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Heavy-Duty Machine Room-Less Elevator Design Guidelines

Abstract: This document provides design guidelines for the fabrication, installation, and testing of MRL elevators.

Keywords: elevator, machine room-less

Summary: The use of this *Recommended Practice* will provide improved availability and reliability of elevator service and equally important will be the improvement in customer safety satisfaction and convenience.

Scope and purpose: This *Recommend Practice* includes design guidelines to assist rail transit agencies as they consider developing a specification for a heavy-duty machine room-less elevator procurement. This design guideline is not intended to be a 100 percent procurement-ready technical specification for all transportation systems. Each owner must determine their requirements based on local factors.

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Introduction

This Introduction is not part of APTA RT-EE-RP-004-02 Rev 2 *'Heavy-Duty Machine Room-Less Elevator Design Guidelines'.*

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

The newest trend in elevator technology is the machine room-less (MRL) elevator. This technology is being developed by all the major elevator manufacturers and is installed in thousands of locations throughout the world, including the United States. This document is intended to outline appropriate transit design guidelines for this new technology.

This design guideline is not intended to be a 100 percent procurement-ready technical specification for all transportation systems. Each Owner may find it necessary to make changes to suit his 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 and notes in the text to guide specifiers in preparation of a procurement specification document.

Agencies should be aware that additional requirements may add to the cost of procurement. However, based on past experience, agencies will need to weigh the cost of whether paying more up-front can compensate for the overall life cycle costs associated with the manufacturer's "standard" product when used in a transportation environment.

The working group has established these guidelines for traction elevators. They can be used at any rise, including those within the low-rise elevator guidelines already established by APTA.

To that end, as with the recently adopted heavy-duty low-rise elevator design guidelines, this working group recommends increasing the capacity of the elevators above and beyond that of the ASME A17.1 code required minimums. **Table 1** shows the APTA-rated minimum load recommendations above that of ASME A17.1, which should be incorporated into the design decisions for all elevators in transportation applications.

TABLE 1

Elevator Platform Size vs. Rate Load Changes

Clear Inside Width(ft.)	Clear inside depth (ft.)	Inside Net Platform Area (ft^2)	ASME A17.1 Max. Inside Net Platform Area (ft^2)	ASME A17.1 Rated Min. (lb.)	ASME A17.1 Rated Nominal (lb.)	APTA Rated @ 1.5 over ASME A17.1 Min. (lb.) THIS IS A RECOMMENDATION
5.8	4.3	24.08	24.2	1993	2000	3000
6.8	4.3	28.33	29.1	2425	2500	3750
6.8	4.3	31.67	33.7	2781	3000	4500
6.8	5.5	36.11	38	3278	3500	5250*
7.8	5.5	41.53	42.2	3920	4000	6000*
5.8	7.10	45.81	46.2	4455	4500	6750*
5.8	8.6	48.88	50	4853	5000	7500*

*Any additional requirement over the ASME A17.1 load is optional and should be determined by the rail transit agency and availability of equipment as appropriate to their needs taking into account empty car weight, and cab design.

Changes are driven by ADA and NEII standards (National Elevator Industry Inc.)

Be sure to coordinate design of elevators with all applicable disciplines affected. This can include mechanical, communication, plumbing, architectural, electrical, structural, HVAC, as well as fire/life/safety designers. The use of this guideline will provide improved availability and reliability of transportation elevators and, most importantly, will improve customer safety, satisfaction and convenience. The result can only be an increase in the public's confidence in the transportation system's ability to meet their needs, and thus, an increase in ridership.

Heavy-Duty Machine Room-Less Elevator Design Guidelines

1.0 General conditions

This section specifies requirements for design, fabrication, installation and testing of heavy-duty elevators. 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.

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 Authority Having Jurisdiction (AHJ) lead times to schedule acceptance tests.

1.1 Applicable codes, standards and publications

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

NOTE TO SPECIFIER: Close coordination with the electrical engineer is recommended to provide the proper power supply for a given installation. Additionally, coordination of power for HVAC, smoke and heat detectors, pit lighting, outlets and sump pumps is required by the electrical designer.

B. For the 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 elevator contractor.

C. For lighting and ground fault circuit interrupter (GFCI) receptacles: 120 V, one-phase, three-wire, 60 Hz terminating at the elevator controller location.

D. Separate disconnect for cab lighting and wiring to cab.

E. Separate service for sill heaters where required.

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. Each product data sheet should include the following:
   1. Electrical characteristics and connection requirements.
   2. Electrical characteristics and connection requirements.
   3. Expected heat dissipation of elevator equipment machine space and controller space BTU based on maximum possible full-load starts per hour.

NOTE TO SPECIFIER: For machines room-less (MRL) applications, space will likely mean that the hoistway, or a portion of the hoistway where the machine is located will need temperature control.

B. Maintenance programs:

1. 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.
2. Coordinated delivery schedule.
3. Manufacturer's recommended preventive maintenance plan, including interim maintenance procedures where applicable.
4. Pre-acceptance test forms.

NOTE TO SPECIFIER: Special loading requirements above should be in accordance with the special duty **Table 1** at the beginning of this guideline.

C. Shop drawings:

1. Submit six (6) copies of approval layout drawings to scale and complete in their entirety. Shop drawings should be in Imperial Measurements. Drawings should be submitted for each elevator and should include but not limited to the following:
   - i) Car, guide rails, buffers and other components in hoistway.
   - ii) Maximum rail bracket spacing.
   - iii) Maximum loads imposed on guide rails requiring load transfer to building structure. Include machine reactions and layout information.
   - iv) Loads on hoisting beams.
   - v) Clearances and travel of car run-by.
   - vi) Clear inside hoistway and pit dimensions.
   - vii) Location and sizes of access doors, hoistway entrances and frames.
   - viii) Car and hall fixtures.
   - ix) Machine loads, motor loads, calculations showing over-design and factors of safety.
   - x) Refuge space on top of car and pit.
   - xi) Hostway layout.
   - xii) Controller and drive space layout.

NOTE TO SPECIFIER:
1. Determine whether shop drawings should occur on paper or in a digital format acceptable to the Owner.
2. Discuss AHJ issues that may arise for controller space locations.

   - xiii) Signal and operating fixtures, operating panels and indicators. Signal and operating fixtures, operating panels and indicators.
   - xiv) Cab design, dimensions and layout.
   - xv) Hostway-door and frame details.

NOTE TO SPECIFIER: (Optional specification for fast-track projects) Shop drawings: Six copies of the shop drawings (or cut sheets with standard dimensions if available) should be provided by the Contractor for approval within three weeks of NTP. All bearing ratings, identification and catalog numbers should be provided.

D. As-built drawings should include the following:

Comment: 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. Car, guide rails, buffers and other components in hoistway.
2. Maximum rail bracket spacing.
3. Maximum loads imposed on guide rails requiring load transfer to building structure. Include machine reactions and layout information.
4. Loads on hoisting beams.
5. Clearances and travel of car run-by
6. Clear inside hoistway and pit dimensions.

