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4 Chapter 4 Primary Repair (Black Box Level)

In this section, the following topics will be covered concerning the escalator components:

- Maintenance and Adjustment
- Repair of components
- Replacement of components

This section contains instructions for maintenance, adjustment, removing and installing major components in the mechanical and most electrical systems for corrective maintenance.

Many of the components are installed to tight tolerances in order to produce a smooth running escalator.

The use of shims is standard and required in most assemblies in order to meet those tolerances.

It is important to record information such as number and location of shims and reference dimensions during disassembly to make reassembling easier and to maintain the performance of the equipment.

Use of the Maintenance Pendant will be required in most of the tasks mentioned in this section. See section 2 paragraph 2.1 for instruction on use of this device.
Be aware of all safety precautions and warnings. A little common sense will go a long way.

Before beginning any service or maintenance, the maintenance worker **MUST** take safety precautions to protect himself, his co-workers, and the riding public.

The work supervisor will provide general procedures for ensuring safety, but the maintenance worker must understand the equipment and the necessary steps for safely maintaining it.

- Always lock and tag out the main power disconnect before performing any adjustment, inspection, lubrication, repair, or service to the equipment.
- Always lock and tag out the auxiliary power disconnects, and the emergency power disconnects before working near the lighting equipment.
- Always barricade both ends of the escalator before beginning any type of work. Barricades must be in place whenever landing plates or steps are removed.
- Always keep safety circuits in operation.
- Always ensure that no bystanders are near the escalator while it is being started.
- Never assume a circuit is de-energized. Always use a circuit tester before beginning to work.
- Electrical troubleshooting may require the testing of live high-voltage circuits. Only qualified electricians and their helpers must perform this.
- When disconnecting the main drive chain or performing maintenance on the brake(s), always set the step chain-locking device.
- Always run steps at inspection speed using the remote control device.
- The following should be worn while working on the escalator:
  - Safety glasses
  - Safety shoes
  - Protective clothing
  - Gloves
4.1 Floorplate Maintenance, Adjustment, Removal, and Replacement

The following instructions will guide the worker through maintenance, adjustment, removal and replacement of the landing plates covering the truss opening.

4.1.1 Maintenance and Adjustment Procedures

The following maintenance and adjustment procedures are for the following:

- Combfinger Segments
- Combplate Assembly
- Comb Impact Switch
- Landing Plates
- Step Guide Rollers

4.1.1.1 Combfinger Segments.

The following steps are for the maintenance and adjustment of the combfinger segments.

1. Check for broken combfingers, cracks, and missing screws used to mount the segments in place. See Figure 4-1 for illustration.
   - Replace comb segments if damaged.
   - Replace missing screws.

2. Remove foreign objects between the combfingers or have become wedged between the combfingers and the step.

3. Inspect alignment and centering position of comb and steps. Center and realign comb if necessary.

4. Tighten all combfinger screws.

Figure 4-1 Combfinger Illustration
4.1.1.2 Combplate Assembly

The following maintenance and adjustment procedures are for the comb plate.

1. Check the condition of the comb plate assembly.
   - Be sure there are no large gouges or cracks.

2. Clean the combplate.
   - Remove all foreign object, gum, oil and grease.

3. Verify that the gap between the combplate and floorplate is clear of debris to allow the combplate to move if a force is applied to it.

4.1.1.3 Comb Impact Switch

The following maintenance and adjustment procedures are for the comb impact switches.

1. Remove newel skirt panels. (See paragraph 4.5.)

2. Manipulate the switches to check if they work.
   - Check that the switches work by LED indication at the fault panel located in the newel section and/or the display on the fault finder/remote monitoring panel.

3. Verify the ¼” gap between combplate and landing plate is clear of debris to allow combplate to move if force is applied to it.

4. Verify the clearance dimensions as noted in Figure 4-2 Comb Impact Device Illustration.

5. Using a spring scale, apply a force at one side of the combplate near the skirt panel.
   - The load required to trip the switch should be between 350 and 400 lbs. Adjust the horizontal spring if necessary to increase or decrease the tripping load.

6. Do the same test at the other side of the combplate.

7. Using the spring scale, apply a force lifting in the center edge of the combplate.
   - The load required to trip the switch should be between 130 to 150 lbs. Adjust the vertical spring to increase or decrease the tripping load.

8. In case of an unsatisfactory condition, check if there is anything wrong with the switch and wiring, such as any broken wires etc. Take required action as needed.
4.1.1.4 Landing plates

The following maintenance and adjustment procedures are for the landing plates.

1. Check the condition of the landing plates.
   - The floorplate joints should be even, and the floorplate should be firm and quiet when walking on it.

2. Clean the landing plates.

Figure 4-2 Comb Impact Device Illustration
4.1.1.5 Step Guide Rollers

The following maintenance and adjustment procedures are for the step guide rollers.

1. Remove the newel skirt panels. (See paragraph 4.5.)
2. Check the condition of the roller.
   - Be sure that the rubber wheel is in good condition.
3. Be sure that the mounting bolts are tight.
4. Check that the guide roller is making proper contact with the step. Do not over tighten the rollers, they should only make light contact
   - The guide roller helps the step to enter the comb area aligned. See Figure 4-1 Combfinger Illustration for guide roller location.
4.1.2 Removal and Replacement Procedures

The following removal and replacement procedures are for the following:

- Combfinger segments
- Combplate Assembly
- Floorplate (i.e. Landing Plates)
- Step Guide Rollers

4.1.2.1 Combfinger Segment Removal and Replacement

The following steps will guide the worker in removal and replacement of the combfinger segments. See Figure 4-3 for illustration.

1. Remove the screws that mount the combfinger segments to the combplate.
2. Remove the combfinger segment.
   - Make a note of any shims that are used.
3. Replace the combfinger segment by centering the fingers in the step tread.
   - Check the clearance and shim if necessary.
4. Apply removable thread locker to the screws and tighten the combfinger segments down.

Figure 4-3 Combfinger Segment Removal and Replacement
4.1.2.2 Combplate Assembly Removal and Replacement

The following steps will guide the worker in removal and replacement of the combplate assembly.

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Remove the newel interior panels and newel skirt panels. (See paragraph 4.4.2 and 4.5.)</td>
</tr>
<tr>
<td>2.</td>
<td>Disconnect the wiring from the impact switches and remove the conduit.</td>
</tr>
<tr>
<td>3.</td>
<td>Remove the two large mounting bolts. See the figure below.</td>
</tr>
<tr>
<td>4.</td>
<td>Replace the combplate assembly in reverse order. (See paragraph 4.1.1.3. for adjustment of the impact device.)</td>
</tr>
</tbody>
</table>

**Warning: Safety Precautions!**

A small crane or other lifting device will be needed to remove the combplate assembly.

This procedure should be performed by a qualified technician.

---

Figure 4-4 Combplate Assembly Removal and Replacement
4.1.2.3 Floorplate Removal and Replacement
The following steps will guide the worker in removal and replacement of the floorplates. See Figure 4-5 for illustration.

WARNING: SAFETY PRECAUTION!
Any time landing plates are removed, it is imperative that the barricades are placed at the top and bottom of the escalator.

1. Remove the center panel first.
   - This is the one with four access holes to unlock the locking devices.
   - With an allen-wrench or “T”-wrench, turn the locking devices 90° in either direction.
2. With a large flat-tip screwdriver or small pry-bar, lift the floorplate from the framework.
3. Loosen the wing nuts that are under the remaining landing plates.
   - Do NOT take the wings nuts off.
4. Slide the fasteners clear of the framework and lift the floorplate clear of the framework.
5. Replace the landing plates the same way they were removed with the final floorplate being the one with the locking devices attached to it.
   - Be sure that the tong faces toward the combplate.
   - If you place the floorplate in the opposite direction, it will not fit together properly.
Figure 4-5 Floorplate Removal and Installation
4.2 Step Maintenance, Adjustment, Removal and Replacement

The following instructions will guide the worker through maintenance, adjustment, removal and replacement of the steps.

4.2.1 Maintenance and Adjustment Procedures.

The following maintenance and adjustment procedures are for the following:

- Steps
- Step Wheels

4.2.1.1 Steps

The following steps are for the maintenance and adjustment of the step.

1. Inspect each step for damage to the riser and tread.
2. Inspect each comb segment for broken fingers, cracks. Replace if needed.
3. Observe the steps for shifting, interference or misalignment.
4. Clean the steps of any debris.
5. Check clearance between the steps and skirt panels.
   - The clearance should be 1/8 inch.
   - Adjust the skirt panel, if required. (See paragraph 4.5.)
6. Check the clearance between steps is not more than 0.15”.
   - If the clearance is more, replace the step chain. (See paragraph 4.3.2.)

4.2.1.2 Step Wheels

The following steps are for maintenance and adjustment of the step wheels.

1. Ride each step to check condition of the rollers.
2. Remove the landing plates to the lower truss area. (See paragraph 4.1.2.3.)
3. Visually inspect the step wheels for excessive wear, or damage.
   - Replace as needed. (See paragraph 4.2.2.2.)
4. Apply a light coat of grease on the Phenolic guide shoe of the step wheel.
5. Tight any step wheel-mounting nuts that may be loose.
4.2.2 Removal and Replacement Procedures

The following removal and replacement procedures are for the following:

- Steps
- Step Wheels

4.2.2.1 Step Removal and Replacement

The following instructions will guide the worker through removal and replacement of the steps.

1. Remove the landing plates, either upper or lower. (See paragraph 4.1.2.3.)
2. Plug the maintenance pendant into the service box in either the upper or lower truss.
3. Position the step so that the opening in the turn track is not blocked and the lock pin and sleeve are accessible.
4. Loosen the setscrew in the yoke, opposite of the lock pin, one and one-half turns.
5. Pull the lock pin using the step-pin lifter and turn the sleeves ¼ turn to prevent the pin from going back into the hole in the sleeve.
6. Hold the step with one hand and move the sleeves toward the center of the axle to release the yoke.
7. Grabbing the step with two hands, raise and rotate the step until the step wheels can be pulled through the opening in the turn track.
8. The steps are numbered. It is important, if removing all of the steps, to mark the first and second steps and corresponding axles. This is done because each step is individually shimmed and has its own characteristics.
9. Install the steps in reverse order concerning numbered sequence.
   - The sleeve is properly seated when an audible click occurs as the pin goes into the hole on the sleeve.
10. Tighten the setscrews and make sure the shaft can be turned by hand.
    - If not, loosen the setscrews until the shaft turns by hand.
11. If the step(s) that are being installed are new, be sure to pay particular attention to the comb impact directions noted on Figure 4-2.
12. Start with a quantity of 5 split shims (D63056001) on each end of the shaft between the sleeve and the chain spacer.
13. Install the step and run it through the comb to check alignment of step with steps in front of and behind it.
14. Add or remove shims from each side as needed to make sure there is no play in the step. (See Figure 4-6 Step Removal illustration.)
Figure 4-6 Step Removal illustration
4.2.2.2 Step Wheel Removal and Replacement

The following instructions will aid the worker in removal and replacement of the step wheel assembly.

1. Remove the step, following steps 1 through 7 in paragraph 4.2.2.1.
2. Loosen and remove M12 nut and lockwasher
3. Remove wheel and axle assembly.
4. Install new wheel and axle assembly.
5. Apply threadlocker to thread of axle, and replace nut.
4.3 Step Chain Maintenance, Adjustment, Removal and Replacement

The following instructions will guide the worker through maintenance, adjustment, removal and replacement of the step chain assembly.

4.3.1 Maintenance and Adjustment Procedures

The following steps for the maintenance and adjustment of the step chain.

1. Remove the landing plates from the lower truss area. (See paragraph 4.1.2.3.)
2. Attach the maintenance pendant to the lower service box.
3. Look for dirt, corrosion, and damage on the outside surface of the roller, contact marks, etc. Also check the inside and edge surface of the link plate and edge surface of the pin.
4. Check the bending of the chain and rotation of the rollers.
5. Insure proper lubrication is being applied to the chain and adjust if needed. See paragraph 4.11.)
6. While the chain is driving, check the following:
   - If the lubricating oil moves toward the link plates.
   - If the chain or rotating disc is immersed in the lubricating oil when the lubrication pump is running.
7. Check for any damage or a red or reddish brown color (which indicates lubrication is improper or insufficient).
8. Check the step chain wheels for damage or debris build up. Clean if needed.
9. Once finished, remove maintenance pendant and replace landing plates.
4.3.2 Step Chain Removal and Replacement

The following instructions will guide the worker through the removal and replacement of the step chain. See Figure 4-7 for illustration.

1. Remove all the steps. (See paragraph 4.2.2.1.)
2. Remove the chain guards at the lower end by removing four M12 bolts.
   • Two are located towards the top of the cord angle, and the other two are located on the support angle about mid-way on the chain guard.
3. Position the master link as shown in Figure 4-7.
4. Loosen the tension carriage springs and disconnect the step chain.
5. Using the maintenance pendant that has been connected to the service box, run the escalator in the down direction until the maximum number of axles comes past the tension carriage.
6. Remove that section of chain and continue to the next.
   • The chain is extremely heavy and no attempt should be made to remove all of it at once. (See Figure 4-7, 4-8, for chain numbering sequence.)
7. A block and tackle or come-a-long winch will be required to remove the rest of the step chain before it clears the drive sprocket.
8. To reinstall the step chain, follow the directions in reverse.

CAUTION!

The Step Chain is VERY HEAVY.
The maximum number of units that can be removed at one time is six (6).
This task should only be performed by a CERTIFIED TECHNICIAN.
Figure 4-7 Step Chain removal and replacement for San Bruno Station
QUANTITY OF STEP CHAIN
UNITS IN CHAIN ASSY.

