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Elevator & Escalator Technical Forum
Working Group

Heavy-Duty Escalator Design Guidelines

Abstract: This *Recommended Practice* contains guidelines for transit systems to use to specify heavy-duty escalators for use in a transit environment.

Keywords: escalators, heavy-duty escalators, transit escalators

Summary: This design guideline is the result of the combined efforts of the members of the APTA Elevator and Escalator Technical Forum over the past several years. The objective is to address the specific heavy-duty escalator needs of North American transportation systems. It is intended as a guideline of technical provisions for the design and construction of escalators that can provide safe, reliable service in the harsh, heavy-usage, high-abuse environment of transportation systems. Membership of the Technical Forum includes transportation systems, consultants and escalator/component manufacturers.

Scope and purpose: This design guideline is not intended to be a 100 percent ready technical specification for all transportation systems. Transit agencies may find it necessary to make changes to suit their specific needs. However, the stringent provisions are the result of the members' combined experiences and, in general, reflect transportation requirements and the need for improved safety and reliability. There are also notes and comments in the text to guide the user in preparation of a procurement specification document.

This document represents a common viewpoint of those parties concerned with its provisions, namely operating/planning agencies, manufacturers, consultants, engineers and general interest groups. The application of any standards, recommended practices or guidelines contained herein is voluntary. In some cases, federal and/or state regulations govern portions of a transit system's operations. In those cases, the government regulations take precedence over this standard. The North American Transit Services Association (NATSA) and its parent organization APTA recognize that for certain applications, the standards or practices, as implemented by individual agencies, may be either more or less restrictive than those given in this document.

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Introduction

This introduction is not part of APTA RT-EE-RP-001-02, Rev. 3, Heavy-Duty Escalator Design Guidelines.

This design guideline is the result of the combined efforts of the members of the APTA Elevator and Escalator Technical Forum and its Working Group over the past several years. The objective is to address the specific heavy-duty escalator needs of North American transportation systems. It is intended as a guideline of technical provisions for the design and construction of escalators which can provide safe, reliable service in the harsh, heavy usage, high abuse environment of transportation systems. Membership of the Technical Forum and its Working Group includes transportation systems, consultants, and escalator/component manufacturers.

This design guideline is not intended to be a 100 percent technical specification for all transportation systems. Each Owner may find it necessary to make changes to suit their specific needs. However, the stringent provisions are the result of the members combined experiences and, in general, reflect transportation requirements and the need for improved safety and reliability. There are also “comments” in the text to guide the user in preparation of a procurement specification document.

It is expected that some these requirements will “add to the cost of the procurement.” Past experience shows that there is a high life cycle maintenance cost associated with the manufacturer’s “standard” product when used in a transportation environment. Paying “more up front” will be more than compensated by the overall reduced life cycle costs. Most importantly, it will improve customer safety, satisfaction, and convenience. The results can only be an increase in the public’s confidence in a transportation system’s ability to meet their needs, and thus, an increase in ridership.

Heavy-Duty Escalator Design Guidelines

1. General conditions

NOTE TO SPECIFIER: Clear instructions must be defined in the general terms and conditions relating to the installer being ready for the inspection, as well as the Owner being ready for items such as emergency power testing, fire alarm and smoke detector testing and communications. Special consideration should be given to AHJ lead times to schedule acceptance tests.

This section specifies requirements for design, fabrication, installation and testing of heavy-duty escalators. Language from this design guideline may be incorporated directly into the technical specification in order to be binding. In the event of a conflict between any APTA referenced standards or recommended practices and the agency's specification, the agency's technical specification should prevail.

1.1 Applicable codes, standards and publications

Escalator design, materials, construction clearances, workmanship and test should conform to the requirements of the codes and regulations and should be listed. Any additional requirements imposed by local agencies should be incorporated into the escalator design specifications.

1.2. Temporary and permanent electrical power services

- A. Temporary power for installation should be made available to the Installer at the time of the installation. Permanent power should be made available for testing. All power should be provided at no cost to the Installer.
- B. For the escalator drive systems: 208, 220 or 480 V, three-phase, three-wire, 60 Hz terminating in a disconnect switch within sight of the controller. Coordination is required between the electrical contractor and escalator contractor.
- C. For lighting and ground fault circuit interrupter (GFCI) receptacles: 120 V, one-phase, three-wire, 60 Hz terminating at the escalator controller location.
- D. Separate disconnect for balustrade lighting, comb plate heater and pit/truss heaters.

1.3. Submittals

- A. Product data:
Submit manufacturer's product data within four weeks of Notice to Proceed (NTP) for each system proposed for use. Include as a minimum the following:
 - 1. Electrical characteristics and connection requirements.
 - 2. Expected heat dissipation of escalator equipment in controller room. BTU based on twenty-four (24) hours per day, seven (7) days per week.
 - 3. Direction of travel shall be considered as either direction, or the unit shall be up and down reversible.
- B. Maintenance programs:
Within 60 days after NTP, and prior to installation, the Contractor should submit detailed interim and revenue service maintenance programs, showing functions to be performed and their scheduled frequency.

- D. Coordinated delivery schedule.
- D. Manufacturer's recommended preventive maintenance plan, including interim maintenance procedures where applicable.
- E. Pre-acceptance test forms.
- F. Shop drawings:
Submit six (6) copies of approval layouts to scale and complete in their entirety. Shop drawings should be in Metric and Imperial Measurements. Drawings should be submitted for each escalator and should include but not limited to the following:
 - i) Facsimile outline of escalator truss in profile and plan
 - ii) Facsimile elevation of escalator balustrade
 - iii) Vertical section through balustrade
 - iv) Truss midway between working points
 - v) Escalator data includes escalator types, load and electrical data

NOTE TO SPECIFIER: Determine whether shop drawings should be on paper or in a digital format acceptable to the Client.

- G. Scale drawings:

NOTE TO SPECIFIER: Scaled drawings should show all relevant structural elements.

Scaled drawings should show detail drawings for each escalator type and should include but not limited to the following:

1. Truss stanchion
2. Track system and supports
3. Drive system
4. Step nosing radius at upper and lower ends
5. Drive chains and gear train
6. Step chain or step links (including chain pitch, step and trailer wheels)
7. Step assembly (including axle, step tread, frame and riser)
8. Handrail system (including profile, guides, drive and tension device)
9. Support details (including upper, lower, intermediate and slip joint), balustrade deck cover, interior panels, skirt panels and their moldings
10. Safety switches and operating devices
11. Motor and emergency brakes
12. Floor plates
13. Speed encoder
14. Metal gauges
15. Radial, vertical and horizontal dimensions required for manufacture, and positions of lower and upper working points
16. Attachment of truss to structure
17. Major mechanical and electrical components within truss
18. Drainage and electrical interfaces
19. Ceiling intersection guards
20. Passenger instruction signs
21. Emergency stop button
22. Operating panel in upper and lower balustrades (including stop button, start and direction selection switches, and fault finder receptacle)
23. All bearing ratings, identification and catalog numbers should be provided.

24. Complete schematic diagram should be provided for the controller and all electrical devices and a detailed drawing depicting the controller component layout and component identification
25. Coordinated machine/controller room layout drawing
26. Test certificates for step chain should be provided for approval
27. Test certificates for step assemblies shall be provided for approval
28. Test certificate for step fatigue test

H. As-built drawings should as a minimum show the following:

NOTE TO SPECIFIER: The contract should identify a specific time frame within the contract limits for the contractor to supply the required as-built drawings for each individual unit.

