- If hoistway door opens, adjust door gate locks and retest operation.
- D. Check Horizontal Car and Counterweight Clearances. CCR §3018.
  - 4. Operate the car from the top-of-the-car, making stops in every floor and measure the clearances between the car:
    - and hoistway enclosure, or any projection in the hoistway shall not be less than 1 inch (25mm). If found to be less than 1 inch the guide rail sliding shoe insert may be worn or the guide roller(s) out of adjustment.
    - and the counterweight shall not be less than 0.75 inch (20mm). The clearance between the counterweight and the counterweight screen and between the counterweight and the hoistway enclosure or any projection in the hoistway shall not be less than <sup>3</sup>/<sub>4</sub> inch (19mm).
    - running clearances and any equipment attached thereto, of elevator operating in multiple hoistway, shall not be no less than **2 inch** (51mm).
    - platform sill and the hoistway edge of any landing sill, or the hoistway side of any vertically sliding counterweighted hoistway door or of any vertically sliding counterbalanced bi-parting hoistway door, shall not be less than <sup>1</sup>/<sub>2</sub> inch (13mm) where side steel guide are used, and not less than <sup>3</sup>/<sub>4</sub> inch where corner steel guides are used. The maximum clearance shall be no more than 1.5 inch (38mm).
    - Replace worn parts and secure all fasteners.

Review Questions: Use separate piece of paper and write your name on top.

6. What is the adjustment of the door sheave eccentric roller against the track?

- a) 1/64 inch
- b) 3/64 inch
- c) 1/16 inch
- d) 3/16 inch
- 7. A missing release roller of the interlock release roller assembly will do what to the hoistway door?
  - a) Will have no effect at all.
  - b) Hoistway door will not open.
  - c) Closes the gate switch prematurely.
  - d) Opens the door gate switch prematurely.
- 8. When is the gate switch electrical contact held close? When the \_\_\_\_\_
  - a) hall door is 1/3 opened
  - b) car door is ½ opened
  - c) car door is <sup>3</sup>/<sub>4</sub> opened
  - d) hall door <sup>3</sup>/<sub>4</sub> is opened
- 9. The recommended gap between the bottom of the door and the sill is \_\_\_\_ ?
  - a) 1/16 inch
  - b) 1/4 inch
  - c) 1/2 inch
  - d) <sup>3</sup>/<sub>4</sub> inch
- 10. When is the door clutch rear vane, fully engaged with the release rollers?
  - a) door opening.
  - b) door closing
  - c) start of car travel.
  - d) all of the above.
- 11. When car and hatch doors are fully engaged, the clutch rear vane is \_\_\_\_\_ inch on to the clutch roller.
- 12. How would you adjust a misaligned (not plumb) door panel?
- 13. What is the clearance of the retractable clutch rear vane from the release roller when hatch door is fully closed?

- 14. What is the adjustment of the car door eccentric roller from the door tracks?
- 15. How would you silence a nudging timer buzzer?
- 16. The gate switch electrical contact opens in normal operation when the \_\_\_\_\_ are fully engaged.
  - a) Doors
  - b) Rear vane
  - c) Spring closure
  - d) Bridging blocks
- 17. What is the maximum distance between the door edges of center-parting doors when fully closed?
  - a) 1/16 inch
  - b) 3/16 inch
  - c) 3/8 inch
  - d) 1/4 inch
- 18. Closing force of a power operated car door must not exceed \_\_\_\_?
  - a) 20 lbf.
  - b) 25 lbf.
  - c) 30 lbf.
  - d) 35 lbf.
- 19. Which elevator component holds the car doors closed while the elevator is away from the unlocking zone.
  - a) Gate switch
  - b) Door interlock
  - c) Door zone lock
  - d) Retractable mechanical lock

FIELD PRACTICAL SKILL TEST, Perform:

Inform the Station Agent and Central Control that elevator \_\_\_\_\_ will be use for training and is available for passenger.

- 1. Inspect and adjust the keeper bridging block off the switch box bumper.
- 2. Inspect and adjust interlocks against the car door clutch. Set clearance(s).
- 3. Inspect and plumb car door panels.