DETAIL OF SPLICE
(CORRECT LOCATION OF JOINT BAR IS CRITICAL.)

TRUSS SPLICE
"N" TRACK
STEP WHEEL
JOINT BAR
OFFSET BAR
TRUSS SPLICE
JOINT BAR
OFFSET BAR
STEP WHEEL
"A" TRACK

MAIN DRIVE SPROCKET
STEP CHAIN
TENSION CARRIAGE SPROCKET

LOOSEN NUT
DISCONNECT STEP CHAIN HERE @ MASTERLINK

Figure 4-8  Step Chain removal and replacement for Millbrae
Figure 4-9 Step Chain removal and replacement for So. San Francisco
4.4 Interior Panel Maintenance, Adjustment, Removal and Replacement

The following instructions will guide the worker through maintenance, adjustment, removal and replacement of balustrade panels.

4.4.1 Maintenance and Adjustment Procedures

The following maintenance and adjustment procedures are for the interior panels, skirt panels, safety strips, deck molding and newel ends.

1. Tighten loose screws and replace screws that are missing.
2. Check the safety strip for missing screws.
3. Check the condition of the brush and replace missing pieces.
4. Clean outer surface with a damp cloth.
   • Be sure to wipe in the direction of the grain.
5. Remove the moisture from the surface with a dry cloth.
   • Note: Wiping surface in a circular motion ruins the hairline finish and allows stains to accumulate there.
6. Apply silicone spray to skirt panels to reduce friction in case of step contact with skirt.

4.4.1.1 Step to Skirt Clearance

The following maintenance and adjustment procedures are for the skirt to step clearance.

1. Verify that steps are shimmed properly so that they follow the same path.
2. Verify that a 1/8 inch gap is maintained between the skirt panel and step.
   • If a constant gap is not maintained, the skirt panel must be adjusted.
3. To adjust the skirt panel, remove the interior panels above the sections to adjust.
4. Loosen the fasteners connecting the skirt frame to the bracket and adjust until an 1/8 inch gap is achieved. Tighten fasteners.
5. Readjust skirt switches if necessary.
6. Replace interior panels.
4.4.1.2 Cleaning of Stainless Steel
Periodic cleaning is important because a slight stain, when left for a long time, will grow into a bad stain that is difficult to remove.

1. If the stainless is slightly stained, wipe it off with a dry cloth.
   • When cleaning with a damp cloth, be sure to remove the moisture with a dry cloth.
   • Wipe the surface along the hairline direction of the stainless steel. Wiping it in a circular motion will ruin the hairline surface.

2. If the stainless is badly stained, wipe the area with a moistened cloth and clean the area with alcohol.
   • Wipe with a cloth moistened with lukewarm water.
   • Remove the moisture with a dry cloth.

4.4.2 Interior Panel Removal and Replacement
The following will guide the worker through the removal and replacement of the interior panel. See Figure 4-10 for illustration.

1. Remove the screws that fasten the Safety Strip to the skirt frame.
   • Be sure to put the screws in a secure location.

2. Remove the screws that fasten the deck molding to the skirt frame.

3. Remove the “D” molding and molding rubber.

4. Remove the screws holding the bottom of interior panel to the skirt frame.

5. Attach suction cups to the panel and pull the bottom of the panel out and down to release the top of the panel.

6. To remove the upper curve interior panel, the adjacent incline interior panel must be removed first.

7. To remove the newel interior panels, the curve interior panels must be removed first.

8. To reassemble, follow the directions in reverse order.
Interior Panels  
(Typical for Incline)

When the newel interior panel cannot be fitted to the newel molding, adjust it by using these brackets.

Hand Rail Cl

Figure 4-10 Interior Panel Removal and Installation
4.5 Skirt Panel Removal and Replacement

The following instructions will guide the worker through the removal and replacement of the skirt panels. See Figure 4-11 for illustration.

1. Remove interior panels. (See paragraph 4.4.2.)
2. Remove skirt panel mounting screws and put them in a secure place.
3. Loosen the joint nut and rotate the joint plate by hand.
   - This plate joins one skirt panel to the next.
4. Attach suction cups to the skirt panel and pull the panels up to release the clips from the lower skirt frame and remove.
5. Reassemble in reverse order of removal procedure.
Figure 4-11 Skirt Panel Removal and Replacement
4.6 Handrail Maintenance, Adjustment, Removal and Replacement

The following instructions will guide the worker through maintenance, adjustment, removal and replacement of the handrails.

4.6.1 Maintenance and Adjustment

The following maintenance and adjustment procedures for the handrail are as follows:

- Cleaning and inspecting
- Adjusting

4.6.1.1 Handrail Cleaning and Maintenance

The following instructions will guide the worker through the cleaning and maintenance of the handrails.

1. Tools and Materials:
   - Cloth should be clean fabric of soft texture (woolen knit, flannel, gauze, etc.).
   - Water, Neutral Detergent-Commercial, detergent should be diluted ten times or more with water.
   - Ethyl Alcohol used to remove grease or chewing gum.
   - Disinfectant soap should be diluted 200 times or more with water.
   - Polishing Liquid, “Rubber Shine” is recommended by the handrail manufacturer.

2. How to clean grease or other dirt:
   - Slight dirt: Wipe away the dirt with a slightly wrung cloth soaked in the neutral detergent. Or apply the rubber cleaner liquid recommended by handrail manufacturer to cloth and wipe away the dirt. Then completely wipe the detergent or liquid off the handrail with a damp cloth that was soaked in clean water. Finally, wipe the surface with a dry cloth until it is completely dry.
   - Grease or Heavy Dirt: Wipe with a cloth soaked in ethyl alcohol. After cleaning, wait until the alcohol has completely evaporated and no odor can be detected. (Use this procedure only when necessary. Repeated alcohol use will dry out the rubber.)
   - Chewing Gum, Glue etc.: Scrap off as much of the foreign material as possible, paying attention not to damage the handrail surface. Then, locally wipe it with a cloth soaked in ethyl alcohol.

3. Periodic Handrail cleaning:
   - Cleaning with water once a week is recommended. Wipe the rubber surface with a damp cloth. Repeat this several times, and change the water when it becomes murky. Finally wipe the rubber surface with a dry cloth to completely remove moisture.
   - Cleaning during operation of escalator. During escalator operation, wipe the handrail surface only with a clean dry cloth such as gauze.
4. Handrail Disinfecting:
   • After completion of cleaning, wipe the handrail surface with a cloth soaked in disinfectant and quickly dry the surface. Then, apply the following finishing procedures.

5. Handrail Finishing:
   • Application of polished liquid: After the handrail surface is completely dry, apply the recommended polishing liquid “Rubber Shine” to the surface with a cloth. Wipe only one light coat of “Rubber Shine” over the entire rubber surface.
   • Finishing (Polishing): After the polishing liquid is completely dry, polish surface with a dry cloth until the rubber surface becomes glossy.

6. Handrail Don’ts
   • NEVER operate the escalator while cleaning the handrail with water, detergent, rubber cleaner, cleaning liquids, disinfectant, and polishing liquid. THESE SUBSTANCES MUST NEVER BE LEFT ON THE HANDRAIL SURFACE.
   • NEVER use heat or hot air to dry the handrail surface.
   • Since unknown materials might cause swelling or deterioration of the rubber surface, NEVER use any material other than those specified.

4.6.1.2 Inspection and Cleaning of Guides and Underside of Handrails
The following instructions will guide the worker through the cleaning of the guides and under portion of the handrail.

1. Before cleaning, drive the handrails to check for any unusual noise over the entire length of the upper side handrails.
   • Give particular close inspection to the sections where unusual noises are detected.
2. Clean and dust the newel, upper curve, lower curve, and incline sections.
   • The initial cleaning should be done after two or three months of operation start.
   • After that, clean semi-annually.
3. Detach handrails from the guides. (See paragraph 4.7.1.)
4. Remove dust or foreign matter at the guides with a vacuum cleaner, brush, etc. Remove all debris from roller guides.
5. Manually rotate the roller guides on the return side to check for smooth rotation.
   • If they generate unusual noises or are defective or damaged, replace the rollers with new ones by removing c-clips.
6. Check for abnormal wear, damage, or loose screws on the guides.
7. Semi-annually, brush the handrail’s canvas surface two or three times with a wire brush over the entire length of the handrails and remove the abrasive dust with a vacuum cleaner.
4.6.2 Handrail Adjustments
The following steps will guide the worker in the adjustment of the following:

- Handrail
- Handrail Drive Chain
- Take-up Device
- Return Guides
- Handrail Drive Sheave Pressure Rollers

4.6.2.1 Handrail Lead/Lag Adjustment
The following steps will guide the worker through the adjustment procedures of the handrail.

1. Perform handrail lead/lag check:
   - Run escalator in the upward direction. Check whether the handrail lags behind the step or leads in front of the step for the length of the escalator.
   - If the handrail lags behind the step, adjust the take-up device. (See paragraph 4.6.2.3.)

<table>
<thead>
<tr>
<th>ALLOWANCE VALUE (IN)</th>
</tr>
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<tbody>
<tr>
<td>LEAD</td>
</tr>
<tr>
<td>2.5” /10FT. SECTION</td>
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</tbody>
</table>

2. Check tension in the handrail by pulling on the spring force gauge. See Figure 4-12 for illustration.

3. If tension is less than 70 pounds, adjust take-up device and pressure rollers. (See paragraph 4.6.2.3 for take-up adjustments and 4.6.2.5 for pressure roller adjustments.)

   [Diagram: Handrail Tension Check]

Figure 4-12 Handrail Tension Check
4.6.2.2 Handrail Drive Chain Maintenance and Adjustment

The following steps will guide the worker through handrail drive chain adjustments.

1. Check for proper chain slack.
   - Take-up slack by adjusting the take-up device in the lower incline if necessary. (See paragraph 4.6.2.3.)
   - For abnormally stretched chain, replace the chain. (See paragraph 4.7.5.)

2. Measure handrail drive chain elongation. See Figure 4-13 for illustration.
   - Measure six links, as shown, using calipers.

   \[
   L = \frac{L_1 + L_2}{2} \\
   E(\%) = \left(\frac{L - S}{S}\right) \times 100 \quad \text{where } S = \text{standard length}
   \]

   Figure 4-13 Handrail chain slack illustration

   - Record \(L_1\) and \(L_2\).
   - Calculate chain elongation, \(E\) using the equations below.

   - If \(E > 1.5\%\), remove the chain.
### Figure 4-14 Handrail Drive Chain Measurement

<table>
<thead>
<tr>
<th>Chain Size (No.)</th>
<th>RS25</th>
<th>RS35</th>
<th>RS41</th>
<th>RS40</th>
<th>RS50</th>
<th>RS60</th>
<th>RS80</th>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Original</td>
<td>38.10 (1 1/2)</td>
<td>57.15 (2 1/4)</td>
<td>76.20 (3)</td>
<td>76.20 (3)</td>
<td>95.25 (3 3/4)</td>
<td>114.30 (4 1/2)</td>
<td>152.40 (6)</td>
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<tr>
<td>1.5% elongation</td>
<td>38.67 (1.52)</td>
<td>58.01 (2.28)</td>
<td>77.34 (3.05)</td>
<td>77.34 (3.05)</td>
<td>96.68 (3.81)</td>
<td>116.01 (4.57)</td>
<td>154.69 (6.09)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Original</td>
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<td>95.25 (3 3/4)</td>
<td>127.00 (5)</td>
<td>127.00 (5)</td>
<td>158.75 (6 1/4)</td>
<td>190.50 (7 1/2)</td>
<td>254.00 (10)</td>
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<td>1.5% elongation</td>
<td>64.45 (2.54)</td>
<td>96.68 (3.81)</td>
<td>128.91 (5.08)</td>
<td>128.91 (5.08)</td>
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<td>RS140</td>
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</tr>
<tr>
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<td>228.60 (9)</td>
<td>266.70 (10 1/2)</td>
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<td>381.00 (15)</td>
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<td>270.70 (10.66)</td>
<td>309.37 (12.18)</td>
<td>348.04 (13.70)</td>
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<td>464.06 (18.27)</td>
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<td><strong>10 Link Measure</strong></td>
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<td></td>
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<td>508.00 (20)</td>
<td>571.50 (22 1/2)</td>
<td>635.00 (25)</td>
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<tr>
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<td>322.26 (12.69)</td>
<td>386.72 (15.23)</td>
<td>451.17 (17.76)</td>
<td>515.62 (20.30)</td>
<td>580.07 (22.84)</td>
<td>644.53 (25.38)</td>
<td>773.43 (30.45)</td>
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Figure 4-15 Handrail Drive Chain Illustration

<table>
<thead>
<tr>
<th>CHAIN LENGTH</th>
<th># OF PITCH</th>
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<tbody>
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<td>4533.9</td>
<td>238</td>
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</tbody>
</table>

<table>
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<tr>
<th>ROLLER CHAIN NO.</th>
<th>PITCH</th>
<th>ROLLER DIAMETER</th>
<th>W</th>
<th>T</th>
<th>H</th>
<th>I</th>
<th>D</th>
<th>L1</th>
<th>L2</th>
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<tbody>
<tr>
<td>60</td>
<td>19.05</td>
<td>11.91</td>
<td>12.7</td>
<td>2.4</td>
<td>18.1</td>
<td>15.6</td>
<td>5.96</td>
<td>12.85</td>
<td>14.75</td>
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</table>

ALL DIMENSIONS ARE IN mm.
4.6.2.3 Handrail Take-up Device Maintenance and Adjustment

The following steps will guide the worker through the maintenance and adjustments for the take-up device. See Figure 4-16 for illustration.