1. Truss stanchion
 2. Track system and supports
 3. Drive system
 4. Step nosing radius at upper and lower ends
 5. Drive chains and gear train
 6. Step chain or step links (including chain pitch, step and trailer wheels)
 7. Step assembly (including axle, step tread, frame and riser)
 8. Handrail system (including profile, guides, drive and tension device)
 9. Support details (including upper, lower, intermediate and slip joint), balustrade deck cover, interior panels, skirt panels and their moldings
 10. Safety switches and operating devices
 11. Motor and emergency brakes
 12. Floor plates
 13. Speed encoder
 14. Metal gauges
 15. Radial, vertical and horizontal dimensions required for manufacture, and positions of lower and upper working points
 16. Attachment of truss to structure
 17. Major mechanical and electrical components within truss
 18. Drainage and electrical interfaces
 19. Ceiling intersection guards
 20. Passenger instruction signs
 21. Emergency stop button
 22. Operating panel in upper and lower balustrades (including stop button, start and direction selection switches, and fault finder receptacle)
- I. Maintenance programs
1. Prior to installation, installer should submit detailed interim and revenue service maintenance programs, showing functions to be performed and their scheduled frequency.
 2. Where applicable, part of the submittal package shall include a maintenance control plan.

1.4. Operating and maintenance manuals

NOTE: Due to the critical nature of Operations and Maintenance (O&M) Manuals, it is recommended that this item be itemized in the project schedule of values.

- A. Prior to installation, the Installer should submit three preliminary sets of operation and maintenance (O&M) manuals for approval six weeks after NTP. After Owner approval and prior to the beginning of acceptance testing, one set of the approved manuals should be provided by the

Installer as well as one copy in an electronic format approved by the Owner. After approval and substantial completion, the final manuals are due no more than 30 days after any punch list items are completed.

The manuals should include the following:

1. Complete table of contents
2. Complete instructions regarding operation and maintenance of equipment including disassembly and assembly of drive system, handrail drive assembly and track system. Included will be complete illustrated, exploded views of all assemblies and a complete, illustrated, exploded view for identifying all system parts.
3. Complete nomenclature, lead time and location of replaceable parts, OEM and installer part numbers, current cost, and source. If the product source is another vendor, the Installer/Contractor should include the name and address of the other vendor.
4. Approved preventive maintenance plan and schedule.
5. Descriptions and locations of safety devices.
6. Safety rules, tests and procedures, including testing of all systems and subsystems.
7. Procedures for adjusting brake, handrail tension, handrail chain drive tension, step chain tension, track system, and mechanical components, including pictorials.
8. Instructions for removing floorplate, replacing comb segments, and removing and installing steps and interior panels.
9. Troubleshooting techniques and flow charts for all systems.
10. Detailed lubrication and cleaning schedule indicating weekly, monthly, quarterly, semiannual and annual lubrication; and a description of each lubrication point, lubrication type and specification.
11. Provide (one) line diagrams that shows the utility power service to each disconnect switch.
12. Provide schematic control drawings and manuals and job specific software.
13. As-built drawings should include the following:
 - i) Control and schematic electrical wiring diagrams of the controller, including wiring of safety devices to connections with remote indication and control panels for each escalator and group of escalators.
 - ii) Electrical layout showing the placement of lighting, light switches, receptacles, light fixtures, disconnect switches, and convenience outlets in machinery and controller spaces and pits.
 - iii) Complete detailed drawings and wiring diagram of escalator fault-finding device and connection to annunciator panel.
 - iv) Electronic and hard copies of ladder diagrams, logic and program.

B. Certification

1. The OEM should provide to the Owner certification that the Owner of the escalator(s) should be provided with copies of all documents related to maintenance, safety, operations, design changes, modifications, retrofits, etc., that relate to any part, component, equipment, system, subsystem, or material and services applicable to the escalators(s) provided.
2. All of the above referenced should be provided by the Installer as it pertains to the original installation through the end of the warranty period.
3. The referenced material should be current and provided within 30 days of publication or internal distribution by the OEM. The material, even if labeled "PROPRIETARY," should be delivered to the Owner without prejudice or delay and at no additional cost. A direct line of communication should be established between the manufacturer and the owner/service provider for the transfer of all final documents after beneficial use has been established.

C. Electronic material

1. Provide all material in a digital format approved by the Owner.
- D. Safety data sheets (SDS) and product data sheets: SDS should be submitted with an index listing each product, along with the application method of the product, approximate quantity of product per escalator, and the component the product is applied to or associated with. The Contractor should allow six weeks for review of SDS by the Owner.

1.5. Training

NOTE TO SPECIFIER: Properties with a third-party maintenance contractor should not require as much time and training by the Contractor, and the time can be reduced to eight HOURS with special consideration to itemizing training on the project schedule of values. Owner-maintained Facilities may want to consider specifying a custom OEM training professional video specific to the equipment in this procurement.

- A. The Manufacturer and Installer should as a minimum:
 1. Provide a qualified trainer.
 2. The proposed training syllabus should be submitted for approval by the owner within sixty (60) days of the Notice to Proceed (NTP)
 3. Provide 40 hours of local training for the Owner and his representatives in the proper use, operations and daily maintenance of escalators. Review emergency provisions, including emergency access and procedures to be followed at the time of failure in operation and other building emergencies. Train the Owner's personnel in normal procedures to be followed in checking for sources of operational failures or malfunctions.
 4. This training will take place at the discretion of the owner at any time prior to expiration of warranty.
 5. Provide manuals for all material covered in the training program. This training will take place at the discretion of the Owner at any time prior to the end of the warranty period.
 6. (Optional) Provide a 60-minute (minimum) video or DVD describing and demonstrating daily maintenance, emergency procedures and troubleshooting techniques for electrical and mechanical failures and malfunctions

1.6. Quality assurance

NOTE TO SPECIFIER: It is recommended to tighten this part of the specification as much as job circumstances and local procurement regulations permit

- A. Escalator design, materials, construction clearances, workmanship and test should conform to the requirements of the codes and regulations LISTED IN Section 1.1 "Applicable codes, standards and publications". Any additional requirements imposed by local agencies should be incorporated into the escalator design specifications.
- B. Manufacturer: Provide escalators manufactured by a firm with a minimum of 10 years' experience in fabrication of heavy duty transit escalators.
- C. Installer: Lead mechanics should have a minimum of 10 years' experience in installation of heavy duty transit escalators. Documentation should be required to document this requirement.
- D. Ensure firms performing escalator work are member of the National Elevator Industry, Inc. (NEII), or the National Association of Elevator Contractors (NAEC) or as approved by the engineer.
- E. Regulatory requirements: Escalator system design and installation should comply with the latest version of ASME A17.1 in effect for this contract.

F. Permits and inspections: The Contractor is to provide licenses and permits and to perform required inspections and tests.

NOTE TO SPECIFIER: The following section may be appropriate in order to inspect and observe construction methods that would be difficult or impossible to observe after installation is complete.

G. Regulatory agencies: Escalator design, materials, construction clearances, workmanship and tests should conform to the requirements of the codes and regulations listed in Section 1.1, “Applicable codes, standards, organizations and publications”.

H. Dimensions: Each escalator should have a 40-in (1000 mm) or 32-in. (800 mm) nominal step width as specified and designed for a maximum of 30 degrees.

NOTE TO SPECIFIER: The ANSI A117.1 prohibits any new escalators with 24 in. nominal step width. however, when replacing an existing 24 in. nominal step width escalator, there may be certain structural limitations in an existing wellway or station that prohibits the installation of nominal step widths larger than 24 in. Also note that 40 in. nominal step widths are preferred to permit side by side travel.

I. Welding: Welding should be performed in accordance with the requirements of AWS or CWB. Welders should produce evidence of current certification by AWS or CWB.

J. Labeling: Every escalator controller should be clearly marked permanently on the controller with rated load and speed, manufacturer serial number, and the designated Owner identification.

