

# HEAVY DUTY, TRANSPORTATION SYSTEM MOVING WALK DESIGN GUIDELINE

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**Heavy Duty Moving Walkway Design Working Group**

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**APTA Elevators and Escalators Technical Forum**

**Abstract:** This document contains design guidelines for transit systems to use to specify heavy duty moving walkways. APTA developed these guidelines to improve operating reliability of moving walkways that operate in a public transit environment.

**Keywords:** heavy duty moving walkways, transit moving walkways

## Introduction

This design guideline is the result of the combined efforts of the members of the APTA Elevator and Moving walk Technical Forum over the past several years. The objective is to address the specific heavy duty moving walk needs of North American Transportation Systems. It is intended as a guideline of technical provisions for the design and construction of moving walks which 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, moving walk and component manufacturers.

This design guideline is not intended to be a 100%, ready technical specification for all Transportation systems. Each Authority 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 manufactures will be quick to tell us that these requirements will “add to the cost of the procurement”. We all know, from past experience, the high life cycle maintenance costs associated with the manufacturer’s “standard” product when used in a Transportation environment. Paying “more up front” will be more than compensated for by the overall reduced life cycle costs. And, most importantly, will improve customer safety, satisfaction, and convenience. The results 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.

August 2003

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# Heavy-Duty, Transportation System Moving Walkway Design Guidelines

## PART I GENERAL

### 1.01 General Description

- A. This section specifies requirements for design, fabrication, installation, and testing of moving walks.

### 1.02 Definitions:

- A. Heavy duty moving walk: A moving walk designed specifically for transportation system usage.
- B. Working points. For inclined moving walks, the points of intersection of pallet or beltway line on the incline and the horizontal line of the top and bottom landing plates at finish elevation.
- C. Special tools: Tools designed specifically for tasks associated with moving walk examinations, maintenance, and repair, or those which are required for these tasks and are not readily available through normal purchasing channels.
- D. Pallet or beltway width: The horizontal distance between skirt panels.
- E. Moving walk support: the upper, lower, and intermediate supports needed to support the total loads of the moving walk.
- F. Slip joints: A slip joint is a sliding joint required to support moving walks in Transportation system and high rise applications. Location can be at top or bottom support areas but are generally located at the platform level or as indicated on the contract drawings.
- G. SCADA: System Control and Data Acquisition system to connect various pieces of equipment in a geographic area.
- H. Installer: The contractor or subcontractor responsible for furnishing and installing the moving walk.
- I. Contractor: Any responsible party involved in the installation other than the installer of the moving walk.

### 1.03 Temporary And Permanent Electrical Power Services:

- A. Temporary power for installation shall be made available to Installer at the time of the setting of truss. Permanent power shall be made available for testing. All power shall be provided at no cost to Installer.

Note to specifier: close coordination with the electrical engineer is recommended to provide the proper power supply for a given installation. Some manufacturers may require transformers for certain voltages.

- B. For the moving walk drive systems: 208 or 480 volts, 3 phase, 3 wire, 60 Hertz terminating in a disconnect switch within sight of the controller.
- C. For lighting and GFCI receptacles: 120 volts, 1 phase, 3 wire, 60 Hertz terminating in the moving walk truss.

Note to specifier: There is no issue date in this guideline for these standards since many jurisdictions have adopted these standards with various effective dates. It is the duty of the specifier to determine the correct version of these standards for the project being designed.

### 1.04 Applicable Codes, Standards, And Publications:

- A. Moving walk designs and installations shall be heavy duty, and shall comply with the following.
1. American Society of Mechanical Engineers (ASME)
    - a. ASME A17.1
    - b. ASME A17.2.3
    - c. ASME A17.5 applicable edition
  2. European Norm, EN115
  3. Canadian Standards Association, CSA B44
  4. National Fire Protection Association (NFPA)
    - a. NFPA No. 130, "Fixed Guideway Transit and Passenger Rail Systems"
    - b. ANSI C1, National Electric Code (NFPA 70)
  5. Americans with Disabilities Act (ADA)
  6. Canadian Welding Bureau (CWB)
  7. American Welding Society (AWS)
  8. American Society of Testing and Material (ASTM)
  9. ISO 281/I-1997

10. AFBMA, Std. 9 and 11

11. National Electrical Manufacturers Association (NEMA)

- B. Any additional requirements imposed by local agencies shall be incorporated into moving walk installations.
- C. In case of a conflict between codes, regulations, or standards, the most stringent requirement shall take precedence.

### 1.05 Design Criteria:

A. General

Moving walks shall be designed with provisions for thermal expansion and contraction of complete moving walk assemblies and for any movement of the facility caused by trains braking when fully loaded.

B. Operational Requirements

- 1. Hours of operation shall be considered as twenty-four (24) hours per day, seven (7) days per week
- 2. Direction of travel shall be considered as either direction, and unit shall be reversible.
- 3. Rated Speed shall not exceed 140 feet per minute (FPM).- The no load to full load speed shall not exceed 4% of the rated speed.
- 4. Moving walk components shall be designed based on the following applied duty cycle during a 24 hour day operation:
  - a. Six (6) Hours with 100% Rated Load
  - b. Twelve (12) Hours with 50% Rated Load
  - c. Six (6) Hours with 25% Rated Load
- 5. Rated load shall be at least  $370 \text{ kg/m}^2$  ( $75 \text{ lbf/ft}^2$ ) of exposed treadway or beltway area. Stationary brake rated load shall be at least  $490 \text{ kg/m}^2$  ( $100 \text{ lbf/ft}^2$ ) based on the exposed treadway or beltway area.