1. Remove the interior panel just over the take-up device location. (See paragraph 4.4.2.)
2. Loosen the lock nut that is at the top of the threaded rod.
3. Turn the adjustment rod to loosen the tension on the handrail device.
4. With the take-up device loosened, check the rollers for any accumulated debris.
5. Clean the rollers with a clean damp cloth. Wipe with a clean dry cloth.
   - In the case of gum or other substance that is difficult to remove, use alcohol.
   - Wipe the roller down and allow the alcohol to dry. Wipe with a clean dry cloth.
6. Check for any damage to the rollers. Replace a roller, if damaged.
7. Adjust the take-up device until proper tension is achieved in the handrail.
8. Tighten the lock nut and replace the interior panel.

![Figure 4-16 Take-up Device Illustration]
4.6.2.4 Return Guides Maintenance and Adjustment

The following instructions will guide the worker through the maintenance and adjustments for the guides. See Figure 4-17 for illustration.

1. Remove all of the interior panels to expose the return guides. (See paragraph 4.4.2.)
2. Release the tension on the handrail by adjusting the take-up device. Be sure to loosen the lock nut before attempting.
3. Remove the handrail from the return guide.
4. Clean dirt and grease from the guide with a soft cloth.
5. Check the guide for any abnormal wear on the guides.
6. Replace handrail on guides and adjust the tension as required.
   - Be sure to run the lock nut back against the take-up bracket.
7. Replace all of the interior panels.

Figure 4-17 Return Guide Rail illustration
4.6.2.5 Handrail Drive Sheave Pressure Roller Maintenance and Adjustment

The following steps will guide the worker through maintenance and adjustment of the pressure rollers. See Figure 4-18 for illustration.

1. Remove the upper landing plates and attach the maintenance pendant.
2. Remove 8 to 12 steps and move the opening so that access to the handrail drive area is possible.
3. Check the condition of the rollers and clean debris from them with a clean damp cloth.
4. Replace any damaged rollers.
5. Check adjustment of the rollers and adjust as needed, as shown in illustration.

Figure 4-18 Handrail Drive Sheave Pressure Roller

- Jam-Nut
- Adjustment Nut
- Rollers
- Spring Standard Value 3.19”
  Limit Value 2.95”
  Solid compressed height is 2.68”
  Free length is 4.33”
4.7 Handrail and Handrail Drive Components Removal and Replacement

The following instructions will guide the worker through removal and replacement of the following components:

- Handrail
- Reinstalling a partially removed handrail
- Handrail Drive Sheave Sprocket
- Take-up Device
- Handrail Drive Chain
- Pressure Rollers

CAUTION!

THE FOLLOWING TASKS SHOULD BE DONE ONLY BY A CERTIFIED ESCALATOR TECHNICIAN

4.7.1 Handrail Removal and Replacement

The following instructions will guide the worker through the removal and replacement of the handrail.

1. Remove the landing plates in the upper or lower truss and attach the maintenance pendant to the service box. (See paragraph 4.1.2.3.)
2. Remove half of the steps to clear access to the skirt panel. (See paragraph 4.2.2.1.)
3. Turn off the main power at the main disconnect.
4. Remove all skirt panels and “D” molding. This is to gain access to the handrail return guides. (See paragraph 4.5.)
5. Remove the lower and upper handrail entry devices. (See paragraph 4.13.18.)
6. Raise the handrail tension device to its uppermost position.
7. Loosen the pressure on the tension rollers that hold the handrail against the sheave.
8. Remove the handrail guides on the return side by loosening the nut and sliding the handrail out through the open slot in the bracket.
9. Remove the handrail at the lower curve by peeling the handrail off of the handrail steel guide.
10. Continue to remove the handrail by peeling from the steel guide. Once the handrail is free of the guide, remove from the truss.
11. To reinstall the handrail, follow the removal directions in reverse order.
4.7.1.1 Reinstalling a Partially Removed Handrail

If the handrail comes off the exposed section of balustrade, use the following procedure to put the handrail back into position.

1. While the handrail is off, check the condition of the handrail and guides per the preventive maintenance in Section 6 of this manual.

2. If the handrail has come off past the handrail entry device, remove the handrail guard per paragraph 4.6.

3. Slip the handrail back on the steel guides in the following order:
   - Slip the handrail over the steel guides on the lower newel.
   - Slip the handrail over the steel guides in the lower curve.
   - Slip the handrail over the steel guides on the upper newel.
   - Slip the handrail over the steel guides on the incline working up to the upper curve.
   - Slip the handrail over the steel guides on the upper curve. This will require some extra force. Pull on the handrail to get the slack on the upper curve side to aid in slipping over the steel guide.

4. Check the handrail tension and lead/lag. (See paragraph 4.6.2.1.)
4.7.2 Handrail Drive Sheave Removal and Replacement

The following instructions will guide the worker through the removal and replacement of the handrail drive sheave. See Figure 4-19 and Figure 4-20 for illustration.

1. Remove five to six steps. (See paragraph 4.2.2.1.)
2. Position the opening over the handrail drive section. Make sure that the master links for the handrail drive chains are accessible.
3. Turn off the main power at the main disconnect.
4. Remove the “D” molding and interior panel at the upper curve section. (See paragraph 4.4.)
5. Remove the handrail drive chain. (See paragraph 4.7.5.)
6. To release the spring force on the handrail-retaining roller, loosen the jam nut and adjust the retaining roller away from the handrail drive sheave.
   • Remember that there are three retaining roller assemblies.
7. Remove the eight bolts that hold the sheave to the hub.
8. Remove the handrail drive chain. Break the chain at the master link.
9. Remove the C-clip from the handrail drive sheave axle.
10. Slide the handrail drive sprocket off the shaft and remove from the truss.
11. To reinstall, follow the removal directions in reverse order.
HOW TO ADJUST FOLLOWING:
HANDRAIL DRIVE SHEAVE, IDLER SPROCKETS

1) ADJUST THREADED INSERT TO PROPER DIMENSIONS BY MEASURING AS SHOWN IN DETAIL "A"

2) JAM INSERT BY DAMAGING THE THREADS WHICH TOUCH THE PLATE ON THE INSIDE OF THE TRUSS BY HITTING THEM WITH A HAMMER & SCREWDRIVER ON THE TOP, BOTTOM, LEFT AND RIGHT SIDES OF THE INSERT.

3) SET HANDRAIL DRIVE SHEAVE, IDLER SPROCKET

4) CHECK TO CONFIRM DIMENSION "X"

5) IF WRONG RE-ADJUST INSERT AFTER LOосENING THE SETTING BOLT.
Figure 4-20 Handrail Drive Sheave - Detail
4.7.3 Handrail Drive Sheave Pressure Rollers

The following instructions will guide the worker through the removal and replacement of the Handrail Drive Sheave Pressure Rollers. See Figure 4-21 for illustration.

1. Remove the landing plates in the upper or lower truss and attach the maintenance pendant to the service box. (See paragraph 4.1.2.3.)
2. Remove 8 to 12 steps and move the opening to the location of the pressure rollers. (See paragraph 4.2.2.1.)
3. Loosen the jam nut and turn the adjusting nut to reduce pressure on drive sheave.
4. Remove 4 bolts mounting the pressure rollers to the mounting bracket.
5. Replace in reverse order of removal.
6. Adjust spring length to 3.19”.
7. Replace steps and landing plates and disconnect the maintenance pendant.

Figure 4-21 Pressure Roller
4.7.4 Handrail Take-up Device Removal and Replacement

The following steps will guide the worker in the removal and replacement of the Take-up device. See Figure 4-22 for illustration.

1. Remove the landing plates at the lower truss and attach the maintenance pendant to the service box. (See paragraph 4.1.2.3.)
2. Remove the interior panel and skirt panel adjacent to the take-up device. (See paragraph 4.4.2 and 4.5.)
3. Remove 5 to 8 steps and move the opening to the location of the take-up device. (See 4.2.2.1.)
4. Loosen the lock nut and put enough slack in the handrail to remove it from the take-up device.
5. Remove the 4 mounting bolts and remove the take-up device.
6. To replace the take-up device, follow the removal procedures in reverse. (For handrail adjustment see paragraph 4.6.2.)
4.7.5 Handrail Drive Chain Removal and Replacement

The following steps will guide the worker in the removal and replacement of the handrail drive chain.

1. Remove the floorplate at the upper truss and connect the maintenance pendant to the service box. (See paragraph 4.1.2.3.)
2. Remove 8 to 12 steps and move the opening to the location of the handrail drive sheave. (See paragraph 4.2.2.1.)
3. Remove the skirt panel that is over the handrail drive sheave area. (See paragraph 4.5)
4. Move the escalator until the master link is accessible.
5. Loosen the drive chain tension by moving the adjustment sprocket to its highest position.
6. Disconnect the chain by removing the clip that is holding the retaining plate in position. After removing the clip, remove the retaining plate and remove the master link from the chain.
7. Replace the drive chain in reverse order of removal.
8. Replace the steps and landing plates and disconnect the maintenance pendant.
4.8 Track Maintenance, Adjustments, Removal and Replacement

The following instructions will guide the worker through maintenance, adjustment, removal, and replacement of the track components.

Track Maintenance and Adjustment

The following maintenance and adjustment instructions cover the following areas of the track:

- A-Track: Upper step chain wheel track
- A-Track Up-thrust
- B-Track: Upper step wheel track
- B-Track Up-thrust
- M-Track: Step wheel return track
- N-Track: Step chain wheel return track
- N-Track Up-thrust
- Turn-around track Upper and Lower

4.8.1.1 Step Chain Wheel Track & Step Wheel Track

The following instructions will guide the worker through the maintenance and adjustments of the Step chain wheel track and the step wheel track.

1. Examine the alignment of the steps in the exposed travel between skirt panels.
2. If steps appear to be shifting, the track may be misaligned or the skirts may be misaligned. (It is recommended that you check the skirt panel alignment first.)
3. Remove the landing plates and attach the maintenance pendant to the service box. (See paragraph 4.1.2.3.)
4. Remove half of the steps. (See paragraph 4.2.2.1.)
5. Engage the pawl brake system to prevent any unwanted movement. (See paragraph 4.10.2.)
6. Clean the track rail with a dry cloth and check the clearance between the wheel and the track, there should be 1mm clearance. (See Figure 4-23 Track Measurement for dimensional instruction.)
7. Check for any loose track, uneven joints, and highly worn areas. Adjust as needed to insure the track is level.

CAUTION!
THE FOLLOWING TASKS SHOULD BE DONE ONLY BY A CERTIFIED ESCALATOR TECHNICIAN
8. Check for rust. Treat as needed.
9. Return the pawl brake system to its run position.
10. Replace the steps and landing plates and disconnect the maintenance pendant.

Figure 4-23  Track Measurement
4.8.1.2 Up-thrust Guides

The following instructions will guide the worker through the maintenance and adjustment of the up-thrust guides.

1. Remove the landing plates and attach the maintenance pendant to the service box. (See paragraph 4.1.2.3.)
2. Remove half of the steps. (See paragraph 4.2.2.1.)
3. Engage the pawl brake system to prevent any unwanted movement. (See paragraph 4.10.2.)
4. Clean up-thrust guide with a clean dry cloth.
5. Check for any loose guides, uneven joints, and highly worn areas.
6. Measure the gap between the top of the step wheel and the bottom of the up-thrust tracks. Adjust the up-thrust guides if necessary.
   Gap should be:
   - 0.04 - 0.10 inches in the upper and lower track.
   - 0.01 - 0.03 inches in the lower curve.
   - 0.25 inches in the incline track.
7. Return the pawl brake system to its run position.
8. Replace steps and landing plates and disconnect the maintenance pendant.

4.8.1.3 Turnaround Track

The following instructions will guide the worker through the maintenance and adjustment of the turnaround track.

1. Remove the landing plates and connect the maintenance pendant to the service box. (See paragraph 4.1.2.3.)
2. Remove 6 to 8 steps to expose the turnaround track. (See paragraph 4.2.2.1.)
3. Position the open to gain maximum access to the turnaround.
4. Engage the pawl brake system to prevent any unwanted movement. (See paragraph 4.10.2.)
5. Verify that the turnaround track is aligned with the step wheel track. Realign if necessary.
6. Clean track rail of foreign objects with a dry cloth.
7. Return the pawl brake system to its run position.
8. Replace the steps and landing plate and disconnect the maintenance pendant.
4.8.2 Track, Up-thrust Guide and Turnaround removal and replacement.

The following instructions will guide the worker through the removal and replacement of the Track. See Figure 4-24 for illustration.

Some time-saving suggestions:

- Scribe a reference line on either side of the track bracket(s) for location.
- Leave the mounting brackets in place.
- Leave the track height adjustment bolts in place.
- Remove the track and up-thrust as one unit in the upper and lower end when connected.

1. Remove upper and lower landing plates. (See paragraph 4.1.2.3.)
2. Remove all steps. (See paragraph 4.2.2.1.)
3. Remove step chain. (See paragraph 4.3.2.)
4. Remove skirt panels. (See paragraph 4.5.)
5. Remove M8 flathead mounting bolts and nuts connecting the track to the track brackets. Put the mounting bolts in a secure area.
6. Remove M8 mounting bolts at the joint with the next section of track. Put the mounting bolts in a secure area.
7. Remove the track section.
8. Remove the turn track by removing eight M10 flathead mounting bolts and nuts connecting the turn track to its base.
9. Remove B-track, B-track up-thrust, M-track, and M-track up-thrust attached to the turn track base.
10. Remove the brace angle by removing two M10 bolts and nuts from the left and right hand turn track bases.
11. Remove lower end turn track bases.
12. Remove upper end bases by removing two M20 bolts and nuts on the left and right side connecting the bases to the truss-mounting bracket.
13. To reinstall, follow the directions in reverse order.
Figure 4-24 Track Removal and Replacement
4.9 Machine Assembly Maintenance, Adjustment, Removal and Replacement

The following instructions will guide the worker through the maintenance, adjustment, removal and replacement of the Machine Assembly.