K. Requirements of regulatory agencies.

1. The Contractor should obtain and pay for all necessary permits and perform such tests as may be required for acceptance and approval of escalator by jurisdictional agencies.
2. The Contractor should notify the proper inspectors to witness required testing.

L. (Optional) Factory visit

NOTE TO SPECIFIER: Not all escalator components are necessarily manufactured in the same location by the same manufacturer.

M. If the owner elects to send representatives for a factory visit, the contractor should provide access for up to three of the owner’s representatives to visit the factory where the escalator is being manufactured so that they may inspect, observe and test various operational.

N. Prior to the factory visit, the manufacturer should submit a factory test procedure that must be approved by the owner.

O. Engineer to observe escalator full function and witness correct operation.

P. Perform a full inventory of all parts and equipment required for the installation and testing of the escalator.

Q. The escalator should be tested with the controller to be shipped with the escalator. The Engineer should observe the steps and chain in operation and test selected devices.

R. The Installer should not ship the escalator without the approval of the owner after the conclusion of the factory visit.

1.7. Temporary use

- A. Should there be a requirement for the use of an escalator during construction, the Contractor should provide at his expense, required guards and protective barriers, power lights and any special labor related to such temporary service. The Contractor should also assume all charges connected with testing and maintenance required for temporary service.
- B. Restore all equipment to a “like new” condition at the Contractor’s expense prior to issuance of Certificate of Final Completion.

1.8. Delivery, storage and handling

- A. Should the building or the site not be prepared to receive the escalator equipment at the agreed-upon date, the Contractor will be responsible to provide a proper and suitable storage area on or off the worksite.
- B. Site storage shall be in area(s) designated by the Engineer. Do not unload or permit the storage of any part of the escalator to be unloaded with a weight that will endanger the safety of the structure.
- C. The complete escalator package should be delivered and stored in the project area.
- D. Store off ground in ventilated and protected manner to prevent deterioration from moisture.
- E. Deliver escalator truss and all components with factory installed protective devices and lifting lugs: Pack components in factory-fabricated protective containers; and deliver materials ready for use.
- F. Deliver valid forms and installation instructions in manufacturer’s packaging.
- G. Handle equipment carefully to avoid damage to components, enclosures, and finish.
- H. Submit the following plans/procedures for approval by the Engineer.
- I. Delivery: Submit a procedure for each escalator showing unloading at the site and delivery to the wellways.
- J. Rigging Plan: Submit a rigging plan for each escalator, signed and sealed by a licensed engineer in the project state, and the plan shall be reviewed by the Engineer prior to execution.
- K. Drawing: Submit a drawing, independent from the approved escalator shop drawings, showing the dimensions and weights of all the truss sections.
- L. Description:
 - 1. Submit a description of the truss installation, including the sequence of events and time duration of installation.
 - 2. Submit drawings showing location of all work and proposed storage areas.

1.9. Spare parts and special tools

- A. Provide spare parts required for maintenance of the escalator equipment installed. The spare parts should be placed in new storage cabinets and become the property of the Owner. Locate storage

cabinet as directed by the Engineer. Upon completion of all work required, a complete set of spare parts should be turned over to the Engineer and a receipt obtained. The list of items outlined should be provided for the escalator. They are an absolute minimum requirement.

- B. Spare Parts: The Contractor shall provide the following listed spare parts upon the completion of the escalator installation:
 - 1. Complete 32" or 40" step assemblies (Qty. To be Determined).
 - 2. One (1) set of handrails per escalator.
 - 3. Center comb plate assemblies (Qty. To be Determined)
 - 4. Side comb plate assemblies (Qty. To be Determined).
 - 5. Complete set deteriorated roller devices per escalator.
 - 6. Step rollers (Qty. To be Determined).
 - 7. Chain rollers (Qty. To be Determined).
 - 8. One (1) set of demarcation lights per escalator.
 - 9. One (1) complete balustrade lighting assembly of each type provided per escalator.
 - 10. Four (4) handrail entry guards.
 - 11. One (1) complete start station
 - 12. One (1) complete emergency stop station.
 - 13. One (1) set of skirt brushes for each escalator.
 - 14. One (1) complete assembly for each safety device provided.
 - 15. One (1) box of each type of fuses.

- C. Prior to seeking final acceptance of the completed work as shown on the Contract Drawings or as specified, deliver to the Engineer a spare replacement for each printed circuit board that is needed to fully operate the escalator and its safety circuits. These spare printed circuit boards should be exact duplicates of those in use and should be provided with "as installed" software programs. Each spare printed circuit board should be run-in on the job site for a period of thirty (30) days without interruption to demonstrate its ability to function in a normal manner.

- D. Provide at the site all special tools required for the operation and maintenance of the escalator, prior to use by the general public.

- E. Any diagnostic tools or devices that is required for maintenance, inspection, testing or troubleshooting (three sets).

- F. Passenger/Maintenance Barrier (three sets).

- G. Keys (three sets per unit).

- H. At the conclusion of the Maintenance Period the Special Tools detailed above shall become the property of the Owner.

1.10. Warranty

- A. Warranty period of one year from the date of Beneficial Use for each escalator should cover defective materials and workmanship.

- B. The acceptance is conditional on the understanding that the warranty covers defective material and workmanship. The warranty period should be one year from the date of beneficial use. The warranty excludes ordinary wear and tear or improper use, vandalism, abuse, misuse, neglect or any other causes beyond the control of the Escalator Contractor, and the express warranty should

be in lieu of all other warranties, express or implied, including any warranty of merchantability or fitness for a particular purpose.

- C. Interim maintenance is required between Beneficial Use and Revenue Service. This service will be performed according to the approved maintenance plan, with no extra charge for overtime required to return the escalator to service. Vandalism and acts beyond normal wear and tear are excluded.

NOTE TO SPECIFIER: The contract document should provide minimum response times for regular time, overtime and emergency calls.

- D. Deliverables: Proof-of-interim-maintenance documents will be required prior to final acceptance.

1.11. Maintenance service

- A. The approved maintenance service consisting of regular examinations, adjustments and lubrication of the escalator equipment should be provided by the escalator Contractor for a period of 12 months after the escalator has been turned over for beneficial use. This service should not be subcontracted but should be performed by the Installer. All work should be performed by competent employees during regular working hours of regular working days and should include 24-hour callback service at no extra cost. This service should not cover adjustments, repairs or replacement of parts due to negligence, misuse, or abuse caused by people other than the escalator Contractor. Only parts and supplies as used in the manufacture and installation of the original equipment should be provided.
- B. Deliverables: Proof-of-maintenance documents and all as-built documents to complete the O&M manuals will be required prior to final acceptance.
- C. Interim maintenance is required between beneficial use and revenue service. This service will be performed according to the approved maintenance plan, with no extra charge for overtime required to return the escalator to service. Vandalism and acts beyond normal wear and tear are excluded.

1.12. Design criteria

- A. General
 1. Escalators should be designed with provisions for thermal expansion and contraction of complete escalator assemblies and for any movement of the facility caused by trains braking when fully loaded.
 2. Each escalator should have a 40-inches (1,000 mm) or 32-inches (800 mm) nominal step as specified and designed for a maximum of 30 degrees.
 3. Escalator installation will require a remote machine room to accommodate the controller, drives and related equipment to operate the escalator. Special care, planning and coordination are essential with architectural, structural, HVAC and electrical disciplines in this design. Typical locations are adjacent or under the incline of the escalator installation, although other locations may be appropriate for consideration. Alternates for this design may require significant truss extensions or wall-mounted control equipment requiring special access and protection from non-escalator personnel for maintenance.
- B. Operational requirements
 1. Hours of operation should be considered as 24 hours per day, seven days per week.
 2. Escalator components should be designed based on the design loads as defined in ASME A17.1. (as amended).