7. Location and sizes of access doors, hoistway entrances and frames.
8. Car and hall fixtures.
9. Machine loads, motor loads, calculations showing over-design and factors of safety.
10. Refuge space on top of car and pit.
11. Hostway layout.
12. Controller and drive space layout
13. Signal and operating fixtures, operating panels and indicators.
14. Cab design, dimensions and layout.
15. Hostway-door and frame details.

E. Maintenance programs:
   1. Prior to the installation, the installer should submit detailed interim and revenue service maintenance programs, showing functions to be performed and their scheduled frequency.
   2. Where applicable as part of a submittal package shall include a maintenance control plan.

1.4 Operating and maintenance (O&M) manuals

NOTE: Due to the critical nature of 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. As a minimum, the manuals should include the following:
   1. Complete table of contents.
   2. Complete instructions regarding operation and maintenance of equipment. 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. Troubleshooting techniques and flow charts for all systems.
   8. Detailed lubrication and cleaning schedule indicating weekly, monthly, quarterly, semiannual and annual lubrication; and a description of each lubrication point, lubrication type and specification.
   9. Provide one-line diagrams that shows the utility power service for each disconnect switch.
   10. Provide schematic control drawings and manuals and job specific software.
   11. As a minimum, 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 elevator and group of elevators.
      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 elevator fault-finding device and connection to annunciator panels.
      iv) Electronic and hard copies of ladder diagrams, logic and programs.

B. Certification
   1. The OEM should provide to the Owner certification that the Owner of the elevator(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 elevator 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 communications should be established between 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:
   1. SDS should be submitted with an index listing each product, along with the application method of the product, approximate quantity of product per elevator, and the component the product is applied to or as associated with. The Contractor should allow six weeks for review of the 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. Since MRL elevators are relatively new, the Owner may want to consider more training or site visits during construction to familiarize himself with the new equipment. The specifier should clarify how many people need to be trained and how many material handouts are required. Timing of the training for Owner-maintained facilities should be considered if the Installer is providing a period of interim maintenance.

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 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 elevators. 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 the end of the warranty period.
   5. Provide manuals for all material covered in the training program.
   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 the recommendation of this working group to tighten this part of the specification as much as job circumstances and local procurement regulations permit.

A. Elevator design, materials, construction clearances, workmanship and test should conform to the requirements if 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 elevator design specifications.

B. Manufacturer: Provide elevators manufactured by a firm with a minimum of 10 years' experience in fabrication of elevators.

C. Installer: Lead mechanics should have a minimum of 10 years' experience in installation of elevators. Documentation should be required to document this requirement.

D. Ensure firms performing elevator work are members of the National Elevator Industry, Inc. (NEII) or the National Association of Elevator Contractors (NAEC) or as approved by the owner's engineer.

E. Regulatory requirements: Elevator system design and installation should comply with the version of ASME A17.1 in effect for this contract.

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

NOTE TO SPECIFIER: The following sections 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: Elevator 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, and publications."

H. Welding: Welding should be performed in accordance with the requirements of American Welding Society (AWS) or Canadian Welding Bureau (CWB). Welders should produce evidence of current certification issued by AWS or CWB.

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

J. Requirements of regulatory agencies
   i) The Contractor should obtain and pay for all necessary permits and perform such tests as may be required for acceptance and approval of elevators by jurisdictional agencies.
   ii) The Contractor should notify the proper inspectors to witness required testing.

K. *(Optional)* Factory visit

NOTE TO SPECIFIER: All elevator components may not be manufactured in the same location by the same manufacturer.

   ii)i The Owner should provide for the costs of up to three of the owner's representatives to visit the factory where the elevator is being manufactured.
   ii)ii The Contractor should not ship the elevator 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 elevator 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 elevator 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 elevator to be unloaded with a weight that will endanger the safety of the structure.

C. The complete elevator package shall be delivered and stored in the project area.

D. Store off ground in a ventilated and protected manner to prevent deterioration from moisture.

E. Deliver 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.

1.9 Spare parts and special tools

The Contractor should provide spare parts required for maintenance of the elevator 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 elevator. They are an absolute minimum requirement.

A. The Contractor shall provide the following listed spare parts upon completion of the elevator installation:
   1. Replacement rollers for main guides (Qty. To be Determined)
   2. Replacement rollers for counterweight guides (Qty. To be Determined)
   3. Hoistway door rollers (Qty. To be Determined)
   4. Car door rollers (Qty. To be Determined)
   5. Hoistway door gibs (Qty. To be Determined)
   6. Car door gibs (Qty. To be Determined)
   7. Electronic door detector (Qty. To be Determined)
   8. Set of replacement lights for each elevator cab (Qty. To be Determined)
   9. Box of each type of fuses (Qty. To be Determined)
   10. Complete door interlock assemblies (Qty. To be Determined)
   11. Door operator motor (Qty. To be Determined)
   12. Complete hall pushbutton assemblies (Qty. To be Determined)
   13. Complete car pushbutton assemblies (Qty. To be Determined)
   14. Complete set of replacement controller boards for each elevator controller (Qty. To be Determined)

B. 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 elevator 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.

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

D. Any diagnostic tools or devices that is required for maintenance, inspection, testing or trouble-shooting (three sets).

E. Passenger/Maintenance Barrier (three sets).

F. Keys (three sets per unit).

G. 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 elevator 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 Elevator 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 elevator to service. Vandalism and acts beyond normal wear and tear are excluded

NOTE TO SPECIFIER: The contract documents should provide minimum response times for regular time, overtime, emergency call and entrapments.

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

1.11 Maintenance service

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

A. The approved maintenance service consisting of regular examinations, adjustments and lubrication of the elevator equipment should be provided by the elevator Contractor for a period of 12 months after the elevator 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 elevator 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 elevator to service. Vandalism and acts beyond normal wear and tear are excluded.

1.12 Design criteria

A. General
   1. Elevators should be designed with provisions for thermal expansion and contraction of complete elevator assemblies.

B. Operational requirements
   1. Hours of operation should be considered as 24 hours per day, seven days per week.
   2. Elevator components should be designed based on the design loads as defined in ASME 17.1 (as amended).
   3. Maximum dwell time per landing in these calculations should be no more than 10 seconds.

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. Reaction loads should be indicated on contract drawings.
   3. 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.

   4. The designer should detail the dimensions of the hoistways on the contract drawings.
   5. The elevator contractor should verify dimensions of hoistways prior to manufacturing elevator, as required.

D. Bearings
   1. Bearings should be rated for an American Bearing Manufacturers Association (ABMA) L10 life as specified, under fluctuating bearing load. All bearings should have basic dynamic load ratings.