*Note to specifier: 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. Installer shall provide moving walk truss mounting angles and intermediate truss supports with attachments, sized as required to install moving walks into wellway structural support system shown on the contract drawing.

2. Moving walk intermediate support points shall be provided by Installer where required. Details and calculations shall be submitted by moving walk Installer for approval by the Authority.
3. Loads shall be indicated on contract drawings.
4. Loads were computed for heavy-duty, transportation system type moving walks as described herein.
5. Loads were computed assuming moving walks shall not require a separate machine room outside of truss envelope.

*Note to specifier: The provisions included in items 1.05.C 2,3 and 5 are intended to provide the moving walk manufacturer with information regarding the load bearing capacity of the structure and require the designer to develop a contract drawing that defines the loading the structure is designed to accept. Inclusion of items 2,3 and 5 is necessary in cases where moving walks are installed in existing wellways, or in any other situation which it is necessary to define constraints on moving walk loading.*

#### D. Environmental Requirements

*Note to specifier: Interior installations include facilities such as airports and controlled environments with no corrosive elements. Exterior installations should be used for all subway, rail and bus applications whether exposed to the weather or not.*

1. General: Moving walks shall be capable of operating with full-specified performance capability while exposed to the following climatic and environmental conditions.
  - a. Interior installations: Moving walks shall be designed to operate in a temperature range of plus five (+5) to plus one hundred and twenty (+120) degrees Fahrenheit, dry bulb; and all conditions of relative humidity while exposed to airborne dust and debris.
  - b. Exterior installations: Moving walks shall 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, de-icing chemicals, airborne dust, and debris, and corrosive elements; and in a dry bulb temperature range of minus ten (10) to plus one hundred and five (+105) degrees Fahrenheit

*Comment: Sound levels typically exceed 49 Dba in Transportation systems, making this requirement difficult to achieve.*

2. Sound Level: Moving walks shall be designed to operate at or below a sixty-five (65) dBA sound level, measured five (5) feet above the moving walk at any location, with the moving walk operating normally, either free running or under load. For multiple moving walk installations, the noise measurements shall be made with only one (1) moving walk unit in operation, but with the entire installation complete and in operating condition. An ambient level not to exceed forty-nine (49) dBA shall be maintained prior to units being turned on.



*Comment: This is an optional requirement. It is only known for one Transportation agency to use this requirement. There is also concern about the availability of test equipment that is not proprietary to test this.*

3. Vibration: Moving walk shall be tested for vibration levels. A maximum velocity reading of four-tenths (0.4) of an inch per second root mean square (RMS) shall not be exceeded. The metering device used to perform the test shall be a Fast Fourier Transform (FFT) analyzer.

Bearing housings noted below shall be provided with a drilled, tapped and spot faced area in the vertical and axial axis accommodate a transducer that FFT analyzer requires. Permanently mount transducers on the drive bearings and run the wires into the controller to a panel with BNC connectors on the ends to accommodate the FFT analyzer.

Motor limit: rigid mount: .15 ips    flex mount: .2 ips  
Main drive bearings: .4 inch per second RMS  
Carriage bearings: .4 inch per second RMS

*Comment: This is an optional requirement. It is only known for one Transportation agency to use this requirement. There is also concern about the availability of test equipment that is not proprietary to test for this requirement.*

4. Fire Protection: Moving walks shall be constructed of noncombustible materials as defined in ASTM A 136 throughout, with the exception of, handrails, handrail rollers, chain pallet or beltway wheels, and electrical equipment, Handrails shall have a flame spread rating of seventy-six (76) to two hundred (200), when tested in accordance with ASTM E 84.
5. Bearings shall be rated for an AFBMA L10 life , calculated in accordance with the rated load and specified duty cycle stipulated in section 1.05.B.1.

## 1.06 Job Conditions:

- A. Protection: During installations, and until moving walk systems are fully operative, Installer shall make necessary provisions to protect systems from damage, deterioration, and environmental conditions.
- B. Coordination Requirements
  1. Alterations: Installer shall coordinate any alterations required to accommodate moving walks with the Authority.
  2. Cladding: Installer shall review all appropriate contract drawings dealing with proposed methods of securing cladding to truss. Installer shall

- coordinate with other appropriate contractors prior to any such actual work.
3. Floor finish at landing plates and newels: Installer shall coordinate with other appropriate contractors and/or trades.
  4. Moving walk pit heating and ventilation: Installer shall install heaters and ventilating fans where required.
  5. Lock and key requirements: Installer shall coordinate with the Authority.
  6. Pit Drainage: Provide a means to prevent water from accumulating in the pit for outdoor moving walks and indoor moving walks subject to ground water or station wash downs.
  7. Rigging Plan: Installer shall supply a rigging plan that is approved by the Authority.
  8. Safety Training: Installer shall attend appropriate safety training programs provided by the Authority at no extra cost.
  9. As built drawings: Installer is responsible to provide revised contract drawings to reflect the actual as built condition including all structural, architectural, electrical, mechanical and plumbing connections to the moving walks.
  10. Methodology: The Installer shall meet with the Authority and provide a written method of installation for approval.
  11. If the moving utilizes a stanchion type (truss-less) type system instead of a truss in the intermediate section, the position of the stanchion mounting plates, or beams, must be coordinated between the installer and the appropriate contractor.

