
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

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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.

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Unit 1: Elevator Maintenance, Safety Practices

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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 leaving 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 leaving 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.

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Unit 2: About Preventive Maintenance

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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?

1. 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. Define 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 **FRICITION** 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.
2. 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.
5. 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	F E B	M A R	A P R	M A Y	J U N	J U L	A U G	S E P	O 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.	M												
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.	M												
8	Pump Unit, Hydraulic 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.	M												
10	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.	M												

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.	M						
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	M						
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.	M						
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 gibbs & rollers.	M						
1 5	Camera Equipment	Check if camera and enclosure equipment is intact.		Inspect camera enclosure and window. Report any damages.	M						
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.	M						
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.	A						
2 6	Gearbox Oil	Inspect for contamination		Drain, clean gearbox and replace oil.	A						
2 7	Counterweight	Inspect for loose or broken weights. Check runby.		Tighten clamp, replace broken weights.	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 gibbs, hanger & eccentric rollers for alignment & wear.

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 $\frac{1}{2}$ 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).

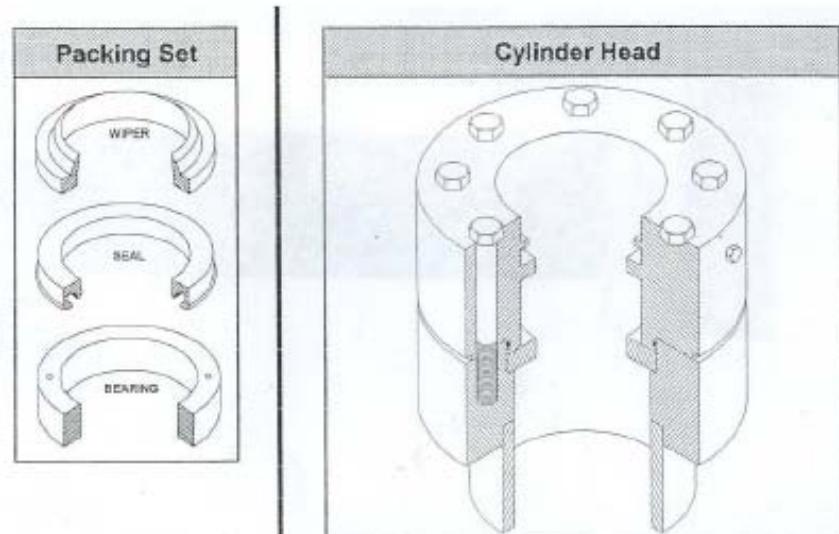


Figure 3-2 Cylinder Head and Packing Seal

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.
2. **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.

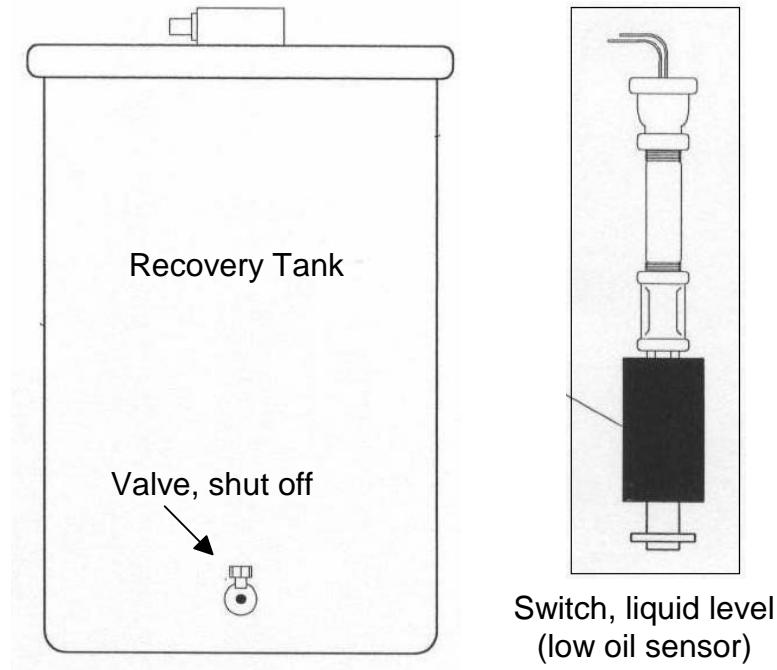


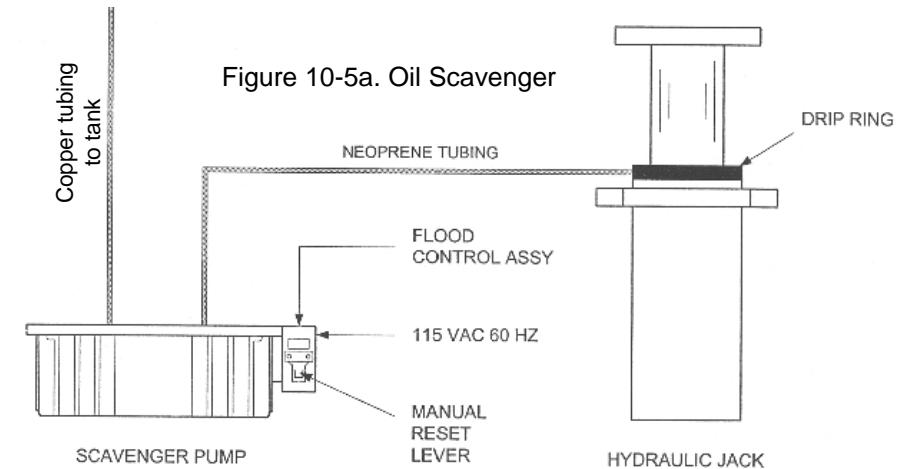
Figure 10-5. Oil Recovery System

- 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 shut 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.