E. Fasteners
   1. Fasteners should be compatible with materials being fastened.
   2. Fasteners should be furnished with self-locking nuts or retaining rings (spring washers, toothed disks).
   3. Fasteners should be galvanized or stainless steel unless otherwise specified in the contract drawings.

1.13 Environmental requirements

A. Operating temperatures
Machine Room Less (MRL) Elevators 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 +35° F to + 104° F.

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

B. Ride quality
All elevators should have a maximum decibel reading of 70 dB with the doors closed during a run in the up direction, measured 5 ft. above the floor in the center of the cab. When measuring decibels, be certain to take ambient station noise levels.

NOTE TO SPECIFIER: Ride quality information can be found in greater detail in the National Elevator Industry Inc. design guideline manual. APTA considered adopting a milli-g requirement of 35 milli-g in each axis in a raw format. A95 is an average of the peak-to-peak readings of the raw data to eliminate inequities in collecting data or in frequencies outside human perception. However, the working group considers vibration requirements too stringent for most transit environments. Special consideration should be given to the application before requiring a vibration ride quality requirement. A better alternative may be to establish a benchmark at acceptance that should be maintained during the life of a maintenance agreement.

C. Seismic zone requirements
The elevator shall be designed to comply with seismic zone 2 requirements as a minimum and in accordance with International Building Code (IBC) 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

During installation and until the elevator 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 elevator components from damage, deterioration, and adverse environmental conditions. The Contractor should not use or allow the use of the elevator(s) for construction purposes for activities such as hauling materials or worker transport during construction.

1.15 Coordination requirements

A. Alterations:
Any alterations required to accommodate the elevators should be coordinated with the Contractor and the Owners designated representative.

B. Floor finish in cab:
The elevator contractor should be responsible for the coordination of the cab flooring as specified.

C. Lock and key requirements:
The elevator contractor should coordinate with the Owners designated representative to provide locks and keys in accordance with the Owner’s key specifications.

D. Pit drainage:
The Contractor should coordinate the locations of sump pits, pumps, pipes and related wiring with the elevator installer and related equipment with all trades.

NOTE TO SPECIFIER: Elevator code prohibits connections of elevator pit drains to sanitary lines.

E. Installation plan:
The elevator contractor should supply an installation plan that is approved by the Owner's designated representative.

F. Rigging plan:
The Contractor should supply a rigging plan that must be approved by the Owner prior to the commencement of equipment installation.

G. Safety training:
The elevator contractor should attend Owner required safety training programs provided by the Owner at no extra cost.

H. Methodology:
The elevator contractor should meet with the Owner designated representative and provide a written method of installation for approval.

I. Electrical: The elevator contractor should coordinate with the Contractor and appropriate trades in relation to CCTV, communications, smoke detectors, shunt trip breakers, power and cab lighting requirements.

J. Construction schedule: The elevator contractor should coordinate deliveries, installation and testing with the Contractor.

K. Narrative Description:
1. Submit a narrative description of the elevator installation, including the sequence of events and time duration of installation.
2. Submit drawings showing location of all work and proposed storage areas.

L. 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 elevators.

2 Products

2.1 Summary of features for passenger MRLs

1. Elevator number
2. Contract load, in pounds: [Specifier to insert requirements]
3. Contract speed, in feet per minute (FPM): [Specifier to insert appropriate speed]

NOTE TO SPECIFIER: The minimum elevator speed should be no less than OEM recommendations based on site conditions.

4. Travel distance: [Specifier to insert distance]
5. Landing Served: [Specifier to insert landing designations]
6. Number of stops: [Specifier to insert appropriate number of stops]
7. Number of openings: [Specifier to insert number of hoistway openings]
8. Machine location: [Specifier to indicate actual machine location]
9. Machine type: [Gearless]
10. Car and hoistway door size: [Specifier to insert size]
11. Car and hoistway door type: [Specifier to insert configuration]

12. Car and hoistway door operation: Closed loop power high-speed, heavy duty (minimum opening speed 3.0 FPS)
13. Hoistway entrance: As specified
14. Cab enclosure: As specified
15. Door-reversal device: Non-contact electronic door reversal device (See Section 2.1 [B]
16. Car operating panel: Stainless steel with vandal-resistant features as specified
17. Car position indicator: Stainless steel with vandal-resistant features as specified
18. Car direction indicator: Stainless steel with vandal-resistant features as specified
19. Hall call stations: Single riser, stainless steel with vandal-resistant buttons as specified
20. Communication system: "Hands-free" as specified
21. Provide keyed switch in car operating panel or hall push button station as directed to shut down elevator.

2.2 Machine components

A. Motor

1. Bearings should be rated with an ABMA L10 life of 65,000 hours as a minimum.
2. The motors should be of the alternating current (AC) reversible asynchronous or synchronous type of a design adapted to the severe requirements of elevator service. Motor should be capable of developing the torque required to meet or exceed an acceleration rate of 2 ft./s² for the elevator car.
3. A means to protect the windings and bearings from airborne dust should be provided.
4. Insulation of all windings should be impregnated and baked to prevent absorption of moisture and oil. The insulation resistance between motor frame and windings should not be less than 1 mega ohm. The motor windings should stand a dielectric test of twice the normal voltage plus 1000 RMS volts of 60 Hz AC for one minute.
5. Motor leads in the conduit box should have the same insulation class as the windings. Motor lead wire should be rated 125 °C /257 degrees F and should be sized for 105 °C/221 degrees F at the motor nameplate amperes at 1.0 power factor per Electrical Apparatus Service Association (EASA) recommendations. Leads are to be numbered for clockwise rotation when facing opposite the shaft end.
6. The motor should be designed to withstand the severe loads encountered in elevator service, and the windings should have a minimum insulation temperature rating two ratings higher than the actual temperature rise of the motor, with a minimum rating of NEMA Class F.

B. Brake:

The brake(s) should be of the self-adjusting fail-safe (spring applied and electrically released) type provided with an external manual brake release and designed to meet the service factor demand of its intended use.

C. Gearless machine:

1. Machine: AC gearless machine, with permanent magnet synchronous motor, direct current electromechanical disc brakes and integral traction drive sheave. Machine to be mounted to the car guide rail or support beam mounted at the top of the hoistway. Machines are to be mounted in proper alignment on isolated bedplate utilizing resilient isolation material. Bolts utilized for seismic restraint of the hoist machines shall not short-circuit the resilient isolation material. Both an overhead or basement configuration are acceptable.
    i) The encoder shall be accessible and be able to be replaced without removing the ropes.
    ii) The machine main bearing can be replaced without having to remove the machine.
    iii) The machine main bearing shall be permanently sealed.

iv) The machine shall have at least 28 poles.
v) The machine shall be provided with two independent brakes. The brakes shall be provided with integral lift switch.
vi) The motor insulation shall be at least class F rated (NEC Standard). The machine shall be designed and CSA (Canadian Standards Association) Certified to operate continuously for one hour under full load in an ambient environment of 40 C (104F).