Inform the Station Agent and Central Control that training is finished on elevator \_\_\_\_\_\_.

Unit 9: Car and Car Operating Controls

# SAFETY REMINDER

Avoid stepping on pipes, fittings, and solenoid boxes in the pit.

Locate a safe refuge area inside the pit.

Before Entering Elevator Pit during inspection and maintenance;

The elevator must be declared out of service by placing a sign or placard on the controller;

ELEVATOR IS UNDER THE CONTROL OF A MECHANIC – DO NOT OPERATE

# Inspect Car and Car Operating Controls

Objective: Upon completion of this module, an Elevator/Escalator Trainee should be able to;

- Inspect car enclosure, cab handrails, and floor.
- Operate alarm and Emergency Stop switch in car service panel.
- Test operate car emergency lighting.
- Verify that all control switches inside the Station Agent booth, inside the cab, and in all landings can perform as required.
- Verify that all display segments illuminate.
- Verify that directional signals perform as required.
- Replace burnt lamps and/or signal lights as required.
- A. Inspect Car Enclosure Every Visit
  - 1. Ride the elevator and listen to any unusual noise.
  - 2. Determine that the car enclosure is structurally sound, securely fastened to the platform, and no sharp edges.
  - 3. Ensure that the car handrails are fastened, no sharp object, and clean.
  - 4. All equipment covers and guards should be in place and fastened.
  - 5. Ensure that the floor is clean, has no tripping hazard or torn tiles.
  - 6. Clean and vacuum door sills inside the car and all floors.
  - 7. Determine that the capacity plates and any required up to date certificates are posted in the car.
  - 8. **Freight Elevators.** In addition to the procedures above, determine that the sign specifying the class of loading is in place and whether the loading imposed on the elevator is as specified on the sign. Determine that the signs restricting passenger use are posted.

- B. Inspect Car Operating Control (signals & fixtures) Every Visit
  - 1. Inform the Station Agent and Central Control that an electric bell test will be performed.
    - Ensure that when the **Emergency Stop** switch (bottom right of figure 10-9) is actuated, the car stops, an audible signaling device is heard.
    - Test and operate the electric bell system or **Alarm** button. An audible alarm inside and outside the hoistway will sound. Note that the alarm does not automatically activate when station power is interrupted.

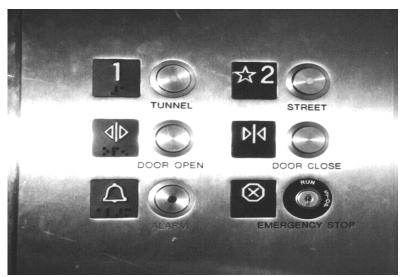


Figure 10-9 Car Operating Control, BART Typical

- 2. Ride and operate the car, making stops in both up and down travels. Activate all automatic operation **push button switches** in the car and on each floor. Insure that they are properly marked, do not stick or bind, not damage, and lamps are working.
  - Insure that the doors must open when "door open" switch is activated during door closing cycle.
  - Insure that the doors must close when the "**door close**" switch is activated and no passenger door interruption.
  - Check all switches of elevator with dual attendant operation located inside the Station Agent booth, inside the car and in the landing floor. Insure that all switches operate properly.
  - Correct failed operating controls as you found them.

- 3. While inside the car, check the **lights and its emergency backup**.
  - Insure that the lights are all illuminating and the fixtures are properly fastened and the tubes are guarded to prevent injury.
  - Test **emergency light switch** (figure 10-9a) to check if the rechargeable battery takes over the normal power supply. The light should flicker but stays on.

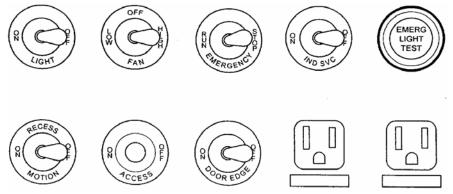
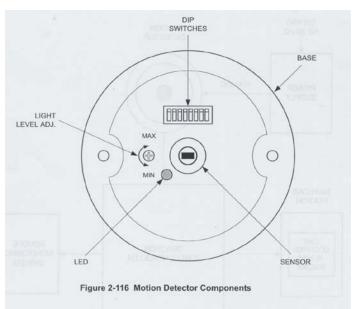