### 1.07 Quality Assurance:

- A. Regulatory agencies: moving walk design, materials, construction clearances, workmanship, and tests shall conform to the requirements of the codes and regulations listed in part 1.04, APPLICABLE CODES, STANDARDS, AND PUBLICATIONS.
- B. Welding: Welding shall be performed in accordance with the requirements of AWS or CWB. Welders shall produce evidence of current certification by AWS or CWB.
- C. Dimensions
  1. Walkway widths shall conform to requirements of ASME A17.1 Code based on speeds and angle of inclination.

*Comment: ADA prohibits 24 inch wide pallet or beltways in below ground Transportation applications. However, there may be certain structural impediments when installing a new moving walk in an existing wellway or station that may require an moving walk with a 24 inch pallet or beltway. Also note that 40 inch wide pallet or beltways are preferred to permit two lanes of pedestrian travel on the moving walk, allowing faster moving pedestrians to walk by standing pedestrians on the moving walk pallet or beltways.*

2. Structural dimension requirements:
  - a. Installer shall design and fabricate moving walks to fit within existing structures.
  - b. Installer shall verify dimensions of wellways prior to manufacturing trusses.
  - c. In the event of a discrepancy, Installer shall notify the Authority immediately, and shall not proceed with installation in the areas of discrepancy, until the discrepancy has been fully resolved, and the Authority has instructed Installer to proceed. Failure of Installer to report discrepancies shall constitute an acceptance of existing work as fit and proper for the execution and completion of Installer's work.
- D. Labeling: Every moving walk shall be clearly marked permanently on the controller with rated load and speed, braking torque, manufacture serial number, and the designated Authority identification.
- E. Requirements of Regulatory Agencies
  1. Installer shall obtain and pay for all necessary permits, and perform such tests as may be required for acceptance and approval of moving walks by jurisdictional agencies.
  2. Installer shall notify the proper inspectors to witness required testing.

*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.*

- F. Factory Visit
  1. The Installer shall provide for the costs of up to three of the operating authorities representatives to visit the factory where the moving walk is being manufactured, per contract, per unit type.
  2. The moving walk shall be tested with its own designated controller. The operating authority shall observe the testing of the controller operation and the testing of the safety devices in each end of the moving walk.
  3. The Installer shall not ship the moving walk without the approval of the operating authority after the conclusion of the factory visit.

### **1.08 Submittals:**

- A. Shop drawings: Six (6) copies of the shop drawings shall be provided by the Installer. Drawings shall include, but not be limited to, facsimile outline of moving walk truss in profile and plan; facsimile elevation of moving walk balustrade, and vertical section through balustrade and truss midway between

working points. Drawings shall show truss stanchion; track system and supports; drive system; pallet or beltway nosing radius at upper and lower ends; drive chains and gear train; pallet or beltway chain or pallet or beltway links (including chain pitch, pallet or beltway, and trailer wheels); pallet or beltway assembly (including axle, pallet or beltway tread, frame, and riser); handrail system (including profile, guides, drive, and tension device); support details (including upper, lower, intermediate, and slip joint), balustrade deck cover, interior panels, skirt panels, and their moldings; safety switches and operating devices; motor and emergency brakes; floor plates; speed governor; metal gauges; radial, vertical, and horizontal dimensions required for manufacture, and positions of lower and upper working points; attachment of truss to structure; major mechanical and electrical components within truss; drainage and electrical interfaces; hand and finger guards; ceiling intersection guards; passenger instruction signs; emergency stop button; and operating panel in upper and lower balustrades (including stop button, start and direction selection switches, and fault finder receptacle). All bearing ratings, identification and catalog numbers shall be provided.

- B. Also, a complete schematic diagram shall be provided for the controller and all electrical devices.
- C. Test certificates for pallet or beltway chain shall be provided for approval.

*Comment: the specifier should stipulate a time frame from Notice to Proceed to obtain these drawings.*

### **1.09 (Optional specification for fast track projects:)**

- A. Shop drawings: Six (6) copies of the shop drawings shall be provided by the Installer for approval within three weeks of notice to proceed. Drawings shall include, but not be limited to, facsimile outline of moving walk truss in profile and plan; facsimile elevation of moving walk balustrade, and vertical section through balustrade and truss midway between working points. All bearing ratings, identification and catalog numbers shall be provided
- B. Record drawings shall be submitted for the following: Drawings shall show truss stanchion; track system and supports; drive system; pallet or beltway nosing radius at upper and lower ends; drive chains and gear train; pallet or beltway chain or pallet or beltway links (including chain pitch, pallet or beltway, and trailer wheels); pallet or beltway assembly (including axle, pallet or beltway tread, frame, and riser); handrail system (including profile, guides, drive, and tension device); support details (including upper, lower, intermediate, and slip joint), balustrade deck cover, interior panels, skirt panels, and their moldings; safety switches and operating devices; motor and emergency brakes; floor plates; speed governor; metal gauges; radial, vertical, and horizontal dimensions required for manufacture, and positions of lower and upper working points; attachment of truss to structure; major mechanical and electrical components within truss; drainage and electrical interfaces; hand and finger guards; ceiling intersection

guards; passenger instruction signs; emergency stop button; and operating panel in upper and lower balustrades (including stop button, start and direction selection switches, and fault finder receptacle). Also, a complete schematic diagram shall be provided for the controller and all electrical devices. The Installer is not relieved of his obligation to meet the specifications. If the record drawings do not comply with specifications, the Installer shall immediately remedy the condition in the field and update record drawing accordingly.

