

Automated People Mover Standards—Part 4

Security
Emergency Preparedness
System Verification and Demonstration
Operations, Maintenance, and Training
Operational Monitoring

This document uses both the
International System of Units (SI)
and customary units

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STANDARDS

In 2003, the Board of Direction approved the revision to the ASCE Rules for Standards Committees to govern the writing and maintenance of standards developed by the Society. All such standards are developed by a consensus standards process managed by the Society's Codes and Standards Committee (CSC). The consensus process includes balloting by a balanced standards committee made up of Society members and nonmembers, balloting by the membership of the Society as a whole, and balloting by the public. All standards are updated or reaffirmed by the same process at intervals not exceeding five years.

The following standards have been issued:

- ANSI/ASCE 1-82 N-725 Guideline for Design and Analysis of Nuclear Safety Related Earth Structures
- ASCE/EWRI 2-06 Measurement of Oxygen Transfer in Clean Water
- ANSI/ASCE 3-91 Standard for the Structural Design of Composite Slabs and ANSI/ASCE 9-91 Standard Practice for the Construction and Inspection of Composite Slabs
- ASCE 4-98 Seismic Analysis of Safety-Related Nuclear Structures
- Building Code Requirements for Masonry Structures (ACI 530-02/ASCE 5-02/TMS 402-02) and Specifications for Masonry Structures (ACI 530.1-02/ASCE 6-02/TMS 602-02)
- ASCE/SEI 7-05 Minimum Design Loads for Buildings and Other Structures
- SEI/ASCE 8-02 Standard Specification for the Design of Cold-Formed Stainless Steel Structural Members
- ANSI/ASCE 9-91 listed with ASCE 3-91
- ASCE 10-97 Design of Latticed Steel Transmission Structures
- SEI/ASCE 11-99 Guideline for Structural Condition Assessment of Existing Buildings
- ASCE/EWRI 12-05 Guideline for the Design of Urban Subsurface Drainage
- ASCE/EWRI 13-05 Standard Guidelines for Installation of Urban Subsurface Drainage
- ASCE/EWRI 14-05 Standard Guidelines for Operation and Maintenance of Urban Subsurface Drainage
- ASCE 15-98 Standard Practice for Direct Design of Buried Precast Concrete Pipe Using Standard Installations (SIDD)
- ASCE 16-95 Standard for Load Resistance Factor Design (LRFD) of Engineered Wood Construction
- ASCE 17-96 Air-Supported Structures
- ASCE 18-96 Standard Guidelines for In-Process Oxygen Transfer Testing
- ASCE 19-96 Structural Applications of Steel Cables for Buildings
- ASCE 20-96 Standard Guidelines for the Design and Installation of Pile Foundations
- ANSI/ASCE/T&DI 21-05 Automated People Mover Standards—Part 1
- ASCE/T&DI 21.2-08 Automated People Mover Standards—Part 2
- ASCE/T&DI 21.3-08 Automated People Mover Standards—Part 3
- ANSI/ASCE/T&DI 21.4-08 Automated People Mover Standards—Part 4
- SEI/ASCE 23-97 Specification for Structural Steel Beams with Web Openings
- ASCE/SEI 24-05 Flood Resistant Design and Construction
- ASCE/SEI 25-06 Earthquake-Actuated Automatic Gas Shutoff Devices
- ASCE 26-97 Standard Practice for Design of Buried Precast Concrete Box Sections
- ASCE 27-00 Standard Practice for Direct Design of Precast Concrete Pipe for Jacking in Trenchless Construction
- ASCE 28-00 Standard Practice for Direct Design of Precast Concrete Box Sections for Jacking in Trenchless Construction
- ASCE/SEI/SFPE 29-05 Standard Calculation Methods for Structural Fire Protection
- SEI/ASCE 30-00 Guideline for Condition Assessment of the Building Envelope
- SEI/ASCE 31-03 Seismic Evaluation of Existing Buildings
- SEI/ASCE 32-01 Design and Construction of Frost-Protected Shallow Foundations
- EWRI/ASCE 33-01 Comprehensive Transboundary International Water Quality Management Agreement
- EWRI/ASCE 34-01 Standard Guidelines for Artificial Recharge of Ground Water
- EWRI/ASCE 35-01 Guidelines for Quality Assurance of Installed Fine-Pore Aeration Equipment
- CI/ASCE 36-01 Standard Construction Guidelines for Microtunneling
- SEI/ASCE 37-02 Design Loads on Structures During Construction
- CI/ASCE 38-02 Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data
- EWRI/ASCE 39-03 Standard Practice for the Design and Operation of Hail Suppression Projects
- ASCE/EWRI 40-03 Regulated Riparian Model Water Code
- ASCE/SEI 41-06 Seismic Rehabilitation of Existing Buildings
- ASCE/EWRI 42-04 Standard Practice for the Design and Operation of Precipitation Enhancement Projects
- ASCE/SEI 43-05 Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities
- ASCE/EWRI 44-05 Standard Practice for the Design and Operation of Supercooled Fog Dispersal Projects
- ASCE/EWRI 45-05 Standard Guidelines for the Design of Urban Stormwater Systems
- ASCE/EWRI 46-05 Standard Guidelines for the Installation of Urban Stormwater Systems
- ASCE/EWRI 47-05 Standard Guidelines for the Operation and Maintenance of Urban Stormwater Systems
- ASCE/SEI 48-05 Design of Steel Transmission Pole Structures

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FOREWORD

The Board of Direction approved revisions to the ASCE Rules for Standards Committees to govern the writing and maintenance of standards developed by ASCE. All such standards are developed by a consensus standards process managed by the ASCE Codes and Standards Committee (CSC). The consensus process includes balloting by a balanced standards committee, and reviewing during a public comment period. All standards are updated or reaffirmed by the same process at intervals of between five and ten years.

This standard is Part 4 of the four-part Automated People Mover Standards, which establish the minimum set of requirements necessary to achieve an acceptable level of safety and performance for an Automated People Mover (APM) system. An APM is defined as a guided transit mode with fully automated operation, featuring vehicles that operate on guideways with exclusive right-of-way.

Parts 1, 2, and 3 cover requirements for design of an APM system while Part 4 covers requirements for an APM in passenger operation. Part 4 contains sections covering security; emergency preparedness; system verification and demonstration; operations, maintenance, and training; and operational monitoring. It also includes three informative annexes which are not mandatory parts of the standard. The provisions of these annexes are written in permissive language and, as such, offer to the user a series of options or instructions but do not prescribe a specific course of action. Significant judgment is left to the user of these annexes.

The ASCE Automated People Movers Standards Committee has been developing these standards since 1991. The committee comprises individuals from many backgrounds, including consulting engineering,

research, transit agencies, airports, transit system design and manufacturing, education, government, and private practice.

This standard establishes the minimum set of requirements necessary to achieve an acceptable level of safety and performance for an APM system. As such, it may be used in the safety certification process. The overall goal of this standard is to assist the industry and the public by establishing standards for APM systems.

This standard has no legal authority in its own right but may acquire legal standing in one or more of the following ways:

1. Adoption by an authority having jurisdiction.
2. Reference to compliance with the standard as a contract requirement.
3. Claim by a manufacturer or manufacturer's agent of compliance with the standard.

This standard will be beneficial to transportation engineers, civil engineers, safety engineers, and contractors of APM systems. Anyone who owns, operates, builds or maintains, designs, tests, insures, oversees, or certifies APMs or other innovative technology transit systems such as magnetic levitation, air cushion, and monorail systems will also benefit from the standard.

This standard has been prepared in accordance with recognized engineering principles and should not be used without the user's competent knowledge for a given application. The publication of this standard by ASCE is not intended to warrant that the information contained therein is suitable for any general or specific use, and ASCE takes no position respecting the validity of patent rights. The user is advised that the determination of patent rights or risk of infringement is entirely their own responsibility.

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Automated People Mover Standards—Part 4

1. GENERAL

1.1 SCOPE

This standard has been divided into four parts to expedite the approval and release process as well as to facilitate ease of use. This document constitutes Part 4 of the standard.

Parts 1, 2, and 3 cover a minimum set of requirements for design of an Automated People Mover (APM) with an acceptable level of safety and performance.

Part 1 consists of:

1. General
2. Operating Environment
3. Safety Requirements
4. System Dependability
5. Automatic Train Control (ATC)
6. Audio and Visual Communications

Part 2 consists of:

1. General
7. Vehicles
8. Propulsion and Braking

Part 3 consists of:

1. General
9. Electrical
10. Stations
11. Guideways

Part 4 is a minimum set of requirements for maintaining an acceptable level of safety and performance for an APM in passenger operation.

Part 4 consists of:

1. General
12. Security
13. Emergency Preparedness
14. System Verification and Demonstration
15. Operations, Maintenance, and Training
16. Operational Monitoring

The APM Standards all use SI units with equivalent English units provided in parentheses.

1.2 EXISTING APPLICATIONS

Existing installations and projects in progress prior to the effective date of this standard need not comply

with the new or revised requirements of this edition, except where specifically required by the authority having jurisdiction. Existing APMs, when completely removed and reinstalled, shall be classified as new installations.

1.3 NEW APPLICATIONS

New installations begun after the effective date of this standard shall comply with the new or revised requirements of this edition.

1.4 REFERENCE STANDARDS

ASCE 21, Part 4 does not directly reference any standards or documents, other than the other three parts of ASCE 21. Those documents and standards referenced by the other three parts of ASCE 21 will be found in the reference section of each respective part.

1.5 DEFINITIONS

Automated People Mover (APM): A guided transit mode with fully automated operation, featuring vehicles that operate on guideways with exclusive right-of-way.

Automatic Train Control (ATC): The system for automatically controlling train movement, enforcing train safety, and directing train operations. ATC includes subsystems for automatic train operation (ATO), automatic train protection (ATP), and automatic train supervision (ATS).

Automatic Train Operation (ATO): The subsystem within the ATC system that performs any or all of the functions of speed regulation, programmed stopping, door and dwell time control, and other functions otherwise assigned to the train operator.