2. Sheaves: Provide machined and grooved sheave for diameter of ropes. All bearings are to be shielded or sealed. Provide resilient isolation materials including isolating grommets and washers at hold down. The sheave material should be accurately machined of semi-steel of hardness Brinell Hardness Number (BHN) 220-250.
3. Dead End Hitch Assemblies: Provide dead end hitch assemblies in accordance with engineered loading requirements.
4. Emergency Auxiliary Stop Switch: An enclosed stop switch, mounted in the over-head machine area and/or on the machine of each elevator in accordance with ASME A17.1 (as amended), shall prevent operation of elevator when switch is activated. Switch shall be of the type described in ASME A17.1 (as amended).

2.3 Controller

NOTE TO SPECIFIER: Remote monitoring is an important part of elevator installations in public transportation facilities. This document will provide elevators capable of connections to many transit SCADA systems. This document does not provide any design guidelines for remote monitoring beyond the option of providing PLC or microprocessor-based controls for the elevators.

A. The controller should be mounted in a NEMA 4X stainless steel cabinet with air conditioning within the control room. The controller cabinet should be equipped with climate controls to meet ASME A17.1 (as amended) temperature/humidity requirements.

NOTE TO SPECIFIER: Review environmental issues based on site conditions when choosing cabinet type.

B. A controller should be provided, governing starting and stopping, as well as preventing, damage to the motor from overload or excessive current. It should automatically cut off the motor current and bring the car to rest in the event any of the safety devices are activated. The controller should be mounted in a vented cabinet within the controller space room.

C. *(Optional)* The controller should be designed to operate automatically on standby power.

D. Provide a separate battery-powered unit that senses loss of power unit. When loss of power occurs, the elevator should ascend or descend to the nearest landing and open the doors automatically. After a predetermined time, the doors should close, and the elevator should remain inoperative until normal power is restored. The door open and alarm buttons should operate under battery power. Reduced speed for evacuation on battery operation is permitted.

E. Elevator drive system
   1. Non-regenerative VVVF drive. The drive should be microprocessor and insulated-gate bipolar transistor (IGBT) based using vector control algorithms. The algorithms should incorporate a motor model to determine the electromagnetic state of the motor. The motor model should also encompass a temperature compensation algorithm, which is essential for speed accuracy.
   2. Velocity should be controlled by a feedback loop to within ±2 percent of contract speed, and speed should be independently supervised.
   3. Floor locations should be stored in non-volatile memory. Stopping accuracy should be ±5 mm (.197 in.) or less. Releveling should be automatic.

4. Resistors should be provided to absorb the power regenerated by the motor. They should dissipate power only when the motor is regenerating. Control should be by IGBT.
5. Maximum total harmonic distortion should not exceed the Institute of Electrical and Electronics Engineers (IEEE) Standard 519 to be measured at the elevator disconnect.

NOTE TO SPECIFIER: There are two main types of variable voltage variable frequency (VVVF) drives now available; regenerative and non-regenerative. Most VVVFD non-regenerative drives generate heat when overhauling loads and must have a means to dissipate heat typically across a resistor bank. While the regenerative may add cost to the installation, the BTU output is almost half that of a non-regenerative system, which absorbs the regenerative energy into a resistor bank. Verify drive compatibility when emergency power is provided.

2.4 Safety devices

A. Safety devices should be provided in accordance with the edition in effect of ASME A17.1 (as amended) and any local jurisdictional requirements.

2.5 Hoistway

A. Roller guides:
Roller guides should be mounted on the top and bottom of the car frames to engage the guide rails. Provide galvanized covers over roller guide assemblies.

B. Guide rails:
Tee-section steel rails and clips painted with corrosion resistant brackets and fasteners. Weight of guide rails shall be in accordance with ASME A17.1 (as amended).

C. Buffer:
Spring/oil buffers in accordance with ASME A17.1 (as amended). Stands and pit channels to be galvanized or stainless steel 316L.

D. Means of suspension:
Should be steel traction elevator ropes of size and configuration for the design application. If belts are considered, all coatings shall adhere to Section 2.5 (E).

E. Counterweight and car frames:
Counterweights consist of a steel frame welded or bolted together. Frame assembly should be 316L stainless steel or galvanized. Counterweight plates shall be single piece sections. Counterweight sections shall be held securely in place within the frame. A minimum of two (2)-tie rods shall pass through the holes in all weight sections. Submit paint finish of counterweights fillers for approval. Paint color selection to be determined by the Owner.
   1. A required counterweight screen where no compensation is used.
   2. The bottom of the counterweight shall have a buffer striking plate and means to attach knock-off blocks, where required, to accommodate rope stretch.
   3. Idler Sheave:
      To be located directly above the counterweight frame and integral with counterweight frame. The sheave material shall be accurately machined of semi-steel of hardness BHN 220-250 or as per manufacturers requirements.
   4. Roller guides shall be mounted on top and bottom of the counterweight frames to engage the guide rails. Counterweight guides shall be of the roller type; each guide shall consist of a set of three (3) polyurethane rollers equipped with sealed preloaded ball bearings. Each roller shall be supported by a pivoted rocker arm that shall automatically adjust itself to guide rail misalignment and prevent excessive lateral frame movement. Provide galvanized covers over roller guide assemblies.

2.6. Car frame

A. A suitable car frame should be provided with adequate bracing to support the platform and car enclosure. Provide welded or bolted ASTM A123 galvanized or type 316L stainless steel channel uprights affixed to crosshead and plank channels with welded or bolted bracing members or gusset plates, which will remove strain from the car enclosure.

B. Roller guides shall be mounted on top and bottom of the car frames to engage the guide rails. Each guide shall consist of a set of three (3) large diameter 150 mm (6") or greater) polyurethane rollers equipped with sealed preloaded ball bearings. Each roller shall be supported by a pivoted rocker arm that shall automatically adjust itself to guide rail misalignment and prevent excessive lateral car movement. Provide galvanized covers over roller guide assemblies.

C. Platform, heavy loading type:
The car platform should be designed to accommodate one-piece loads weighing up to 25 percent of the APTA rated load, such as wheeled food carts, hand trucks, etc. The car platform should be fabricated to the same type and grade material as car frame (galvanized or stainless steel).

2.7 Wiring

NOTE TO SPECIFIER: All wiring should be rated in accordance with the NEC table requirements for conductors. All interior elevator locations should use NFPA ratings for damp conditions, while outdoor locations should be rated for wet locations. Interior installations with a high-water table should be rated for wet locations.