- C. Maintenance programs: within sixty (60) days after notice to proceed, and prior to installation, Installer shall submit detailed interim and revenue service maintenance programs, showing functions to be performed and their scheduled frequency.
- D. Operating and Maintenance manuals: Prior to installation, Installer shall submit six (6) complete sets of Operation and Maintenance manuals for approval: After Authority approval and prior to the beginning of acceptance testing, six (6) sets of the approved manuals shall be provided by the Installer. The manuals shall 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 of replaceable parts, part numbers, current cost, and warehouse location. If product source is another vendor, Installer shall include name and address of other vendor.
  4. Sample copies of a preventive maintenance chart.
  5. Descriptions 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, pallet or beltway chain tension, track system, and mechanical components, including pictorials.
  8. Instructions for removing floor plate, replacing comb segments, and removing and installing pallet or beltways, and interior panels.
  9. Troubleshooting techniques.
  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. Control and schematic electrical wiring diagrams of controller, including wiring of safety devices to connections with remote indication and control panels for each moving walk and group of moving walks.

12. Electrical layout showing placement of lighting, light switches, receptacles, light fixtures, disconnect switches, and convenience outlets in machinery room, truss envelope, and pits.
13. Complete detailed drawings and wiring diagram of moving walk fault finding device and connection to annunciator panel.

E. Certification:

1. The moving walk manufacturer shall provide to the operating authority, certification, that the operating authority of the moving walk(s) shall be provided with copies of all documents related to maintenance, safety, operations, design changes, modifications, retrofits, etc., Which relate to any part, component, equipment, system, subsystem, or material and services applicable to the moving walk provided.
2. All of the above referenced shall be provided as it pertains to the original installation and for a period of ten (10) years after final acceptance of the last moving walk provided under any contract.
3. The referenced material shall be provided within thirty (30) days of publication or internal distribution by the moving walk manufacturer. The material, even if labeled PROPRIETARY, shall be delivered to the Authority without prejudice or delay and at no additional cost.
4. Provide all material on CD-ROM in a format approved by the Authority.

- F. MSDS and product data sheets: Shall be submitted with an index listing each product, along with the application method of the product, approximate quantity of product per moving walk, and the component the product is applied to or associated with. The Installer shall allow 6 (six) weeks for review of MSDS.

## PART 2 PRODUCTS

### 2.01 General:

- A. Installer shall furnish and install moving walks that shall comply with the following requirements:
1. All moving walks supplied under this contract shall be the product of a single manufacturer.
- B. Moving walks shall comply with the following:
1. Length: As Shown On Contract Drawings  
Vertical Rise: As Shown on Contract Drawings [Inclined Walks]
  2. Inclination As shown on drawings [not to exceed 10 degrees]
  3. Nominal Pallet or beltway Width: as shown on contract drawings
  4. Speed not to exceed 140 FPM

5. Maintenance speed: not to exceed 25 feet per minute

C. Controls and safety devices

1. Operating controls:
  - a. Moving walks 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.
  - b. Each keyed switch shall be clearly and permanently labeled, including starting and direction selection.
  - d. Interlocks shall be provided to bring the moving walk to a smooth stop, in either direction of travel, before a change of direction may be made.

2. Safety Devices:

- a. Safety devices include, but are not limited to those which are 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 pits of moving walks.

3. A fault finding device shall be provided in the newels, capable of producing indications of the following data:

- a. Date, time, and cause of moving walk stoppages.
- b. The fault indication shall remain visible until reset by an authorized person.

a) Balustrades, skirt panels, and decking

*Note to specifier: If a the moving walk must be resistant to salt and dust (presumably containing corrosive pollutants) and there are humidity levels of 45% or above, Type 304 can start to corrode at least superficially. It is presumed that all of the moving walks will be in sheltered locations which are exposed to the atmosphere. Sheltered areas are far more aggressive environments than exposed locations. In urban locations with moderate to high pollution, industrial areas within 10 miles of a large salt water body, where deicing salt is used, or where exposure to urine is likely, Type 316 with a smooth finish (no rougher than Ra 20 micro-inches or 0.5 microns) should be used. In urban areas with high pollution levels or industrial areas with moderate to high pollution, the Type 316 should be cleaned at least quarterly to remove pollutants or if cleaning is not likely, a higher grade of stainless steel should be used such as 317L, 317 LMN, or 904L. Type 304, with the same surface roughness restriction, should only be considered in rural areas and low pollution urban areas where there is no possibility of salt or urine exposure. This is suggested based on the assumption that no staining of the surface is desired.*

1. Balustrades and skirt panels:

- a. Panels shall be a minimum of 3mm solid type 316 Stainless steel. Backing panels, where used, shall be noncombustible, and subject to Authority approval.
- b. Panels shall be constructed, when practical, in equal lengths for interchangeability.

- c. Panels shall be attached to permit easy removal for inspection, lubrication, and adjustment of safety devices.
- d. Panels shall be sized so that not more than two (2) persons shall be required to remove a panel, and without the aid of special handling equipment.
- e. Exposed panel fastener requirements (where used): panels shall be fastened to their respective supports or mating portions with tamper-proof, flathead machine screws.