**CAUTION!**

THE FOLLOWING TASKS SHOULD BE DONE ONLY BY A CERTIFIED ESCALATOR TECHNICIAN

4.9.1 Maintenance and Adjustments

The following maintenance and adjustment procedures are for the following:

- Drive Motor
- Coupling
- Gear Reducer
- Sprocket Maintenance
- Main Drive Chain
- Main Drive
- Tension Carriage
Figure 4-25 Machine Assembly Millbrae, San Bruno
Figure 4-26  Machine Assembly So. San Francisco
4.9.1.1 Drive Motor Maintenance and Adjustments

The following instructions will guide the worker through the maintenance and adjustment of the drive motor.

1. As the escalator is running at normal speed, listen for any unusual noise that might be coming from the upper truss area, mainly around the area of the motor. Check for any rhythmic vibrations in this area.

2. Shut down the escalator and barricade the lower and upper truss area to prevent pedestrians from entering the escalator.

3. Remove the upper landing plates to expose the upper pit area and attach the maintenance pendant to the service box. (See paragraph 4.1.2.3.)

4. Remove six to eight steps and move the opening over the drive motor area. (See paragraph 4.2.2.1.)

5. Check that the motor is clean.
   - Check that the interior and exterior of the motor is free of dirt, oil, grease, water, etc. Debris can accumulate and block the motor ventilation. If the motor is not properly ventilated, overheating can occur and cause early motor failure.

6. Check that all mounting bolts are tight.

7. Clean all grease fittings. (See service schedule when to lubricate.)

8. Remove grease outlet plugs. See Figure 4-27 for locations.

9. Add grease slowly until new grease appears in the shaft hole (fan side of motor) and the outlet plug.

Figure 4-27 Drive Motor illustration
10. Reinstall the grease outlet plug.

11. Use a “Megger” periodically to ensure that the integrity of the winding insulation has been maintained.
   - Record the Megger readings.
   - Immediately investigate any significant drop in insulation resistance.

12. Replace the steps and run the escalator at inspection mode.

13. Listen for any unusual sounds.

14. Remove the maintenance pendant and replace the landing plates after all work is accomplished.

15. Remove the barricades.
4.9.1.2 Coupling Maintenance and Adjustment

The following instructions will guide the worker through maintenance and adjustment of the coupling.

1. Check for unusual vibration and/or noise.
   - If not aligned properly, the coupling will vibrate or make a loud beating sound.
   - The same sound and vibration will occur when the “spider” is worn and in need of replacement.

2. Shut down the escalator immediately if unusual vibration or noise is present
   - Misalignment of a “C-face” style machine may be a symptom of a larger problem.

3. Inspect the spider. See Figure 4-28 for illustration.
   - Replace the “spider” if worn or cracked or hard to the touch, or realign the coupling, motor and gear reducer.
   - Never operate the escalator if the spider is worn beyond 25% of original thickness (limiting value). Replace spider as needed.

4. Check coupling for excessive play.
   - This may indicate a loose setscrew or damaged key and/or keyway.

(See paragraph 4.9.2.3 for removal and replacement of coupling.)

![Coupling Spider Illustration](Manufacturer: Lovejoy, Part No. L190)

<table>
<thead>
<tr>
<th>Original Thickness (inches)</th>
<th>Limiting Value (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.88</td>
<td>0.68</td>
</tr>
</tbody>
</table>

Figure 4-28 Coupling Spider illustration
4.9.1.2.1 Misalignment Overview

The function of a coupling is to connect driving and driven equipment. In addition, a coupling serves to protect costly equipment from the effects of misalignment, shock loads, vibration and shaft end float. Of these factors, the most common is misalignment and end float (also known as axial misalignment).

Misalignment is a condition created by two shafts whose axes are not in the same straight line. There are three forms of misalignment: parallel, angular, or the combination of the two. End float is the relative motion of two shaft ends.

Parallel misalignment occurs when the axes of the connected shafts are parallel, but not in the same straight line. See item 1 in Figure 4-29.

Angular misalignment occurs when the axes of the shafts intersect at the center point of the coupling. See item 2 in Figure 4-29.

End float occurs when one shaft moves along its axis relative to the other shaft.

Misalignment can result from a combination of manufacturing tolerances, poor installation practices, thermal growth or shrinkage, foundation movement, and/or component wear.

The combination of angular and parallel misalignment within a system may be more detrimental to the coupling and equipment than either of the individual misalignments.

Axial misalignment, which is the result of thrust loads, reaction loads or heat generated movement, compounds the problem.

Understanding the amount of misalignment that the coupling must handle or installing a coupling where it exceeds a maximum rated misalignment can result in premature coupling failure and/or significant equipment damage.

4.9.1.2.2 Misalignment and Coupling failure

The life expectancy of a coupling is affected by the degree of misalignment.

The larger the misalignments, the shorter the life of the coupling (as shown in item 5 on Figure 4-29).

Misalignment may causes heat generation, fatigue, and an increased in wear in bearings of the drive and driven components.
Figure 4-29 Misalignment illustration
4.9.1.2.3 When misalignment can not be measured

When it is not possible to measure the misalignment of a system, or in designing a new system, the following method can be used to estimate angular, parallel and combined misalignment.

Each type of misalignment is first calculated and then the results are combined.

To calculate the maximum angular misalignment, the distance (L) and the angle (a) must be known or estimated (see example below).

- First, calculate the angular misalignment noting the critical plane or midpoint of the shaft ends.
- Second, using the maximum parallel misalignment, be sure to consider both horizontal and vertical directions (item 3, Figure 4-30). Maximum parallel misalignment occurs when the shafts are diagonally opposed.
- Third, combine the results.

4.9.1.2.4 Worked example

Calculate the worst possible composite alignment, misalignment when:

\[ a_1 \text{ max} = \pm 0.4^\circ \quad a_2 \text{ max} = \pm 0.4^\circ \]

\[ P_1 \text{ max} = 0.008 \text{ in.} \quad P_1 \text{ max} = 0.2 \text{ mm} \]

\[ P_2 \text{ max} = 0.008 \text{ in.} \quad P_2 \text{ max} = 0.2 \text{ mm} \]

1. Worst possible angular misalignment (fig.1) = \( a_1 + a_2 \)
   \[ = 0.4^\circ + 0.4^\circ = 0.8^\circ \]

2. Maximum radial misalignment (fig. 2) = \( R_1 + R_2 \)
   Since \( a_1 \) and \( a_2 \) are equal, \( R_1 = R_2 \)
   Calculate for 2(\( R_2 \)) = 2(tan \( a_1 \)xL)
   = 2(tan 0.4x75) = 2(0.007x75) = 2(0.007x3) = 1.05mm

3. Maximum parallel misalignment \( P_3 \) (fig. 3) = \( \sqrt{P_1^2 + P_2^2} \)
   = \( \sqrt{0.008^2 + 0.008^2} \) = \( \sqrt{0.2^2 + 0.2^2} \)
   = 0.0113 inches = 0.28mm

4. Worst possible misalignment (fig. 4) \( R_c = R_1 + R_2 + P_3 \)
   = 0.042 + 0.0113 = 1.05 + 0.28
   = 0.0533 inches = 1.33mm

No matter how relatively minor angular misalignments are, they can produce disproportionate radial misalignments. In this example, they account for approximately 80% of the worst possible composite misalignment.
Figure 4-30 Alignment illustration
4.9.1.3 Gear Reducer Maintenance and Adjustment

The following instructions will guide the worker through maintenance and adjustment of the gear reducer. See Figure 4-30 for illustration.

1. Check for excessive noise and vibration, which could indicate bearing failure.
2. Check oil level using the sight gauge. Check condition of oil.
   - If oil level is low, add MOBIL GLYGOYLE 30 SYNTHETIC OIL or equivalent lubricant.
   - If oil level is high, remove excess. It is important that oil remain at the correct level. Excess oil will cause heat build-up from excessive oil agitation and may cause seals to leak.
3. Check seals for excess wear or leaks. Replace seals as needed.
4. Change oil according to service schedule.
   - Use only MOBIL GLYGOYLE 30 SYNTHETIC OIL or equivalent lubricant. Use an adequate container and dispose of properly.
5. Check the output sprocket for excessive or unusual tooth wear.
   - Replace or align as needed.

Note: Special Instructions for Converting Mineral to Synthetic oil:

1. Run Machine until mineral oil is hot.
2. Drain oil.
3. Fill with synthetic oil to bottom of sight glass.
4. Run Machine until synthetic oil is hot.
5. Drain oil.
   - Pour some of drained oil into clear glass container.
   - If two layers are visible after a few minutes, repeat steps 3-5.
   - If only one layer can be seen, continue to step 6.
6. Fill with synthetic oil to the middle of sight glass.
Figure 4-31 Gear Reducer illustration
4.9.1.4 Sprocket Maintenance and Care

Almost every situation concerning your sprockets is in direct relationship to the maintenance that is performed on the drive chain. Proper maintenance is essential to longevity and good service.

It is important to check the sprocket and chain engagement by observing the roller and tooth surfaces. The proper margin (A) and improper margin (B) are shown in Figure 4-32.

The installation should also be checked. The normal area where wear will occur is slightly about the bottom of the lowest point between the sprocket teeth. When an idler or tightener is used, wear will occur almost directly between the sprocket teeth.

Figure 4-32 Sprocket Wear illustration
4.9.1.5 Main Drive Chain Maintenance and Adjustment

Chain life is generally considered to have expired when the chain does not engage properly with the sprocket due to damage of its parts or elongation. The Chain is usually replaced when this occurs.

A long working life without unexpected trouble can be achieved if the chain is properly maintained. To help prevent premature wear or damage, the following points should be checked.

Observe the chain and sprockets for these symptoms:

- An abnormal noise such as, grinding, squealing or clucking.
- Vibration of the chain. Some vibration may be experienced during normal operation. However, a large amount should be noted.
- Chain rising or climbing on the sprocket.
- Chain winding around the sprocket.
- Stiff bending of chain, or kinks, the chain does not seem to straighten out.
- Amount and condition of lubrication.
- Whether the chain contacts the case.
- Appearance of the chain. Check for dirt, corrosion, and damage on the outside surface of the roller, contact marks, etc. Also, check the inside and edge surface of the link plate and edge surface on the pin.
- Damage on the sprocket teeth surfaces and side surfaces of teeth and engaging area.
- Abrasive stretch of the chain.
- Bending of chain and rotation of roller

The following are checkpoints and are important to the maintenance of the drive chain.

**Lubrication:**

- While the chain is driving, check if the lubricating oil moves toward the link plates, and if the chain or rotating disc is immersed in the lubricating oil when the lubrication pump is running.
- When the chain is stopped, check for dirt or abrasive particles produced by improper lubrication.
- When the chain is removed, the connecting link pin and the edge of the side of the bushing should be checked.
- If there is any damage or a red or reddish brown color can be noticed, lubrication is improper or insufficient.
Link Plate:

If repeated loads more than the allowable loads are applied to the chain, there is a strong possibility of fatigue breakage of the link plate.

Fatigue breakage is difficult to anticipate until a crack is produced. Usually a crack develops at the edge of a hole or at the side of the link plate, as shown below. The presence of the cracks should be checked carefully.

![Figure 4-33 Likely Link Plate Crack Areas](image1)

![Figure 4-34 Cracked Link Plate](image2)

Roller Link:

Avoid repeated impact loads over the allowable load as fatigue breakage may occur.

Check the roller in the same way as the link plate. If foreign objects interfere with the engagement of the roller and sprocket, damage will occur to the roller and a crack may develop. Careful attention should be paid to this.

Replace any chains damaged due to fatigue breakage.

Chain Elongation:

Chain stretch is calculated as the total amount of elongation caused by wear on the pin and bushing, but not caused by deformation of the link plate.

Remaining chain life can be estimated by measuring chain elongation.

Measure main drive chain elongation.

- Measure six links as shown below using calipers.
- Record L1 and L2.
- Calculate chain elongation, E, using the equations below.
  \[ L = \frac{(L1+L2)}{2} \]
  \[ E(\%) = \frac{(L-S)}{S} \times 100 \quad (S = \text{standard length}) \]
- If \( E > 1.5\% \), replace chain.
Figure 4-35 Main Drive Chain Measurement for elongation

<table>
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<tr>
<th>CHAIN SIZE (No.)</th>
<th>RS25</th>
<th>RS35</th>
<th>RS41</th>
<th>RS40</th>
<th>RS50</th>
<th>RS60</th>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Original</td>
<td>38.10</td>
<td>57.15</td>
<td>76.20</td>
<td>76.20</td>
<td>95.25</td>
<td>114.30</td>
<td>152.40</td>
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<tr>
<td>(1½)</td>
<td>(2¼)</td>
<td>(3)</td>
<td>(3)</td>
<td>(3)</td>
<td>(3¾)</td>
<td>(4½)</td>
<td>(6)</td>
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<tr>
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<td>58.01</td>
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<td>(3.05)</td>
<td>(3.81)</td>
<td>(4.57)</td>
<td>(6.09)</td>
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<td>158.75</td>
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<td>(2½)</td>
<td>(3¼)</td>
<td>(5)</td>
<td>(5)</td>
<td>(6¾)</td>
<td>(7½)</td>
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<td>(12)</td>
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<td>(15.23)</td>
<td>(18.27)</td>
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<tr>
<td>10 link measure</td>
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<td>(20)</td>
<td>(22½)</td>
<td>(25)</td>
<td>(30)</td>
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<td>1.5% elongation</td>
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<td>386.72</td>
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<td>(20.30)</td>
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<td>(25.38)</td>
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1mm (inch)
Proper chain slack, S=Lx0.02

L = 36.43 inches
S = 0.81 inches

Figure 4-36 Chain slack

Take up slack or loosen by adjusting the main drive idler sprocket if necessary.
For abnormally stretched chain, replace the chain.
Figure 4-37 Main Drive Chain Details
4.9.1.6 Main Drive Maintenance and Adjustment

The following instructions will guide the worker through the maintenance and adjustment of the main drive. See Figure 4-38 for illustration.