Automatic Train Protection (ATP): The subsystem within the ATC system that provides the primary protection for passengers, personnel, and equipment against the hazards of operations conducted under automatic control.

Automatic Train Supervision (ATS): The subsystem within the ATC system that monitors and manages the overall operation of the APM system and provides the interface between the system and the central control operator.

Bogie: The bogie consists of the elements which transmit lateral, longitudinal, and vertical loads between the guideway and the carbody. Bogies are also referred to as “trucks”.

Braking, Emergency: Irrevocable braking to a complete stop at a rate never less than the minimum guaranteed rate.

Braking, Service: Braking of vehicle motion at a rate that is regarded as comfortable for repeated use in service stopping and/or slowing.

Carbody: The structural body shell, enclosing the passenger compartment(s).

Central Control: The location where ATS is accomplished for the entire transit system; the train command center.

Central Control Operator: Any person authorized to operate the APM system from central control.

Consist: The makeup or composition (number and specific identity) of a train of vehicles.

Cosmetic Damage: Damage that does not impair system function, performance, safety, or structural integrity.

Dwell Time: The total time the train services the station, measured as the time from the door open command to the time the doors are closed and locked.

Dynamic Sign: A sign on which the messages can be changed.

Fail-Safe: A characteristic of a system or its elements whereby any failure or malfunction affecting safety will cause the system to revert to a state that is known to be safe.

Failure: Inability to perform an intended function.

Free Field: An isotropic, homogeneous sound field that is free from all bounding surfaces.

Guideway: A track or other riding surface (including supporting structure) that supports and physically guides transit vehicles specially designed to travel exclusively on it.

Hazard: An existing or potential condition that can result in an accident.

Headway: The time separation between two trains, both traveling in the same direction on the same guideway, measured from the time the head end of the leading train passes a given reference point to the time the head end of the train immediately following passes the same reference point.

Interlock: An arrangement of control elements so interconnected that their operations must succeed each other in proper sequence.

Jerk: The time rate of change of acceleration or deceleration.

MTBHE: Mean time between hazardous events (ANSI/ASCE/T&DI 21-05, Section 3.4, Table 3-1).

Operating Loads: Definitions of operating loads are presented in ASCE/T&DI 21.2-08, 7.4.4.1.1, as lateral loads, vertical loads, and longitudinal loads.

Overspeed: Train speed that is in excess of the speed limit as defined for the relevant point on the guideway.

Overtravel: Continued movement of a train beyond a specified stopping point.

Passenger Compartment: If a vehicle is divided into separate areas between which passengers are either unable or not permitted to move, each such area is defined as a passenger compartment. If the vehicle is not so divided, the entire carbody is the passenger compartment.

Permissive Decision: Granting permission or authority for the system or a part of the system to enter any state other than the safe state.

Risk: A measure of the severity and likelihood of an accident.

Safe State: System state that is deemed acceptable by the hazard resolution process (ANSI/ASCE/T&DI 21-05, Section 3.1.2).

Safety Critical: A designation placed on a system, subsystem, element, component, device, or function denoting the satisfactory operation of which is mandatory to mitigation of unacceptable and undesirable hazards as defined in ANSI/ASCE/T&DI 21-05, Section 3.4, Table 3-1.

Separation: The distance between the adjacent ends of two trains traveling along the same guideway, as measured along the guideway centerline.

Shall: In this standard, the word “shall” denotes a mandatory requirement.

Should: In this standard, the word “should” denotes a recommendation.

Slow-Speed People Movers: Defined as those particular site applications in which all vehicles travel no more than 32 km/h (20 mph) at any location on their route during normal operation.

Subsystem: A major functional subassembly or grouping of items or equipment that is essential for operational completeness of a system.

System: A composite of people, procedures, facilities, and/or equipment that are integrated to perform a specific operational task or function within a specific environment.

System Dependability: The overall set of criteria used to measure the performance of an operating system in terms of reliability, maintainability, and availability.

System Safety: The application of engineering and management principles, criteria, and techniques to

optimize all aspects of safety within the constraints of operational effectiveness, time, and cost throughout all phases of the system life cycle.

Tabletop Drill: A simulated/theoretical drill where personnel carry out their functions by discussion.

Train: A consist of one or more contiguous vehicles combined into an operating unit.

Vehicle: The smallest unit that can operate alone or that comprises one of the basic building blocks of a train.

Zero Speed: A specified speed below which ATC considers a train to be stopped.

12. SECURITY

A System Security Program, per 12.1, shall be instituted during the system planning/design phase and continue throughout the system construction, testing, and operation. The System Security Program shall emphasize the prevention of incidents by identifying and resolving threats and vulnerabilities in a systematic manner. A written plan shall be developed in accordance with 12.2 to assist in implementing and documenting that program. The System Security Program and Emergency Preparedness Program, per Section 13, shall be coordinated to avoid conflicts.

12.1 SYSTEM SECURITY PROGRAM

A System Security Program shall meet the following requirements.

12.1.1 Management and Accountability

The System Security Program and Emergency Preparedness Program shall be established and documented in plans per 12.2 and 13.1, respectively.

1. These plans shall be updated to reflect anti-terrorist measures and any current threat conditions.
2. These plans shall be part of an integrated system program, including regional coordination with other agencies, security design criteria in procurements, and organizational charts for incident command and management systems.
3. These plans shall be signed, endorsed, and approved by senior management.
4. Management of these plans shall be assigned to a senior-level manager.
5. Security responsibilities shall be defined and delegated throughout the entire organization.
6. All operations and maintenance supervisors, forepersons, and managers shall be held accountable for security issues under their control.

12.1.2 Security Problem Identification

A threat and vulnerability assessment resolution process shall be established and used. Security-sensitive intelligence information shall be shared among appropriate security-related authorities.¹

12.1.3 Employee Selection

Background investigations shall be established. Criteria shall be established for these background investigations.

12.1.4 Training

Security orientation or awareness materials shall be provided to all employees. Ongoing training programs on security required by 15.8 shall be provided by work area. Public awareness materials shall be developed and distributed on a system-wide basis.

12.1.5 Audits and Drills

Periodic audits of security policies and procedures shall be conducted at the following intervals:

1. Tabletop and functional security drills shall be conducted at least once every six months.
12. Full-scale exercises, coordinated with appropriate emergency response providers, shall be performed at least annually.

12.1.6 Document Control

Access to documentation of security critical systems and facilities shall be controlled.

12.1.7 Access Control

Requirements for access control shall be established.

12.2 SYSTEM SECURITY PROGRAM PLAN

A written System Security Program Plan shall be developed to document the System Security Program and assist in the implementation and monitoring of the program. The plan shall be approved and signed by the owner/management.

Guidance to assist in the development of a System Security Program Plan is set forth in Annex C, Bibliography.

¹For guidance concerning definition of security-critical systems and facilities, see the System Security Program Plan bibliography in Annex C.

13. EMERGENCY PREPAREDNESS

This section presents requirements for an Emergency Preparedness Program.

13.1 EMERGENCY PREPAREDNESS PROGRAM PLAN

The Emergency Preparedness Program shall be documented in an Emergency Preparedness Program Plan. The Emergency Preparedness Program Plan shall be developed during the system planning/design phase and implemented during the system testing and operation phases.

13.1.1 Objective of Plan

The objective of the program plan shall be to document how the system, system employees, other support groups, and other supporting agencies will respond to an emergency.

13.1.2 Contents of Plan

The program plan shall, as a minimum, include the following contents:

13.1.2.1 Introduction

This section shall identify the purpose and scope of the program plan.

13.1.2.2 Policy

This section shall state the commitment of the owner/operator to emergency preparedness.

13.1.2.3 Scope of Program

This section shall include a summary description of the APM system and identify the responsibilities and functions covered by the program plan.

13.1.2.4 Participating Agencies and Agreements

This section shall identify the other agencies that may be involved, provide contact information, identify their capabilities and responsibilities, and reference applicable interagency agreements.

13.1.2.5 Emergency Management Process

This section shall identify the process the system operator will follow once an emergency has been identified. The process shall include, as a minimum, the following:

1. Notification
2. Response

3. Resolution
4. Restoration of operations
5. Reporting

13.1.2.6 Central Control Responsibilities

This section shall identify and describe the responsibilities of Central Control personnel in an emergency. This section of the Emergency Preparedness Program Plan shall be coordinated with 15.1, Operations, Maintenance, and Training—System Operations Plan.

13.1.2.7 Duties and Responsibilities

This section shall assign duties and responsibilities to personnel. These include, at a minimum, the following:

1. Management and Administration
2. Emergency Commander
3. Dispatcher
4. Operations
5. Maintenance
6. Safety
7. Security/Law Enforcement
8. Fire Fighting
9. Medical
10. Environmental
11. Public Information Officer

13.1.2.8 Emergency Preparedness Response Policies and Procedures

This section shall identify emergency response policies and procedures to be developed. These policies and procedures shall be coordinated with the requirements of Section 15, Operations, Maintenance, and Training, and Section 12, System Security. Specifically, the results of the threat assessment carried out under Section 12 shall be used as input into the Emergency Preparedness Program Plan. The following are examples of emergencies that shall be addressed:

1. Fires
2. Vehicle collisions or derailment
3. Bomb threats
4. Hazardous materials or other environmental hazards
5. Terrorist acts
6. Structural failure
7. Regionally occurring natural disasters such as floods, tornadoes, hurricanes, earthquakes
8. Medical emergencies
9. Power and communication infrastructure failures

13.1.2.9 Emergency Preparedness Training and Drills

This section shall identify and describe the training, including drills that will be required of APM system personnel, other support groups within the APM or owner's organization, and outside responding agencies. (See 13.2.)

13.1.2.10 Plan Management

This section shall identify who is responsible for the plan, its revisions, and its dissemination.

Topics to be addressed include but are not limited to:

1. Frequency of review and updates.
2. Changes in emergency preparedness in response to changes in system configuration.
3. Documentation control with regard to revisions and distribution of the plan.
4. Debriefings after emergencies to aid in improving training and updating the plan. (See 13.3.)

13.1.2.11 Appendices to Plan

Supporting documents or portions thereof required for effective implementation of the Emergency Preparedness Plan shall be included in appendices unless covered elsewhere in the plan.