*Note to specifier: Moving walk cladding consists of enclosing the sides and bottom of the moving walk, typically with 2mm stainless steel #4 finish. It is typically performed by an ornamental metals contractor. It is critical to ensure that this work is specified in the appropriate section, even if only for the newel ends that may be exposed.*

2. Decking shall be stainless steel, identical to balustrade, with minimum of 2mm.
3. Decking between moving walks shall be designed to support a live load of one hundred and seventy-five (175) pounds per square foot, without permanent deformation.
4. Paneling, decking, and other enclosures shall be supported on steel frame.
5. When framework to which decking are fastened is less than one quarter (1/4) of an inch thick, steel backup plates with a minimum one quarter (1/4) of an inch thickness shall be added which have tapped holes or clearance holes where necessary.

## b) Electrical Equipment

1. Motors: The driving motors shall be AC induction motors with starters. Voltage 480 V.A.C., 3 phase, Frequency 60 Hertz 3 wire.

*Note to specifier: Other motor voltages are permitted where different voltage is present.*

- a. The motors shall be totally enclosed with external cooling fins.
- b. The motor protection class shall be equivalent to. IP 55 Insulation group: F
- c. Driving motors and motor switchgear shall provide a smooth start.
- d. The motor shall be designed for continuous operation(s) with stipulated loading and duty cycles.

## 2. Controller

- a. The moving walk 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.



- b. Switch gear shall be mounted in NEMA 4X cabinets with strip heaters and labeled terminal strips.
  - c. The main controller shall use an Programmable Logic Controller (PLC) or approved equal, to control and monitor the status of the moving walk. The PLC shall be designed to communicate over Ethernet or approved equal. The PLC shall be SCADA and DeviceNet compatible.
  - d. The PLC racks shall provide space for two (2) future single slot modules.
  - e. The PLC in the remote control panel shall also have hardware and firmware provisions to communicate with interactive operator interface (monitor).
  - f. The PLC shall store the last 99 faults, accessible via laptop connection, panel view or remote communications.
  - g. Provide a copy of all working programs on approved computer medium as well as a printed program listing.
  - h. The Programmable Controller 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.
3. The main control switchgear of an moving walk shall contain at least the following devices:
- a. Lockable main switch thermal and magnetic motor protection starter for up and down travel, hour counter, auxiliary contactors, phase failure device, phase sequence monitor, and ground fault monitor.
  - b. The controller cabinet shall contain a permanently mounted fault indicator board with indicator lights. Each group of safety devices shall be connected to one (1) signal lamp.
  - c. 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.
  - d. All terminals shall have identification markings and all cables shall be provided with cable markers.
  - e. The controller shall be equipped with an AC induction motor reduced voltage starter; installed in line between the standard type contactor and the drive motor. The starter shall be solid state, capable of starting motors smoothly and gradually, reducing inrush current and mechanical shock upon start up. Adjustable settings for accelerating time and starting torque shall be provided. The starter shall also contain auxiliary contacts and a thermal overload relay for motor protection.

- f. Maintenance Receptacles: Electric power receptacles shall be furnished and installed in the upper and lower pits. Each receptacle shall be of the GFCI duplex type, waterproof, grounded, and rated for one hundred and twenty (120) volts at twenty (20) amperes. The receptacles in the pits shall be surface mounted on the walls, not less than thirty (30) inches from the floor.
- g. Relays shall be provided with visual indication that they are energized.
- h. Adjustable settings for accelerating time and starting torque shall be provided. The starter shall also contain auxiliary contacts and a thermal overload relay for motor protection.

*Refer to specifier: When using a maintenance drive, be aware of the consequences of using a variable frequency drive to accomplish this. Different requirements for overspeed, grounding and electrical noise protection must be considered.*

- F. Maintenance Drive Unit: Means shall be provided for reduced speed maintenance operation that shall be controlled by a manual handset. When operated, the moving walk shall run in the direction selected, at a speed of not more than 25 fpm. This speed shall be maintained when pallet or beltways are removed for servicing. Moving walk operation shall be continuous so long as an up or down button on the handset is being pressed. The handset shall have a ten (10) foot retractable type cord with a plug connector. When plugged into receptacle, there shall be no means of operating or running the moving walk except by the service handset. Receptacles shall be located in both the upper and lower pits.

## 2.02 Materials:

- A. Stainless steel
  - 1. Shapes and bars: ASTM A-276, type 304 or 316, A-554 for tubes.
  - 2. Plate, sheet, and strip
    - a. Over one eighth (1/8) of an inch:-ASTM A-240. Type 304 on a36 base.
    - b. Under one eighth (1/8) of an inch: ASTM A-240, Type 304 or 316.
- B. Fasteners
  - 1. Fasteners shall be compatible with materials being fastened fasteners shall be furnished with self locking nuts or retaining rings (spring washers, toothed disks).
  - 2. Fasteners shall be equal to or of greater corrosion resistance than the most corrosion resistant metals being fastened.

## 2.03 Finishes:

- A. Stainless Steel: No. 4 finish ASTM A-480

- B. Aluminum Castings and Extrusions: Commercial mill finish:
  - C. Galvanizing
    - 1. Sheet Steel: ASTM A446, or A526, as applicable. Coating designation G185.
    - 2. Other galvanizing ASTM A123, AS1M A 153, ASTM A 385, or ASTM A 386, as applicable.
  - D. Galvanizing Touch up: Zinc dust coating, MIL-P-21035 or MIL-P-26915.
- c) Paint and Corrosion Protection Each moving walk 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% 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 inhibitive primer coat after preparation by sandblasting.
  - 3. Steel parts which are not specified to be galvanized shall be painted as follows:
    - a. Primer coat two (2) mil (dry film thickness), minimum thickness.
    - b. Second finish coat two (2) mil (dry film thickness), minimum thickness.
  - 4. Bright or uncoated axles, shafts, etc. Shall be protected by zinc chromate, or chrome plating.
  - 5. Oil collector chutes and collection trays shall be fabricated of galvanized steel.

