



APTA STANDARDS DEVELOPMENT PROGRAM
RECOMMENDED PRACTICE

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Comparison of Rail Transit Vehicle Reliability Using On-Time Performance

Abstract: This *Recommended Practice* describes the basic common procedures that rail transit systems can use to make meaningful comparisons of vehicle reliability .

Keywords: 5-minute reliability, on-time performance, rail transit, vehicle reliability

Summary: This standard establishes a common measure, vehicle 5-minute on-time performance reliability, that allows rail transit systems to compare their vehicle reliability with the vehicle reliability of their peers, or to monitor changes in their vehicle reliability over time. These comparisons can be made weekly, monthly, quarterly or annually.

Scope and purpose: This *Recommended Practice* applies to rail transit systems that wish to have a basis for making meaningful comparisons of vehicle reliability. Use of this practice is entirely at the option of transit systems. The practice can be used only to compare vehicle reliabilities. It cannot be used to compare the reliability of overall transit system operations.

This *Recommended Practice* represents a common viewpoint of those parties concerned with its provisions, namely, transit operating/planning agencies, manufacturers, consultants, engineers and general interest groups. The application of any standards, practices or guidelines contained herein is voluntary. In some cases, federal and/or state regulations govern portions of a transit system's operations. In those cases, the government regulations take precedence over this standard. APTA recognizes that for certain applications, the standards or practices, as implemented by individual transit agencies, may be either more or less restrictive than those given in this document.

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The American Public Transportation Association greatly appreciates the contributions of **Tom Peacock**, who provided the primary effort in the drafting of this *Recommended Practice*.

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Introduction

(This introduction is not a part of APTA RT–VIM-RP-024-12, “Comparison of Rail Transit Vehicle Reliability Using On-Time Performance.”)

This *Recommended Practice* describes the basic common procedures that rail transit systems can use to make comparisons of vehicle reliability among rail transit systems meaningful. APTA recommends the use of this practice by rail transit systems interested in comparing their vehicle reliability with the vehicle reliability of their peers or, by rail transit systems interested in monitoring changes in their vehicle reliability over time.

Next to safety, perhaps the most important transit system performance indicator to transit customers is on-time performance. Rail transit systems have long desired to have meaningful benchmarks for performance among peers or of changes in their own performance over time.

As a result, the Vehicle Inspection and Maintenance Committee attempted to develop a relatively simple algorithm for transit systems to use to calculate vehicle 5-minute on time performance reliability. Using this practice is entirely voluntary. However, to make reliability comparisons meaningful, rail transit systems must use common definitions, take data in the same way and use a common algorithm to calculate reliability. This document sets out how this can be done.

The *Recommended Practice* also discusses some of the other factors that rail transit systems should consider when comparing their 5-minute on-time vehicle reliability to that of their peers.

To make comparisons using this *Recommended Practice* most meaningful, transit systems should select peer systems with similar vehicles and similar operating environments for the comparison.

Note on alternate practices

Individual rail transit systems may modify the practices in this standard to accommodate their specific equipment and mode of operation. APTA recognizes that some rail transit systems may have unique operating environments that make strict compliance with every provision of this standard impossible. As a result, certain rail transit systems may need to implement the standards and practices herein in ways that are more or less restrictive than this document prescribes. A rail transit system may develop alternates to the APTA standards so long as the alternates are based on a safe operating history and are described and documented in the system’s safety program plan (or another document that is referenced in the system safety program plan). Documentation of alternate practices shall:

- identify the specific APTA rail transit safety standard requirements that cannot be met;
- state why each of these requirements cannot be met;
- describe the alternate methods used; and
- describe and substantiate how the alternate methods do not compromise safety and provide a level of safety equivalent to the practices in the APTA safety standard (operating histories or hazard analysis findings may be used to substantiate this claim).