Figure 10-9a Extension Stations, COP Elevator Service Panel

- Where the standby (emergency) lighting is supplied by rechargeable batteries check that such batteries are in good condition, properly maintained, and that any recharging equipment is operable. Replace emergency batteries with life span of either 4 or 5 years as required.
- Insure that the **motion detector** (figure 2-116) works properly with the switch ON in the

COP. The motion sensor will operate upon detection of movement or energy source from human body inside the cab after the doors have closed. A red LED turns ON to indicate that motion the is detected in the cab. A 15 seconds time delay is a normal setting.

4. Test the cab exhaust fan switch



inside the COP (figure 10-9a) to low, off and high. When the fan is set to LOW, the operation is quite.

- Ensure that the fan does not wobble or vibrate when switch to HIGH.
- If the fan vibrates, clean the fan blades, lubricate the bushing, and retest for normal operation.
- 5. Check all **hall and car signals, fixtures** (figure 10-9b) and **Braille** plates to be operational, with legible markings and not damaged.
  - Buttons, toggle and key switches should not stick and not plugged.
  - All fasteners should be in place and secured.
  - Indicator lamps should illuminate, as required.
  - Broken lenses should be replaced.
  - Audible alarm and buzzers should be operational.
  - Car alarm bell and Car Position/Direction Indicators should be operational.
  - Clean all markings, signals and fixture covers. Replace defective parts.
  - Braille plates should be intact and no damage to characters.

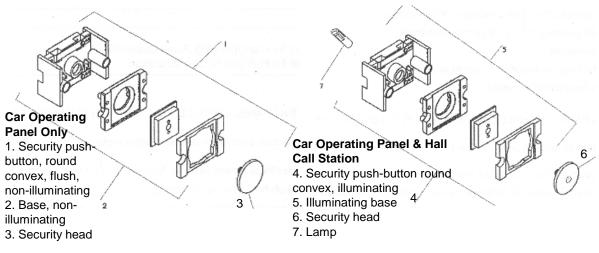
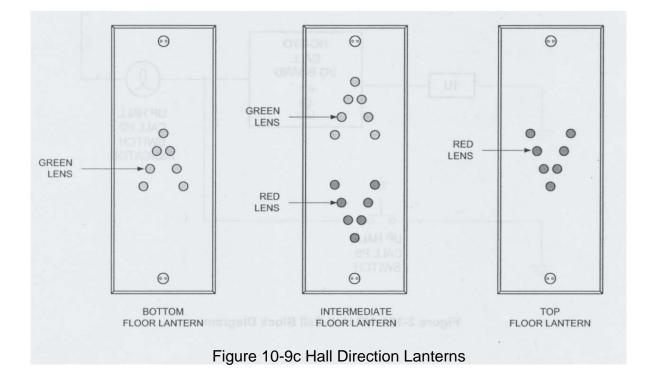


Figure 10-9b COP or Hall Call Station Push Button

- 6. Inspect all **Hall Direction Lanterns** (figure 10-9c) and **Hall Chimes**.
  - Insure that the landing hall lanterns illuminates several seconds before the car arrives.
  - Observe and insure that the lamps in all landings are lit for each arrow, all fasteners are secured, and the cover surfaces are clean.
  - Inspect for any evidence of water contamination or corrosion. Insure that the fixtures are watertight.



• Insure that the Hall Chimes will chimes; once for up, twice for down.

- Insure that the **Car Position Indicator (PI)** indicates the corresponding floor numbers as the car passes or stops at a floor. An audible signal shall sound as a PI changes floor.
- C. Inspect and Test Emergency and Signal Devices

**CCR Elevator Safety Orders §3041.** Passenger elevators and automatic operation freight elevators shall be provided with an emergency alarm system, operable from within the car, which will provide effective means for summoning assistance at all hours in case of emergency.