3. Direction of travel should be considered as either direction and unit should be up-and-down reversible.
4. Rated speed should not exceed 100 feet per minute (FPM). The no-load-to-full-load speed should not exceed 4 percent of the rated speed.

NOTE: The above-noted duty cycle is a general reference to stipulate anticipated load cycles encountered during normal operation. Duty cycles are utilized in design calculations for components to determine compliance with design and life requirements. Anticipated load, or duty, cycles should be reviewed and amended as needed for the anticipated usage requirements.

C. Structural requirements

1. The designer is required to develop a contract drawing that defines the loading that the structure is designed to accept.
2. The installer should provide escalator truss mounting angles and intermediate truss supports with attachments, sized as required to install escalators into wellway structural support system shown on the contract drawing.
3. Escalator intermediate support points should be provided by the installer where indicated on drawings. Details and calculations should be submitted by the escalator installer for approval by the owner.
4. Reaction loads should be indicated on contract drawings.
5. Seismic designs must be based in accordance with A17.1 (as amended) and prevailing local building codes.

NOTE TO SPECIFIER: Seismic calculations are to include transit grade equipment loadings.

D. The designer should detail the dimensions of the wellways on the contract drawings.

E. The escalator contractor should verify dimensions of wellways prior to manufacturing trusses.

1.13. Environmental requirements

A. Operating temperatures

Escalators should be designed to operate while exposed to the natural elements of weather, including sunlight, rain, slush, snow and ice; all conditions of relative humidity while exposed to salt, deicing chemicals, airborne dust, debris and corrosive elements; and in a dry-bulb temperature range of -10 °F. to + 120 °F. Truss heaters should be considered for operations in cold climates.

NOTE TO SPECIFIER: Follow all applicable building code requirements for installation temperature limits.

NOTE: Escalator and all control equipment installed in interior installations include facilities such as airports and controlled environments may require alternate design considerations.

B. Seismic Zone requirements

The escalator shall be designed to comply with seismic zone requirements in accordance with International Building Code regardless of edition of ASME A17.1 (as amended) approved for this project. The sole exception to this requirement is where the owner or design professional has designed the structure for a more stringent seismic requirement.

1.14. Protection requirements

- A. During installation and until the escalator system(s) are fully operational and accepted for public use under the warranty period by the owner, the Contractor should make all necessary provisions to protect all escalator components from damage, deterioration, and adverse environmental

conditions. The Contractor should not use or allow the use of the escalator(s) for construction purposes for activities such as hauling materials or worker transport during construction.

1.15. Coordination

- A. Alterations: Any alterations required to accommodate the escalators should be coordinated with the Contractor and the Owners designated representative.
- B. Cladding: Contract drawings should identify all required cladding for escalator enclosures, as required.
- C. Floor finish at landing plates: The contract should provide for coordinated floor finishes and drainage at the escalator limits at perimeter landing plates.
- D. Escalator pit heating: The contract should specify all heaters. Temperature ranges to be included in the specifications by the owner dependent on prevailing local conditions.
- E. Lock and key requirements: The escalator contractor should coordinate with the Owner's designated representative to provide locks and keys in accordance with the owner's key specifications.
- F. Pit drainage: The Contractor should provide a means to prevent water from accumulating in the escalator pit.
- G. Installation plan: The escalator contractor should supply an installation plan that is approved by the Contractor and Owner designated representative.
- H. Rigging Plan: Contractor should supply a rigging plan that must be approved by Owner prior to the commencement of equipment installation.
- I. Safety training: The escalator contractor should attend Owner required safety training programs provided by the Owner at no extra cost.
- J. Methodology: The escalator contractor should meet with the Owner designated representative and provide a written method of installation for approval.
- K. Electrical: The escalator contractor should coordinate with the General Contractor and appropriate trades in relation to power requirements.
- L. Construction schedule: The escalator contractor should coordinate deliveries, installation and testing with the Contractor.
- M. Narrative description:
 - 1. Submit a narrative description of the escalator truss installation, including the sequence of events and time duration of installation.
 - 2. Submit drawings showing location of all work and proposed storage areas.
- N. As Built: The Contractor is responsible for providing revised contract drawings to reflect the actual as-built condition, including all structural, architectural, electrical, mechanical and plumbing connections to the escalator(s).

2. Products

2.1 General

A. In a single contract, efforts should be made to provide escalators from a single manufacturer. The contractor shall furnish and install escalators that shall comply with the following requirements:

1. Vertical rise: As shown on contract drawings.
2. Nominal step width: 1,000 mm (40 in.) or 800 mm (32 in.).

NOTE: 40 in. steps: Where possible, 40-in. steps are preferred to permit side by side travel.

3. Speed: Not to exceed 100 feet per minute (FPM).
4. Flat steps: Three minimum for less than 10 m (32 ft., 10 in.) rise; four minimum for greater than 10 meters (32 ft., 10 in.) rise

NOTE: The code minimum is two flat steps at both landings. Existing structural conditions often prohibit installations of escalators with more than three flat steps. Note that code minimum is two flat steps at both landings. Note that the flat step requirement does not mean that the escalator will have three flat steps simultaneously at both ends.

5. Maintenance speed: Should be 10 percent of rated speed.
 - i) Upper track radius: Less than 10 m (32 ft., 10 in.) rise: 2.6 m (8 ft., 6 in.) or approved equivalent. Greater than 10 m (32 ft., 10 in.) rise – OEM to consider larger radii.
 - ii) Lower track radius: 2 m (6 ft., 6.75 in.).

TRACK RADIUS NOTE: Existing structural conditions often make it difficult to install escalators with a radius as recommended here. Every effort should be made to obtain the largest radius possible when planning a new escalator installation.

- iii) Static brake load (load per step on the total number of exposed steps on the incline):
 - 1000 mm step: 306 kg (674 lb) 800 mm step: 245 kg (540 lb)
- iv) Dynamic brake load (load per step running in down direction on exposed steps on the incline):
 - 1000 mm step: 145 kg (320 lb)
 - 800 mm step: 116 kg (256 lb)
- v) Motor duty load. With a minimum step load per step (on incline only) as follows:
 - 1000 mm step: 145 kg (320 lb)
 - 800 mm step: 116 kg (256 lb)
- vi) Step chain load. To be based on the step loads as follows:
 - 1000 mm step: 145 kg (320 lb)
 - 800 mm step: 116 kg (256 lb)

2.2. Controls and safety devices

2.2.1. Operating controls

- A. Escalators shall have key-operated switches, accessible at both upper and lower landings, located on the exterior deck above the newel base. Alternate locations may be used subject to approval by the Authority Having Jurisdiction (AHJ).
- B. Each keyed switch shall be clearly and permanently labeled, including starting and direction selection.

2.2.2. Safety devices

- A. Safety devices include but are not limited to those required by the edition of ASME A17.1 in effect for this installation.

- B. A lockable stop switch or disconnect shall be provided in both escalator pits.
- C. A switch shall prevent operation of the escalator if any part of the floor plate is not in place. This shall not be a manual reset device.

2.2.3. Balustrades, skirt panels and decking

NOTE: In certain applications, such as airports, glass balustrade panels may be appropriate. In these circumstances, the owner should be aware that replacement glass panels may be an issue once in operation. APTA recommends utilizing laminated safety glass, in accordance with ASME A17.1 (as amended) glass requirements, as well as consideration of the handrail V-groove requirement impact on the glass newel arrangement.