1. Remove the upper landing plates to gain access to the upper pit and attach the maintenance pendant. This will expose the main drive sprocket for inspection.

2. While running the escalator in inspection mode, check for bearing noise (such as a growling or squeal) coming from the main drive area.

3. Apply new grease per maintenance schedule.
   - Be sure not to over grease the bearings and blow out the seals.

4. Check for wear on the step chain and main drive sprockets.
   - Insure that the main drive chain and step chains are seating the sprocket correctly.

5. Once inspections are complete, remove the maintenance pendant and replace landing plates.

Figure 4-38 Main Drive illustration
4.9.1.7 Tension Carriage Maintenance and Adjustment

The following instructions will guide the worker through the maintenance and adjustment of the tension carriage. See Figure 4-39 for illustration.

1. As the escalator is running, verify that the steps enter the combfingers squarely.
   - Listen for any unusual noise.

2. Shut down the escalator, remove the landing plates, and attach the maintenance pendant.

3. Remove about five or six steps to allow access to the tension carriage frame.

4. Inspect the rollers and the carriage rail for rust or debris that may have built up.
   - Clean if needed.

5. Replace the steps that were taken out and run escalator at inspection speed to check that the steps are entering the comb correctly.
   - Adjust to correct skew if needed.

6. If a meshing of the step chain is heard, check the following:
   - Height of track. Adjust if necessary.
   - Spring force of tension carriage. Adjust if necessary.

7. Add grease to tension carriage bearings per maintenance schedule.
Detail "A"

Figure 4-39 Tension Carriage illustration
4.9.2 Removal and Replacement

The following removal and replacement procedures are for the following:

- Main Drive Chain
- Drive Motor
- Gear Reducer
- Coupling
- Main Drive Shaft Assembly
- Tension Carriage.

4.9.2.1 Main Drive Chain Removal and Replacement

The following will be a guide the worker through removal and replacement of the main drive chain.

1. Remove the upper truss landing plates to access the main drive chain and pawl brake system. Attach the maintenance pendant to the service box. (See paragraph 4.1.2.3.)
2. Remove the “D” molding and the Safety brush from the upper truss, right hand side only. (See paragraph 4.5.)
3. Remove the Interior panel, newel panel and skirt panel on the right hand side only. (See paragraph 4.4.2.)
4. Move the escalator until the master link is accessible.
5. Remove 6 steps and move the opening to the location of the drive chain idler. (See paragraph 4.2.2.1.)
6. Activate the pawl brake to prevent the escalator from “free-wheeling” when the main drive chain is removed.
7. Reduce the tension on the chain and remove the master link to break the chain and remove it.
8. When replacing the new drive chain, be sure that the link that connects both ends is within reach.
9. Adjust the chain slack.
10. Replace all the interior panels, moldings and safety brushes.
11. Reset the pawl brake system.

CAUTION!

THE FOLLOWING TASKS SHOULD BE DONE ONLY BY A CERTIFIED ESCALATOR TECHNICIAN
12. Replace the missing steps and run the escalator. Be sure to lubricate the drive chain and run it to insure proper fit. Watch for any of the symptoms noted earlier.

13. Remove the maintenance pendant and replace the landing plates.

4.9.2.2 Main Drive Machine Removal and Replacement

The following procedures will guide the worker through removal and replacement of the escalator drive machine. See Figure 4-40 for illustration.

**Warning: Safety Precautions!**

**HIGH VOLTAGE**
The Main Power Disconnect
**MUST BE LOCKED-OUT AND TAGGED-OUT**

It will be important to barricade the area of the upper truss and lower truss of the escalator. This is where most of the work will take place.

Along with the standard tools that the maintenance worker will need, a small crane will be required to lift the machine out of the truss.

1. Remove landing plates from the upper & lower truss area. See paragraph 4.1.
2. Remove all steps. See paragraph 4.2.
3. Remove a portion of the step chain that is in the upper truss area. Be sure to tie off the remaining portion to the truss to prevent it from piling up in the lower truss area. See paragraph 4.3.2 for step chain removal and replacement.
4. Remove A-Track, A-Track up-thrust, B-Track, B-Track up-thrust and turn around. For information on removal and replacement see paragraph 4.8.
5. Remove the interior panels, skirt panels, D-molding and Safety Strip for the upper truss area. See paragraph 4.4 for further instruction.
6. Remove handrail from around upper newel section.
   - This can be accomplished by first reducing the tension on the handrail.
   - ✓ To do this the interior panel over the handrail tension device will need to be removed. This will expose the tensioning device.
   - ✓ With a wrench, raise the idler wheels from the handrail to release the tension. After the tension is released the handrail can be “peeled” off of the handrail guide around the upper newel.
7. Disconnect wiring from emergency stop switch, operating panel, and indicator lights. Be sure to remove conduit from the switch boxes. The newel will be removed to ensure clearance to remove the machine.
8. Remove upper newel. Disconnect the upper A-Molding from the newel molding and the newel sheave base. Remove the newel mounting bolts and then remove the newel. *(For illustration see figure 4-4 in the back of this section.)*

9. Remove the comb fingers from the combplate and put them in a safe place.

10. Remove the lubrication lines that lubricate the main drive chain.

   ✓ This can be done by simply loosening the pipe clamps and moving the lines out of the area.

   ✓ Then the lubrication brush that lubricates the handrail drive chain needs to be removed.

   ✓ Removal of the mounting bracket may not be required.

11. Remove the demarcation lamp from the upper truss area. Be sure to remove the conduit from the demarcation lamp. Remove the mounting bracket for the demarcation lamp.

12. Remove the pulsar disc from the end of the shaft; then remove the digital sensor and mounting bracket. Move the digital sensor to a location of the upper truss where it will not be damaged.

13. Disconnect the wiring for the machine brake. Be sure to remove the manual brake cable from the manual brake handle. Remove the 100% brake deterioration switch and place it in a safe place.

14. At this time disconnect the main power lines from the motor.

   This can be done at the junction box on the side of the motor. Be sure to mark the lines and the terminals so that there is no possibility of damage done to disconnect wires.

15. Adjust main drive chain idler sprocket to a position, which maximizes chain slack.

16. Adjust handrail drive chain idler sprocket to a position, which maximizes chain slack.

17. Disconnect master links from main drive chain and remove. Be sure to place master link components in a safe place. You will need to use them again.

18. Disconnect the master link from the handrail drive chain. Be sure to place the master link components in a safe place. You will need to use them again.

19. It is important to measure the shims under the pillow block bearings that the output shaft is mounted to and record that number.

   • It is important to put the same amount of shims in the same place upon assembly.

   • At this time remove the jam nuts that are on the mounting bolts for the pillow block.

   • Then remove the mounting bolts them selves.

   • Once this is done, back off the jam bolt to allow freedom of movement of the bearing blocks.

20. At this time attach the lifting hoist to the machine and pull the slack out of the lines.

21. Remove mounting bolts that hold machine into place. Be sure that the slack is taken up on the hoist cable to prevent the machine from dropping.

   • It is important that while doing this operation that you are aware of the attitude of the machine. It may want to twist.
22. Carefully lift the machine from truss area.

23. When replacing the machine back into the upper truss it is extremely important that the maintenance personal are aware of what is going on around them. This equipment is heavy and much can happen quickly.

24. Place the machine back into the truss area.

25. With a pinch bar line up the mounting holes.

26. Once the holes are aligned replace the hardware that was removed.

27. For the remainder of the replacement process follow the removal instructions in reverse order.
Figure 4-40 Machine Removal and Replacement
4.9.2.3 Coupling Removal and Replacement

The following procedures will guide the worker through removal of the machine coupling. See Figure 4-41 for illustration.

1. Follow steps 1 through 3 and 5 of paragraph 4.9.2.2 Machine Removal and Replacement.
2. Once the machine is exposed, disconnect the wiring inside the terminal box on the side of the motor. Be sure to mark the leads.
3. Connect the cable of the lifting apparatus to the lifting eye on the motor and pull the slack out of the line.
4. Begin to remove all the mounting bolts to the flange that mounts the motor to the gear reducer. Put the bolts in a safe place, you will need them when reinstalling the motor.
5. Once the mounting flange has been disconnected, push the motor back slightly and begin to lift it out of the truss. Be aware of the spider it may drop out of the coupling.
6. Once the motor is out of the truss, you will notice that the coupling has three parts.
   - The one metal part is attached to the motor output shaft; the other metal part is attached to the reducer input shaft. There should be no reason to remove either one of these from the shaft unless the motor or gear reducer is being replaced.
   - The portion that will more then likely be replaced will be the spider. This is what cushions the shock of the start-up and also gives some flexibility if there is a slight misalignment between the motor and the reducer.
7. To remove the coupling fingers loosen the setscrews that hold the coupling to the shaft.
   - After this is done, the coupling fingers should slide off the shaft.
   - There is a possibility that a dead-blow hammer will be needed to tap off the coupling fingers.
8. To replace follow instructions in reverse order. Be sure not to damage the spider.
   - If the spider becomes damaged, misalignment of the coupling could occur.

![Figure 4-41 Coupling Removal and Replacement](image-url)
4.9.2.4 Gear Reducer Removal, Repair, and Replacement

The following procedures will guide in the removal, repair and replacement of the gear reducer. Limited repair to the gear reducer is available.

**Warning**

Before removing any components from the gear reducer itself or “cracking the case” be sure to read the manufacturer’s instructions and warranties that may apply. Any unauthorized repair to the gear reducer could and probably will void any warranty that may be applied.

1. Follow the instruction for removal of machine in paragraph 4.9.2.2.
2. Once the machine is removed from the escalator, separating the gear reducer from the drive motor can begin. *(It is advisable that the machine bed be placed on blocks or stands so access can be gained to the gear reducer mounting bolts).*
   - Be sure to connect the cable from the floor crane to the lifting eye on the motor. Take the slack out of the cable.
3. Remove the mounting bolts from the mounting flange on the gear reducer. Be sure to put the bolts in a safe place.
4. Separate the motor from the reducer. Watch for the spider to fall out of the coupling. Be sure to put the spider in a safe place also. If the reducer is to be replaced. Now is a good time to remove the coupling from the input shaft of the reducer and place it with the spider. Place the motor in a safe location.
5. Remove the Electromagnetic brake from the from the gear reducer. Loosen the setscrews that hold the torque-adjusting ring and remove it. Under the torque-adjusting ring are the three socket-head screws that are counter sunk. Remove these screws and slide the brake from the shaft. There will be a spline gear left on the shaft, loosen the setscrew that is holding it in place. To remove the spline gear from the shaft may require a gear puller. Be sure to put the spline gear in a safe place.
6. Remove the four mounting bolts that are located on the bottom side of the machine frame and lift from frame.
7. To replace follow instructions in reverse order.
4.9.2.5 Main Drive Shaft Assembly Removal and Replacement

The following instructions will aid in the removal and replacement of the Main Drive Assembly. It is recommended that a heavy-duty crane be used for this operation.

**Warning: Safety Precautions!**

Main Drive Assembly is VERY HEAVY

1. Remove upper and lower landing plates to gain access to the upper and lower trusses. For floorplate removal see paragraph 4.1.

2. Remove all of the steps see paragraph 4.2. Because the step chain will be broken and tied off it is important to reduce the weight.

3. Remove the interior panels, skirt panels, D-molding and Safety Strip. See paragraph 4.4 and 4.5 for directions.

4. Remove the portion of the handrail that goes around the upper newel. See paragraph 4.7 for directions.

5. Disconnect wiring from the emergency stop switch, operating panel, and indicator lights. Be sure to remove conduit from the switch boxes, the newel will be removed to ensure clearance for the removal of the main drive.

6. Remove the upper newel. Disconnect the upper A-molding from the newel molding and the newel sheave. Remove the newel mounting bolts and then remove the newel.

7. Remove the combplate/floorplate, disconnect the comb impact switch wires and remove the conduit. Remove the combplate mounting bolts and lift the combplate from the truss.

8. Remove lubrication tubing from main drive-chain area and lubricator spray nozzles from the step chain area. Be sure that all tubing is clear of main drive shaft.

9. Remove chain guard. The guard that is over the step chains needs to be removed.
   - There are two mounting bolts at the top of the guard that are attached to the upper cord angle and two on the front side of the guard attached to an angle.
   - Loosen all four mounting bolts, with one hand holding the guard remove the bolts, bottom first then top. Once the bolts have been removed lift the guard out of the truss.

10. Remove the step chain from the upper truss area. Be sure to tie-off the step chain and remove about 6 units to clear the step chain drive sprockets.

11. Remove the A-track up-thrust and A-track together, B-track and B-track upthrust and turn around track. See paragraph 4.7 Track removal replacement instructions.

12. Disconnect the main drive chain.
   - Adjust the Drive Chain Idler to allow slack in the drive chain. Locate the master link and break the chain.
   - Be aware that once the main drive chain is broken the pawl brake will drop into place.
When the time comes to reconnect the drive chain remember to place the pawl brake back into the “armed” position.