## **2.04 Mechanical Equipment:**

- A. Tracks
  - 1. Fabrication of tracks shall retain pallet or beltways and running gear safely under load requirements and at the highest speed specified
  - 2. Installer shall assemble and secure sections of track together for easy removal and replacement of defective sections. The system shall be adjustable, and welding of the track sections is not acceptable.
  - 3. Design of the mechanical components shall provide for easy installation and removal without the dismantling of parts of the structure.
  - 4. Tracks shall be properly supported on trusses to provide correct alignment and smooth transition to return stations. The rolling surface of the track shall be a minimum thickness of 3mm.
  - 5. The guiding system for the pallet or beltway chains and pallet or beltway 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.
6. The tracks and supporting structure shall be designed with sufficient stiffness to limit deflection to no more than 1/1000 of the span between supports when subjected to the rated loading.

*Note to Specifier: the APTA EETF recommends following the most up to date version of A17.1-d 2000 for optimum safety regarding pallet or beltway to skirt gaps. However, careful coordination with the local jurisdictional Authority is recommended since there are potential conflicts with previous versions of A17.1.*

## B. Pallet/Beltways

1. The entire pallet assembly shall be unpainted natural aluminum finish or treated with not less than one (1) coat of zinc chromate primer or iron phosphate and one (1) coat of powder coated enamel for corrosion resistance.
2. Beltways shall use all steel re-enforcement and have a maximum deflection of 1% cross deflection.
3. Pallets and their various attachments shall permit removal of pallets without disturbing balustrades.
4. The design shall permit the running of the drive without pallets during cleaning and inspection at maintenance speed.
5. Pallet trailing rollers, if used, or beltway support rollers shall have polyurethane tires on hubs, sealed roller bearings. Roller design shall include sufficient diameter to provide reliability, maintainability, smoothness of motion and compliance with overall noise levels specified. Bearings shall have an L10 rated life of 200,000 hours using rated load and duty cycle specified. Pallet or beltway rollers shall not require any additional lubrication and must be rated for severe, heavy-duty service.
6. Pallets shall be constructed so as to be driven by pallet linkages to pallet rollers.
7. Washers and nuts shall be provided as follows:
  - a. Tap bolts: Lock washers
  - b. Through bolts: Lock nuts or Authority approved equal

## C. Pallet Chain

1. Chain shall be endless, roller type pallet chains; one (1) on each side of pallet.
2. Pallet chains shall be of heat treated steel construction, supported at intervals by linkage wheels.
3. A means to prevent pallet from coming into physical contact with each other and to prevent chains from sagging or buckling shall be provided
4. A means to maintain constant distance between pallet axles shall be provided.
5. 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.
6. Pallet chains shall be constructed to permit removal of segments as may be

required for replacement purposes at a minimum of every 6 axle section. Each moving walk shall have at least two one axle sections.

7. Support wheels spaced to distribute load and to guide linkage throughout run shall be constructed of polyurethane material, with diameter sufficient to provide reliability, maintainability, smoothness of motion, and to operate within noise level requirements specified. The chain rollers shall have polyurethane tires on metallic hubs, sealed bearings, an L10 life of not less than 200,000 hours with the rated load and load duty cycle, must require no additional lubrication, and be replaceable without disassembly of the chain.
8. Wheels shall be affixed to permit rapid replacement.
9. Each pair of pallet or beltway chains shall be a matched set within manufacturing tolerances. Only precision, roller fishplate chains of high grade heat treated steel shall be used as pallet or beltway chains. The pins, axles, bushing, and rollers shall be hardened and ground.
10. Pallet chain pins shall be of a size such that the surface pressure at engaging points will not exceed 20N/mm<sup>2</sup> (2,900 psi) with non-ferrous bushings and 30N/mm<sup>2</sup> (3,450 psi) with ferrous bushings. This is to be based on pallet or beltway loads of at least 370kg/m<sup>2</sup> ( 87 lbf/ft<sup>2</sup>) of exposed treadway area.
11. The safety factor shall be 10 against breaking.
12. A test certificate for the chain breaking load shall be provided.
13. A shielding device shall be provided to protect chain, track guides, and rollers against water, dirt, and debris.

#### D. Combplate Assemblies

1. Complete assemblies of wear resisting, non-corrosive metal material, with exposed anti slip surfaces shall be fabricated.
2. Combplate sections meeting the following requirements shall be provided
  - a. Shall be removable to permit ease of replacement.
  - b. Shall be yellow in color for safety/demarcation.
  - c. Shall have not less than three (3), nor more than seven (7), combplate sections per Combplate assembly.
  - d. Provisions for lateral and vertical fine adjustments shall be provided so that cleats of pallet or beltway treads pass between combteeth with minimum clearances.
  - e. Combteeth meeting the following requirements shall be provided
  - f. Teeth shall be designed so as to withstand a load of two hundred and fifty (250) pounds applied in an upward direction at the tip of any one (1) tooth.