- 1. Inform the Station Agent and Central Control that an electric **bell system test** will be performed.
- 2. Test and operate the **telephone system**.
  - Inform the Station Agent and Central Control that you are about to test the telephone system.
  - Lift the telephone headset, or the hands free PUSH for HELP button is pushed and listen to the Station Agent response.
  - If the Station Agent cannot acknowledge the call within **90 seconds**, Central Control should acknowledge the test or an emergency call will register.
- 3. Coordinate with an electrician to test **smoke detector system** in the hoistway. The smoke detector may or may not be connected to the elevator controller to recall the elevator to a designated landing.
- 4. Test and inspect **Firefighter Service**.
- NOTE: Because elevators are unsafe to use during fire emergency, the code requires that elevators serving three or more landings or with a travel of 25 feet or more be equipped with "Firefighter Service." This is intended to prevent the elevator from being used by building occupants, maintenance and security personnel but only available for firefighters.
- **PHASE I** Emergency Recall Operation: When Phase I recall is initiated, all elevators will return nonstop to the designated level and park with the doors open. Phase I recall can only be initiated by a key operated switch at the designated level, or a smoke sensor located in the machine room, hoistway or one of the lobbies serve by the elevators. Doors will only close by maintaining a constant pressure on the door close position until the door is fully closed.
- **PHASE II Emergency In-car Operation**: A three-position (OFF, HOLD, and ON, in that order) key operated switch shall be labeled "FIRE OPERATION,"

provided in an operating panel in each car; and shall be readily accessible. This can only be initiated by a special key switch located in the car and from the designated or alternate level when Phase I Emergency Recall Operation is in effect. This allows the person in the car to have a complete control of the elevator operation. The switch shall be rotated clockwise to go from OFF to HOLD to ON. The key shall be removable in the OFF and HOLD position.

The code requires that the key switches for Phase I and Phase II be operated by the same key but shall not be part of the building master key system.

One elevator at a time must be isolated for individual testing.

- Test operate three-position (ON, OFF, and BYPASS) key switch provided at the designated floor. When turn to ON position, all elevators controlled by this switch which are in automatic service must return nonstop to the designated level and the doors shall open and remain open. CCR, Elevator Safety Order, §3041.
- The key is only permitted to be removable in the OFF or HOLD position.
- When Fire Operation is in the ON position, the elevator shall be on Phase II Emergency In-Car Operation, for use by emergency personnel only.
- During Fire Operation test, the Station Fire Alarm System may trip the elevator circuit breaker from the power panel. Reset power panel circuit breaker to return elevator back to service.
- 5. Return the elevator to service. Inform the Station Agent and Central Control that the test is completed.

- D. Clean & Inspect Freight Elevator Manually Operated Hoistway Door
  - 1. Open, close and examine each manually operated hoistway door including any hand operated latches/lock bars.

- Insure that the doors operate freely.
- Insure that all manual door handle lift straps are secured and operational.
- 2. Clean and inspect all latches, rollers and guides, sheaves and safety astragal for wear and tear and secure fastening.
  - Replace and/or adjust worn parts as necessary.
- 3. **Clean and lubricate** all rollers, chains, pivot points, guide shoes and guide rails. Wipe off any excess lubricants.
- 4. **Clean and inspect door stop**, open and close limit switches, and cams for proper operation, they are watertight and not corroded. Adjust and/or replace if necessary.
- 5. Inspect all signals and fixtures to be secured, watertight, not corroded, and operational.
- 6. Clean and inspect all tracks for secure fastening.
- 7. Return the elevator to service. Inform the Building/ Shop Supervisor.

**Review Questions:** Use separate piece of paper and write your name on top.

- 20. Where does the elevator cab light receive its power?
  - a) DC motor power supply.
  - b) The controller ac power supply.
  - c) Controller main disconnect switch.

- d) Separate ac source from the main disconnect.
- 21. How often should you inspect car enclosure and operating control devices?
- 22. Central Control will acknowledge the signal from the elevator telephone within \_\_\_\_\_ seconds if the Station Agent failed to response.
  - a) 30
  - b) 60
  - c) 80
  - d) 90
- 23. What would be the probable cause of vibrating exhaust fan in the cab?
  - a) Wrong power supply.
  - b) Misaligned control switch.
  - c) Dirty fan blades.
  - d) Dirty motor windings.
- 24. An elevator equipped with "Firefighter Service" can be use by an Elevator Mechanic during fire emergency.
  - a) True
  - b) False
- 25. When Phase I Emergency Recall Operation is initiated, all elevators will?
  - a) Stay where it was, park and open doors.
  - b) Move only to the floor where the Firefighter call was.
  - c) Return nonstop to the designated level and park with doors open.
  - d) Return nonstop to designated level and park with doors close to avoid passengers from using.