13. Loosen the bearing block mounting bolts and measure/count and record the shims on each side of the main drive.

14. Run the adjusting bolts back to allow for maximum room. Attach the crane to the main drive and carefully lift out of the truss.

15. Replacement of main drive shaft follows removal instructions in reverse. (See for illustration.)
Figure 4-42 Main Drive Assembly
4.9.2.6 Tension Carriage Removal and Replacement

The following procedures will guide the worker through removal and replacement of the escalator tension carriage.

It will be important to barricade the lower and upper truss. Along with the standard tools that are needed, a small crane will be required to lift the tension carriage out of the truss.

1. Remove landing plates on lower truss to expose tension carriage. See paragraph 4.1 for instruction on removal of landing plates.

2. Remove all steps. See paragraph 4.2 for instruction on removal and replacement of steps.

3. Remove the interior panels, skirt panels, D-molding and Safety Strip for the lower truss area. See paragraph 4.4, 4.5 for further instructions on removal and replacement of the above mentioned.

4. Remove handrail from around lower newel section.
   ✓ This can be accomplished by first reducing the tension on the handrail. To do this the idler wheels from the handrail tension device will need to be raised. Expose the tension device, it should be behind the first interior panel on the incline truss.
   ✓ Remove the interior panel and with a wrench raise the tension device. Once the tension is removed from the handrail, it can be peeled from the guide around the lower newel.

5. Disconnect wiring from emergency stop switch, operating panel, and indicator lights. Be sure to remove conduit from the switch boxes, the newel will be removed to ensure clearance to remove the step chain tension device.

6. Remove the lower newel assembly, disconnect the lower A-molding from the newel molding and the newel sheave base. Remove the newel mounting bolts and then remove the newel.

7. Disconnect the comb impact switches and remove the conduit connections. Remove the combplate from the truss, there are four mounting bolts on either side of the truss, remove these bolts and lift the combplate/floorplate clear of the truss area.

8. Remove the chain guard. Remove the step chain from around the tension carriage area. Be sure enough step chain is removed to allow the A-B track and associated parts to be removed.

9. Remove the A-track up-thrust and A-track: be sure to scribe a reference line on the track brackets at the top or bottom of the track.
   ✓ This will help line up the track to it’s previous position when reinstalling. Leave the mounting brackets and the track height adjustment bolts in place.
   ✓ With this in mind, remove the M8 flathead mounting bolts and nuts connecting the track to the track brackets.
   ✓ Remove the M8 flat head mounting bolts at the joint with the next section of track and remove the track section.

10. Release the tension carriage springs and disconnects the threaded rods from the tension carriage. When taking the threaded rods from the tension carriage be careful not to damage the thread.
11. Connect a crane of hoist to the tension carriage and carefully remove from the truss.

12. For reinstallation follow instructions in reverse. Be sure to set the carriage centerline and the spring length according to the dimensions on figure 4-12.

13. Adjust the broken step chain device. (See Figure 4-43 Tension Carriage Assembly for illustration.)
Figure 4-43 Tension Carriage Assembly
4.10 Brake Systems Maintenance Adjustment, Removal and Replacement.

The following instructions will guide the worker through maintenance, adjustment, removal and replacement of the brake systems. The following systems will be covered.

- Machine Brake
- Pawl Brake (Emergency Brake)

4.10.1 Machine Brake Maintenance and Adjustment

The following instructions will guide the worker through the maintenance and adjustment of the Machine Brake.

1. Remove the landing plates from the upper truss and connect the maintenance pendant. (See paragraph 4.1.2.3 for landing plat removal and replacement.
2. Remove 6 to eight steps and move opening over the machine brake area. (See paragraph 4.2.2 for step removal and replacement.
3. Check condition of wiring and sensors.
4. Clean brake with a clean dry cloth. Be sure to remove all brake dust. It may be helpful to use compressed air, this will assist with the cleaning to remove the dust form small areas. (Be sure to wear proper safety equipment when remove dirt from the brake will compressed air.)
5. Check the air gap. The factor air gap setting is .3mm[0.012”]. When the gap reaches .6mm[0.024”] the air gap should be adjusted.
6. Precise adjustment is easily carried out using a socket wrench and a spanner wrench.
   - Slacken the socket head cap screws to release the threaded spacers which can be adjusted in and out to change axial position of the armature and the mounting plate. This, in turn, changes the axial air gap which should be set to 0.25mm~0.35mm[0.010”~0.014”]. See Figure 4-44 Matrix Electromagnetic Brake illustration.
7. Check stopping distance under no-load conditions. (Stopping distance should be 8-12 inches.

CAUTION!

THE FOLLOWING TASKS SHOULD BE DONE ONLY BY A CERTIFIED ESCALATOR TECHNICIAN
8. Check the brake torque. Required torque is specified on the label plate attached the brake cover. (97 to 117 ft-lbs.) for MB & SB (128 to 148 ft-lbs) for SSF. To check the torque do the following:
   - Use a torque wrench that displays ft-lbs and a socket for a 10mm bolt.
   - Using the bolt, hat is attaching the disk for the governor speed disk, attach the socket wrench and pull with a smooth steady motion.
   - Just before the escalator begins to move check the indicator dial on the torque wrench. Be sure the torque is at proper reading. Adjust as needed.

9. To adjust the torque the following must be done:
   - Loosen 2 setscrews on the torque adjusting ring.
   - Loosen ring to increase the gap. This will decrease the torque.
   - Tighten the ring to reduce the gap. This will increase the torque.
   - Tighten the setscrews to lock the ring in position.

10. Check the hand brake cable to insure it is in proper operating order.

11. After adjustments are made replace steps, remove maintenance pedant and replace landing plates.
Figure 4-44 Matrix Electromagnetic Brake
4.10.2 Pawl Brake Maintenance and Adjustment

The following instructions will guide the worker through the maintenance and adjustment of the pawl brake system.

1. Remove the landing plates from the upper truss area and attach the maintenance pendant. See paragraph 4.1.2.3 for removal and replacement of the landing plates.

2. Remove 6 to 8 steps to gain access to the pawl brake cable. See paragraph 4.2.2 for step removal and replacement.

3. Using the maintenance pendant move the escalator as needed to gain access to the pawl brake cable.

4. Check the cable housing for damage.

5. Actuate the pawl brake by testing the broken drive chain device. This came done by removing the guide shoe.

6. After the guide shoe has been removed, actuate the broken drive chain device by allowing it to drop to the drive chain. This should push the cable in and actuating the pawl brake locking mechanism. Adjust the cable if needed.

7. Verify that the pawl is actuated and that it seats into the ratchet properly.

8. Check the condition of the guide shoe and replace if needed.

9. In sure that the limit switch trips when the pawl brake gets to with in 1 inch of the ratchet. This can be done by manually manipulating the pawl. Check LED #5 on the fault panel attached to the newel skirt, it should be illuminated.

10. Reset the pawl brake system after the inspection is complete. Before the escalator can be started the system has to be reset at the control panel.

11. Remove the maintenance pendant; replace the steps and landing plates.
Figure 4-45 Pawl Brake illustration
4.10.3 Machine Brake Removal and Replacement

The following instructions will guide the worker in the removal and replacement of the Machine Brake.

1. Remove the upper landing plates to gain access to the upper truss area. See paragraph 4.1 for instructions.

2. Attach the maintenance pendant to the service box in the upper truss.

3. Remove six to eight steps to gain access to the machine brake. Position the opening over the machine area exposing the machine brake. (See paragraph 4.2 for instructions.)

4. Engage the pawl brake at this time. Open the Lever Lock Box and with one hand hold the pawl in position and with the other depress the lever. This will clear the locking area and allow the lock lever to swivel out of the way releasing the pawl brake. Do not let the pawl drop, place it into position.

5. Remove the digital sensing head and disc from the machine brake. This is to avoid any unwanted damage when removing the brake.

6. Disconnect the manual release cable and remove threaded rod. Be sure to put threaded rod in a secure place.

7. Disconnect the brake temperature device. The connection is in the pull-box, which is located over the brake wear device. Be sure that the connector is removed from the pull box before removing the brake.

8. Loosen the setscrew that holds the torque-adjusting ring and remove the ring.

9. Three socket head screws mount the brake to the mounting plate. Remove these screws and carefully slide the brake from the shaft.

10. To replace the machine brake follow the directions in reverse order.

11. Before tightening the setscrews on the torque ring, set the air gap to the proper opening. (See Figure 4-46 Machine Brake Removal and Repair illustration for Millbrae and San Bruno.) (See Figure 4-47 Machine Brake removal and repair for SSF illustration for South San Francisco.)
Figure 4-46 Machine Brake Removal and Repair for MB & SB
Figure 4-47  Machine Brake removal and repair for SSF
4.10.4 Pawl Brake Removal and Replacement

The following instructions will guide the worker in the removal and replacement of the pawl brake.

1. Remove the landing plates from the upper truss area and attach the maintenance pendant. See paragraph 4.1.2.3 for landing plate removal and replacement.

2. Remove 2 or 3 steps and move the opening over the area of the pawl brake. See paragraph 4.2.2 for step removal and replacement.

3. Release the pawl brake from the locking device.

4. Remove the pawl brake mounting bolts and remove the pawl brake. Be sure to count the number of shims. The same number will need to be replaced.

5. Attach a hoist to the pawl and lift from the truss.

6. To replace follow instructions in reverse order.
Remove these mounting bolts

Figure 4-48 Pawl Brake Removal illustration
4.11 Maintenance, Adjustment, Lubricator Removal and Replacement

The following instruction will guide the worker through the maintenance, adjustment, removal and replacement. This portion of the lubricator instruction will also cover lubrication types.

4.11.1 Automatic Lubrication Device Maintenance and Adjustment

The following instructions will guide the worker through the maintenance and adjustment of the lubrication unit.

1. Cautions for Oiling:
   - Insure that the nozzles and pipes are located in the correct positions. See Figure 4-49 Lubrication Point Locations for illustration.
   - Replenish oil tank with Way Oil #68 medium or equivalent.
   - A lack of oil results in chain elongation. Lubrication during the first few months is crucial, so verify that the auto lubrication system is in proper working order from the first day of operation.

2. Replenish Oil every two weeks.

3. Memory power switch (memory switch) is incorporated in the timer. Remove the rubber bushing from the right face of the timer and raise the switch lever to on. After memory power is on remount the rubber bushing. The average life of the battery is 10 years.

4. The timer setting has been preset before shipping from the factory. The standard setting values are as follows:
   - Cumulative Interval Time: 20 hours
   - Oiling Time: \( t(\text{sec}) = \frac{82xN}{V+10} = 80 \text{ sec.} \)
   - \( N: \) Total Qty of steps
   - \( V: \) Escalator Velocity (fpm)

5. The interval time and oiling time can be adjusted by turning each of the timer adjustment dials with a screwdriver.
Figure 4-49 Lubrication Point Locations
4.11.2 Automatic Lubrication Device Removal and Replacement

The following procedures will guide the worker in removal and replacement of the Lubrication system.

1. Remove the landing plates on the upper truss. *(See paragraph 4.1 for instructions.)*
2. Turn off the main power switch. Breaker CB1.
3. Disconnect the wiring at the lubricator terminal box.
4. Disconnect the main supply pipe fitting at the lubricator pump unit. It is suggested that the open end of the supply pipe be taped off to prevent dirt from entering the system.
5. Record the settings on the lubricator timer. Put this information in a safe place you will need it when reinstalling the unit.
6. Remove the four mounting screws holding the lubricator to the mounting bracket. Be sure to place the screws back into the holes, you will need them when reinstalling the unit.
7. Pour the remaining oil into a clean container, if it is clean and will be reused soon. Otherwise dispose of properly.
8. To reinstall the lubricator, follow the directions in reverse order of removal.
9. Fill the reservoir with the remaining oil from step 7, unless it is contaminated then it should be discarded and not used. Fill the reservoir up to the “H” mark on the oil level gauge with Mobile DTE medium or equivalent. As the reservoir is being filled be sure that no contaminate enter into the tank.
10. Adjust the settings to match the recorded settings in step 5.
11. Press the “battery check” button. If the light does not come on then move memory power source switch to the “ON” position. This switch is located on the right side of the timer behind a rubber cover. If the check light still does not come on check the fuse.
12. The pressure is set by the manufacturer at 215 psi. Check that the oil comes out in a constant thin stream at the step chain by pressing the pump test button. If it is dripping, raise the pressure by turning the pressure-adjusting valve with a screw driver. *(See Figure 4-50 Lubrication Removal and Replacement for illustration.)*
Figure 4-50 Lubricator Removal and Replacement
4.12 Newel Ends Maintenance, Removal and Replacement

The following instructions will guide the worker in the maintenance, removal and replacement of the newel ends.

4.12.1 Newel End Maintenance

The following instructions will guide the worker through the maintenance of the newel end.

1. While the escalator is running, listen carefully for any peculiar noise coming from the newel area. Any growling or scraping sound investigate immediately.

2. Clean debris from around the handrail guide area.

3. Remove the handrail from the newel and inspect the handrail guides and newel roller. Clean any debris from them.

4. Insure that the newel roller moves freely and does not rub against the newel molding or frame work.

4.12.2 Newel End Removal and Replacement.

The following instructions will guide the worker through the removal and replacement of the newel ends.

1. Remove the landing plates where the newel will be removed. See paragraph 4.1 for removal and replacement.

2. Remove the newel interior panel. (See paragraph 4.4 for removal and replacement information.)

3. Remove five or six steps for clear access to skirt panels in the newel area. See paragraph 4.2 for removal and replacement information.