A. Conduit and wiring
   1. Cables and conductors
      i) Unless otherwise specified, all electrical conductors in the pits and hoistways, except traveling cable connections to the car, should be provided in rigid steel conduit with steel outlet boxes, except that a small amount of flexible sealed type conduit may be used where conduit is not subject to moisture or embedded in concrete.
      ii) Rigid steel conduit should be full weight, threaded, hot-dip galvanized, inside enameled, and conforming to ANSI C80.1.
      iii) Conduit fittings and bodies should meet ANSI/NEMA FB 1; threaded type; material to match conduit.
      iv) Terminal boxes, pull boxes and other similar items, should be of approved construction, thoroughly reinforced, and should meet ANSI/NEMA FB 1.
      v) All electrical boxes exceeding 150 cubic inches should be supported independently of the conduits.
      vi) All raceways should be threaded rigid steel conduit complying with ANSI/NEMA FB 1.
      vii) Where permitted, flexible heavy-duty service cord, type SO [Cable type], may be used between fixed car wiring and switches on car doors for Door reversal devices.
      viii) Where permitted, flexible metal conduit should be fabricated in continuous length from galvanized steel strip, spirally wound and formed to provide an interlocking design with a gray XLPO Thermoset Type 2 outer jacket.
      ix) All conduit terminating in steel cabinets, junction boxes, wire ways, switch boxes, outlet boxes and similar locations should have approved insulation bushings. If the bushings are constructed completely of insulation material, then a steel locknut should be installed under the bushing. At ends of conduit not terminating in steel cabinets or boxes, the conductors should be protected by terminal fittings having an insulated opening for the conductors.

x) All conduit terminating in NEMA 4X boxes should be backed up with stainless steel plates to fit the entire area where the conduit penetrated the box.
xi) All conduit fittings and connections should be compression type. The use of set screws or indentations as a means of attachment is not permitted.
xii) Connect motors and other components subject to movement or vibration to the conduit systems with flexible conduit.
xiii) All solid state and electrical components located on top of the car enclosure or in the hoistway should be installed within NEMA 4X enclosures.
xiv) Conduits should be brought and connected to suitable approved connection boxes at all outlets, apparatus and panels.
xv) Conduit sizing, arrangement and support
    a) Size conduit per NEC for conductor type installed or for Type THW conductors, whichever is larger; 0.75 in. minimum size for conduit.
    b) Conduits for small devices such as door switches, interlocks, etc. should be permitted at 0.5 in.
    c) The total overall cross-sectional area of the wires contained in any conduit should not exceed 40 percent of the internal area of the conduit.
    d) Arrange conduit to maintain code required headroom as close to the ceiling while maintaining a neat appearance.
    e) Route exposed conduit parallel and perpendicular to walls and adjacent piping
    f) Maintain minimum 6-in. clearance between conduit and piping. Maintain 12-in. clearance between conduit and heat sources such as flues, steam pipes and heating appliances.
    g) Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using galvanized straps, lay-in adjustable hangers, clevis hangers or bolted split stamped galvanized hangers.
    h) Group conduit in parallel runs where practical and use conduit rack constructed of steel galvanized steel channel with conduit straps or clamps. Provide space for 25 percent additional conduit on racks.
    i) Do not fasten conduit with wire or perforated pipe straps. Remove all wire used for temporary conduit support during construction, before conductors are pulled.
    j) No conduit should be attached to a cable tray or installed within 6 in. of a cable tray or light fitting except for termination.
    k) Approved strain boxes should be installed for all vertical runs in accordance with code.
xvi) Where conduit penetrates fire-rated walls and floors, seal opening around conduit with UL listed through penetration fire stop system to maintain wall or floor rating.
xvii) All interlock, hall button and limit switch branch wiring should be enclosed in flexible steel conduit with covering of liquid-tight Type EF with connectors having nylon-insulated throats.
xviii) All screws used for terminal connections of all wiring (machine room, hoistway and pit) should be provided with “star washers” of proper size and type.
xix) All existing conduit and wiring should be removed, and wall/floor slabs patched with fire-rated material.

B. Conductors
1. Unless otherwise specified, conductors, exclusive of traveling cables, should be 98 percent conductivity copper, solid, for size 10 AWG and smaller, and stranded for size 8 AWG and

larger should be stranded or solid coated annealed copper in accordance with the NEC for Type THHW.

2. Where 16 and 18 AWG are permitted by code, either single-conductor cable in accordance with code for Type TF, or multiple-conductor cable may be used, provided the insulation of single-conductor cable and outer jacket of multiple-conductor cable is flame retardant and moisture resistant.
3. Insulation voltage rating: 600 V.
4. Insulation:
   i) Insulation shall be in accordance with American National Standards Institute (ANSI) and National Fire Prevention Association (NFPA) 70.
   ii) Type Thermoplastic High Heat Water Resistant Nylon Coated (THHN) or Thermoplastic High Heat Water Resistant (THWN), or Cross-Linked High Heat Water Resistant Insulated Wire UL (XHHW) or Temperature Humidity Wind (THW).
5. The use of PVC insulation should not be permitted. Low Smoke Halogen Free (LSHF) wiring shall be used throughout the elevator hoistway.
6. Color coding: All power conductors identified as to phase and voltage by means of color impregnated insulation, as follows:

Voltage	ØA	ØB	ØC	Neutral	Ground
120/208 V	Black	Red	Blue	White	Green
277/480 V	Brown	Orange	Yellow	White	Green

NOTE: For wire sizes No. 8 AWG and larger, color banding tape, minimum 2 in. wide, may be used at all accessible locations in lieu of colored insulation.

7. Multiple-conductor cable should have color coding or other suitable identification for each conductor. Conductors for control boards should be in accordance with all codes.
8. No joints or splices should be permitted in wiring except at outlets. Tap connectors may be used in wire ways, provided that they meet all UL requirements.
9. All wiring should test free from short-circuits or grounds. Insulation resistance between individual external conductors and between conductors and ground should be not less than 1 mega ohm.
10. Where size of conductors is not given, capacity should be such that maximum current should not exceed limits prescribed by all codes.
11. Equipment grounding should be furnished and installed. Ground conduits, supports, controller enclosures, motors, platform and car frames, and all other non-current conducting metal enclosures for electrical equipment should be in accordance with electrical code. The ground wires should be copper, green, insulated and sized as required.
12. Terminal connections for all conductors used for external wiring between various items of elevator equipment should be solderless pressure wire connectors in accordance with electrical code. The Contractor may at its option make these terminal connections on No. 10 or smaller conductors with approved terminal eyelets set on the conductor with a special setting tool, or with an approved pressure-type terminal block. Terminal blocks using pierce-through serrated washers are not acceptable.
13. Elevator contractor to provide all necessary conduit and wiring between all remote machine room and hoistway.

C. Traveling cables
   1. Traveling cables from junction box on car to junction box in hoistway or elevator controller should consist of flexible traveling cables conforming to the requirements of code.
   2. Junction boxes in the hoistway and on the car should be equipped with terminal blocks. All connections to terminal blocks should be made with either terminal eyelet connections or

pressure wire connectors of the clamp type that meet UL 486 requirements for stranded wire.