A. Balustrades and skirt panels

1. Panels shall be a minimum of 3 mm (1/8in.) solid type 316 stainless steel and backing panels, where used, shall be noncombustible and are subject to owner approval. In harsh environments, designers should consider a more corrosive resistant stainless steel such as 316L.

NOTE: For owners interested in glass balustrade panels the designer should consider laminated safety glass, meeting the requirements specified in ASME A17.1 (as amended) glass requirements.

2. Panels shall be constructed, when practical, in equal lengths for interchangeability.
3. Panels shall be attached to permit easy removal for inspection, lubrication and adjustment of safety devices.
4. Panels shall be sized so that no more than two people are required to remove a panel, and without the aid of special handling equipment.
5. Requirements for exposed panel fasteners (where used): Panels shall be fastened to their respective supports or mating portions with tamperproof flathead machine screws. When the framework to which panels are fastened is less than 6 mm (0.25 in.) thick, steel backup plates with a minimum 6 mm (0.25 in.) thickness shall be added. These plates shall have tapped holes or clearance holes where necessary.

NOTE: Escalator cladding consists of enclosing the sides and bottom of the escalator, typically with 2mm stainless steel with a No. 4 finish. It is critical to ensure that this work is specified in the appropriate specification section, even if only for the newel ends that may be exposed.

6. Decking shall be a minimum of 2 mm thick solid type 316 stainless steel, identical in finish to balustrade.
7. Decking between escalators shall be designed to support a live load of 175 lb. /ft² without permanent deformation.
8. Paneling, decking and other enclosures shall be supported on a steel frame.

2.2.4. Electrical equipment

A. Motors

1. The driving motors shall be AC induction motors with starters. Voltage 480 VAC, three phase, frequency 60 Hz. Other motor voltages are permitted where power supply differs.
2. Motor shall be sized to match duty cycle as stated in the design criteria.
3. The motor protection class shall be equivalent to IP55 insulation Class F.

NOTE: Driving motors and motor switchgear with a smooth start option is available if required by owner.

B. Controller - PLC

1. The escalator control equipment shall contain diagnostic capabilities as required for the ease of complete maintenance. The diagnostic system shall be an integral part of the controller and provide user-friendly interaction between the service person and the controls. All such systems shall be free from decaying circuits that must be periodically reprogrammed by the manufacturer.
2. Switchgear shall be mounted in NEMA 4X cabinets with strip heaters and labeled terminal strips. The main controller shall use a programmable logic controller (PLC) to control and monitor the status of the escalator. The PLC shall be designed to communicate over Ethernet or approved equal.
3. The PLC racks shall provide space for two future single-slot modules.
4. The PLC in the remote-control panel shall also have hardware and firmware provisions to communicate with human machine interface (HMI).
5. The PLC shall store the last 99 safety device faults, accessible via laptop connection, panel view or remote communications.
6. A copy of all working programs on approved computer medium, as well as a printed program listing, shall be provided.
7. The PLC shall have one dedicated serial port, which supports RS-232-C signals. It shall be accessible in ladder logic and provide support for point-to-point and slave SCADA communication protocol systems. Alternatively, it must be usable for programming purposes or for access to remote programmers via modems.

C. Controller – Microprocessors

1. The new controller shall be digital drive.
2. The software for programming shall be non-proprietary. Propriety based systems will not be acceptable.
3. All software must be stored on an EPROM (Erasable Programmable Read-Only Memory) with no battery backup requirements.
4. If a tool is required to adjust, program, troubleshoot or maintain the system, one such tool shall be provided and will become the property of the building owner.
5. Tools that require periodic reprogramming are not acceptable.
6. If a licensing agreement is required to be executed prior to parts availability, the controller is unacceptable.
7. The controller shall include complete wiring diagrams and control diagrams, emergency instructions, troubleshooting manuals, diagnostic access information/codes, routine maintenance procedures and repair information available to manufacturer and installer's maintenance personnel.
8. If electronic information or documents are provided for the machine room, a laptop must also be provided for viewing them and will become the property of the Owner.
9. The owner or owner's agent will make any necessary determinations on whether equipment is to be considered "proprietary".

D. Main control switchgear

1. The main control switchgear of an escalator shall contain at least the following devices:
 - i) Lockable main disconnect switch, thermal and magnetic motor overload protection, starter for up and down travel, hour counter, auxiliary contactors, phase failure device, phase sequence monitor and ground fault monitor.
 - ii) The controller cabinet shall contain a permanently mounted full-color view panel capable of providing fault and operating data.

- iii) The indication shall be locked automatically. Reset shall be done by a separate switch installed in the controller. The emergency stop shall not be locked.
- iv) All terminals shall have identification markings, and all cables shall be provided with cable markers.
- v) The controller shall be equipped a full-time regenerative variable frequency drive (VFD) capable of full-speed control for maintenance and future “sleep mode” operation.
- vi) Electric power receptacles shall be furnished and installed in the upper and lower pits within the truss structure. Each receptacle shall be of the GFCI duplex type, waterproof, grounded, and rated for 120 volts at 20 amperes.
- vii) Relays shall be provided with visual indication that they are energized.
- viii) The controller shall be capable of operating the escalator in variable rated speed operation as per ASME A17.1 (as amended)
- ix) The escalator shall be provided with the capability of running at any speed up to and including the indicated contract speed. The speed of the escalator shall be user selectable and shall be displayed on the HMI.

NOTE: This technology is relatively new in North America to determine any advantages over any specific passenger detection system design. The owner should investigate all appropriate design solutions (stanchion, radar, proximity, etc.) for the most effective, reliable nonproprietary system for the application.

- x) Activation of sleep mode and setting of the sleep delay and sleep speed parameters shall be performed on the PLC’s LCD display. The LCD display’s main screen shall indicate if the escalator is in sleep mode operation and what the sleep delay and sleep speed parameters are.

D. Truss wiring and conduit

- 1. Galvanized rigid pipe and/or liquid tight flexible metal conduit shall be used in the truss.
- 2. In Class 2 circuits, SO cord may be used in lengths not to exceed 3 ft.
- 3. Liquid tight flexible metal conduit must be CSA/UL approved.

2.3. Materials

2.3.1. General material requirements

- A. No wood or wooden products shall be used in escalators.
- B. Low-Smoke, Halogen Free (LSHF) wiring shall be used throughout the escalator installation.
- C. PVC may not be used in the escalator installation.

2.3.2. Stainless steel

- A. Shapes and bars: ASTM A-276, type 316 or 316L, A-554 for tubes.
- B. Plate, sheet and strip: ASTM A-240. Type 316 or 316L.

2.3.3. Fasteners

- A. Fasteners shall be compatible with materials being fastened. Fasteners shall be furnished with self-locking nuts or retaining rings (spring washers, toothed disks).
- B. Fasteners shall be equal to or of greater corrosion resistance than the most corrosion resistant metals being fastened.

2.4. Finishes

- A. Stainless steel: No. 4 finish ASTM A-480.
- B. Aluminum castings and extrusions: Commercial mill finish.
- C. Galvanizing:
 - 1. Sheet steel: ASTM A653, as applicable. Coating designation G185.
 - 2. Other galvanizing: ASTM A123, ASTM A153, ASTM A385, or ASTM A90 as applicable.
- D. Galvanizing touch-up: Zinc dust coating, MIL-P-21035 or MIL-P-26915.
- E. Paint and corrosion protection: Each escalator shall have the following minimum corrosion protection:
 - 1. After welding, the truss shall be hot dipped galvanized with a coating in accordance with ASTM A90. A 100 percent zinc thermal spray coating to ASNI/AWS C.18-93 is an acceptable alternative.
 - 2. Cast metal parts such as gear housings, chain sprockets and return station half circles shall be painted with a rust inhibitor primer coat after preparation by sandblasting.
 - 3. Steel parts that are not specified to be galvanized shall be painted as follows:
 - i) Primer coat: 2 mil (dry film thickness) minimum thickness.
 - ii) Second finish coat: 2 mil (dry film thickness) minimum thickness.
- F. Bright or uncoated axles, shafts, etc., shall be protected by zinc chromate or chrome plating.
- G. Oil collector chutes and collection trays shall be fabricated of galvanized steel.