13.1.3 Guidance

Guidance to assist in the development of the Emergency Preparedness Program Plan is set forth in Annex C, Bibliography.

13.2 TRAINING AND DRILLS

The training program required by 15.8 shall incorporate means to maintain proficiency in understanding and implementing the Emergency Preparedness Program and its procedures. In addition, a means to periodically update the training program in these areas shall be provided.

Refresher training shall be conducted at least annually to review procedures with response personnel.

Drills of emergency scenarios shall be conducted as part of the training requirement, shall be conducted at least annually, and shall include outside agencies when applicable.

13.3 POST-EMERGENCY INCIDENT AND DRILL COORDINATION

The owner/operator shall conduct formal debriefings attended by representatives of the involved personnel

after drills and emergency incidents to critique and improve the Emergency Preparedness Program.

14. SYSTEM VERIFICATION AND DEMONSTRATION

Included in this section are the specifications of the minimum standards by which an APM system application shall be verified to meet the ASCE APM Standards, Parts 1, 2, and 3. Verification that an APM system application meets ASCE APM Standards may be carried out separately or integrated with acceptance and demonstration activities.

14.1 APPLICABILITY OF PRIOR VERIFICATION

Where a feature of the APM system application is site-specific, it shall be verified to meet applicable requirements for that application and shall not be verified by any previous similar verification.

Where a feature of the APM system application is not site-specific, previous verification of the feature may be used, provided that it is updated as needed to account for:

1. Pertinent changes in environmental or operating conditions which affect the feature;
2. Pertinent engineering changes in the feature design, materials, manufacturing processes, and/or interfaces;
3. Experience with the same feature from a prior application; and
4. Current verification requirements and conditions as specified in these standards.

14.2 METHODS OF VERIFICATION

Compliance with ASCE APM Standards shall be verified by:

1. Design review
2. Analysis
3. Qualification test
4. Acceptance test
5. Inspection
6. Demonstration
7. Previous experience

or combinations thereof.

14.3 SYSTEM VERIFICATION PLAN

Compliance of an APM system application with the ASCE APM Standards shall be verified in accordance with a System Verification Plan. The following defines the minimum requirements for the System Verification Plan.

14.3.1 Plan Requirements

The plan shall set forth the specific verification activities, their sequence, and dependencies. Verification activities shall be grouped into categories. Verification activities shall be conducted by category, with no activity being performed unless all of the activities in the prerequisite categories have been successfully completed and the results documented. Any modification that invalidates a previous verification activity shall be cause for reverification. Activities that are closely related may be conducted together, but documentation must be kept separated. All documentation required by the standard shall be verified for compliance.

14.3.2 Verification Sequence

The logical sequence for verification is as follows:

1. Reviews of Designs and Analyses
2. Manufacturer (or contractor, or entity building the system) Verification
3. Major Subsystem and Integrated System Verification

On-site Major Subsystem and Integrated System Verification shall be conducted in accordance with the sequence illustrated in Fig. 14-1.

14.3.3 Inspection and Test Procedure Documentation

Each verification activity shall be documented and include pass/fail criteria. Verification inspection or test procedures shall include the following:

1. TITLE: Title of inspection or test.
2. REFERENCE SECTION OF STANDARD: The section number(s) and title(s) of the specific ASCE APM Standards that is (are) addressed by the inspection or test.

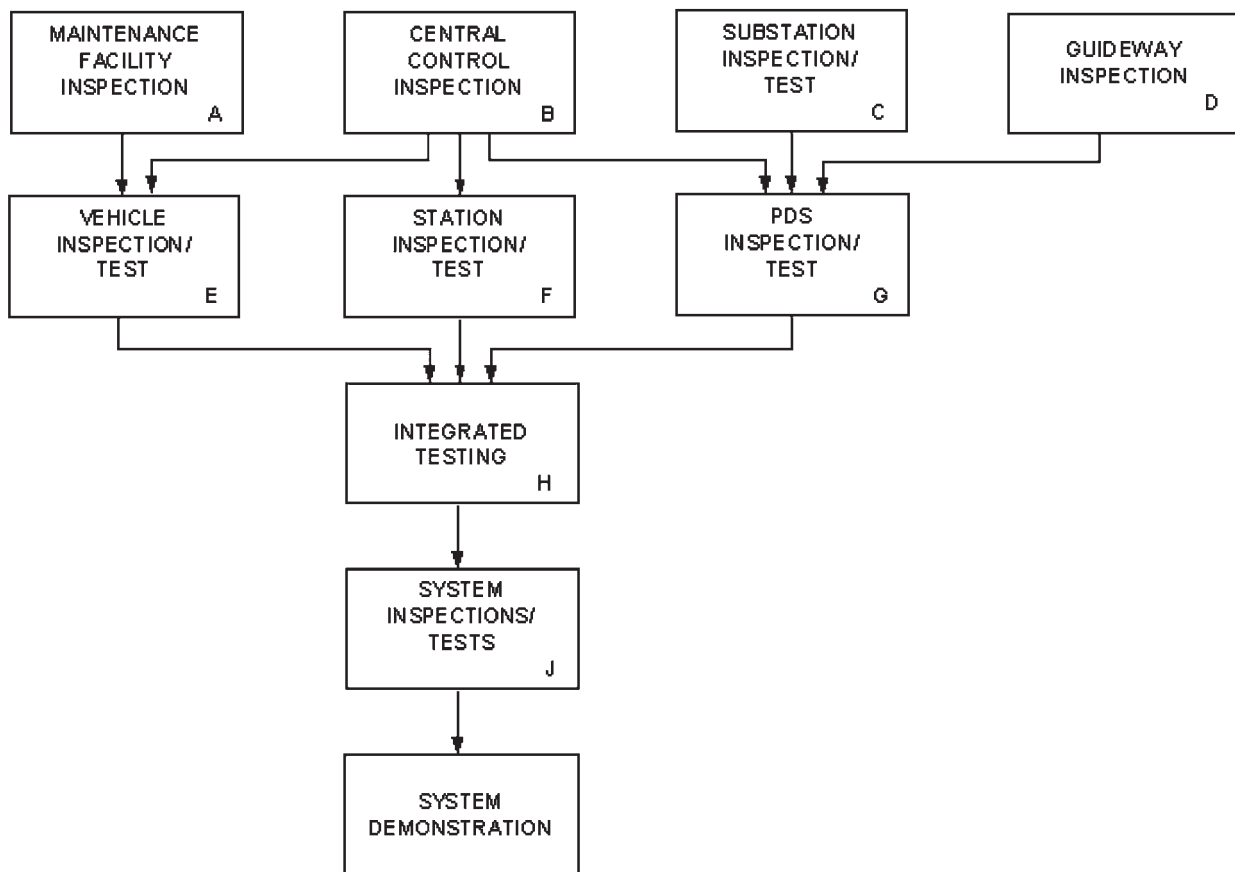


FIGURE 14-1. Major Subsystem and Integrated System Verification Sequence.
 PDS = Power Distribution System.

3. **PREREQUISITE ACTIVITIES:** The verification activity categories that must be successfully completed prior to conducting the inspection or test.
4. **OBJECTIVES:** The specific requirement(s) to be verified.
5. **SAMPLE SIZE:** The number of units (e.g., vehicles) required to be used in the inspection or test or the specific area involved (e.g., guideway section).
6. **ENVIRONMENTAL REQUIREMENTS:** Any specific environmental conditions required in order for the inspection or test to demonstrate conformance with the referenced standard requirement(s).
7. **EQUIPMENT/FACILITY REQUIREMENTS:** Any test equipment or special facility needs.
8. **PERSONNEL/SKILL REQUIREMENTS:** The personnel and skills required.
9. **DATA TO BE RECORDED:** The specific data that are necessary to show compliance and the means by which they are to be obtained. The specific method of documentation shall be identified.
10. **PASS/FAIL CRITERIA:** The specific limits within which the data identified in Item 9 must fall in order for the verification activity to be acceptable.
11. **PROCEDURES:** The detailed, step-by-step description of the inspection or test.
12. **COMMENTS:** Narrative description of any occurrences or events that may have an impact on personnel safety, equipment integrity, or the validity of the data.
13. **CONCLUSIONS:** The results of the inspection(s) or test, including documentation.

14.4 MINIMUM VERIFICATION REQUIREMENTS

Table 14-1 references each of the requirements to be verified according to section/subsection number of ASCE 21. For each referenced standard the verification requirements cite “what” specifically is to be verified and “how” it is to be verified. Items identified in the Hazard Analyses required by ANSI/ASCE/T&DI 21-05, Section 3.1.2.1 as affecting safety shall be verified by an individual who is qualified in the safety of APM systems in accordance with 16.3.1.

Where ASCE 21 contains specific means of verification, such requirements shall be verified as specified.

14.5 APPLICATION-SPECIFIC ACCEPTANCE REQUIREMENTS

Beyond the acceptance requirements specified for demonstrating compliance with ASCE 21, most APM installations should satisfy additional application-specific acceptance requirements. Annex A provides a recommended practice for taking acceptance of an APM system, including typical requirements beyond those which demonstrate compliance with ASCE 21.

15. OPERATIONS, MAINTENANCE, AND TRAINING

This section presents planning and documentation requirements for system operations, maintenance, and training.

15.1 SYSTEM OPERATIONS PLAN

A System Operations Plan shall be prepared prior to the beginning of passenger service. The plan shall include a comprehensive description of operating strategies, procedures, and staffing for the system and shall be coordinated with the instructions provided in the system operating manuals. It shall specifically cover all requirements for operation of the system defined by the owner.

The System Operations Plan shall, as a minimum, contain the following sections, which are detailed in 15.1.1, 15.1.2, and 15.1.3 below:

1. System Operational Strategies
2. Manual of Operating Procedures
3. Staffing Plan

15.1.1 System Operational Strategies

The first section of the System Operations Plan shall provide a description of system operational strategies, including hours of system operation during weekdays, weekends, holidays, and special events; modes and levels of service for each period; methods for selecting and changing modes; and consist complement on each route for each period.