### FIELD PRATICAL SKILL TEST, Perform

Inform the Station Agent and Central Control that elevator \_\_\_\_\_ will be use for training and is available for passenger.

- 1. Test telephone system of the elevator.
- 2. Test transfer of cab lighting to emergency.

Inform the Station Agent and Central Control that training is finished on elevator \_\_\_\_\_\_.

# Unit 10: Governor Overspeed, Safeties and Runby

## SAFETY REMINDER

Never clean or lubricate rope surfaces while the car is moving. Look for overhead obstructions and locate a safe refuge area while at the-car-top and inside the elevator pit.

DO NOT SPILL ANY LUBRICANTS ONTO THE GOVERNOR ROPE.

Do not check overspeed governor with power applied to the system.

Look for refuge area inside the pit and stay away from the counterweight while running the car.

Clean and Inspect Governor Overspeed, Safeties and Runby

Objective: Upon completion of this module, an Elevator/Escalator Trainee should be able to;

- Understand all safeties involved when accessing the elevator hoistway, the car top, and the pit.
- Inspect governor, overspeed switch and seal.
- Lubricate all pivot points of governor and its component but not the wire rope.
- Test governor switch.
- Inspect the counterweight runby.
- **NOTE:** Speed Governor Required and Locations: Counterweight safeties, where provided with rated speeds over 150 fpm (0.76 m/s), and car safeties, shall be actuated by separate speed governor. This is applicable to all BART parking garage traction elevators and Daly City Yard elevator.

**Car Speed Governor Tripping Speed:** The speed governors for car safeties shall be set to trip at no less than 115% of the rated car speed, **CCR §3036**.

**Counterweight Speed Governors:** Speed governors, where provided for counterweight safeties, shall be set to trip at an overspeed greater than that at which the car speed governor is to trip, but no more than 10% higher, **CCR §3036**.

- H. Clean, Inspect, and Lubricate Governor, Overspeed Switch & Seal
  - 1. Open the mainline disconnect switch, lockout and tagout the elevator with overhead machinery.

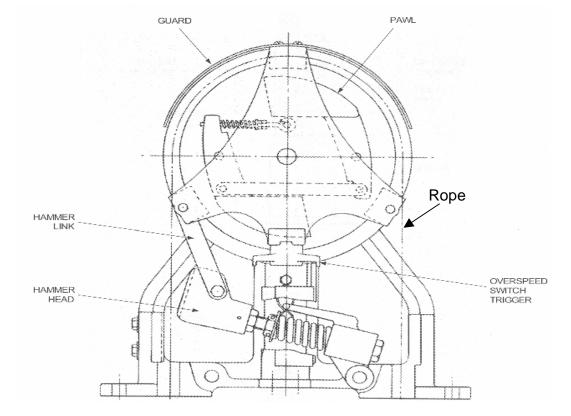
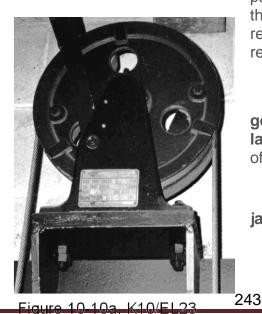


Figure 10-10. Elevator Governor Parts, Book 217 Volume 2B Page 2-108

- 10. **Examine the car and counterweight governors**, for secure fastening and free running of the rope. The rope must **not** be rubbing against the governor jaws or other parts.
- 11. **Clean and check all moving parts** to insure that there are no restriction and corrosion.
- 12. **Hand trip the governor by lifting the pawls (weights)** or other mechanisms to determine that there is ample room for movement of all



parts with the governor rotation. Insure that the overspeed switch trigger releases and the micro-switch lever resets to normal.

13. **Examine all linkages, gears, pins, collars, bushings, latches**, and mechanisms for evidence of excessive wear and lost motion.