3. Terminal blocks should have permanent indelible identifying numbers for each connection. The outer covering must remain intact between junction boxes. Abrupt bending or twisting producing distortion of cable is not permitted.
4. Cables should be free from any possible contact with the hoistway structure, car or other equipment. Furnish and install shields or pads to protect the cables.
5. Travel cables should include, as a minimum:
    i. Two RG6 coaxial cables shielded for the CCTV system
    ii. Five twisted shielded pairs for security and telephone systems

NOTE TO SPECIFIER: Coordinate travelling cable requirements with the Owner's security requirements; i.e., card readers, cameras, etc.

POWER AND CONTROL CABLES CAN BE COMBINED INTO ONE CABLE. THIS WILL DEPEND ON THE LOCAL AHJ.

6. Cables should include 20 percent spare wires between each controller, selector and hoistway junction box. All spares are to be properly tagged or otherwise identified with clear and indelible markings.
7. All insulated wiring, control wiring and wiring in traveling cables should be tag coded at their terminals in the motor room, and the hoistway junction box, elevator cab junction box, and push-button stations within the cab, and should agree with the approved wiring diagrams.
8. The use of PVC insulation should not be permitted. LSHF wiring shall be used throughout the elevator hoistway.

D. All cabinets containing motor drives, filter boxes, transformers and power reactors should be supported on rails and isolated from the base building structure with elastomer pads having a minimum static deflection of ⅜ inches (Mason Type N, or equivalent). All connections to and from the cabinetry should be flexible in order not to compromise the isolation system. Use flexible conduit for the final electrical connection, with all other conduit supports and clamps provided on a neoprene sponge insert. Cabinets should be NEMA 4X.

NOTE TO SPECIFIER:
1. Owner to select NEMA4X enclosure requirements.
2. Careful coordination with other engineering disciplines is required to ensure that proper grounding methods are followed in the elevator machine room, as well as proper steps to reduce noise on VFAC elevator drive systems.

E. Signals to be provided to the elevator controller to indicate special emergency condition due to lobby smoke detector activation; and smoke detectors in the elevator lobby and controller space in accordance with the ASME A17.1 (as amended).
F. Car lighting and fan circuit for the elevators should be located in a circuit breaker panel or disconnect in the controller space.

2.8 Cab enclosure

NOTE TO SPECIFIER: Cab finishes are typically designed by an architect. This section provides the cab shell, cab front, floor and dome only. The final cab finishes should be detailed in the bid drawings developed in coordination between the architect and the elevator designer. This guideline is focused on key items for materials and finishes.

A. Cab finish stainless steel type 316L No. 4 finish with vertical grain as a minimum for all stainless steel.

NOTE TO SPECIFIER: An elevator car sized to fit a gurney or emergency stretcher is not required by ASME A17.1 (as amended), however, it may be a requirement of the local governing code and is recommended for consideration.

B. Where solid shaft construction is not required, the hoistway and the car enclosures may be partially glass. An observation car may have glass on a minimum of one wall or a maximum of three walls, including glass entry car doors or doors with vision panels.

C. The glass observation panels should be operable, opening into the car so that the panels can be cleaned, and access is provided for cleaning the hoistway glass panels from within the car. ASME A17.1 (as amended) code requirements include the following, which must be reviewed by the designer:
   1. A stationary panel must be 3 to 6 in. in height below the panel that opens.
   2. The open panel must have locks and safety shutoff feature as required by code.
   3. A handrail must be at each glass observation panel.
   4. The designer must coordinate with the car manufacturer and establish that the operating panel size of 9/16 in. glass does not exceed the limitations of the hinges used.

D. Cab configuration and materials should be in accordance with contract drawings prepared by the architect and as specified herein.

E. Cab flooring:
Floor finishes is chosen to resist corrosive liquids. Avoid seams and multi-part floor systems.
   1. Seamless and resilient elevator cab flooring should be poured or laid in accordance with manufacturer's instructions over a type 316 stainless steel platform to meet the deflection of ASME A17.1 (as amended).
   2. Resilient flooring systems should be self-extinguishing, have 200° F heat resistance, 11,700 psi compressive strength, 2200 psi tensile strength, and 5000 psi flexural strength.

2.9 Ceiling type

A. The clear height under the ceiling canopy should be a minimum of 8 ft. unless existing structural conditions dictate otherwise. Ceiling canopies should be resilient, vandal and moisture resistant.

B. Ventilation:
Finish and material of fan enclosure and blade should match the finish and material of the ceiling having a NEMA 4X enclosures fans. Air change requirements shall be in accordance with ASME A17.1. (as amended).

C. Materials and finishes for exposed parts of elevator car enclosures should be resilient, vandal and moisture resistant

NOTE TO SPECIFIER: The desired thickness of stainless steel should always be shown in inches. ASTM does not define stainless steel gauges, and each producer has its own definition. The specifier will have no legal protection if a gauge number is specified and the thickness is not what was desired. List a minimal thickness or a nominal thickness with an acceptable tolerance variation. The nominal thickness typically associated with 12 and 14 gauges are as follows: 12-gauge, (0.109 in.) (nominal); 14-gauge, (0.078 in.) (nominal).

2.10 Observation cars

A. Where glazing is used, safety-glazing material must be specified in accordance with ANSI Z97.1. These are defined as glazing constructed, treated or combined with other materials to minimize cutting and piercing injuries when broken by human contact. The following when in compliance with ASME A17.1 and Z97.1 should be used:
   1. Laminated glass: Two or more sheets of glass held together by one or more interlayers of plastic material.

2. Tempered glass: A single sheet of specially heat or chemically treated glass that cannot be cut, drilled, milled or polished after treatment.
3. Wired glass: A single sheet of glass with wire completely embedded in it.
4. Safety plastic: One or more sheets laminated of synthetic plastic in the form of fibers or flakes, which are poured and molded, and which contain an organic substance of large molecular weight.
5. Vandal shield coated glass: A single sheet of glass with an applied protective coating on one or both sides.

B. Where enclosures include panels of glass, transparent or translucent plastic, they should be a minimum 9/16 inches thick laminated glass complying with ASME A17.1 (as amended).

2.11 Handrail type

A. Handrails: 1.5 in. outside diameter type 316L stainless steel. Wall connectors should have security type fastenings and should be the same material and finish as the handrail. Handrail height should conform to code requirements placed on non-entry walls.

B. The handrail should be able to support a load of 600 lb. measured in the center of the rail without separating from the wall.

2.12 Hoistway entrance

A. Entrance frames:
Should be of welded or bolted construction for complete one-piece unit assembly. All frames should be securely fastened to fixing angles mounted in the hoistway and should be of 6 mm (1/4”) type 316L stainless steel. Provide an additional type 316L stainless steel sill angle support. The sill should be type 316L stainless steel or nickel silver extrusions: ASTM B151 (ASTM B151M), alloy UNS No. C74500.