#### E. Floor Plates

1. Shall have 316 stainless steel frames at floor openings, designed to be supported on truss heads.

2. Shall be designed to cover entire area of upper and lower landings as indicated.
3. Shall be reinforced, as necessary, to be rigid and able to withstand a live load of two hundred and fifty (250) pounds per square foot with no more than 1/500 span in deflection.
4. Shall be extruded of die cast aluminum in a ribbed pattern transverse to the moving walk axis. Ribs shall be designed to provide maximum traction, and will be finished in the same manner as the combplates.
5. Shall have exposed portions constructed of material and finish to harmonize with pallet or beltways and combplates.

#### F. Drive Machinery

*Note to specifier: The drive may be located within the truss for most applications. Where very high rise moving walks require larger HP motors, or if the client prefers to work on machinery while the moving walks are being used as stairs, you can select a drive outside the truss envelope. Be prepared for a cost increase of about 300% for the entire installation as well as additional general construction costs to build and maintain the new room to locate the drive. Select one:*

1. 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.
2. 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.

#### 1. Gear Box Requirements.

- a. Gear bearings shall be rated with an AFBMA L10 life of 200,000 hours, utilizing the specified duty factor, and housed in an oil tight, dust proof case provided with a sight glass or dipstick method of determining oil level in the case. The case shall provide a convenient method of draining the oil.
- b. Use synthetic lubricants, subject to Authority approval.
- c. The assembly shall have no openings in order to minimize accumulation of dust and debris.
- d. Rotating parts shall be provided with a means for lubrication and retention of lubricants.
- e. Sealed bearings shall be used in those environmental conditions where entry of water or dust may adversely affect bearing performance.
- f. Exposed, moving, drive elements shall be protected by sealed metal housings, which shall provide continuous lubrication to components.
- g. Provide a low oil sensor to prohibit starting of the moving walk on

automatic operation with low oil in the gearcase.

2. V-belt and tooth belt drives shall not be considered acceptable. When chain drives are used, they shall be protected against dirt and water, and shall have an automatic lubricating device and a means of taking up any slack in the chain.
3. Main drive bearings shall be rated for AFBMA L10, 200,000 hours.

F. Drip Pans

1. Galvanized steel water tight drip pans for the entire length of trusses shall be provided. They shall be constructed to prevent oil from leaking below the moving walk.
2. Drip pans of sufficient size to collect and maintain, within truss areas, oil and grease drippings from pallet or beltway linkage and all forms of loose debris that maybe deposited in drip pans from pallet or beltways at turn around points at 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 spent lubricants into sewer system.
3. Access to drip pans at both landings of moving walks for the purpose of cleaning drain catch basins shall be provided.

G. Handrails:

1. General

- a. Handrails shall receive their motion from main moving walk drive through direct gearing and drive shaft or drive chains, so that handrail and pallet or beltways operate at the same speed in each direction of travel. Driving and guiding wheels shall have a groove to accept the wedge on the underside of the handrail.
- b. A means to take up handrail slack using a tensioning device, where required, shall be located within moving walks. In addition, an approved method of releasing the device for repair or removal of handrails shall be provided pre tensioning of handrail shall be considered unacceptable.
- c. Newels meeting the following requirements shall be provided
  - 1) Newels shall be designed and constructed so that handrail shall return into newel end at a point inconspicuous and difficult for passengers to reach
  - 2) Newel sheaves shall be provided at upper and lower newels.
  - 3) Handrails, handrail drive system, and guides shall be so designed and installed that handrail cannot be thrown off or disengaged while running, and special design attention shall be given to area where handrail passes from drive system to guides.
  - 4) Handrail rollers shall have sealed bearings rated at AFBMA

L10, 100,000 hours and have provision for retention of lubricant to ensure satisfactory lubrication and operation. Additional lubrication shall not be required.

- 5) Friction drive sheaves and idlers shall be designed and positioned so that lubricant cannot reach surface of handrail. Marking and spotting of handrail by drive equipment shall not be permitted. Provide sealed bearings rated at AFBMA L10, 100,000 hours.
- 6) Handrails shall be constructed of laminated, steel, wire mesh, or steel cable reinforced, flexible elastomer material vulcanized into an integral, seamless, smooth handrail resistant to environmental conditions. A V-shaped underside design shall be used, providing a more positive drive.
- 7) Handrail color shall be black.
- 8) Handrail guides shall be continuous on exposed portion of handrails, constructed of 316 stainless steel which shall not subject to corrosion nor pitting, and shall have a polished or specially coated, permanent finish to minimize frictional wear to under surface of handrail. 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.
- 9) Provide synthetic slider material.
- 10) Handrail gearbox, if provided, shall have bearings rated at AFBMA L10, 200,000 hours.

## I. Braking Requirements

### 1. Motor Brake

- a. Brake shall be capable of stopping and holding a descending moving walk with a load on the exposed pallets or beltways of at least  $370 \text{ kg/m}^2$  ( $75 \text{ lbf/ft}^2$ ) per ASME A17.1 deceleration requirements.
- b. The brake coil shall be insulated to class F.
- c. A monitor shall be provided, and if brake lining becomes insufficient for safe usage, restart of moving walk shall be prevented.

### 2. Pallet or beltway Band Lock

- a. Shall be manually applied and mechanically engaged to prevent movement of linkages, while moving walk is disconnected from its power supply.
- b. Electrical interlock that shall prevent moving walk drive motors from starting while pallet or beltway band lock is engaged shall be



provided.