15.1.2 Manual of Operating Procedures

The second section of the System Operations Plan, the Manual of Operating Procedures, shall provide detailed operating instructions for the system,

Table 14-1. Minimum Verification Requirements

CODES:

DR: Design Review. Compliance with the standard is determined by means of the design review activity.

A: Analysis. An analysis must be submitted to demonstrate compliance with the standard.

QT: Qualification Test. A test must be conducted to confirm that the design meets the standard. Alternatively, documentation from a prior test of the same item may be submitted.

AT: Acceptance Test. A test must be conducted to assure that the installed or as/built system meets the standard.

AT1: Acceptance Test. Conducted on only one item of the subject equipment within the total population of such equipment.

ATall: Acceptance Test. Conducted on the total population of such equipment within the system.

I: Inspection. Inspection of the installed item for compliance with the standard.

D: Demonstration. Demonstration by actual operation that the installed system performs per the standard.

E: Previous Experience. Confirmed by documentation of experience equivalent to QT.

| Section | Specific Requirement | Verification Type |
|--|--|-------------------|
| 2 Operating Environment | Verify system designed per Section 2 | DR |
| 2.1.4 Lightning | Lightning protection | I |
| 2.1.5 Existing Atmospheric Pollution | Dust and dirt | QT, E |
| 2.1.8 Electromagnetic Background | EMI susceptibility | D |
| 2.2.1 Exterior Airborne Noise | Exterior noise level | AT1 |
| 2.2.2 Structure-Borne Noise/Vibration | Noise/vibration level | D |
| 2.2.3 Electromagnetic Radiation | EMI emissions | D |
| 3 Safety Requirements | As specified | A, DR |
| 3.4 Verification and Validation | Automatic Train Control (ATC) system mean time between hazardous events (MTBHE) | A, DR |
| 4 System Dependability | Service availability | D |
| 5 Automatic Train Control (ATC) | Verify ATC designed per Section 5 [Note: For APM systems that utilize communications-based train control for ATC, verify requirements per corresponding sections of IEEE P1474.1 as correlated below.] | DR |
| 5.1.1 [IEEE 6.1.1] Presence Detection [Train location/train speed determination] | Operation confirmed by test | ATall |
| 5.1.2 [IEEE 6.1.2] Separation Assurance [Safe train separation] | Operation confirmed by test | ATall |
| 5.1.3 [IEEE 6.1.4] Unintentional-Motion Detection [Rollback protection] | Operation confirmed by test | ATall |
| 5.1.4 [IEEE 6.1.3] Overspeed Protection [Overspeed protection and brake assurance] | Operation confirmed by test | ATall |
| 5.1.5 [IEEE 6.1.5] Overtravel Protection [End-of-track protection] | Operation confirmed by test | ATall |
| 5.1.6 [IEEE 6.1.6] Parted Consist Protection [Parted consist protection and coupling and uncoupling of trains] | Operation confirmed by test | ATall |
| 5.1.7 [IEEE 6/Paragraph 2] Lost Signal Protection [Functional requirements] | Operation confirmed by test | ATall |
| 5.1.8 [IEEE 6.1.7] Zero Speed Detection [Zero speed detection] | Operation confirmed by test | ATall |
| 5.1.9 Unscheduled Door Opening Protection | Operation confirmed by test | ATall |
| 5.1.10 [IEEE 6.1.8] Door Control Protection Interlocks [Door opening control protection interlocks] | Operation confirmed by test | ATall |

| Section | Specific Requirement | Verification Type |
|--|--|-------------------|
| 5.1.11 [IEEE 6.1.9] Departure Interlocks [Departure interlocks] | Operation confirmed by test | ATall |
| 5.1.12 [IEEE 6.1.12] Direction Reversal Interlocks [Traffic direction reversal interlocks] | Operation confirmed by test | ATall |
| 5.1.13 [IEEE 6.1.10] Propulsion and Braking Interlocks [Emergency braking] | Operation confirmed by test | ATall |
| 5.1.14 [IEEE 6.1.11] Guideway Switch Interlocks [Route interlocking] | Operation confirmed by test | ATall |
| 5.2.1 [IEEE 6.2.1] Motion Control [Automatic speed regulation] | Operation confirmed by test | ATall |
| 5.2.2 [IEEE 6.2.2] Programmed Station Stop [Platform berthing control] | Operation confirmed by test | ATall |
| 5.2.3 [IEEE 6.2.3] Door and Dwell Time Control [Door control] | Operation confirmed by test | ATall |
| 5.3.1 Constraints on ATS | Functions confirmed by demonstration | D |
| 5.3.2 Status and Performance Monitoring | Functions confirmed by demonstration | D |
| 5.3.3 Performance Control and Override | Functions confirmed by demonstration | D |
| 6.1 Audio Communication | Confirm meets NFPA 130 | DR, I |
| 6.1.1 Station Public Address | Live messages override recorded messages Announcements delivered simultaneously | D D |
| 6.1.2 Emergency Station and Wayside Communications | Heavy duty, tamper- and weather-resistant enclosure | DR, I |
| 6.1.2 Emergency Station and Wayside Communications | Automatic activation | D |
| | Identification of Emergency Communication Device (ECD) at Central Control | D |
| | ECD user information | D |
| 6.1.3 Train Voice Communications and Public Address (PA) | Two-way voice communication activation and display | D |
| | Train PA operating modes | D |
| | Live messages override recorded messages | D |
| 6.1.3 Train Voice Communications and Public Address | Speaker fire resistance | DR, I |
| 6.1.4 Operations and Maintenance (O&M) Personnel Communications | Heavy duty, tamper- and weather-resistant enclosure | DR, I |
| | Sufficient quantity of radios | DR, I |
| 6.1.5 Recording of Audio Transmissions | Recording capacity | D |
| 6.1.6 Intelligibility of Audio Communications | Coverage and clarity of communication | AT1 |
| 6.2.1 CCTV Central Control Equipment | Surveillance coverage and layout of monitors | I |
| 6.2.2 CCTV Passenger Station Equipment | Camera sensitivity and tamper-proof design and locations | DR, I |
| 6.2.3 Recording of Video Transmissions | Recording capacity | D |
| | Identification of camera, time, and date | D |
| 6.3.1 Passenger Information—Vehicle | Automatic audio and visual station information | D |
| 6.3.2 Passenger Information—Stations | Automatic audio and visual warnings and information | D |
| 7.1 Vehicle Capacity and Load | Passenger load density | DR |
| 7.2 Vehicle Dynamic Envelope | Dynamic envelope | DR, QT |
| 7.3 Clearance in Stations | Vertical and horizontal gaps | ATall |
| 7.4 Vehicle Structural Design | Verify vehicle structural design per 7.4 | A, DR |
| 7.4.4.1.2 Worst-Case Loads | Seat loading | QT |
| | Wheelchair loading | QT |

Table 14-1. Continued

| Section | Specific Requirement | Verification Type |
|---|---|-------------------|
| | Stanchion horizontal load | QT |
| | Door load | QT |
| 7.4.4.2 Jacking and Lifting | Frame rigidity | QT |
| 7.4.4.6 Deformation | Deformation interfering with normal and/or safe operation | D |
| 7.5.1 Mechanical Design | Coupling operation and lock | D |
| 7.5.2 Electrical/Control | Coupling operation and lock | D |
| 7.5.3 Coupler Interfaces | Electrical and pneumatic coupling connection | D |
| | Grounding | D |
| 7.6 Suspension and Guidance | Tire or levitation failure | DR |
| 7.7.1 Heating and Air Conditioning | Heating/cooling capacity and temperature control | QT |
| 7.7.2 Ventilation | Fresh air flow | QT |
| 7.7.3.1.1 Maximum Sustained Acceleration | Acceleration limits | QT |
| 7.7.3.1.2 Maximum Jerk Rate | Jerk limits | QT |
| 7.7.3.2 Human Response Testing | Ride quality | QT |
| 7.7.4 Noise Levels | Interior noise | QT |
| 7.7.6.1 Priority Seating Signs | Signage requirements | I |
| 7.7.6.2 Interior Circulation, Handrails, and Stanchions | Passenger accommodation | DR, I |
| 7.7.6.3 Floor Surfaces | Slip resistance | DR, I |
| 7.7.6.4 Materials and Fasteners | Vandal resistance | DR, I |
| 7.8 Doors, Access, and Egress | Dimensions | ATall, D |
| | Locking | ATall, D |
| | Obstruction detection/operation | ATall, D |
| | Closing force | ATall, D |
| | Manual operation | ATall, D |
| | Emergency evacuation | ATall, D |
| 7.9 Windows | Glazing | DR |
| 7.10 Fire Protection and Flammability | Chapter 8, NFPA 130 | DR |
| 7.10.1 Material Selection | Chapter 8, NFPA 130 | DR |
| 7.10.2 Thermal Protection | Thermal protection | QT |
| 7.10.3 Fire Extinguishers | Location and type | I |
| 7.10.4 Smoke Detectors | Activation/annunciation | ATall |
| 7.11.1 Interior Lighting | Design and illumination | DR, D |
| 7.11.2 Emergency Lighting | Illumination and duration | QT |
| 7.11.3 Directional Identification and Headlights | Directional identification | ATall |
| | Illumination | ATall |
| 7.12.2.1 Low Voltage Power | Ventilated, isolated enclosure | I |
| 7.12.2.2 Protection Devices | Circuit breakers and fuses | DR, D |
| 7.12.2.3 Emergency Power | Power level and duration | QT |
| 7.12.3 Wiring | Size and marking | DR, I |
| 7.12.4 Power Collectors | Electrical capacity | DR, D |
| | Shop power | DR, D |
| 7.12.5 Grounding | Carbody grounding | DR, ATall |
| | Equipment grounds | DR, ATall |