2.5. Mechanical equipment

2.5.1. Tracks

- A. Fabrication of tracks shall retain steps and running gear safely under load requirements and at the highest speed specified.
- B. Installer shall assemble and secure sections of track together for easy removal and replacement of defective sections. The system shall be adjustable, and connecting of the track sections by welding is not acceptable.
- C. Design of the mechanical components shall provide for easy installation and removal without the dismantling of parts of the structure.
- D. Tracks shall be properly supported on trusses to provide correct alignment and smooth transition to return stations. The rolling surface of the passenger side track shall be a minimum thickness of 3 mm (1/8 in.). Return side track shall be a minimum thickness of 2 mm (5/64 in.).
- E. The guiding system for the step chains and step wheels shall be of zinc plated or galvanized steel profiles with smooth and even running surfaces and with the joints cut diagonally to the running direction. The guide profiles shall not be welded together at the joints.
- F. A second, continuous guiding profile shall be provided above the step chain rollers so that the step chains are positively guided in the area of the escalator open to passengers

2.5.2. Steps

- A. The entire step assembly shall be treated with not less than one coat of zinc chromate primer or iron phosphate and one coat of powder-coated enamel for corrosion resistance.
- B. Steps and their various attachments shall permit removal of steps without disturbing balustrades.
- C. The design shall permit the running of the drive without steps for convenience in cleaning and inspection.
- D. Step rollers shall have polyurethane tires on hubs, sealed roller bearings, and a diameter of no less than 76mm (3 in). Step rollers shall have a minimal 90 Shore A rating. Step rollers shall not require any additional lubrication and must be rated for severe, heavy-duty service. Step roller bearings shall have a minimum L10 rating of 100,000 hours.
- E. Steps shall be constructed so as to be driven by step linkages to step or step rollers.
- F. Washers and nuts shall be provided as follows:
 - 1. Tap bolts: Lock washers.
 - 2. Through bolts: Lock nuts or owner-approved equal.

2.6.3 Rated loads

- A. In addition to the minimum requirements given in the codes, the installer shall design the steps for a minimum load of 320 lb. (145 kg) per 40-in. step or 256 lb. (116 kg) per 32-in. step with an ultimate strength safety factor of 8.
- B. The steps shall carry the load under maximum concentric and eccentric loading conditions without failure.
- C. Die-cast aluminum steps shall not have more than 0.3 percent copper content.

2.6.4 Step chain

- A. Chain shall be endless, roller-type step chains with one on each side of the step.
- B. Step chains shall be of heat-treated steel construction, supported at intervals by linkage wheels.
- C. A means to prevent steps from coming into physical contact with one another and to prevent chains from sagging or buckling shall be provided.
- D. A means to maintain constant distance between step axles shall be provided.
- E. An automatic tensioning device to maintain tension under load and to compensate for wear shall be provided. The device shall be located within the truss at the lower end.
- F. A means for individual fine adjustment of tension for both the left and right-hand step chain systems shall be provided.
- G. Step chains shall be constructed to permit removal of segments as may be required for replacement purposes at a minimum of every six-axle section. Each escalator shall have at least two one-axle sections.

- H. Support wheels spaced to distribute load and to guide linkage throughout the run shall be provided. Rollers shall be constructed of polyurethane material, with a diameter sufficient to provide reliability, maintainability, smoothness of motion and to operate within the noise level requirements specified. The chain rollers shall have polyurethane tires, sealed bearings and diameters of not less than 4 in. They shall require no additional lubrication and be mounted outside chain link. The wheels, hubs and bearings shall have an L10 rating of 100,000 hours.
- I. Wheels shall be affixed to permit replacement without specialized tools.
- J. Each pair of step chains shall be a matched set within manufacturing tolerances. Only precision, roller fishplate chains of high-grade heat-treated steel shall be used as step chains. The pins, axles, bushing and rollers shall be hardened and ground.
- K. Step chain and chain pins shall have a surface pressure at engaging points that shall not exceed 30 N/mm² (4,351 psi). This is to be based on the step loads as defined in the step chain load requirement in Section 2.6.3.
- L. The safety factor shall be at least 6.
- M. A test certificate for the chain-breaking load shall be provided by an independent certified testing facility
- N. A shielding device shall be provided to protect chain, track guides and rollers against water, dirt and debris.

2.6.5 Step chain tensioning device

- A. The step chain tensioning device shall be of a design that keeps the step chains at the correct tension.
- B. A pointer and scale shall be provided to gauge step chain tensioning and wear.
- C. Bearings, if used, shall be rated ABMA L10, 200,000 as a minimum.

2.6.6 Comb plate assemblies

- A. Complete assemblies of wear-resisting, noncorrosive metal material with exposed anti-slip surfaces shall be fabricated.
- B. A separate switch for vertical and horizontal detection shall be provided.
- C. Comb plate sections meeting the following requirements shall be provided:
 - 1. Shall be removable to permit ease of replacement.
 - 2. Shall be yellow in color for safety/demarcation.
 - 3. Provisions for lateral and vertical fine adjustments shall be provided so that cleats of step treads pass between comb teeth with minimum clearances as specified in A17.1 (as amended)

2.6.7 Floor plates

- A. Floor plates shall have type 316 or 316L stainless steel frames at floor openings, designed to be supported on truss heads.

- B. Shall be designed to cover entire area of upper and lower landings.
- C. Shall be reinforced, as necessary, to be rigid and able to withstand a live load of 250 lb. /ft² with zero permanent deformation.
- D. Shall be extruded or die-cast aluminum in a ribbed pattern transverse to the escalator axis. Ribs shall be designed to provide maximum traction. Where stainless steel is provided, a diamond pattern is acceptable.

2.6.8 Drive machinery

NOTE: The drive may be located within the truss for most applications. Where very high-rise escalators require larger HP motors, a drive outside the truss envelope may be selected. This could result in a potential cost increase, as well as additional general construction costs to build and maintain the new room to locate the drive.

For drive machinery - Select one - A or B:

- A. Motor and drive mechanism shall be mounted within the truss envelope at the upper end. Shafts shall be designed for ease of assembly or disassembly.
- B. Motor and drive mechanism shall be mounted outside the truss envelope in the upper head section. The drive shall be securely fastened to a bedplate and have chain guards provided around the drive chains. Shafts shall be designed for ease of assembly or disassembly.
- C. Gear box requirements
 1. Gear bearings shall be rated with an ABMA L10 life of 200,000 hours as a minimum and housed in an oil-tight, dust-proof case. The case shall provide a convenient method of draining the oil.
 2. Rotating parts shall be provided with a means for lubrication and retention of lubricants.
 3. Sealed bearings are preferred.
 4. Exposed, moving drive elements shall be protected by metal housings, which shall provide access for lubrication of components.
 5. A low-oil sensor should be provided to prohibit starting of the escalator on automatic operation with low oil in the gear case.
 6. Head shaft bearings shall be rated for ABMA L10, 200,000 hours as a minimum.