B. Doors:
Entrance doors should be of hollow metal construction with vertical internal channel reinforcements. Panel’s front and rear, framing, operating levers, and integral hardware should be type 316L stainless steel; panel should be 2 mm (5/64”).

C. Entrance finish:
Finish should be type 316L stainless steel.

D. Sight guards:
Type 316L stainless steel.

NOTE TO SPECIFIER: Hoistway fascia can be avoided by recessing the hoistway landing sills or, if ASME A17.1 2000 (as amended) rules apply, by providing a door lock on the car door. It is recommended to plan on fascia in all front and rear opening installations.

E. Fascia:
Should be type 316L stainless steel.

NOTE TO SPECIFIER: Full width of hoistway fascia recommended.

F. Provide sill-mounted closers at all landings when applicable.

NOTE TO SPECIFIER: Coordinate this item with entrance door parameters.

G. Provide a vandal-resistant access key switch in top and bottom landings.

H. Provide escutcheon key and hole.

2.13 Signal devices and fixtures

NOTE TO SPECIFIER: ASME A17.1 (as amended) has specific requirements for key schedules, fire service keys, access keys and machine room keys. This should be reviewed during the development of the final specifications. Consideration should be given to high-security locks in areas accessible to the public.

A. Car-operating panel:
A type 316L stainless steel panel should be provided with vandal-resistant push buttons designed to bottom out against the panel plate and not the contacts or key switches.

B. Provide one car swing operating panel integral with a stationary return panel.

C. Braille/Arabic designations should be flush with inconspicuous mechanical mounting.

NOTE TO SPECIFIER:
1. Larger buttons for car and hall stations may be worth considering for improved visibility for the disabled. Vandal resistant buttons are still required.
2. The car operating panel should be supplied with flange and gaskets.

D. Provide a service cabinet with a locked flush hinged or sliding door and integral certificate frame. The certificate frame should have a durable Plexiglas window and be accessible from the backside of the locked door. Minimum window size is to be approved by the owner. The cabinet should contain the following key type controls:
   1. Light switch
   2. Multi-speed fan switch
   3. Inspection switch conforming with code
   4. Independent service switch
   5. A duplex 120 V AC GFCI convenience outlet
   6. An emergency stop switch

NOTE TO SPECIFIER: Location of service cabinet shall be reviewed during design.

E. Engrave the car operating panels in accordance with the ANSI Code with the following:
   1. No Smoking. Minimum 1 inch. lettering and graphic symbol
   2. Elevator Number over operating buttons. Minimum 0.25 inch. lettering.
   3. Elevator Capacity. Minimum 0.25 inch. lettering.
   4. Firefighters Operating Instructions. Minimum 0.125 inch. high lettering.
   5. And other information as dictated by local code

F. Car position indicator:
A vandal-resistant car position indicator should be provided integral with the car operating panel. Communication: A hands-free communication device should be provided that has been designed in response to ADAAG requirements. ASME A17.1 (as amended) requires two-way communications between the cab and continuously manned response point.

G. Communications:
A hands-free communication device should be provided that has been designed in response to ADAAG requirements.

NOTE TO SPECIFIER: ASME A17.1 (as amended) also requires communication between remote machine rooms and the elevator cab. This can mean at times that there are two modes of communication in the elevator cab.

H. Car lantern and chime:
A stainless-steel vandal-resistant directional lantern visible from the corridor should be provided in the car entrance. When the car stops, and the doors are opening, the lantern should indicate the direction in which the car is to travel, and an adjustable electronic chime will sound.

I. Hall fixtures:
Hall fixtures should be provided with necessary stainless-steel vandal-resistant push buttons and key switches for elevator operation. Raised markings should be provided for each push button. Fixture cover must have gaskets.

J. Landing passing signal:
An adjustable electronic chime bell should sound in the car to tell a passenger that the car is either stopping at or passing a floor served by the elevator.

2.14 Door operator equipment

A. Provide a GAL MOVFRW-II water proof or approved equal door operator with VVVF drive and the following features:
   1. 0.5 HP motor and heavy-duty sprocket, chain, belt and sheaves.
   2. Closed-loop regulated speed performance.
   3. Handheld keypad programming.
   4. Adjustments can be stored in the keypad and downloaded to another operator.
   5. Adjustable door obstruction reversal.
   6. Optical cams with LED indicators.
   7. Test switches for open, close, nudging and speed zone setup.
   8. Universal inputs for open, close and nudging.
   9. Reversing switch to back up the door reversal device.

B. Provide a non-contact door reversal device with light immunity: The door reopening device should cause both the car and the hoistway doors to reverse, should they detect an obstruction in the elevator entrance. The device electrical wiring should be supplied with quick-disconnect terminals to facilitate replacement. The infrared curtain detector should include the following:
   1. A protective infrared detector field extending from 1.5 inches above the car sill to a height of 68 inches. This detector should be designed to be completely waterproof and to withstand impact, abrasion and vandalism
   2. A fail-safe control system to prevent the doors from closing in case of power loss to the detector

3.0 Execution

NOTE TO SPECIFIER: Include any decibel or vibration testing in the Design Criteria in Section 1.12 of this recommended practice.

3.1 General

Contractor should install complete and operating elevators in accordance with the OEM's instruction and approved shop drawings.

3.2 Field testing

A. General

1. The Contractor should notify the Owner seven days prior to each scheduled test. The elevator contractor should perform testing in the presence of an Owner representative.
2. The elevator contractor should notify the appropriate local authorities having jurisdiction a minimum of seven days in advance of final acceptance tests.
3. The elevator contractor should provide all instruments, materials and labor required for tests specified herein.
4. The elevator contractor should pre-test all devices within his control and provide documentation to prove compliance prior to jurisdictional inspection.

B. Acceptance testing requirements

1. Testing should be performed in accordance with ASME A17.2.1 (as amended) procedures with the following additions or adaptations.
   a) Test period: The elevator should be subjected to a test for a constant period of 24-hours continuous run with applied duty cycle during operation in accordance with ASME A17.1 (as amended) rated load.
   b) During the test run, the car should be stopped at all floors in both directions of travel for a standing period of 10 s per floor without tripping the motor overload device.
      i) Speed load tests: The actual speed of the elevator car should be determined in both directions of travel with full contract load and with no load in the elevator car. Speed should be determined by a tachometer. The actual measured speed of the elevator car with full speeds obtained under the various conditions outlined between the up and down directions should be checked.
      ii) Post-acceptance inspection: After the elevator is accepted by the local jurisdiction, a second inspection will be conducted (without weights) to determine specification compliance above and beyond the code requirements of the acceptance inspection.