| Section | Specific Requirement | Verification Type |
|---|---|-------------------|
| 8.1 Propulsion Braking Systems (PBS) Rating | Duty cycle | DR |
| 8.2.2 Tension Member Propulsion | Rope, rope drives, and sheaves | DR |
| 8.2.3 Air Flow Propulsion | Protection of environment | I |
| 8.3.1 Service Braking | Function and duty cycle | DR, ATall |
| 8.3.2 Emergency Braking | Function, duty cycle, fail safety, stopping distance | DR, ATall |
| 8.3.3 Parking Braking | Function | DR, ATall |
| 8.4.1 PBS Design Requirements | Special hazard analysis | DR |
| 8.4.2 PBS Service Requirements | Duty cycle, manual release, and deterioration over time | DR, QT, D |
| 8.5 Installation and Protection | Protection from rotating equipment | DR, I |
| 8.6 Controls and Interlocks | Propulsion/brake interlocks | DR, D |
| 9.1.1 Safety | All blue-light stations | D |
| 9.1.2 Corrosion Control | Galvanic protection and stray currents | DR |
| 9.1.3 Electrical System Protection | Fault, overload, overvoltage, undervoltage, ground fault, and phase imbalance | DR, ATall |
| | Provision of harmonic filters | DR, ATall |
| | Surge and ground fault protection | DR, ATall |
| | Circuit breaker trip annunciation | DR, ATall |
| 9.1.4.1 Traction Power Grounding | Voltage under worst-case fault current | DR, A, QT |
| 9.1.4.2 Facilities and Structure Grounding | Compliance with NFPA 70 | DR, I |
| 9.1.5 Redundancy | No single-point failure to preclude operation | DR, D |
| 9.1.6 Design Life | Design life | DR |
| 9.1.7 Voltage Regulation | Minimum worst-case voltage | DR |
| 9.1.8 Power Distribution Capacity | Duty cycle | DR, D |
| 9.2.2 Power Factor | Power factor | AT1 |
| 9.2.3 Harmonics | Voltage distortion limits | D |
| 9.2.4 System Monitoring and Alarms | Substation monitors and alarms | D |
| 9.2.5 Power Regeneration Equipment | Acceptance by system and utility of regenerated power | D |
| 9.2.6 Remote Monitoring and Control | Logging of power application and removal | D |
| 9.2.7 Local Control | Control and lockout | DR, D |
| 9.2.8 Restoring Power | Power restoration | D |
| 9.2.9 Substation Facilities | Compliance with NFPA 70 | DR, I |
| | Provision of fire protection | DR, I |
| | Compliance with NFPA 130 | DR, I |
| 9.3.1 Guideway Mounted Power Distribution | Electrical insulation | DR, I |
| | Expansion joints | DR, I |
| | Protective covers | DR, I |
| | Power rail sizing and mounting | DR, I |
| 9.3.2 Power Zones | Zone isolation and bridging | DR, D |
| 9.3.3 Splice Joint Requirements | Power rail splices | DR |
| 9.3.4 Expansion Joints/Sections | Thermal expansion | DR |
| | Short circuit electromechanical loads | DR |
| | Current carrying capacity | DR |
| 9.3.5 Power Rail Transitions | Engagement/disengagement of collectors with power rail | D |
| 9.3.6 Insulators | Insulation properties, including flammability | DR, E, QT |
| | Protection from inadvertent contact by persons | DR, E, QT |
| 9.3.8 Power Rail to Earth Resistance | Electrical resistance to ground | QT |

Table 14-1. Continued

| Section | Specific Requirement | Verification Type |
|---|--|-------------------|
| 9.3.9 Power and Ground Rail Heating | Heating for de-icing | DR, QT |
| 9.4 Passenger Station Electrical Equipment | Compliance with NFPA 70 | DR, I |
| 9.5 Uninterruptible Power Supply | Electrical capacity and duration | DR, QT |
| 10.1.2 Detectable Warning Strip | Tactile platform edge strip | DR, I |
| 10.2.1 Intrusion Prevention System and 10.2.2 Intrusion Control System | Door requirements | QT |
| | Door structural load | QT |
| | Glass safety | QT |
| | Door locking, closing forces, closing energy, obstruction detection | DR, ATall |
| | Emergency egress and manual operation | DR, ATall |
| | Door closing audio/visual warning signals | DR, ATall |
| | Space between platform doors and vehicle doors | DR, ATall |
| | Vehicle/platform door coordination | DR, ATall |
| 10.2.3 Intrusion Detection System | Size of object | DR, D, ATall |
| | Initiation of braking | DR, D, ATall |
| | Stopping of moving apparatus on guideway | DR, D, ATall |
| | Alarm to central control | DR, D, ATall |
| | Restoration of service | DR, D, ATall |
| 10.3 Evacuation of Misaligned Trains | Design features | D |
| 10.4 Emergency Lighting and Ventilation | Performance with applicable codes | DR, I |
| 10.5.1 Fire Detection | Provision of smoke alarms and annunciation at central control | D |
| 10.5.2 Fire Containment | Provision of fire barriers | DR, I |
| 10.5.3 Fire Suppression | Compliance with codes | DR, I |
| 11.2 Intrusion Protection and Detection | Fencing of right-of-way | DR, I, D |
| | Intrusion alarms | DR, I, D |
| 11.3 Emergency Evacuation and Access | Voice communication | DR, D |
| | Protection after manual door opening | DR, D |
| | Labeling and locking of station and guideway doors | DR, D |
| 11.3.1 Tunnel Guideway | Compliance with NFPA 130 | DR, I |
| 11.3.2 Surface Guideway | Compliance with NFPA 130 | DR, I |
| 11.3.3 Elevated Guideway | Compliance with NFPA 130 | DR, I |
| 11.3.3 Elevated Guideway | Definition of other “suitable means” | DR, AT1 |
| 11.4 Fire Protection | Compliance with NFPA 130 | DR, I |
| 11.5 Signage | Requirements for life safety signage | I |
| 11.6 Emergency Lighting and Ventilation | Compliance with NFPA 130 | DR |
| 11.6 Emergency Lighting and Ventilation | Egress route illumination level | ATall |
| 11.7 Emergency Power Supply | Compliance with NFPA 130 | DR, I |
| 11.8 Guideway Alignment | Vehicle floor inclination when stopped | DR, AT1 |
| 11.8.1 Clearances | Vehicle/fixed facilities clearances | ATall |
| 11.8.1 Clearances | Contact with platform edge | DR, D |
| 11.8.3 Drainage | Drainage routes and slopes | DR, I |
| 11.9.1 Loads and Forces | Guideway design loads and forces | DR, A |
| 11.9.2 Load Combinations | Guideway design loads and forces | DR, A |
| 11.9.3 Design and Analysis | Guideway design loads and forces | DR, A |

each component, and/or subsystem. The manual shall, as a minimum, provide operating procedures for:

1. Startup
2. Shutdown
3. Modes of operation
4. Vehicle dispatching
5. Vehicle operation and function
6. Mode changing
7. Failure management
8. Emergency responses
9. Passenger communications/management
10. Service restoration
11. Power distribution system management
12. General rules for staff

The Manual of Operating Procedures shall contain a detailed description of control console(s) and their functional role in system operations, with a listing of procedures for dealing with all anticipated normal and abnormal conditions.

15.1.3 Staffing Plan

The third section of the System Operations Plan shall be the Staffing Plan. This plan shall include an organizational chart, job descriptions, qualifications, and staffing levels required for operation, maintenance, and administration of the system.

15.2 MANAGEMENT PLAN

The Management Plan shall include the description, policies, rules, and procedures for managing the organization. Details of the Management Plan are beyond the scope of this standard.

15.3 PLANNED SYSTEM STARTUP AND SHUTDOWN

System startup and shutdown shall be done in accordance with documented procedures.

15.3.1 Planned System Startup

Procedures for startup shall state that prior to commencing service, the following processes shall be followed:

1. It shall be verified that the guideway is clear of persons, tools, equipment, and hazards.
2. It shall be confirmed that system elements are ready for operation.
3. Announcements that system operation will commence shall be made in stations and on the vehicles.

4. Appropriate graphics and/or communications shall be activated at each station.
5. Vehicle operations may then begin.

15.3.2 Planned System Shutdown

Procedures for shutdown shall state that prior to discontinuing service, the following processes shall be followed:

1. Announcements that system operation will cease shall be made in stations and on the vehicles.
2. Appropriate graphics and/or communications shall be activated at each station.
3. Adequate procedures shall prevent passengers from being stranded within the system.
4. Vehicle operations shall then be terminated, and the system secured.

15.3.3 Unscheduled System Shutdown/Startup

Unscheduled system shutdown and startup shall address the processes listed in 15.3.1 and 15.3.2 as applicable. In addition, the cause and duration of the shutdown shall be investigated and logged and a system announcement shall inform passengers and personnel of the system condition.

15.4 SERVICE RESTORATION ANALYSIS

A Service Restoration Analysis shall be prepared, detailing failure conditions that can take place throughout the entire system and the appropriate response to each. Based on this analysis, criteria and methodology shall be established to restore normal operations with minimal downtime. This criteria and methodology shall include:

1. Criteria for determining when, where, and how maintenance personnel are dispatched and whether guideway power should be de-energized.
2. Criteria for determining if the disruption results from a wayside fault and, if so, that personnel are provided with guidance needed to initiate the necessary repair or replacement and check-out operations.
3. Criteria for determining if the disruption results from a vehicle fault and, if so, that personnel are provided with guidance for choosing between manual operation and other retrieval responses.
4. Criteria for determining if the disruption results from conditions external to the system.
5. Criteria to confirm that all system personnel, equipment, and other persons or systems are prepared for the restart of service.

6. Timely options for reacting to short-term disruptions caused by disabled vehicles, including criteria for choosing the appropriate option.
7. Conditions required to provide a clear path for the removal of disabled vehicles, re-entry of vehicles used to recover another vehicle, and introduction of spare vehicles onto the system.
8. Conditions required to enable passenger egress from disabled vehicles in an orderly fashion.

This document shall serve as a primary input to the System Operations Plan and operation and maintenance manuals.

15.5 ALARMS AND MALFUNCTIONS REPORTING

Operational system components shall be automatically monitored for malfunction per ANSI/ASCE/T&DI 21-05, Section 5.3.3.3.

