



Designation: F3243 – 21

Standard Practice for Implementing Communications Impairments on A-UGV Systems¹

This standard is issued under the fixed designation F3243; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice considers impairments of communications within an automatic, automated, or autonomous unmanned ground vehicle (A-UGV) system during task execution. An A-UGV system typically uses communications between an A-UGV and fixed system components and resources, such as off-board control, job and fleet scheduling, infrastructure equipment interactions, or cloud-computing programs for tasks. Communications impairments can cause an A-UGV operation to change in various ways that can include delays or failure to complete the task.

1.2 This practice is designed for applying known communications impairments to an A-UGV system in conjunction with A-UGV task testing. It is designed to create similar changes in communications that can possibly cause task performance limiting effects that are often experienced by an A-UGV system in different environments.

1.3 This practice is intended to simulate impairments that may be present during the operation of an A-UGV system. This practice can be used, for example, by a manufacturer to indicate that system performance was tested to be robust against specific test communications impairments. The tests are not intended to test situations that should be eliminated during system installation, for example, a duplicate internet protocol (IP) address on the network.

1.4 This practice only describes communications impairments. It does not specify an A-UGV task. The A-UGV task should be a defined ASTM International test method or task description in similar detail.

1.5 This practice defines methods to record communications impairment types and extents while the A-UGV is stationary or performs a task. Temporal or spatial extents in which communications impairments occur include the timing, duration, location within the task, or other triggered events. Examples for implementing common communications impairments are provided.

1.6 This practice is not intended for:

1.6.1 Communications impairments between onboard components of an A-UGV, for example, onboard sensors-to-onboard computers.

1.6.2 Communications or measurement impairments directly affecting external reference or positioning systems, for example, global positioning system (GPS) used for navigation and range/azimuth sensor-to-wall reflectors.

1.7 The values stated in SI units are to be regarded as the standard. No other units of measurement are included in this standard.

1.8 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use. Safety standards for A-UGVs (for example, ITSDF B56.5, ISO 3691-4) should be followed.*

1.9 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*²

F3200 Terminology for Driverless Automatic Guided Industrial Vehicles

F3218 Practice for Documenting Environmental Conditions for Utilization with A-UGV Test Methods

F3244 Test Method for Navigation: Defined Area

F3265 Test Method for Grid-Video Obstacle Measurement

F3237 Practice for Recording the A-UGV Test Configuration

¹ This practice is under the jurisdiction of ASTM Committee F45 on Driverless Automatic Guided Industrial Vehicles and is the direct responsibility of Subcommittee F45.04 on Communication and Integration.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

2.2 Other Standards:

ANSI/ITSDF B56.5 Safety Standard for Driverless, Automatic Guided Industrial Vehicles and Automated Functions of Manned Industrial Vehicles³

ISO 3691-4 Industrial trucks — Safety requirements and verification — Part 4: Driverless industrial trucks and their systems⁴

3. Terminology

3.1 Many terms used within this standard are defined as in Terminology F3200. The following terms and definitions are used within this standard and are not defined within Terminology F3200.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *communications impairment, n*—specified change in the communications that can include changes in connectivity state, latency, data rate, and/or data integrity between the A-UGV and other equipment that is part of the A-UGV system.

4. Significance and Use

4.1 A-UGVs operate in a wide range of indoor and outdoor applications that include many communications challenges that can affect A-UGV control and monitoring. An A-UGV system or A-UGVS as defined in Terminology F3200 includes the A-UGV and all associated components, equipment, software, and communications necessary to make a fully functional

system. Communications impairments can cause: (1) changes in A-UGV operation, (2) changes in behavior in system components such as control and scheduling, or (3) changes in operation or timing of infrastructure equipment coordination. This practice is intended to record the task performance of an A-UGV while communications are impaired in a specified and repeatable manner (for example, standard test method).

4.2 Communications impairments can occur at a variety of locations within the A-UGVS. The network topology in Fig. 1 shows many of the common communications links that could be impaired. The numbered arrows in Fig. 1 label different places where communications impairments could occur. The box colors (that is, green, red, blue) indicate different types of impairments where the two red boxes are similar to each other. Fig. 1 will be used throughout this practice and included on the test report for use in describing the test setup and results by the test supervisor.

4.3 The requested expected results provide pass/fail reporting criteria along with recorded notes pertinent to the test or results or both. It is possible that the communications impairments used will have no noticeable effect, and this is often the desired outcome.

5. Summary of Practice

5.1 This section provides an outline of the practice describing the essential features of the procedures. Two types of tests are summarized: (1) stationary test and (2) task tests (baseline and impaired communication) where the task is a repeatable representative or actual real-world A-UGV task. Impairments and expected results are then outlined.

5.2 Tests:

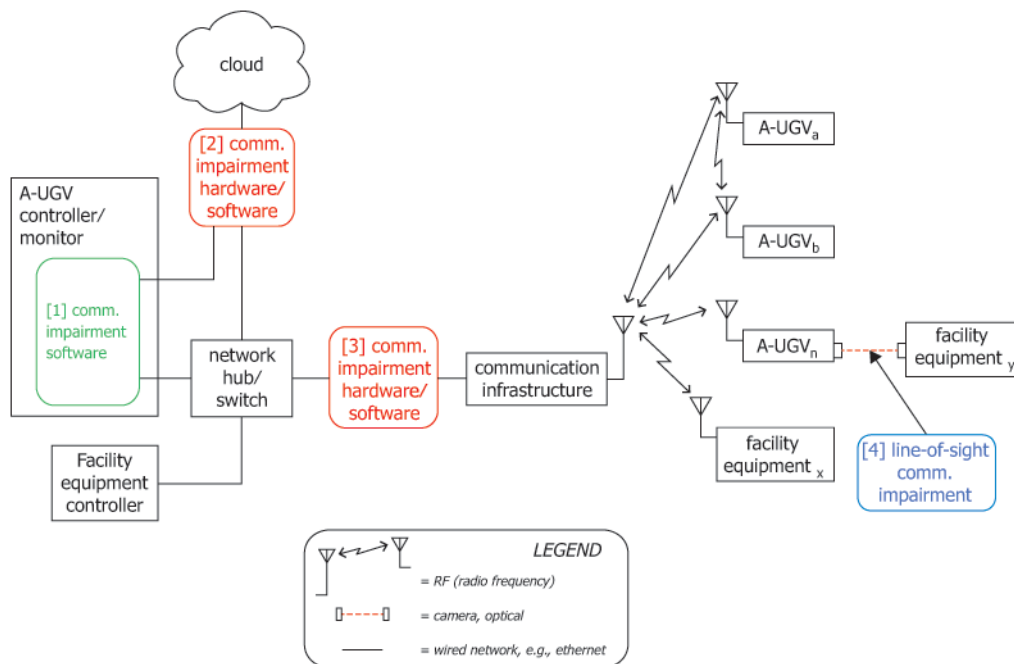


FIG. 1 Block Diagram of Communications for Control/Monitoring of A-UGVs and Associated Facility Equipment in which Numbers with Arrows Indicate Examples of Communications Impairment Locations