14. Check all governor grip jaws and rubbing surfaces to make sure

Overspeed Governor Sheave hoistway overhead mount

that they are not worn and are free of paint.

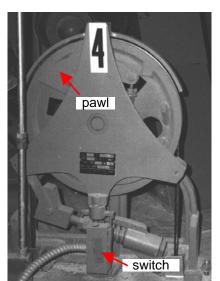


Figure 10-10b, W20/EL89 Overspeed Governor Sheave

15. **Lubricate all pivot pins** with drop of oil. Lubricate **bearing hubs** with a pressure gun. Wipe off any excess or spilled lubricants.

BART K10/EL23 (figure 10-10a) and similar governors are equipped with an access **oil cover cap behind the sheave for replenishing**. Replenish oil with bearing oil recommended by manufacturer.

16. PM must be perform for elevators with machinery in the pit level or in the hoistway as follows:

• With the power ON, ride on top-of-the-car to the highest platform. Turn top-of-the-car inspection switch to STOP, perform PM on the **governor mechanism**.

• Run the elevator to the lowest platform to perform PM on the governor overspeed switch located under the car safety plank.

• Inspect switch mechanism of Governor Overspeed and Anti-slack Cable Safety. Turn power off. Open switch cover and check for corrosion, tightness of screws, and switch proper operation.

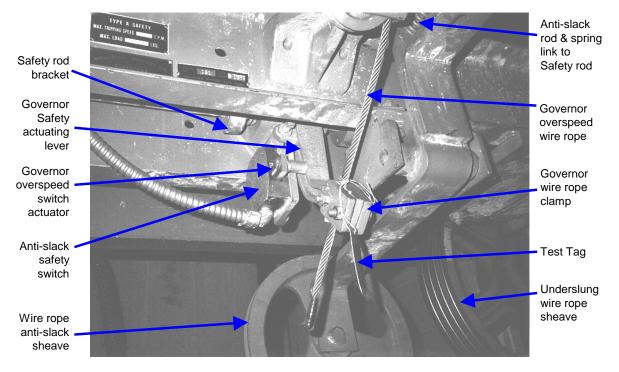


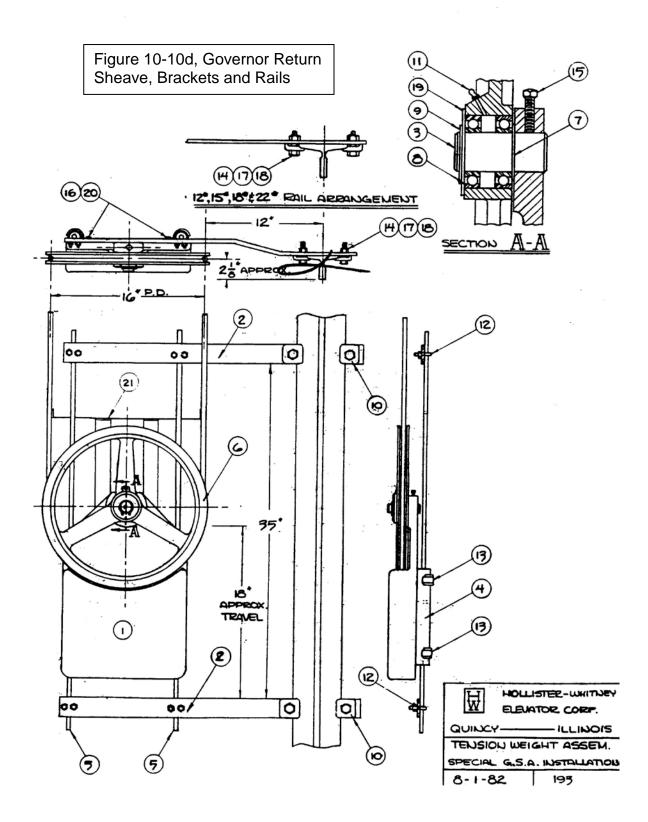
Figure 10-10c K10/EL23 Governor & Anti-slack Safety Device

- 17. **Examine the test tag** attached to the governor and note the date that the next five years test is due.
- **NOTE:** An authorized representative of the DIS shall witness this test, or the division may accept reports of witnesses recognized as competent by the division. A metal data tag attached to the governor fastening must bear the following wire rope data as per CCR §3036:
  - the diameter in inches;
  - the manufacturer's rated breaking strength;
  - the grade of material used;
  - the month and year the rope was installed;
  - whether non-preformed or preformed;
  - construction classification;
  - name of the person or firm who installed the rope;
  - name of the manufacturer of the rope.