15.6 RECORDKEEPING AND MANAGEMENT REPORTS

Procedures and methodology for evaluating reports of system alarms and acknowledgments of all Central Control Operator (CCO) commands, and other CCO-initiated activities shall be developed, in accordance with ANSI/ASCE/T&DI 21-05, Section 5.3.3.4. Voice communications between the CCO and passengers shall provide for recording of all conversations (see ANSI/ASCE/T&DI 21-05, Section 6.1.5). Recorded media shall be retained for a prescribed period of time, to be agreed upon with the authority having jurisdiction. In the event of an incident/accident or hazardous condition, relevant information shall be retained pending investigation. Procedures shall be provided such that system data associated with failures and/or alarms are maintained and stored as required for system maintenance, troubleshooting, and recovery.

15.7 MAINTENANCE

The Maintenance Program shall be comprehensive and shall be incorporated into all aspects of system design. The Maintenance Program shall include the development of system maintainability data for the full system and subsystems; planning and procedures for preventive maintenance; procedures for corrective maintenance; and the documentation of all processes and parts in maintenance manuals.

15.7.1 System Maintainability

A maintainability program shall be developed and implemented during the design and manufacturing period that will promote ease of maintenance, diagnostics, repair, check-out, and test. The maintainability program shall include the involvement of qualified personnel. (A maintainability program shall not be required if the system is already in operation when this standard is applied.) Maintainability requirements shall be consistent with overall system/equipment requirements.

15.7.2 Maintenance Plan

A comprehensive Maintenance Plan for the system shall be developed consistent with the system dependability requirements. For all subsystems and equipment, the Maintenance Plan shall prescribe preventive maintenance schedules and delineate each task necessary to accomplish inspection and calibration of equipment, servicing, preventive maintenance, corrective maintenance, and overhaul. The plan shall include procedures to prevent equipment that has not fulfilled check-out requirements from being placed into revenue service.

The Maintenance Plan shall include lists of spare equipment, parts, and consumable supplies. It shall also include procedures for maintaining an adequate inventory of spare parts and consumables, and shall estimate necessary storage requirements for these items. The plan shall prescribe the facilities and equipment necessary for each maintenance task, and specialized tools required, together with realistic estimates of the required manpower, skill levels, and task duration.

15.7.3 Maintenance Manuals

Maintenance manuals shall be provided for all elements of the system. These manuals shall detail procedures and reference data for performing all of the required maintenance tasks. The text and detail of these manuals shall be consistent with the required maintenance personnel skill levels, facilities, and equipment. The manuals shall include instructions for assembly and disassembly and expanded assembly diagrams as required. The maintenance manuals shall, as a minimum, contain the following items:

1. Preventive maintenance and overhaul schedules for all system components.
2. Descriptions of maintenance procedures for all system components.
3. Description of system operations, including interactions between major subsystems elements.
4. Detailed technical descriptions of individual subsystems, assemblies, and circuits, including

- clearances, tolerances, circuit operations, test point voltages, and waveforms as required for maintenance. These descriptions shall refer to system drawings as needed.
5. Descriptions of components, including drawings and other information as necessary for maintenance.
 6. Detailed descriptions of system-specific test equipment operation and procedures for its correct use in equipment maintenance.
 7. Troubleshooting guides at the system, subsystem, and subassembly level to aid in diagnosis of common failure modes.
 8. Safety warnings as appropriate for equipment and procedures.
 9. An illustrated parts breakdown, including a description of replacement parts, and associated part numbers.
 10. Special requirements and qualifications for maintenance personnel.

15.8 TRAINING

Training shall be provided for Operation and Maintenance personnel prior to the start of passenger service and as needed thereafter to maintain competency. The training program shall include formal instruction and on-the-job training and shall lead to qualification of employees for their respective tasks.

Training shall include instructional literature and equipment necessary to train personnel. Training on the actual system equipment and/or spare equipment is permitted.

Note 1: Training for Emergency Response personnel is included in 13.2.

Note 2: Training for Security personnel is included in 12.1.

Note 3: The training program is typically designed and provided by the system supplier.

15.8.1 Training Plan

A Training Plan shall be developed which identifies the following elements as a minimum:

1. Training program goals and objectives.
2. A schedule illustrating sequence and duration for training.
3. Methods and materials for conducting classroom and hands-on training.
4. Requirements and methods for determining and documenting training and qualification for each individual.
5. Qualifications for training personnel.

6. Process for updating the training and qualification program to keep it current.
7. Levels of competency associated with job descriptions (from the Staffing Plan per 15.1.3).
8. Tasks associated with each job description.
9. Statement of training objectives for each task.
10. Pass/fail criteria.

15.8.2 Training Instructors

Instructors shall be proficient in oral and written communication, and qualified and knowledgeable in their area of instruction.

15.8.3 Training Materials

Courses shall be defined and developed for training of all personnel identified in 15.1.3. The following training materials shall be provided for each course:

1. Lesson Plan/Instructor Guide
2. Trainee Workbook
3. Training aids, such as visual aids, exercises, or other interactive tools
4. Reference materials

15.8.4 Ongoing Training

The owner/operator training program shall be continued throughout the life of the system.

15.8.5 Training Manuals

Manuals for equipment and subsystems shall be provided for use in training. The manuals shall be updated as required throughout the life of the system to conform to equipment configuration. Manuals shall provide sufficient information and detail to enable personnel to gain a full understanding of the design parameters and criteria, the operation and functioning, and the means of corrective, preventive, and overhaul maintenance for all equipment and subsystems. The following types of manuals shall be provided:

1. Equipment Operating Manuals
2. Spare Parts List per 15.7.2
3. Maintenance Manuals per 15.7.3
4. Software Manuals
5. Equipment Room Plans
6. Special Equipment Manual
7. Any other manuals necessary to effectively operate and maintain the system

Software manuals shall be provided for each user-programmable device or subsystem, and shall include a user's guide, operating instructions, and description of the software and associated hardware. Commercial "off the shelf" software shall be provided with the software manufacturer's documentation and licenses.

Equipment room(s) plans shall be provided for each station location and shall include all wiring diagrams and circuits, equipment layout, terminal and cable listings, and related information for externally connected equipment, such as guideway-mounted equipment.

The Special Equipment Manual shall provide application, operation, usage, adjustment, inspection, maintenance, troubleshooting, repair, and storage instructions and parts information for all special equipment required to operate the APM.

16. OPERATIONAL MONITORING

A program shall be developed and implemented to monitor the system operation. This program shall consist of the items in the following sections.

16.1 SYSTEM OPERATIONAL MONITORING PLAN

An Operational Monitoring Plan shall be provided to document the system operational monitoring program and identify the activities required to implement the program. This plan shall identify the system elements to be monitored, the organizations responsible for monitoring, and a schedule for the monitoring effort.

16.2 ANNUAL INTERNAL AUDIT RESPONSIBILITIES

A thorough Annual Internal Audit Process shall be developed and implemented to provide management with a mechanism for documenting that key safety-related activities are being performing in accordance with the System Safety Program Plan (SSPP). The process shall identify the facilities, equipment, procedures, functions, and safety responsibilities subject to audit. This section details the organizational elements that shall be included and how the auditing process relates to each.

16.2.1 Audit Responsibility

The individual designated to be responsible for the safety of the system, as identified in ANSI/ ASCE/ T&DI 21-05, Section 3.1, System Safety Program, shall be responsible for implementation and oversight of the Annual Internal Audit Process. In order to ensure the integrity and independence of the audit process, the individual(s) or department conducting the

audit must not be the individual(s) or department in charge of implementing the activities being audited. Auditors shall be knowledgeable about the activities being audited and able to report their findings and recommendations succinctly.

16.2.2 Audit Reporting

The audit report is an official document that is provided to all appropriate levels of management. Each department being audited shall be provided with the audit report for their respective department, or the report in full. A summary of recommended corrective actions, if any, shall be included in the audit report. Corrective actions approved by owner/operator shall then be formally tracked for compliance.

16.2.3 Audit Procedures

All departments involved shall be notified when audits will be conducted and how the audit will examine departmental documents. While ongoing inspections may be conducted on an unannounced basis, actual audits shall be done on a coordinated basis, with full management support.

Audited departments shall know when to expect audits. Audits shall be scheduled so that they are as unobtrusive as possible. Unannounced inspections or spot audits shall be approved as part of the overall audit process with concurrence of the owner/operator. The cycle for audits shall be developed and approved in advance. Spot-checking of maintenance documents and records shall be performed on a random basis.

A list of items to be audited shall be prepared in advance. When necessary, audited departments shall be given time to produce necessary documentation. This does not preclude spot-checks of individual records, such as maintenance or personnel qualification records.

16.2.4 Audit Elements

The following audit elements, as a minimum, shall be included as a part of the documented audit process. The audit process shall verify documentation that inspections and tests as required by 16.4 have been conducted.

1. The audit process shall verify that all elements of the configuration management program specified in 16.5 are in place and functioning.
2. Audits shall verify that a process for the inter-departmental and interagency coordination and exchange of safety-related information specified in 16.6 is in place.
3. Audits shall verify that an employee safety program incorporating applicable local, state, and federal requirements is in place as specified in 16.7.

4. Audits shall verify that a hazardous materials program incorporating applicable local, state, and federal requirements is in place per 16.8.
5. Audits shall verify that a drug and alcohol abuse program per 16.9 is in place and documented, per local, state, and federal requirements.
6. Audits shall verify that documentation is maintained showing that all contractor personnel are instructed, understand, acknowledge, and comply with the safety procedures as required by 16.10.
7. Audits shall verify that procedures are in place and enforced to preclude the introduction into the APM system of unauthorized hazardous materials and supplies, as well as defective or deficient equipment, as required by 16.11.