2.6.9 Drip pans

- A. Galvanized, 3 mm (1/8 in.) steel, watertight drip pans for the entire length and width of trusses shall be provided. They shall also be sloped for proper drainage and collection of lubricants, as well as any moisture or water that may enter the escalator. They shall be constructed to prevent oil from leaking below the truss.
- B. Drip pans of sufficient size to collect and maintain, within truss areas, oil and grease drippings from step linkage and all forms of loose debris that maybe deposited from steps at turnaround points at the upper and lower portions of truss shall be provided. This system shall be separate from the water drain in order to prevent the discharge of lubricants into the drainage system.
- C. Access to drip pans at lower landings of escalators shall be provided for the purpose of cleaning drain catch basins.
- D. Specifier to determine the requirements for an oil/water separator as directed by local jurisdiction.

2.6.10 Handrails

- A. Handrails shall receive their motion from the main escalator drive through direct gearing and drive shaft or drive chains, so that the handrail and steps operate at the same speed in each direction of travel.
- B. A means to take up handrail slack using a tensioning device, where required, shall be located within the escalator. In addition, a method of releasing the device for repair or removal of handrails shall be provided.
- C. Newels meeting the following requirements shall be provided:
 - 1. Newels shall be designed and constructed so that the handrail will return into the newel end at a point inconspicuous and difficult for passengers to reach.
 - 2. Newel sheaves shall be provided at the upper and lower newels.
 - 3. Handrail drive system and guides shall be so designed and installed that the handrail cannot be thrown off or disengaged while running. Special design attention shall be given to the area of transition between the handrail drive system to the guides.
 - 4. Handrail rollers shall have a diameter of not less than 60mm and sealed bearings rated at ABMA L10, 100,000 hours and weighed by OEM. Handrail shall not be bent in the positive or negative direction more than 15 degrees over any single individual roller.
 - 5. Friction drive sheaves and idlers shall be designed and positioned so that lubricant cannot reach the surface of the handrail. Marking and spotting of the handrail by drive equipment shall not be permitted. Provide sealed bearings rated at ABMA L10, 100,000 hours as a minimum.
 - 6. The handrail shall be a composite of either vulcanized rubber or molded thermoplastic urethane or an approved equal with a synthetic fabric slider, and shall be constructed with a steel cable tension member providing a minimum breaking strength of 25 kN/5620 lbs. force over the splice area.
 - 7. Handrail guides shall be continuous on the exposed portion of handrails, constructed of type 316 or 316L stainless steel, and shall have a polished or specially coated permanent finish to minimize frictional wear to the under surface of the handrail. Guide transitions shall be smooth and free of exposed edges. On the unexposed portion, guiding shall be by adjustable rollers having sealed bearings, and set in a way so as not to cause wear on the handrail.
 - 8. Handrail gearbox, if provided, shall have bearings rated at ABMA L10, 200,000 hours as a minimum.

2.6.11 Braking requirements

- A. Motor brake
 - 1. The brake shall be capable of stopping and holding a descending escalator with the following load on the exposed steps in the incline area:
 - i) 1000 mm (40 in.) wide step: 145 kg (320 lb.) per step.
 - ii) 800 mm (32 in.) wide step: 116 kg (256 lb.) per step.
 - 2. The brake coil shall be insulated to Class F.
 - 3. A monitor shall be provided to indicate when brake lining becomes insufficient for safe usage and to prevent a restart of the escalator.
- B. Step band lock
 - 1. A step band lock shall be manually applied and mechanically engaged to prevent movement of linkages while the escalator is disconnected from its power supply.
 - 2. An electrical interlock that shall prevent escalator drive motors from starting while the step band lock is engaged shall be provided.

2.6.12 Trusses

A. General

1. The deflection of the loaded truss shall not exceed one-thousandth of the span under a live load of 320 lb. per 1000 mm (40 in.) step and 256 lb. per 800 mm (32 in.) step.
2. The slip joint slide bearings shall not use grease for lubrication.
3. A permanent identification shall be provided on the truss for the centerline at both ends of the escalator and in both transition curves.
4. Permanent mark reflecting track system working point distances shall be provided at both ends of the escalator trusses.
5. No intermediate supports are permitted for spans less than 50 ft.

NOTE: Local conditions may require the use of an intermediate support at lower spans than what are in these guidelines. Close coordination with the structural engineer is advised for these circumstances.

B. Field splices, connections and shims.

1. Field splices shall be rigid and non-deforming, and shall maintain alignment.
2. Field modification shall not compromise the paint and corrosion protection specified in Section 2.4. (Finishes)
3. All shims shall be type 316 or 316L stainless steel.
4. Support shims shall not exceed 2 in.

NOTE: Define clearly who is to provide cladding on the escalator truss. Coordination with the OEM on weight and fastening methods is essential. Generally, welding and drilling into the escalator truss should be avoided. Coordinate with the OEM to determine truss cladding installation methods to minimize impact on the truss integrity. If access is desired into the truss with an access panel, coordination with the OEM is recommended.

2.6.13 Lubrication system requirements

A. Step chain

1. All parts, other than sealed items, requiring lubrication shall be designed for an automatic or remote lubricating system. The system shall operate only when the escalator is running, and the amount of lubrication shall be fully adjustable. A reservoir with a low-oil signal to the controller, and a minimum capacity capable of providing the lubrication for one month of operation based on the specific operating hours for this installation, shall be provided.
2. OEM to provide a list of acceptable non-proprietary lubricants.
3. System shall be positive acting, located in the escalator pit.
4. A reservoir level indication shall be provided where lubricants are contained within housings, supply tanks and larger filler cups.
5. A means to maintain lubricant viscosity shall be provided where required.

B. Miscellaneous lubrication

The installer shall furnish and mount on the controller cabinet a laminated lubrication chart for each escalator. The chart supplied by the OEM shall show the location of each lubrication point, the type of lubricant to be used and the frequency of lubrication.

C. Bearings

1. Sealed bearings shall be used where possible.
2. Bearings requiring manual lubrication shall be furnished with fittings to accommodate the use of a pressure gun for lubrication.
3. Self-lubricating bearings or material other than ball or roller type.

D. Manual lubrication

Manual lubrication points shall be provided and easily accessible.

2.6.14 Indicators

A green light shall be illuminated at the entrance for escalator running direction, and the red lamp shall have a horizontal white stripe and shall be illuminated at the exiting end. Recommended that LED lighting be used.

2.6.15 Room storage cabinet

- A. A standard storage cabinet of not less than 20 ft³ in volume (52 in. high × 36 in. wide × 18 in. deep) shall be provided in a room assigned by the owner. One cabinet per escalator.
- B. The cabinet shall have lockable doors and be mounted on legs or on a pedestal at a minimum of 4 inches off the floor.
- C. The cabinet shall be painted and marked for control purposes, as directed by the owner, and the installer shall store the wiring diagram, maintenance control plans, small parts, supplies, tools and other materials within it.

2.6.16 Lock cylinders

- A. All locks and key types shall be as per owner approval.
- B. The owner shall verify with the installer that the requirements for hardware have not been amended or superseded.
- C. The installer shall provide the owner with length, finish and camming requirements of each cylinder required.

2.6.17 Demarcation lights

Demarcation lights shall be UL labeled and suitable for wet locations.

3. Execution

3.1 Installation

- 1. The installer shall install complete and operating escalators in accordance with the manufacturer's instruction and approved shop drawings.
- 2. The installer shall install special tools in the room storage cabinet as specified in Section 2.6.16.

3.2 Field testing

3.2.1 General

- A. The installer shall notify the owner seven days prior to each scheduled test. The installer shall perform testing in the presence of an owner representative.
- B. The installer shall notify the appropriate local authorities having jurisdiction a minimum of seven days in advance of final acceptance tests.
- C. The installer shall provide all instruments, materials and labor required for tests specified herein.

3.2.2 Acceptance testing requirements

Testing shall be performed in accordance with ASME A17.2 (as amended) procedures with the following additions or adaptations.

