Determining Requirements for Automated Transit Bus Test Facilities: Considerations for Practitioners



Automation technologies are being deployed on a number of roadway vehicles, and applying these technologies to transit buses has potential benefits for service, costs, and efficiency. Prior to deploying automation in transit, testing will be necessary to demonstrate safety, effectiveness, feasibility, durability, and maintainability. This testing may take place at closed test facilities, in local restricted areas (e.g., maintenance yard, parking lot, or closed campus), and on public roads.

FTA conducted research to develop a set of voluntary test facility requirements for transit industry consideration. These requirements provide a resource and reference for selecting test facilities with appropriate and necessary characteristics for transit bus automation research and development, and to assure that transit bus automation testing produces meaningful results. The requirements may be used by a variety of organizations, including, but not limited to: technology developers and providers, bus manufacturers, integrators, academics, and transit agencies and operators.



Figure 1: EasyMile EZ10 Automated Shuttle Testing in Jacksonville, FL

FTA considered requirements for five technology packages and associated use cases, which are defined in the FTA <u>Strategic Transit Automation Research Plan</u>. These technology packages and use cases are listed in Table 1.

Technology Package	Use Case
Transit Bus Advanced Driver Assistance Systems	 Smooth Acceleration and Deceleration Automatic Emergency Braking and Pedestrian Collision Avoidance Curb Avoidance Precision Docking Narrow Lane/Shoulder Operations Platooning
Automated Shuttles	Circulator Bus ServiceFeeder Bus Service
Maintenance, Yard, Parking Operations	 Precision Movement for Fueling, Service Bays, and Bus Wash Automated Parking and Recall
Mobility-on-Demand Service	 Automated First/Last Mile Automated Americans with Disabilities Act (ADA) Paratransit On-Demand Shared Ride
Automated Bus Rapid Transit (BRT)	Automated BRT

Numerous stakeholders, including transit bus manufacturers, operators, test facilities, and federal agencies, were consulted to develop the requirements. A list of "mandatory" and "optional" requirements were compiled for each of the use cases and technology packages. The 91 requirements fall into six broad categories:

- Test Center Features: Physical features of the facility needed to support testing
- Functionality and Performance: Permanent or temporary equipment or mock-ups needed to verify and quantify functionality and/or performance
- Safety: Safety protocols and resources to verify system safety during testing and deployment
- Environmental Resilience: Controlling or simulating environmental factors such as lighting, visibility, and precipitation
- Human Factors: Resources to verify and quantify human factors issues for the system
- Data Collection and Management: Resources to acquire, store, and analyze relevant test data

In the context of this research, "mandatory" requirements relate to basic operation and testing of automated transit vehicles, participant safety and privacy, and the collection and management of data. They would be relevant in testing of virtually every vehicle that fulfills the mission of a particular use case. Most requirements are considered optional depending on the specific goals or other parameters associated with a particular project. That is, they may be disregarded if the project was not designed or intended to demonstrate functionality under the operational design domain (ODD) that generated the requirement. For example, a vehicle designed to be deployed in an enclosed garage need not demonstrate environmental resilience to precipitation.

The requirements generated in this research are intentionally broad to provide flexibility in defining parameters for specific demonstrations and pilot projects. However, requirements for specific projects should contain appropriately detailed specifications.







Figure 2: Virginia Tech Transportation Institute's Virginia Smart Road Facility, including a Blacksburg Transit bus on a bridge (top), weather and lighting testing equipment (middle), and a bus shelter mockup in the Urban Roadway Test Area (bottom)

For more information:

- Access the full report: Access the full report: <u>Determining Requirements for Automated Transit Bus Test</u>
 <u>Facilities: Considerations for Practitioners</u>
- Contact FTA's Office of Research, Demonstration and Innovation at transitautomation@dot.gov