In addition, the audit process shall also confirm that the following other elements of ASCE 21 are being properly conducted and documented:

1. Audits shall verify that safety data acquisition and analysis is performed as specified in ANSI/ASCE/T&DI 21-05, Section 3.1.2, Hazard Resolution Process.
2. The annual internal audit process shall verify the implementation of operating rules and procedures as specified in 15.1.2, Manual of Operating Procedures.
3. The audit process shall contain a mechanism for determining if proper documentation is being kept on all maintenance activities specified in 15.7. A review of the maintenance records shall be conducted, including document controls over equipment manuals, shop- and site-specific procedures, and tracking and resolution of problems identified during inspections. The audit process shall verify that recordkeeping coincides with actual maintenance and that required maintenance is being performed.
4. The audit process shall record that all necessary training is being conducted and documented as specified in 15.8, Training. Certification records of operating (including maintenance) personnel shall be reviewed for completeness and accuracy. The audit shall verify that the procedures for updating the training materials are being followed.
5. Audits shall confirm that a proactive, prevention-oriented approach to security is in place and operating as required by Section 12.
6. The audit process shall record that all security-sensitive procedures and documentation are maintained in accordance with 12.1.6.
7. The audit shall assess compliance with emergency response preparedness activities per Section 13.

8. The audit shall verify that a management plan to address changes and modification is in place for the implementation of new procedures.

16.3 INDEPENDENT AUDIT ASSESSMENT

An independent evaluation or audit of all key elements with identified system safety responsibilities shall be performed, as a minimum, once every three years (triennially).

16.3.1 Independent Audit Requirements

The independent auditor shall be sufficiently independent of the system owner/operator to permit its assessment or audit to be objective. This does not rule out the independent auditor being a related company to the system owner/operator, provided there are adequate arrangements in place to insulate the independent auditor's operation from the commercial operations of the system operator. The independent auditor shall be a licensed professional engineer or have at least three years' experience participating in similar audits.

16.3.2 Independent Audit Reporting

The independent audit findings shall be documented in written reports that include an evaluation of the adequacy and effectiveness of the SSPP and implementing procedures, and as applicable, any required corrective action or recommendations and implementation schedule for completion of correction action and status reporting.

16.4 INSPECTIONS AND TESTS

A program of periodic inspections and testing shall be developed for safety-related facilities/equipment.

NOTE: Such items as fire protection equipment, emergency communications equipment, and employee safety devices would be included in the category of safety-related facilities/equipment. However, it is not practical to develop a complete list in this document, especially since a custom list for each APM system needs to be developed. See Annex B for a sample list of safety-related inspection items.

16.4.1 Manufacturer Tests

The manufacturer of the APM system shall develop specific operational and safety-related tests and/or inspections along with minimum intervals for these tests and/or inspections to be performed. These

tests will allow the owner/operator of the APM system to determine whether a given APM system is operating within prescribed operational limits. The manufacturer shall recommend components to be tested and/or inspected along with appropriate acceptance criteria. The owner/operator is responsible for implementing the test procedures. Any changes or additions to these recommendations shall be communicated to all known owners/operators for the APM system, and to independent auditors via manufacturers' bulletins.

16.4.2 Test Acceptance Criteria

The APM system test acceptance criteria should be reasonably obtainable during the expected design life, assuming recommended maintenance and operative procedures have been followed.

16.4.3 Test Procedures

The level of difficulty associated with conducting all test procedures shall not require skills or abilities beyond that which trained owner/operator personnel can reasonably be expected to possess.

16.4.4 Operational Testing Limits

Operational testing of the APM system shall be accomplished within the rated limits of the equipment as provided by the manufacturer. Any operational test, including load testing, performed on an APM system shall be nondestructive in nature.

16.5 CONFIGURATION MANAGEMENT

For safety-critical items, manufacturers shall not make design changes without advising the owner/operator, nor shall the owner/operator make design changes without advising the manufacturer, so that the effect of the change can be suitably assessed. The following should be developed and in place:

1. A description of the configuration management control process, including the identification of who shall have the authority to make configuration changes, render approvals, and formally notify all involved parties.
2. A point of responsibility to identify that modifications are included in the hazard resolution process.
3. A review process for new equipment and modifications to existing equipment that includes description of impact on affected personnel, including safety and training.
4. An operational readiness process, including sign-off, certification, and reporting for new equipment and modifications prior to entering service.

After the system has been accepted by the owner/operator, and throughout the operational life of the APM system, the owner/operator shall be responsible for maintaining an effective configuration management program.

16.6 INTERDEPARTMENTAL AND INTERAGENCY COORDINATION

A process for the interdepartmental and interagency coordination and exchange of safety-related information should be in place.

16.7 EMPLOYEE SAFETY PROGRAM

An employee safety program that incorporates applicable local, state, and federal requirements shall be established. The employee safety program shall include a hazard and injury reporting process and provide for the development of corrective actions.

16.8 HAZARDOUS MATERIALS PROGRAMS

A hazardous materials program that incorporates applicable local, state, and federal requirements shall be implemented.

16.9 DRUG AND ALCOHOL ABUSE PROGRAMS

A drug and alcohol abuse program should be in place and documented, per local, state, and federal requirements.

16.10 CONTRACTOR SAFETY COORDINATION

Contractors working on, or in close proximity to, the owner/operators' property shall follow all safety requirements and procedures. Documentation should be maintained showing that all contractor personnel are instructed, understand, acknowledge, and complying with the safety procedures.

16.11 PROCUREMENT

Procedures should be in place and enforced to preclude the introduction into the APM system of unauthorized hazardous materials and supplies, as well as defective or deficient equipment. The system

owner/operator shall have an appropriate quality management system for spares, components, services, and tools defining what is required and verifying that what is delivered will meet this requirement.

ANNEX A. RECOMMENDED PRACTICE FOR ACCEPTANCE OF AN APM SYSTEM APPLICATION

THIS ANNEX IS INFORMATIVE AND IS NOT A MANDATORY PART OF THE STANDARD.

A.1 Introduction

The following are recommended practices for acceptance of an APM system that fulfills technical requirements for a specific application, including requirements for safety certification and demonstration of compliance with contractual requirements. The practices cited in this Annex are in addition to the demonstration of compliance with the requirements of ASCE 21, Parts 1, 2, and 3, as specified in Section 14. Acceptance typically consists of two major increments: Certification of readiness to enter into unrestricted passenger service (Passenger-Ready-Status) and Final Acceptance.

A.2 Prerequisites for Achieving Passenger-Ready-Status

Passenger-Ready-Status can be achieved upon completion of all activities prerequisite to unrestricted passenger service, including as a minimum the following items, plus any additional requirements imposed by the authority having jurisdiction and/or the owner. Section references are noted with respect to ASCE 21.

1. Construction and installation work substantially complete.
2. Applicable testing demonstrating compliance with the requirements of ASCE 21, Parts 1, 2, and 3 successfully completed, as required by Section 14.
3. System performance aspects not covered in ASCE 21 demonstrated to comply with contractual requirements, as described in A.5 of this annex.
4. Safety certification activities complete, including documentation of concurrence by the authority having jurisdiction and the owner.
5. Security and Emergency Preparedness Programs in place per Sections 12 and 13.
6. Operations and maintenance (O&M) documentation submitted and formal training of O&M staff completed as required per Section 15.
7. Necessary spare parts and maintenance tools available to support service.
8. Successful completion of System Demonstration Testing as described in Annex A.6.
9. Development of an agreed list of items remaining to be resolved after commencement of unrestricted passenger service.

A.3 Prerequisites for Achieving Final Acceptance

Final acceptance can be achieved upon completion of the following items as a minimum, plus any additional requirements imposed by the authority having jurisdiction and/or the owner.

1. Achievement of Passenger-Ready-Status.
2. Completion of all remaining construction activities, including any punchlist items.
3. Acceptance of all remaining documentation, including as-built design documents and any required updates to other deliverable documents.
4. Completion of any unsatisfied contract requirements.

A.4 System Verification, Acceptance, and Demonstration Plan

Verification of the system's compliance with all contract safety and performance requirements as a prerequisite to entering passenger service should be performed in accordance with a System Verification, Acceptance, and Demonstration Plan. The minimum requirements for a System Verification, Acceptance, and Demonstration Plan include a means of verifying compliance with the requirements of ASCE 21, as detailed in Section 14; demonstration of compliance with system performance requirements not covered in ASCE 21, as discussed in A.5 herein; and the definition of a System Demonstration Test designed to confirm the system's operating modes, reliability/availability, and the readiness of the Operations and Maintenance (O&M) staff to successfully operate the system, as described in A.6 herein. This plan is subject to approval by the owner and the authority having jurisdiction, and should provide for oversight of test activities and review/approval of test report documentation by the authority having jurisdiction and the owner.

The plan should follow the verification sequence of 14.3.2, items 1–3. Verification, acceptance, and demonstration activities should be documented and include pass/fail criteria. Test procedures should include all elements as specified in 14.3.3.

A.5 Verification of Requirements not Specified in ASCE 21

Verification of requirements in addition to those imposed by ASCE 21, Parts 1, 2, and 3 should be included in the System Verification Acceptance and Demonstration Plan, and should consider all requirements of the contract documents as well as applicable codes and regulations.

The following lists typical contractual requirements for system acceptance that are in addition to the requirements of ASCE 21:

1. System performance/passenger capacity under normal and failure conditions
2. Travel times
3. Degraded-mode operations
4. Failure recovery provisions
5. System configuration
6. System equipment quality
7. System equipment quantities
8. System equipment aesthetics
9. System operating features
10. System security features and equipment
11. System safety features, equipment, and performance not specified in the ASCE APM Standards
12. Vehicle capacity and passenger accommodations
13. Vehicle performance under normal and failure conditions
14. Alternative train configurations/vehicle coupling
15. Station platform passenger accommodation and passenger loading/unloading performance
16. Passenger information provisions
17. Communication systems (CCTV, PA, telephones, maintenance radios)
18. Maintenance and Storage Facility—functionality, equipment, tools, spare parts, and supplies
19. Outfitting of offices and auxiliary facilities

A.6 System Demonstration

Requirements for performance of the System Demonstration should be included in the System Verification, Acceptance, and Demonstration Plan.

The System Demonstration should involve day-to-day operation of the APM system in accordance with the System Operations Plan of 15.1 and the Maintenance Plan per 15.7. During the System Demonstration the system should be operated as if in passenger service (typically without passengers) in strict accordance with all operations and maintenance policies and procedures. The System Demonstration should not be deemed complete until the specified System Service Availability has been achieved over a specified operating period (e.g., 7 days to 30 days dependent upon system complexity). During the

System Demonstration the owner may elect to require that some or all trains in operation be loaded to simulate passengers.