3.3 Re-inspection

If any equipment is found to be damaged or defective, or if the performance of the elevator does not conform to the requirements of the contract specifications or the safety code, no approval or acceptance of elevators should be issued until all defects have been corrected. When the repairs and adjustments have been completed and the discrepancies corrected, the Owner or owner's representative should be notified, and the elevator will be re-inspected. Rejected elevators per ASME A17.1 and 2 (as amended) code must not be used until they have been re-inspected and approved.

NOTE TO SPECIFIER: Consider a re-inspection penalty in addition to any additional fees imposed by the AHJ for repeated inspections. Significant liquidated damages should be considered if any punch list items are not completed within one follow up inspection, and the elevator contractor should be back charged for re-inspection.

3.4 Adjusting and cleaning

A. All equipment should be adjusted prior to final testing and acceptance.

B. Paint exposed work soiled or damaged during installation should be rectified.

Other APTA Standards

None

References

- Elevator designs and installations should be of the heavy-duty type and should comply with the following applicable codes, standards, organizations and publications:

  Any additional requirements imposed by local agencies should be incorporated into elevator installations. In case of a conflict between codes, regulations or standards, the most stringent requirement should take precedence.

- American Society of Mechanical Engineers (ASME)
  1. *ASME A17.1, A17.2.3, A17.5 applicable edition*
  2. *ASME A17.1S-2005 (supplement to ASME A17.1-2004)*
- **NOTE TO SPECIFIER:** You must identify which edition of ASME A17.1 (as amended) is applicable for your jurisdiction, as different editions may affect procurement and installation. Some jurisdictions may not have adopted A17.1S-2005 but will use that addendum to justify a variance.

- Canadian Standards Association, CSA B44

- National Fire Protection Association (NFPA)
  1. *NFPA No. 130, "Fixed Guideway Transit and Passenger Rail Systems"*
  2. *ANSI C1, National Electric Code (NFPA 70)*

- Americans with Disabilities Act Accessibility Guidelines (ADAAG)

- IEEE 519 Standard Practices and Requirements for Harmonic Control in Electrical Power Systems

- Canadian Welding Bureau (CWB)

- American Welding Society (AWS)

- American Society of Testing and Material (ASTM)

- International Standards Organization, ISO 281/I-1997

- American Bearing Manufacturers Association, ABMA, Std. 9 and 11

- Occupational Safety and Health Act (OSHA)

Definitions

A95: A95 is referred to in the 2003 version of the ISO standard which is now superseded with ISO 18738-1:2012. It is a measurement of ride quality – Part 1 – Lifts …. Note 2 to entry: 'The deprecated unit GAL (Galileo) is sometimes used. 1 Gal = 0.001m/s^2. Value of acceleration or vibration, within defined boundaries or limits, which 95% of found values are equal to or less than.

ABMA: American Bearing Manufacturers Association have a code system which identifies bearings by type, size and construction.

ABMA L10: 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% of bearings will survive. Or, conversely, 10% 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 the elevator is placed into service, which may be prior to the site being ready for public use.

Contractor: The general contractor.

dwell time: The period of time the elevator is at a landing while the doors open, passengers transfer and doors close.

elevator: a hoisting and lowering mechanism, equipped with a car or platform, which moves in guide rails or racks and serves two or more landings and is classified by the following:

elevator, freight: An elevator used primarily for carrying freight and on which only the operator and the people necessary for unloading and loading the freight are permitted to ride.

elevator, passenger: An elevator used primarily to carry people other than the operator and people necessary for loading and unloading.

elevator, machine room-less: A traction or hydraulic elevator that does not require a machine room.

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

heavy-duty elevator: An elevator designed specifically for the harsh environment and duty load cycles common to transportation system usage.

Installer/Elevator contractor: The responsible party who installs the elevator.

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

Notice to Proceed (NTP): The date that the elevator installer is notified to proceed with the project.

Owner: The person in control of the facility. (The person in control of the facility may not necessarily be the owner – it could be an O&M contractor)

revenue service: The station or facility opening date.

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

Abbreviations and acronyms

AC	alternating current
ADAAG	Americans with Disabilities Act Accessibility Guidelines
ABMA	American Bearing Manufacturers Association
AHJ	authority having jurisdiction

ANSI	American National Standards Institute
APTA	American Public Transportation Association
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWG	American wire gauge
AWS	American Welding Society
BTU	British thermal unit
CCTV	closed-circuit television
CFR	Code of Federal Regulations
CSA	Canadian Standards Association
CWB	Canadian Welding Bureau
EASA	Electrical Apparatus Service Association
FFT	fast Fourier transform
FPM	feet per minute
FPS	feet per second
GFCI	ground fault circuit interrupter
HVAC	heating, ventilation, air conditioning
IEEE	Institute of Electrical and Electronics Engineers
IGBT	insulated-gate bipolar transistor
ISO	International Organization for Standardization
Milli-g	Unit of acceleration
MRL	machine room-less
SDS	safety data sheet
NATSA	North American Transit Services Association
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NTP	Notice to Proceed
O&M	operating and maintenance
OEM	original equipment manufacturer
OSHA	Occupational Safety and Health Act
PVC	polyvinyl chloride
RMS	root mean square
SCADA	Supervisory Control and Data Acquisition
THHW	Thermoplastic High Heat Water Resistant
THHN	Thermoplastic High Heat Resistant Nylon Coated
THWN	Thermoplastic Heat and Water-Resistant Nylon Coated
XHHW	Cross-Linked High Heat Water Resistant Insulated Wire *(UL)*
THW	Temperature Humidity Wind *(heat index calculation)*
RG	Radio Guide
UL	Underwriters Laboratories
UNS	The UNS number (short for "Unified Numbering System for Metals and Alloys") is a systematic scheme in which each metal is designated by a letter followed by five numbers. It is a composition-based system of commercial materials and does not guarantee any performance specifications or exact composition with impurity limits. Other nomenclature systems have been incorporated into the UNS numbering system to minimize confusion. For example, Aluminum 6061 (AA6061) is assigned UNS A96061. Likewise, AISI 1018 steel becomes UNS G10180
VFAC	variable frequency alternating current ø
VVVF	variable voltage variable frequency
XLPO	cross-linked polyolefin

Summary of document changes

1. Document formatted to the new APTA standard format.
2. Sections have been moved and renumbered.
3. Definitions, abbreviations and acronyms have been moved to the back of the document.
4. Three new sections added: 'Related APTA Standards", "Summary of document changes" and "Document history."
5. Section 1 headings in this document changed so that the headings in this document and Section 1 headings in its companion escalator document (APTA RT-EE-RP-001-02 Rev 1) reflect the same.
5. Some global changes to section headings and numberings resulted when sections dealing with references and acronyms were moved to the end of the document and other cosmetic changes, such as capitalization, punctuation, spelling, grammar and general flow of text.

Document history

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First published	May 2006	-	-	June 10, 2006	June 2006
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