Comparison of Rail Transit Vehicle Reliability Using On-Time Performance

1. Taking data

Rail transit systems should record data over commonly recognized periods of time using the definitions given on Page 3. APTA recommends that rail transit systems record data over weekly, monthly, quarterly and annual periods of time.

Rail transit systems should record the following data over each of the time periods selected by the rail transit system:

- total trips
- total “vehicle-caused” late trips

2. Calculation of vehicle 5-minute on-time performance reliability

Rail transit systems should calculate vehicle 5-minute on-time performance reliability using the following algorithm:

$$5\text{-Minute Reliability} = \frac{(\text{Total Trips} - \text{Total “Vehicle-Caused” Late Trips}) \times 100}{(\text{Total Trips})}$$

For example, over a weekly time period, if a rail transit system records 1000 trips with 20 vehicle-caused late trips, then the 5-minute reliability for that week would be calculated as follows:

$$5\text{-Minute Reliability} = \frac{(1000 - 20) \times 100}{(1000)} = 98\%$$

3. Factors to consider in making vehicle reliability comparisons

Rail transit systems should take into account many factors when interpreting comparisons of their vehicle 5-minute on-time performance with that of other transit systems. Some transit systems have reliability-centered maintenance philosophies that attempt to perform maintenance and part replacement at intervals to prevent failures from occurring. Other transit systems have an approach that allows vehicle failures to occur before maintenance is performed. Transit systems with a reliability-centered maintenance approach would be expected to have a better vehicle 5-minute on-time reliability than those using a perform-maintenance-upon-failure approach.

The definitions used in this *Recommended Practice* do not take into account the distance the vehicle runs. Some rail transit vehicles are used for short trips, others for much longer trips. Some rail transit vehicles complete many trips per day, others only a few trips per day. If a transit system wishes to take into account reliability based on distance traveled, a mean-distance-between-failures reliability measure should be used.

The reliability approach described in this *Recommended Practice* also does not take into account average vehicle age or climatic factors, both of which can influence reliability. Other factors that can affect vehicle reliability include:

- the type of right-of-way (i.e., street running versus separated lines);
- the number of stops per trip; and
- the number of trains and train trips per system.

In a high-frequency, integrated network of bus and rail lines, vehicles may need to be on time at transfer locations, not just at the end of the line. Under this *Recommended Practice*, a vehicle could be late throughout a trip but make up time near the terminus, and still be considered “on time.” In these situations, transit systems should measure on-time performance using all scheduled timepoints along a line.

Rail transit systems can have interlocking locations where trains must be on time; otherwise they become out of order. Therefore, trains being early can sometimes cause system problems.

4. Definitions

departure station: The first or initial station of a trip, where the train is either first placed in service or changes direction to start a new trip.

destination station: The final or terminal station of a trip, where the train is either taken out of service or changes direction to start a new trip.

late trip: A trip in which the train arrives at its destination station more than 5 minutes later than its scheduled arrival time at that station. A late trip is measured from end to end of the run. A train may be late at intermediate stations, but the time can be made up prior to reaching the destination station. A trip in which the train skips stations to make up time must be counted as a late trip.

on-time trip: A trip in which the train arrives at its destination station no more than 5 minutes later than its scheduled arrival time at that station.

total trips: The total number of trips taken over a given period of time (usually weekly, monthly, quarterly or annually).

total “vehicle-caused” late trips: The total number of times that a train completes a late trip due to a vehicle failure over a given period of time (usually weekly, monthly, quarterly or annually).

trip: Travel of a train from its departure station to its destination station.

“vehicle-caused” late trip: A trip in which the train arrives at its destination station more than 5 minutes past its scheduled arrival time due to a vehicle failure on that train. Subsequent late trains with no vehicle failures made late by a dead train are not counted as vehicle-caused late trips.

vehicle failure: The malfunction of any vehicle system, subsystem or component.

5. Abbreviations and acronyms

APTA	American Public Transportation Association
VIM	Vehicle Inspection and Maintenance (Committee)