- I. Governor Tension Return/Sheave; Clean, Inspect, and Lubricate
  - 6. Place the elevator on inspection at the lowest landing and have access to the pit.
  - 7. Clean dust shield and examine **governor tension sheave** (figure 10-10d p8) and its rail fastening for corrosion, obstruction and that they are clean and secured.
  - 8. Run the elevator in inspection mode, listen for **bearing noise and examine sheave movement and vibration**. Insure it does not wobble.
  - 9. Stop the elevator, **lubricate bearings and pivot pins**. Wipe off any excess or spilled lubricants.
- J. Safety Linkage & Safety for Traction Elevator; Clean, Inspect, and Lubricate: CCR §3035 Safeties;
  - 6. Place the elevator on inspection or independent service at the lowest landing to inspect **safety linkages** located under the car.

These safety linkages may be part of the **governor overspeed** or **the wire rope anti-slack devices** that are currently applicable to BART elevators EL23 (figure 10-10c p6), EL25, EL53, EL55, EL57, EL34, EL36, EL37, and EL45.

- 7. If governor-actuated safety linkages are located on or near the top-ofthe-car, have access to the cartop. This is applicable to parking garage and Daly City Yard elevators.
- 8. Clean and inspect **links and pins** of governor-actuated safety gear for freedom of movement.
- 9. Lubricate all **pivot points** with a few drops of oil. Wipe off excess oil.
- 10. Clean and **inspect safety mechanism** for corrosion and any obstruction. Lubricate all pivot points. Wipe off excess oil.



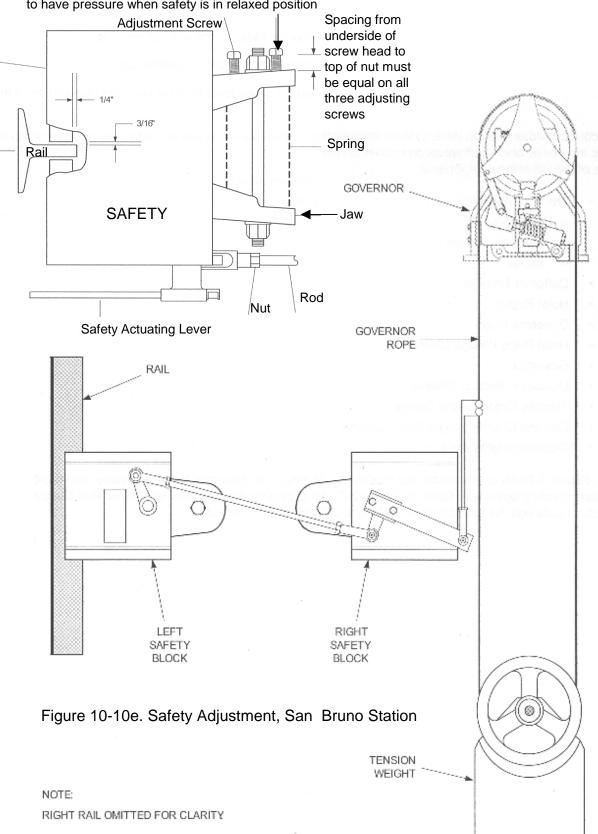
# CAUTION: DO NOT OVER LUBRICATE ANY MECHANISM AROUND THE RAIL.

- 6. Insure that the metal **safety marking plate(s)** is attached to each safety so as to be readily visible, and shall be marked in a legible and permanent manner with letters and figures not less than <sup>1</sup>/<sub>4</sub> inch in height indicating the following:
  - type of safety;
  - maximum tripping speed in feet per minute for which the safety is designed to be used;
  - maximum weight in pounds for which the safety is designed to be used with the car frame in which it is installed;
  - name of the manufacturer and the identifying number of the safety;
  - date of the initial safety test required by CCR section 3035[a] witnessed by a representative of the division.
- 15. Check clearance between **rail and gripping face of wedges and jaws** (figure 10-10e p10 from Book 217 p4-77 & 78).