The number and skills of personnel involved in the operations and maintenance of the system during the System Demonstration should not exceed the number and skills identified in the Staffing Plan prepared in accordance with 15.1.3. Training and qualification of operations and maintenance personnel required per 15.8 shall be completed. This is exclusive of personnel required for performing demonstration administration and data collection.

The Manual of Operating Procedures required per 15.1.2 and Maintenance Manuals required per 15.7.3 shall be utilized during the System Demonstration, and any deficiencies noted for subsequent revision.

Data should be collected, analyzed, and presented to demonstrate that the required system performance has been met.

ANNEX B. INSPECTION AND TEST GUIDELINES

THIS ANNEX IS INFORMATIVE AND IS NOT A MANDATORY PART OF THE STANDARD.

This Annex is not a part of the requirements of this standard but is included for informational purposes only.

This guideline suggests items that should be considered in compiling an inspection and test checklist. It is provided as a sample to assist an owner/operator in developing their own checklist. This guideline is not all-inclusive and may contain items not common to every system. The objective of the Annex is to provide examples for *internal* inspection and testing by knowledgeable technicians and *not* audit checklist items.

B.1 Vehicle

The vehicle is typically inspected to the following criteria:

1. Check the condition of the cabin unit for body damage or deterioration.
2. Visually inspect the cabin unit for loose or missing fasteners.
3. Visually inspect all individual seat units for damage and deterioration.
4. Visually inspect for sharp or protruding objects in the passenger areas.
5. Check the condition of the floor surface.
6. Inspect the entry doors and operating mechanisms for proper function or damage.

7. Visually inspect the cabin chassis for cracks or damage.
8. Check the road wheels, steel wheels, and guide wheels for abnormal wear or damage.
9. Check the HVAC for leaks and proper operation.
10. Visually inspect the batteries and storage trays.
11. Check the emergency exit doors for proper operation.
12. Check the communications equipment for proper operation.
13. Check the interior safety signage.
14. Visually inspect the brake linkages and safety switches.
15. Check elastomeric body mounts for deterioration.
16. Check low tire pressure detector sensors.
17. Check that grab bars, hand holds, and access panels are properly secured.
18. Check the cabin interior lighting.
19. Check the onboard pneumatic or hydraulic system and reservoirs.
20. Inspect fire extinguishers and other applicable safety equipment for scheduled maintenance, operational condition, and accessibility.
21. Test emergency electric power and charging systems.
22. Check low level sensing system.
23. Check compliance of vehicle with clearance envelope.
24. Visually inspect the suspension components.
25. Check bearings for abnormal wear or damage.
26. Visually inspect the sanding system.
27. Visually check windows for damage and proper fit.
28. Visually inspect coupler(s).
9. Check the power feed and electrical service to the guideway and track.
10. Inspect the vertical and horizontal guide sheaves and mounts.
11. Check the access platforms, walkways, catwalks, and railings.
12. Visually inspect the track expansion and seismic joints.
13. Visually inspect the track running surface.
14. Check the overall condition of the guideway.
15. Visually inspect the condition of the isolator bushings.
16. Visually inspect the guideway safety rail.
17. Check all switches for damage.
18. Visually inspect conductor rail.
19. Visually inspect track end buffer.
20. Visually inspect grounding rail.
21. Visually inspect signals/signs.
22. Check the tunnel ventilation systems.

B.3 Queue and Holding Areas

The queue and holding areas are typically inspected to the following criteria:

1. Visually inspect the queue walls and fencing for security and damage.
2. Visually inspect the holding areas for hazards to passengers.
3. Check for proper queuing techniques, i.e., signage, graphics, or other.
4. Check for adequate lighting in the passenger traffic areas.
5. Visually inspect for slip, trip, and fall hazards in the queue area.
6. Check for sharp or protruding objects in the queue area.
7. Check the condition, content, and location of all warning and informational signs.
8. Function test all of the station door systems.
9. Check the communication equipment for proper operation and condition.
10. Check the station areas for adequate staffing or monitoring.
11. Visually inspect emergency exits and egress paths for obstructions.

B.4 Propulsion and Braking

The propulsion and braking system is typically inspected to the following criteria:

1. Visually inspect the drive equipment (wiring, power supply, etc.) for obvious hazards.
2. Test the emergency drive system unit for proper operation, maintenance, and adequate fuel.

B.2 Guideway, Track, and Support Structure

The guideway, track, and support structure are typically inspected to the following criteria:

1. Visually inspect the guideway for cracks, damage, foreign objects, debris, or deterioration.
2. Check the guideway and track fasteners for looseness or deterioration.
3. Check the vertical and horizontal guide sheave bearings for adequate lubrication.
4. Check for loose or missing fasteners on the guideway and track.
5. Visually inspect the footings and anchor points.
6. Check for abnormal wear or contact between the cabin and the guideway.
7. Visually inspect the track rail and pedestal mounts for cracks.
8. Check the guideway return trough access ports and covers.

3. Check the fire suppression equipment if provided.
4. Check the gear reducers for proper oil level and leakage.
5. Visually inspect the tachometric generators and gears.
6. Visually inspect the drive motor.
7. Visually inspect the service brake.
8. Visually inspect the emergency brake.
9. Check the condition of all hydraulic or pneumatic hoses.
10. Check for the proper installation and application of drive guards.
11. Check the brake hydraulic or pneumatic system and manual release systems.
12. Check tension rope for abnormal wear and damage.

B.5 Electrical Equipment

The electrical equipment is typically inspected to the following criteria:

1. Check the transportation device-related distribution equipment.
2. Check for the proper use of GFCIs and grounding, including metal vehicle parts.
3. Visually inspect the lighting for proper operation.
4. Visually inspect the condition of conduit, wiring, connections, and grounding.
5. Check for the proper condition, operation, and labeling of control stations.
6. Check the accessibility for authorized personnel and guarding against passenger access.
7. Check the high voltage distribution panels for appropriate signage.
8. Check all control station indicator lights and displays for proper function.
9. Test all of the internal telephones located at the operator positions.
10. Check the rope supervision output signal, including derailment function.
11. Visually inspect the batteries and their charging systems.
12. Record the operating hours and the trip cycle count.
13. Perform ATC/ATP diagnostic if provided.
14. Check passenger vehicle sound and visual annunciation systems.
15. Visually inspect lightning protection.

B.6 Operational Tests

The operational tests are typically performed to the following criteria:

1. Test the service stop and emergency stop buttons at all stations and on vehicles.

2. Test the operator console controls for proper operation.
3. Cycle the APM in auto mode through at least three complete cycles (six trips); record the running test cycle times and check the average running speed.
4. Test the programmer(s) in the test mode.
5. Test the overspeed governing system.
6. Test the acceleration and deceleration supervision in both directions.
7. Check the approach supervision in both directions.
8. Test the zero speed system.
9. Test the vehicle communication devices.
10. Test the overtravel protection system in the stations.
11. Test the vehicle door open sensors and force limit for proper operation.
12. Test the vehicle emergency door system for proper operation.
13. Test flat tire detection system.
14. Test the service brake.
15. Test the emergency brake and verify proper stopping capability.
16. Check the CCTV for proper operation.
17. Test station vehicle leveling systems.
18. Test fail-safe function of the brake system(s).
19. Check the coupler(s) for proper function.
20. Check the sanding system for proper operation.

B.7 Operational Emergency Tests

The operational emergency tests are typically performed to the following criteria:

1. Check emergency equipment and signage on vehicles and at stations.
2. Review emergency situation procedures.
3. Review evacuation procedures.
4. Review operating personnel procedures.
5. Review fire protocols.
6. Perform tunnel ventilation system test.

B.8 Records and Miscellaneous

Records and Miscellaneous items are typically inspected to the following criteria:

1. Verify that operations and maintenance pre-opening inspection forms were completed.
2. Check the lockout/tag-out points and procedure.
3. Check for proper maintenance and testing of the fire suppression equipment.
4. Check the building fire alarm system for activation devices/audible alarms.
5. Check the drawings, manuals, calculations, etc. for on-site availability.

6. Check that the applicable nondestructive testing has been performed within the required time period and appropriately documented.
7. Check the evacuation routes for proper clearances and accessibility.
8. Check for improper storage of hazardous materials.
9. Check each station for the proper rescue equipment (e.g., ladders).
10. Check the station eyewash unit for proper function.
11. Check safety records.
12. Check maintenance records for safety-critical systems.

ANNEX C. BIBLIOGRAPHY

THIS ANNEX IS INFORMATIVE AND NOT A MANDATORY PART OF THE STANDARD.

Guidance to assist in the development of a System Security Program Plan pursuant to Section 12 is provided in the following documents:

1. *FTA's Transit System Security Program Planning Guide* (FTA-MA-90-7001-94-1)
2. *Transit Security Procedures Guide* (FTA-MA-90-7001-94-2)

3. *The Public Transportation System Security and Emergency Preparedness Planning Guide* (DOT-FTA-MA-26-5019-03-01)

Guidance to assist in the development of the Emergency Preparedness Program Plan per Section 13 is provided in the following documents:

1. *Recommended Emergency Preparedness Guidelines for Rail Transit Systems* (UMTA-MA-06-0152-85-1)
2. *Recommended Emergency Preparedness Guidelines for Elderly and Disabled Rail Transit Passengers* (UMTA-MA-06-0186-89-1)
3. *Recommended Emergency Preparedness Guidelines for Urban, Rural, and Specialized Transit Systems* (UMTA-MA-06-0196-91-1)
4. *Critical Incident Management Guidelines* (FTA-MA-26-7009-98-1)
5. *Public Transportation System Security and Emergency Preparedness Guide* (DOT-FTA-MA-26-5019-03-01)
6. *Standard Protocols for Managing Security Incidents Involving Surface Transportation Vehicles* (DOT-FTA)
7. *NFPA 130 Standard for Fixed Guideway Transit and Passenger Rail Systems*

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