4. Remove skirt panels at the newel area. See paragraph 4.5 for removal and replacement information.

5. Turn the main power off. Lockout/Tag-out applies.

6. Remove the fault indicator.

7. Disconnect the operation panel and E-stop in the newel that these are mounted on. Be sure to remove the conduit from it.

8. Remove the handrail from around the newel. See paragraph 4.16 for removal and replacement.

9. Disconnect the A-Molding from the newel molding and the newel sheave frame.

10. Remove the four mounting bolts that mount the newel frame to the truss and remove newel from the truss.

11. To reinstall follow the removal directions in reverse. (See Figure 4-51 Newel End Assembly for illustration.)
Figure 4-51 Newel End Assembly
4.13 Safety Switches Testing, Adjustment, Removal and Replacement

This portion of section 4 covers the maintenance, adjustment and replacement procedures for safety switches. All of the safety switches are wired normally closed and open only when triggered.

Note part numbers and label wires to make installation easier.

When testing the safety switches the LEDs mounted on the fault panel located in the newel section will illuminate. Each LED has a specific fault that it represents see figure 2-25 for further information.

For Safety Switch locations see Figure 4-52 Safety Device Locations.
Figure 4-52 Safety Device Locations
4.13.1 Broken Drive Chain Device Testing and Adjustment
See the pawl brake system for testing and adjustments of the broken drive chain device.

4.13.2 Broken Drive Chain Device Removal and Replacement
The following instructions will guide the worker through the removal and replacement of the broken drive chain device. Lock-out/Tag-out rules apply.

Turn off the main power and Lockout/Tag-out the system.

1. Remove the upper truss landing plates. See paragraph 4.1 for removal and replacement directions.

2. Locate the pawl brake trigger box. This should be located on the right side of the truss just in front of the main drive. The pawl brake is directly under the box.

3. Open the trigger box and locate the lock block. This should be the block sits between the lock lever and the idler. With one hand hold the pawl in position and with the other lift the lock block. The moment that the lock block clears the lock lever the pawl will be released. Carefully allow the pawl to settle into position.

4. Locate the limit switch that the pawl triggers. It should be just below the pawl weight. This is the broken chain device switch.

5. Disconnect the wiring and the conduit from the switch.

6. Remove the limit switch mounting screws. In addition, remove the switch.

7. To reinstall follow the removal directions in reverse. (See Figure 4-53 Broken Drive Chain Device for illustration.)
Figure 4-53 Broken Drive Chain Device
4.13.3 Broken Step Chain Device Testing and Adjustment

The following instructions will guide the worker through the testing and adjustment of the broken step chain device.

1. Remove the lower truss landing plates to gain access to the lower pit and connect the maintenance pendant. See paragraph 4.1.2.3 for landing plate removal and replacement.

2. Locate the broken step chain devices and inspect the switches and wiring.

3. Push the plunger up until the switch trips. There should be an audible clicking noise from the switch actuating.

4. Verify that the switch is tripped by the LED on the newel fault panel or on the fault finder in the machine room.

5. Reset the device by pressing the reset button on the maintenance pendant.

6. Verify that the plunger wheel is centered in the kicker. If the switch is not centered loosen the lock nut and move the kicker center of the switch.

7. When finished with all inspection remove maintenance pendant and replace landing plates.

4.13.4 Broken Step Chain Device Removal and Replacement

The following Instruction will guide the worker through the removal and replacement of the broken Step chain device switch. Lock-out/Tag-out rules apply.

Turn off the main power and Lockout/Tag-out the system.

1. Remove the lower truss landing plates. See paragraph 4.1 for removal and replacement directions.

2. The broken step chain switches are located on both sides of the tension carriage.

3. Disconnect the wiring and conduit from each switch.

4. Remove the two pan head screws and nuts to remove the switch from the bracket.

5. To reinstall follow removal directions in reverse. (See Figure 4-54 Broken Step Chain Device for illustration.)
4.13.5 Skirt Obstruction Device Testing and Adjustment

The following instructions will guide the worker through the testing and adjustment of the skirt obstruction devices.

1. Remove the landing plates at either the upper or lower truss depending on device location. A minimum number of panels need to be removed. Only the maintenance pendant is required to be connected to the service box.

2. Measure the force it takes to actuate the skirt switch by using a spring scale.

3. Place the spring scale on the skirt pane at the switch location. The standard tripping force should be between 90 and 130 pounds.

4. To adjust the device the interior panel adjacent to the skirt switch will need to be removed. See paragraph 4.4.2.

5. Loosen the mounting screws on the switch and move towards or away from the skirt panel. Moving the switch away will increase the amount of force needed to trigger the switch. Moving the switch towards the panel will decrease the amount of force required.

6. Check the device for broken wires or other damage.

7. Verify the device is working by visually identifying that LED #3 on the newel fault panel is illuminated.

8. When task is complete remove maintenance pendant and replace landing plates.

4.13.6 Skirt Obstruction Device Removal and Replacement

The following instructions will guide the worker through the removal and replacement of the skirt obstruction switches. Lock-out/Tag-out rules apply.

1. Turn off main power and Lockout/Tag-out the system.

2. Remove the interior panel above the switch to be replaced. See paragraph 4.4 for removal and replacement. Also, see figure 1-15 to help locate approximate location of obstruction switch.

3. Remove the mounting screws that hold the switch to the bracket.

4. Disconnect the wiring and conduit from switch.

5. To reinstall switch follow directions in reverse order.

6. Adjust the switch so that the plunger just touches the skirt and tighten down. (See Figure 4-55 Skirt Obstruction Device for illustration.)
Skirt Panel

Switch Mounting Bolt & Nut (M6)

Swing Switch

DETAIL Y Mounting Hardware Inside Skirt Switch

Figure 4-55 Skirt Obstruction Device
4.13.7 Step Level Device Testing and Adjustment

The following instructions will guide the worker through the testing and adjustment of the step level device.

1. Remove the landing plates at the lower truss section and attach the maintenance pendant. See paragraph 4.1.2.3 for landing plate removal and replacement.

2. Remove one step and move the opening to the step level device that is to be checked. Adjust the step position so that the gap between the riser and the switch is easy to measure.

3. The gap measurement should be 3/32 inch. Adjust if needed.

4. Trip the switch to verify that the fault indicator on the newel fault panel illuminates and that the escalator will not start.

5. Reset the master reset on either the maintenance pendant or the controller.

6. Replace the step and landing plates. Remember to remove the maintenance pendant before replacing the landing plates.

4.13.8 Step Level Device Removal and Replacement

The following instructions will guide the worker through the removal and replacement of the step level switch. Lock-out/Tag-out rules apply.

1. Remove the upper or lower truss landing plates. See paragraph 4.1 for removal and replacement information. In addition, attach the maintenance pendant to the service box.

2. Remove two steps. See paragraph 4.2 for removal and replacement information.

3. Move the missing step section to the location of the switch to be replaced. This is to be done with the use of the maintenance pendant.

4. Once the opening is in the correct location turn off the main power and tag-out/lock-out the system.

5. Remove four M5 pan head screws and nuts to remove switch from bracket.

6. Disconnect the wiring and conduit from the switch.

7. To reinstall follow the removal directions in reverse order. (See Figure 4-56 Upper Step Level Device, Figure 4-57 Lower Step Level Device for illustration.)
NOTE:
1. THE CENTER OF THE ROLLER ACTUATOR MOUNTED ON THE
   SWITCH SHOULD BE LOCATED
   AT THE POINT SPECIFIED WITH DIMENSIONS FROM E.P. POINT
2. SWITCH SHOULD TIP AT 2º WHEN RISER OR STEP AXLE
   DROPS 5 [120] FROM LEVEL
3. INSTALL CONDUIT & FITTINGS PER JOB SPEC. WIRE PER JOB WIRING DIAGRAM.

Figure 4-56 Upper Step Level Device
NOTE:
1. THE CENTER OF THE ROLLER ACTUATOR MOUNTED ON THE SWITCH SHOULD BE LOCATED AT THE POINT SPECIFIED WITH DIMENSIONS FROM S.P. POINT.
2. SWITCH SHOULD TRIP AT 25° WHEN RISER OR STEP AXLE DROPS 5 [.20] FROM LEVEL.
3. INSTALL CONDUIT & FITTINGS PER JOB SPEC. WIRE PER JOB WIRING DIAGRAM.

Figure 4-57 Lower Step Level Device
4.13.9 Step Up-thrust Testing and Adjustment

The following instructions will guide the worker through the testing and adjustment procedures.

1. Remove the landing plates at either the upper or lower truss and attach the maintenance pendant. Just remove the landing plates needed to access the service box. See paragraph 4.1.2.3 for landing plate removal or replacement.

2. Run the escalator at inspection speed in the direction indicated in Figure 4-58 Up-thrust Test illustration.

3. Grip the riser edge with pliers near the comb fingers with the escalator moving away from the combplate.

4. Hold onto the handrail with the other hand and lift the riser as it begins it transition from the flat level position to the incline at either end.

5. Verify that the switch stops the escalator and that the LED illuminates in the fault finders at either end of the escalator.

6. If the escalator does not stop the switch is out of adjustment. The clearance between the step yoke and the switch roller lever should be ¼ inch.

7. Reset the fault and unplug the maintenance pendant.

8. Replace the landing plates.
4.13.10 Step Up-thrust Device Removal and Replacement

The following instructions will guide the worker through the removal and replacement of the step up-thrust device. Lock-out/Tag-out rules apply.

1. Remove upper or lower landing plates. See paragraph 4.1 for removal and replacement information. In addition, be sure to attach the maintenance pendant to the service box.

2. Remove two steps. See paragraph 4.2 for removal and replacement information.

3. Move missing step section to the step up-thrust device switch to be replaced. The Up-Thrust devices are located on the lower B track or upper B track.

4. Turn off the main power and Lock-out/Tag-out the system.

5. Remove the switch by removing two screws and nuts from bracket connected to the step wheel track.

6. Disconnect wiring from the switch.

7. Replace the step safety switch in the reverse order of removal. (See Figure 4-59 Step Up-thrust Device for illustration.)
Figure 4-59 Step Up-thrust Device

Notes:
1. Switches are located on LH and RH sides of truss.
2. Make sure the roller lever rotates parallel to the track face to prevent damage.
3. Install conduit & fittings per job spec. wire per job wiring diagram.
4. Verify that when step is moved up and down to the switch, it can activate the switch.
5. Confirm the switch cuts power to the escalator when activated.
4.13.11 Missing Step Device Testing and Adjustment

The following instructions will guide the worker through the testing and adjustments of the missing step device.

1. Remove the landing plates at the lower truss. Do not attach the maintenance pendant. See paragraph 4.1.2.3 for landing plate removal and replacement.

2. Remove 1 step. See paragraph 4.2.2 for step removal and replacement.

3. Run the escalator at normal speed and verify that the escalator stops when the missing step section reaches the proximity sensor.

4. Try to restart the escalator it should not start until the controller is reset. This will have to be done at the controller.

5. If the escalator does not stop check the missing step switch to insure that there is no metal on or near the device, such as, metal shavings that may come from the step chain or step. Be sure that there is nothing on or near the sensor that might hamper its operation. Wipe with a clean dry cloth.

6. An LED that is built into the sensor is will be on when electricity (24V AC) is being sent to it.

7. Replace the step and landing plates. Be sure to reset the escalator at the controller.

4.13.12 Missing Step Device Removal and Replacement

The following instructions will guide the worker through the removal and replacement of the missing step device. Lock-out/Tag-out rules apply.

1. Remove upper or lower landing plates as needed. See paragraph 4.1 for removal and replacement information. In addition, be sure to attach the maintenance pendant to the service box.

2. Remove three steps. See paragraph 4.2 for removal and replacement information.

3. Move missing step section to the upper or lower end, whichever end is to be worked on, and make sure that the missing step device can be accessed.

4. Turn off the main power and Lock-out/Tag-out the system.

5. Disconnect wiring and conduit from switch.

6. Remove missing step device by removing four screws and nuts.

7. Replace missing step device in the reverse order of removal. (See Figure 4-60 Missing Step Device for illustration.)
Figure 4-60 Missing Step Device
4.13.13 Broken Handrail Device Testing and Adjustment

The following instructions will guide the worker through the testing and adjustment of the broken handrail device.

1. Remove the interior panel that is adjacent to the broken handrail switch. See paragraph 4.4.2 for interior panel removal and replacement.
2. Verify the switch works by moving the handrail aside and allowing the device to drop and actuate the switch.
3. Verify that the LED #8 in the newel fault finder is illuminated.
4. If the switch did not activate a fault check the wiring for brakes or cuts.
5. Check the switch, there should be an audible click. If not Replace the switch.

4.13.14 Broken Handrail Device Removal and Replacement

The following instructions will guide the worker through the removal and replacement of the broken handrail device. Lock-out/Tag-out rules apply.

1. Remove upper landing plates. See paragraph 4.1 for removal and replacement information. In addition, be sure to attach the maintenance pendant to the service box.
2. Remove two or three steps. See paragraph 4.2 for removal and replacement information.
3. Move missing step section to access the broken handrail device with the use of the maintenance pendant.
4. Remove the skirt panel adjacent to the switch to be replaced. See paragraph 4.5 for removal and replacement information.
5. Turn off the main power and Lock-out/tag-out the system.
6. Remove two screws and nuts to remove the broken handrail switch.
7. Disconnect wiring and conduit from the switch.
8. Remove two bolts and nuts from the hinged bracket to remove roller assembly.
9. Replace the broken handrail device in the reverse order of removal.. (See Figure 4-61 Broken Handrail Device for illustration.)
ADJUSTMENT OF THE SWITCH

1. ADJUST THE SWITCH WITH BOLTS "A" & "B" SO THAT ROLLER CENTER IS ON THE HANDRAIL CENTER IN ESC. WIDTHWISE DIRECTION, AND VERTICAL DIRECTION.