#### NOTE: As per CCR §3035 for Minimum Permissible Clearance between Rail Gripping Faces of Safety Parts:

In the normally retracted position of the safety, the distance between the rail-gripping faces of the safety parts shall be not less than the thickness of the guide rail plus **9/64 inch** (3.6mm). The clearance on any side between the gripping face and the guide rail shall be not less than **1/16 inch** (1.6mm) as measured on the side of the rail toward which the car frame is pressed with sufficient force to take up all clearances in the guide shoe assembly. Safety jaws, while in the retracted position, shall be so restrained as to prevent a reduction of this minimum clearance. See figure 10-10e p10.

16. Inspect the portion of the car accessible from the pit. Determine whether all fastenings, including those between the car frame and the platform, are securely in place and that the frame is not distorted.



It is not necessary for screw nearest the end of jaw to have pressure when safety is in relaxed position

- D. Inspect Wire Rope in the Pit for Stretch
  - 1. Perform **wire rope inspections** annually at the elevator pit;
    - Run the elevator at the top most landing to a floor level.
    - Access the elevator pit to inspect runby clearance.
    - Insure that the **runby clearance** (figure 10-10f below) of the **counterweight striking plate must be no less than 6 inches from the top of the shock absorber**.

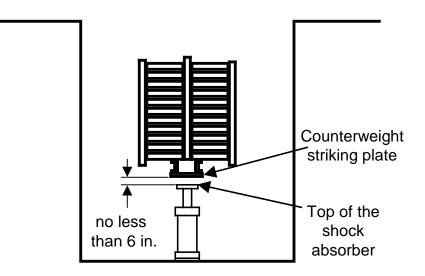


Figure 10-10f, Bottom Runby Clearance of Counterweight

- If found to be less than six inches, make a report to your Foreworker for **stretched wire rope**.
- 2. Clean the bottom floor rear of **sills** while at the pit.
- 3. Check **pit lights**. Replace lamps as required.
- 4. Clean and check all **fasteners** of the **pit channels**, **guide rails**, and **spring buffers.** They should be secured and free of corrosion.
- 5. Clean and check the **platform toe guards and aprons** to insure they are securely fastened and not corroded.

**Review Question:** Write your name and answer in a separate piece of paper.

- 1. Name four (4) BART elevators whose governor overspeed sheave bearings are lubricated with oil.
- 2. Where is the wire rope anti-slack sheave monitored for R20/EL45?
  - a) elevator pit
  - b) top of the hoistway
  - c) inside the machine room
  - d) underneath the safety plank
- 3. What is the minimum gap between the bottom of the counterweight and the top of the shock absorber?
  - a) .6 inch
  - b) 6 inch
  - c) 8 inch
  - d) 12 inch
- 4. What safety precaution should you take while checking governor overspeed for PM?
  - a) Power must be applied to the system.
  - b) No power applied to the system.
  - c) Only when the elevator is running.
  - d) Only when the elevator is stopped.
- 5. How would you test the governor switch without running the elevator?
  - a) Lift the weights
  - b) Dismount the spring
  - c) Disconnect the switch
  - d) Manually push the switch
- 6. What is the cause of elevator runby to be below its minimum?
  - a) Lack of governor wire rope lubrication
  - b) Stretched governor wire rope.
  - c) Stretched elevator wire rope.
  - d) Slipping brakes.

FIELD PRACTICAL SKILL TEST, Perform:

Inform the Station Agent and Central Control that elevator \_\_\_\_\_ will be use for training and is available for passenger.

- 1. Access K20/EL25 hoistway and enter top-of-the-car to lubricate governor overspeed sheave.
- 2. Inspect and lubricate governor overspeed safety component at the safety plank of K10/EL23.
- 3. Clean and inspect counterweight runby of R50/EL74.

Inform the Station Agent and Central Control that training is finished on elevator \_\_\_\_\_\_.

This page is intentionally left blank.