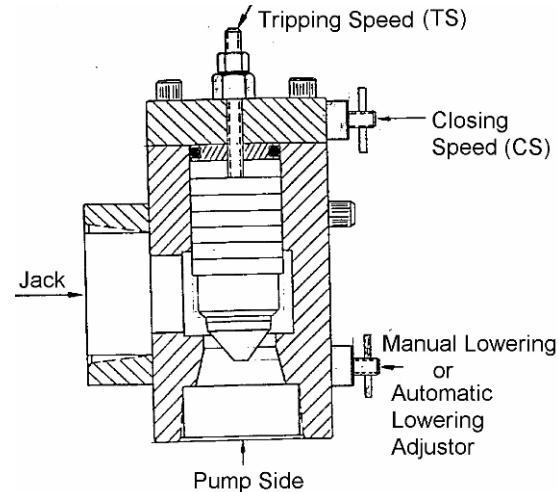
If unable to perform corrective maintenance, report to your Foreworker.



Figure 10-5b Victaulic Coupling
Courtesy of Wikipedia 2008

2. 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**.



PIPE RUPTURE VALVE (EXTENSION 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 cannot 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.
 - 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.

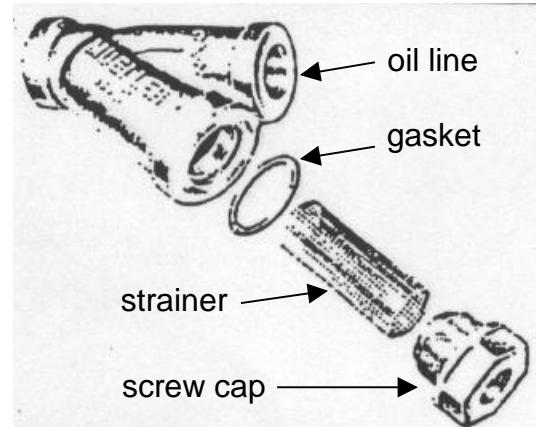


Figure 10-5d. "Y" Type
Screwed End Strainer

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 _____ .

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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.
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.

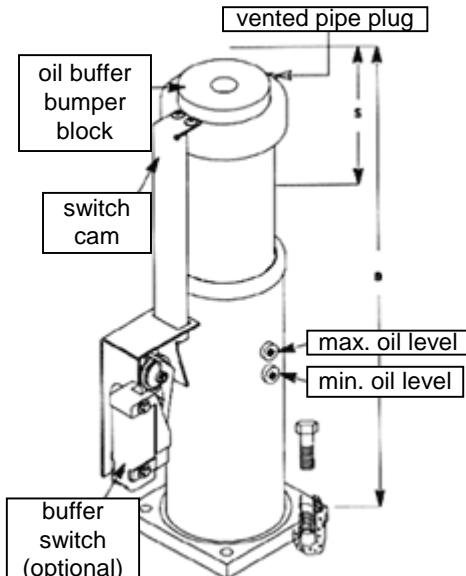


Figure 10-7 Oil Buffer

6. Clean and inspect **oil buffer safety switch**, if equipped, check for corrosion and secured fastening.
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.



Figure 10-7a
Spring Buffers

- 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 **¾ 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.

E. Inspect Clearance Between Cars and Landing Sills and Car Leveling

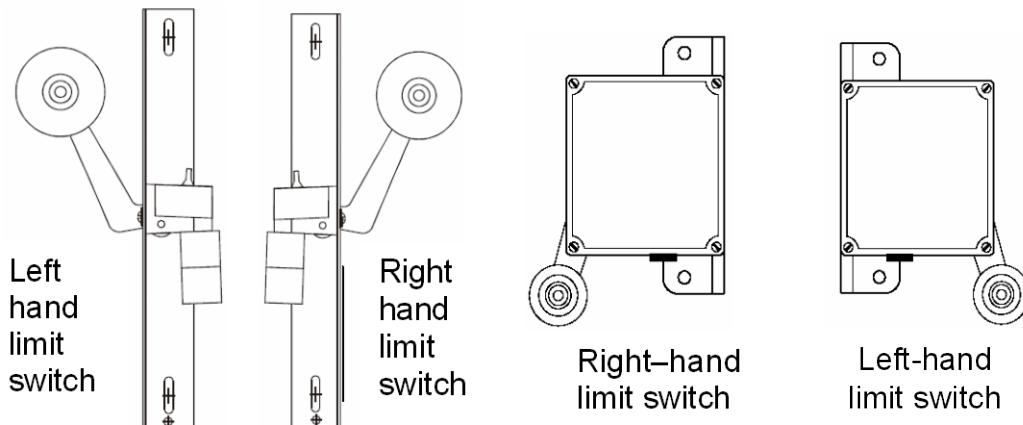
1. Operate the car, making stops in every floor.
 - Observe the relationship of the car platform sill to the landing sill. The clearances must be;
A side-post construction must be **1.5 inch maximum and ½ inch minimum**.
A corner-post construction must be at **1.5 inch maximum and ¾ inch minimum**.
 - 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 ½ 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.



Examples of Hoistway Limit Switches

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 place. 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 $\frac{3}{4}$ 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 _____ .

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