2. CONFIRM THE SWITCH OPERATES WHEN ROLLER FALLS WITHOUT HANDRAIL. MAKE SURE ROLLER BRACKET MAKES CONTACT WITH SWITCH BRACKET BEFORE TOTAL TRAVEL IS REACHED TO PREVENT DAMAGING THE SWITCH.

3. ROLLER SHALL BE BOUND THROUGH TRANSPORTATION.

4. SWITCHES ARE LOCATED ON LH & RH SIDES OF TRUSS.

Figure 4-61 Broken Handrail Device
4.13.15 Handrail Speed Device Testing and Adjustment

The following instructions will guide the worker through the testing and adjustment of the handrail speed device.

1. Remove the interior panel adjacent to the handrail speed device. See paragraph 4.1.2.3 for interior panel removal and replacement.
2. Check the magnetic plate to insure there is no damage and that it moves with the handrail.
3. Run the escalator and check in side the enclosure for the fault finder/remote monitoring. The LED that is located on the high speed counter card should flash as the pulser disk rotates. These LEDs are marked in conjunction with the terminals that the sensor is wired to. These LED numbers are 0 and 2 on the High Speed Counter Module.
4. Check condition of the wiring and take required action as needed.

4.13.16 Handrail Speed Device Removal and Replacement

The following instructions will guide the worker through the removal and replacement of the handrail speed device. Lock-out/Tag-out rules apply.

1. Turn main power off and lockout/tag-out the system.
2. Remove interior panel above the handrail speed device. For approximate location see figure 4-18. See paragraph 4.4 for removal and replacement instructions.
3. Remove lock nut from digital sensor device and remove sensor from bracket.
4. Disconnect wiring at the junction box.
5. Remove machine screw from pulsar disc.
6. Replace handrail speed device in reverse order, be sure to apply locktite type compound to screw. (See Figure 4-62 Handrail Speed Device for illustration.)
2.) THE DESIGN INTENT OF THE HR SPEED DEVICE IS TO OPEN CIRCUIT BASED ON SPECIFIED UPPER AND LOWER SET POINTS. (APPROX. NOMINAL RATED SPEED: ±5 PERCENT)

- UPPER SET POINT: 77
- LOWER SET POINT: 70 (SET AT SPEED SWITCH IN THE CONTROLLER)

1.) THE DISTANCE FROM SENSING HEAD TO PULSER DISK SHOULD STAY WITHIN INDICATED TOLERANCE THROUGH 360° REVOLUTION.

3.) INSTALL CONDUITS AND FITTINGS PER JOB WIRING DIAGRAM.

Figure 4-62 Handrail Speed Device
4.13.17 Handrail Entry Device Testing and Inspection

The following instructions will guide the worker though the testing and adjustment of the handrail entry device.

1. Push the rubber guard using a spring scale and verify that it requires 7 to 13 pounds to trip the switch.
2. If the force is too large, then reduce spring force by loosening the “A” screw.
3. If the force is not enough then increase the spring force by tightening the “A” screw.
4. Retest the switch.
5. Check the vertical and horizontal clearances between the handrail and guard rubber. Adjust if needed.

4.13.18 Handrail Entry Device Removal and Replacement.

The following instructions will guide the worker through the removal and replacement of the Handrail Entry Device. Lockout/Tag-out applies.

1. Turn off the main power and Lock-out/Tag-out the system.
2. Remove the four screws that hold the rubber guard in position. Be sure to put the screws in a secure place. There are also springs with the screws. Then remove the guard rubber from around the handrail. The rubber guard is C-shaped and flexible.
3. Remove the guard bracket. There are four mounting screws. Be sure to put the screws in a secure place.
4. Disconnect the wiring from the switches.
5. To reinstall follow the directions in reverse order. (See Figure 4-63 Handrail Entry Device for illustration).
Figure 4-63 Handrail Entry Device
4.13.19  Fault Indicator Panel Removal and Replacement

The following instructions will guide the worker through the removal and replacement of the fault indicator panel. Lock-out/Tag-out rules apply.

1. Turn main power off and lockout/tag-out the system.
2. Remove newel interior panel. (See paragraph 4.4.)
3. Remove Handrail entry device. Do NOT disconnect any wiring. (See paragraph 4.6.)
4. Remove Newel skirt. (See paragraph 4.5.)
5. Remove mounting nuts to remove indicator from skirt when necessary.
6. Remove conduit and wiring.
   - Be sure that the wires are marked for proper rewiring when reinstalling the indicator panel.
7. To reinstall, follow the removal directions in reverse order.
4.14 Controller Repair on site

This portion of section 4 covers the replacement procedures for components that are part of the Controller. At any time that work is being done to the controller all power should be shut off. Lock-out/Tag-out should be strictly enforced. For component locations see Figure 4-64 Controller Panel Location, Figure 4-65 Controller Panel Layout San Bruno and So. San Francisco Figure 4-66 Control Panel Layout for Millbrae Figure 4-67 Fault Finder & Remote Monitoring Panel Layout.
Figure 4-65 Controller Panel Layout San Bruno and So. San Francisco
Figure 4-66  Control Panel Layout for Millbrae
4.14.1  Toggle Switch Removal and Replacement
The following instruction will guide the worker through the removal and replacement of the toggle switch.

1. Orient the replacement switch in the same direction as the faulty switch.
2. Remove one wire at a time placing the removed wire on the new switch.
3. Remove the waterproof cap from the faulty switch and replace with the new toggle switch.

4.14.2  Breaker Removal and Replacement
The following instruction will guide the worker through the removal and replacement of the breakers.

1. Label each wire on the breaker with some means of individual identification.
2. Remove two screws and the wiring.
3. Remove the faulty breaker and replace with a new one.
4. Mount the breaker and rewire as marked.

4.14.3  Circuit Breaker Removal and Replacement
The following instruction will guide the worker through the removal and replacement of the circuit breakers.

1. Firmly grasp the top and bottom sides of the breaker and pull straight out.
2. Plug in the new breaker by aligning the pins. Push the breaker into place until you feel it “pop”.

4.14.4  Contactor Removal and Replacement
The following instruction will guide the worker through the removal and replacement of the contactor.

1. Label each wire on the contactor with some means of individual identification.
2. Remove the wiring and two mounting screws.
3. Remove the faulty contactor and replace with a new one.
4. Mount the contactor with the two screws and rewire as marked.
4.14.5 Diode Removal and Replacement
The following instruction will guide the worker through the removal and replacement of the diode.

1. Remove solder along the axial leads of the diode.
2. Replace with new diode making sure the orientation is the same as the one removed and solder the leads back to the terminal.

4.14.6 Diode Bridge Removal and Replacement
The following instruction will guide the worker through the removal and replacement of the Diode Bridge.

1. Label each wire on the Diode Bridge with some means of individual identification.
2. Remove the solder from each diode leg.
3. Replace the faulty Diode Bridge with a new one making sure of correct orientation.
4. Solder the wire back to the diode legs as marked.

4.14.7 Data Filter Removal and Replacement
The following instruction will guide the worker through the removal and replacement of the Data Filter.

1. Trace the wires from the Data Filter to its termination.
2. Label each wire with some means of individual identification.
3. While removing the wire, note how many turns each wire passes through the filter.
4. After removing all wires, remove the two crews and remove the old filter and replace with a new one.
5. Run the wire through the filter making the same amount of turns as originally and terminate to its respected termination.

4.14.8 Fuse Removal and Replacement
The following instruction will guide the worker through the removal and replacement of the fuse.

1. Clamp the fuse with the “fuse puller” and pull directly out.
2. Align the new fuse in the fuse holder and push straight in until you feel it seat.
4.14.9 Lamp Removal and Replacement
The following instruction will guide the worker through the removal and replacement of the lamp.
   1. To remove the lamp first remove the bezel by turn it counterclockwise.
   2. Remove the lens, then firmly grasp the bulb with and turn counterclockwise.
   3. To replace the bulb follow the directions in reverse order.

4.14.10 LED Removal and Replacement
The following instruction will guide the worker through the removal and replacement of the lamp.
   1. Remove the solder on wire leads.
   2. Turn the bezel counterclockwise and remove LED
   3. Replace with new LED and solder wires back to LED terminals.

4.14.11 PCB Relay Removal and Replacement
The following instruction will guide the worker through the removal and replacement of the PCB Relay.
   1. Label each wire with some means of individual identification.
   2. Remove the four screws that hold the relay in place.
   3. Replace with new PCB and place wires back in terminals.

4.14.12 Push Button Removal and Replacement
The following instruction will guide the worker through the removal and replacement of the push button.
   1. Remove the wires on the button terminals and place on the new button one at a time, putting them in the identical places.
   2. Remove the bezel by turning it counterclockwise and remove the push button.
   3. Place the new push button in and tighten the bezel by turning it clockwise on the button.
4.14.13 Relay Cube Removal and Replacement

The following instruction will guide the worker through the removal and replacement of the relay cube.

1. Snap off the two clips that hold the relay cube in place.
2. Pull the relay straight out.
3. Align the new relay with the base. Be sure that the keyed center pin is aligned.
4. Plug the relay cube in by pushing firmly, the cube, into the holder and snap the clips back into place.

4.14.14 Relay Over-Current Removal and Replacement

The following instruction will guide the worker through the removal and replacement of the over-current relay.

1. Label each wire with some means of individual identification.
2. Remove the two screws that mount the relay in place.
3. Replace with the new relay.
4. Replace the wires back on the relay.

4.14.15 Relay SH-4Z/168 Removal and Replacement

The following instruction will guide the worker through the removal and replacement of the relay SH-4Z/168.

Label each wire with some means of individual identification.
Remove the two screws that mount the old relay in place.
Replace the wires on the new relay.

4.14.16 Timer Relay Removal and Replacement

The following instruction will guide the worker through the removal and replacement of the timer relay.

1. Snap off the two clips that hold the relay in place.
2. Pull the relay straight out, and align the new relay with the socket. Be sure that the key center pin is aligned properly.
3. Firmly push the relay back into the base and snap the clips back into position.
4.14.17 Terminal Blocks Removal and Replacement

The following instructions will guide the worker through the removal and replacement of the terminal blocks.

1. Label each wire with some means of individual identification and remove the wires.
2. Remove the two screws that mount the old terminal block in place and replace with the new one.
3. Replace the wire back into there terminals and tighten.

4.14.18 Transformer Removal and Replacement

The following instructions will guide the worker through the removal and replacement of the transformer.

1. Label each wire with some means of individual identification and remove from the faulty transformer.
2. Remove the four mounting screws and remove the faulty transformer.
3. Using the same screws mount the new transformer in place.
4. Replace the wires back into there appropriate terminals and tighten.

4.14.19 Voltage Sensor Removal and Replacement

The following instructions will guide the worker through the removal and replacement of the voltage sensor.

1. Snap off the two mounting clips and remove the faulty voltage sensor.
2. Pull the sensor straight out of its base and align the new one into position.
3. Firmly push the new voltage sensor into the socket and replace the clips.

4.14.20 Voltage Supply Removal and Replacement

The following instructions will guide the worker through the removal and replacement of the voltage supply.

Label each wire with some means of individual identification and remove the wiring for the voltage supply.

Remove the two mounting screws and remove the faulty voltage supply. Using the same screws mount the new one.

Replace the wires to there proper terminals and tighten.
4.14.21 Foreign Voltage Relay

This portion of this section covers the replacement procedures for components that are part of the Foreign Voltage Relay. At any time that work is being done to the Foreign Voltage Relay all power should be shut off! Lockout/Tag-out should be strictly enforced. For component locations see Figure 4-65.

4.14.22 Relay SC-4-0

The following instructions will guide the worker through the removal and replacement of the relay.

1. Label each wire with some means of individual identification and remove from relay.
2. Remove the two mounting screws the hold the old relay in place, and replace with the new relay.
3. Replace the wires to there proper terminals and tighten.

## Lubricant Schedule

<table>
<thead>
<tr>
<th>Component</th>
<th>Lubricant</th>
<th>Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Gear Box</td>
<td>Mobil Glygoyle 30</td>
<td>Semi-Annually</td>
</tr>
<tr>
<td>Motor Bearings</td>
<td>Shell Doliun R or Chevron SR1</td>
<td>Annually</td>
</tr>
<tr>
<td>Handrail Drive Bearings</td>
<td>Mobilith AW2 (green)</td>
<td>Annually</td>
</tr>
<tr>
<td>Tension Carriage Bearings</td>
<td>Mobilith AW2 (green)</td>
<td>Annually</td>
</tr>
<tr>
<td>Main Drive Shaft Bearings</td>
<td>Mobilith AW2 (green)</td>
<td>Annually</td>
</tr>
<tr>
<td>Newel Sheave Bearings</td>
<td>Mobilith AW2 (green)</td>
<td>Annually</td>
</tr>
<tr>
<td>Step Chain</td>
<td>Mobil DTE Medium</td>
<td>Daily (automatic)</td>
</tr>
<tr>
<td>Main Drive Chain</td>
<td>Mobil DTE Medium</td>
<td>Daily (automatic)</td>
</tr>
<tr>
<td>Handrail Drive Chain</td>
<td>Mobil DTE Medium</td>
<td>Daily (automatic)</td>
</tr>
<tr>
<td>Step Axle Sleeves</td>
<td>Mobil RP 501</td>
<td>Quarterly</td>
</tr>
<tr>
<td>Step Chain Wheel Guide Shoe</td>
<td>Mobilith AW2</td>
<td>Quarterly</td>
</tr>
</tbody>
</table>

Figure 4-68 Lubricant Schedule