- A. No-load tests: The installer shall perform the following tests on each escalator without load:
 1. The comb impact device shall be tested and calibrated with an appropriate scale at both ends of the escalator in both the horizontal and vertical directions. No adjustments shall be permitted in between measurement of vertical and horizontal calibration.
 2. Measure braking deceleration rate with no load over five consecutive stops in the down direction using test equipment designed to obtain this information.
- B. Full-load tests: The installer shall perform the following tests on each escalator under full load:
 1. Each escalator shall have a full dynamic brake load (as specified in Section 2.1) dynamic brake test performed on it. The stopping distance in the down direction shall meet all requirements of ASME A17.1.
 2. The escalator shall operate continuously for 40 hours after the acceptance test with no faults. If any fault occurs that shuts the escalator down, the fault must be corrected and a new 40-hour test will begin.
 3. If either the no-load or full-load brake tests fail, both tests must be repeated with the same torque setting on the brake for both no load and full load.

4 Applicable codes, standards and publications

Escalator designs and installations shall be of the heavy-duty type, and shall comply with the following:

NOTE: In case of a conflict between codes, regulations or standards, the most stringent requirement shall take precedence.

- American National Standards Institute (ANSI), ASME A17.1, “*Safety Code for Elevators and Escalators*”; ASME A17.2, “*Guide for Inspection of Elevators, Escalators, and Moving Walks*”; and ASME A17.5, “*Committee on Elevator and Escalator Electrical Equipment*”; applicable editions.
- National Fire Protection Association (NFPA), NFPA No. 130, “*Fixed Guideway Transit and Passenger Rail Systems*” (new and extension of existing systems only) and ANSI C1, “*National Electric Code*” (NFPA 70).
- Americans with Disabilities Act (ADA). <http://www.ada.gov/>
- Canadian Welding Bureau (CWB). <http://eng.cwbgroup.org>
- American Welding Society (AWS). <http://www.aws.org/w/a/>
- ASTM International. <http://www.astm.org/>
- International Standards Organization, ISO 281/I-2007 (as amended)
- Anti-Friction Bearing Manufacturers Association (ABMA), Std. 9, “*Load Ratings and Fatigue Life for Ball Bearings,*” and Std. 11, “*Load Ratings and Fatigue Life for Roller Bearings.*”
- Occupational Safety & Health Act (OSHA). <http://www.osha.gov/>
- Any additional requirements imposed by local agencies shall be incorporated into escalator installations.

Definitions

NOTE: Special care must be taken to coordinate definitions with other parts of a larger procurement contract.

ABMA L-10: The usual life rating for industrial applications is called “L-10” life. Simply put the L-10 life is the number of hours in service that 90 percent of bearings will survive. Or, conversely, 10 percent of bearings will have failed in the L-10 number of service hours.

authority having jurisdiction (AHJ): As defined by ASME A17.1 (as amended)

beneficial use: The time when the escalator is placed into service, which may be prior to the site being ready for public use.

contractor: The general contractor.

escalator support: The upper, lower and intermediate supports needed to support the total loads of the escalator.

final acceptance: The point at which the owner accepts the escalator project as being complete, including all submittal requirements. This may be a different point in time than substantial completion.

flat steps: The distance, expressed in step lengths, that the leading edge of the escalator step travels after emerging from the comb before moving vertically.

heavy-duty escalator: An escalator designed specifically for transportation system usage.

human-machine interface (HMI): The software interface between the SCADA and the PLC.

installer: The responsible party who installs the escalator.

interim maintenance: Maintenance from the point of substantial completion, but prior to revenue service.

Notice to Proceed (NTP): The formal notification in which the escalator installer is notified to proceed with the project.

owner: The owner in control of the facility.

revenue service: The station or facility opening date.

slip joints: Sliding joints required to support escalators in transportation system and high-rise applications. They can be located at the top or bottom support areas but are generally located at the platform level or as indicated on the contract drawings.

shall: The word *shall* is used in standard documents to indicate mandatory requirements strictly to be followed in order to conform to the standard and from which no deviation is permitted unless the transit system can demonstrate equivalent safety is achieved through an alternate approach.

should: The word *should* is used in recommended practice documents to indicate that, among several options, one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not required.

special tools: Tools designed specifically for tasks associated with escalator examinations, maintenance and repair, or those that are required for these tasks and are not readily available through normal purchasing channels.

step width: The horizontal distance between skirt panels.

substantial completion: The point at which the escalator is ready for use, whether the site is finished or not. This is where the jurisdictional inspection usually takes place.

system control and data acquisition (SCADA): A system to connect various equipment in a geographic area.

working points: Points of intersection of step nosing line and the horizontal line of the top and bottom landing plates at finish elevation.

Abbreviations and acronyms

ABMA	American Bearing Manufacturers Association
ADA	Americans with Disabilities Act
AHJ	authority having jurisdiction
ANSI	American National Standards Institute
APTA	American Public Transportation Association
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing Material
AWS	American Welding Society
BIM	building information modeling
CSA	Canadian Standards Association
CWB	Canadian Welding Bureau
FFT	Fast Fourier Transform
FPM	feet per minute
GFCI	ground fault circuit interrupter
HMI	human-machine interface
HP	horsepower
HVAC	heating, ventilation, air conditioning
KN	kilonewton
LCD	liquid crystal display
LSHF	low-smoke, halogen free
SDS	Safety Data Sheet
NATSA	North American Transit Services Association
NFPA	National Fire Protection Association
NTP	Notice to Proceed
O&M	operation and maintenance
OEM	original equipment manufacturer
OSHA	Occupational Safety & Health Act
PLC	programmable logic controller
PVC	polyvinyl chloride
SCADA	supervisory control and data acquisition
UL	Underwriters Laboratories
VVVF	variable voltage variable frequency drive

Summary of document changes

- Document formatted to the new APTA standard format.
- Sections have been moved and/or renumbered.
- The title of the document has changed from ‘Recommended Practice for Heavy-Duty Transportation System Escalator Design Guidelines’ to ‘Heavy Duty System Escalator Design Guidelines’.
- Titles within the document have been adjusted to minimize the use of abbreviations
- The ‘Introduction’ section was moved and the text was edited.
- The “Overview” section was condensed
- Reference section was removed to the back of the document
- Scope and summary moved to the front page.
- Sections of definitions, abbreviations and acronyms moved to the rear of the document.
- The whole of Section 1 and its sub sections reorganized so that this document and its companion document ‘Heavy-Duty Machine Room-Less Elevator Design Guidelines’ have similar section headings.
- Section 2.2.1 ‘Operating controls’ substituted the word ‘Owner’ for ‘Authority having jurisdiction (AHJ)’.
- Section 2.2.1 Deleted 3rd bullet relating to Interlocks.
- Section 2.2.3 ‘Balustrades, skirt panels and decking’ deleted the first note, which started as ‘If an escalator must be resistant to
- Section 2.2.3 ‘Balustrades and skirt panels’ added a new note regarding compliance with ASME 17.1.
- Section 2.2.3 ‘Balustrades and skirts’ deleted sixth bullet
- Section 2.2.3 ‘Balustrades, Skirt Panels and Decking’ the first note was deleted
- Two new sections added: “Summary of document changes” and “Document history.”
- Section 4 ‘Applicable codes, standards and publications’ deleted reference to ‘Canadian Standards Association.

Document history

Document Version	Working Group Vote	Public Comment/ Technical Oversight	Rail Transit CEO Committee Approval	Rail Transit Policy & Planning Approval	Publish Date
First published	Feb. 6, 2002	—	June 3, 2002	Sept. 22, 2002	Sept. 22, 2002
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