*Note to specifier: If the building structure's deflection is an issue, closer coordination with the structural engineer and designer of the moving walk is required to determine if a truss based walk or a stanchion based walk is appropriate for the site specific circumstances.*

J. Walkway Supporting Structure

1. General

- a. The vertical deflection of truss and/or supporting elements, including rated load between support points shall not exceed 1/1250 of the unsupported span. Lateral stiffness/stiffeners shall be required between the treadway track support structures.
- b. The slip joint slide bearings shall not use grease for lubrication.
- c. Provide a permanent identification on the truss for the centerline at both ends of the moving walk and in both transition curves.

2. Field Splices, Connections and shims

- a. Field splices shall be rigid, non deforming, and shall maintain alignment.
- b. Field modification shall not compromise the paint and corrosion protection specified in section 2.03.B.
- c. Shims shall be 316 stainless steel with a maximum shim height of 2 inches.

K. Pallet Chain or Beltway Tensioning Device

1. The pallet chain or beltway tensioning device shall be of a design that keeps the pallet or beltway chains at the correct tension.
2. A pointer and scale shall be provided to gauge pallet chain or beltway tensioning and wear.
3. Bearings: If used, shall be rated: AFBMA L10, 200,000.

L. Lubrication System Requirements

1. Pallet Chain or beltway:

- a. All parts, other than sealed items, requiring lubrication shall be designed for an automatic or remote lubricating system, The system shall operate only when moving walk 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 of two and one half (2 1/2) gallons shall be provided.
- b. System shall be positive acting, located in moving walk pit.
- c. Reservoir level indications shall be provided where lubricants are

- contained within housings, supply tanks and larger filler cups.
- d. Electric heaters installed and connected to panel shall be employed to maintain lubricant viscosity where required.

2. Miscellaneous Lubrication:

- a. Installer shall furnish and mount—on the controller cabinet, a laminated-lubrication chart for each moving walk. The chart shall show the location of each lubrication point, type of lubricant to be used, and the frequency of lubrication.
- b. 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 bearings may be used where practical.

3. Manual Lubrication--Location of manual lubrication points shall be easily accessible and available.

M. Indicators

1. Moving walk users shall be informed by means of indicator lights of the predetermined running direction of the moving walk.
2. Two (2) circular cut outs, minimum diameter two and three quarter (2 ¾") inches. Shall be provided in the upper and lower right hand balustrade newels, each containing an inset red and green light. The green light shall be illuminated at the entrance for moving walk running direction and the red lamp shall have a horizontal white stripe and shall be illuminated at the exiting end. No incandescent lamps shall be permitted.

N. OPTIONAL: Room Storage Cabinet

1. A metal cabinet of not less than twenty (20) cubic feet in volume (52 inches high x 36 inches wide x 18 inches deep) shall be provided in a room assigned by the Authority.
2. Cabinet shall have lockable doors and be mounted on legs or a pedestal, a minimum of four (4) inches off the floor.
3. Cabinet shall be painted and marked for control purposes, as directed by the Authority, and Installer shall store small parts, supplies, tools and other materials within.

O. Lock Cylinders

1. All locks and keys shall be as per Authority approval.
  - a. Authority shall verify with the Installer that the requirements for hardware have not been amended or superseded
  - b. Installer shall provide the Authority with length, finish, and camming requirements of each cylinder required

P. Demarcation Lights--Shall be U.L. labeled suitable for wet locations.

## **PART 3 EXECUTION**

### **3.01 Installation**

- A. Installer shall install complete and operating moving walks in accordance with manufacturer's instruction and approved shop drawings.
- B. Installer shall install special tools in the room storage cabinet as specified in part 2.04.

### **3.02 Field Testing:**

- A. General
  1. Installer shall notify the Authority seven (7) days prior to each scheduled test. Installer shall perform testing in the presence of an Authority representative.
  2. Installer shall notify the appropriate local authorities having jurisdiction a minimum of seven (7) days in advance of final acceptance tests.
  3. Installer shall provide all instruments, materials, and labor required for tests specified herein.
- B. Acceptance testing requirements
  1. Testing shall be performed in accordance with ASME A17.2.3 procedures with the following additions or adaptations.
  2. Installer shall perform the following tests on each moving walk without load
    - a. Comb impact device shall be tested and calibrated with an appropriate scale at both ends of the moving walk in both the horizontal and vertical direction.
    - b. Brakes: Measure deceleration rate with no load over 5 consecutive stops in the down direction using test equipment designed to obtain this information.
    - c. *(Use only if sound requirements of 1.05 are specified)* Moving walk shall produce no noise louder than sixty five (65) decibels measured five (5) feet above the floor or stair level at the entrance combs at both ends with the moving walk operating normally, either free running or under load. For multiple moving walk

installations, the noise measurement at each group shall be made with only the one (1) moving walk unit under evaluation in operation. Ambient noise level shall not exceed forty nine (49) decibels.

- d. *(Use only if vibration requirements of 1.05 are specified)* Moving walk shall be tested to meet vibration requirements of section 1.05. The meter and the method shall be identical for all tests.
3. Installer shall perform the following tests on each moving walk under full load.
- a. Each moving walk shall have a full load as specified in 2.01.B brake test performed on it. The stopping distance in the down direction shall meet all requirements of ASME A17.1.
  - b. Twenty four hour test: the moving walk shall operate continuously for 24 hours after the acceptance test with no faults. If any fault occurs that shuts the moving walk down, the fault must be corrected and a new 24 hour test will begin.

**END OF SECTION**