APTA STANDARDS DEVELOPMENT PROGRAM

STANDARD

American Public Transportation Association
1300 I Street NW, Suite 1200
Washington, DC, 20005

APTA RT-VIM-S-017-03 Rev 2

First Published September 28, 2003
First Revision November 2, 2006 (Reaffirmed)
Second Revision January 6, 2015 (Reaffirmed)

Rail Transit Standards Vehicle Inspection and Maintenance Working Group

Calibration of Inspection and Maintenance Precision Measuring Devices and Tools

Abstract: This *Standard* covers basic procedures for calibration of inspection and maintenance precision measuring devices and tools.

Keywords: calibration, precision measuring device, tools

Summary: This document establishes a standard for the calibration of precision measuring devices and tools used by vehicle maintenance departments within a rail transit system. Rail transit systems shall tailor this standard to accommodate their specific equipment and mode of operation.

Scope and purpose: This standard, in combination with the ISO standard referenced, includes all essential periodic inspection and maintenance requirements for the calibration of precision measuring devices and tools used to inspect and maintain rail vehicles. This procedure covers all types of electronic test equipment, mechanical tools and measuring devices used to generate quantitative measurements and/or data. Calibration and certification is based on standards set by the National Institute of Science and Technology, original equipment manufacturers' recommended calibration cycles, and a transit agency's specifications. This standard is intended for use by the vehicle maintenance department within a rail transit system. It establishes procedures for the periodic calibration of inspection and maintenance of precision measuring devices and tools to ensure the accuracy of measurements obtained by these devices.

Participants

The American Public Transportation Association greatly appreciates the contributions of the **Rail Transit Standards Vehicle Inspection and Maintenance Committee**, which provided the primary effort in the drafting of this *Standard.*

At the time this standard was completed, the working group included the following members:

Ken Morford, *Chair*
Scott Laps, *Vice Chair*

Marwan Al-Muktar
Juan Aristizabal
Dave Barber
Chris Barbour
Damian Barnhart
Sherif Bastawros
Steve Bethel
Jerry Blackman
Stephen Bonina
John Condrasky
Richard Curtis
Henry Davis
Paul Denison
Jeff Dunham
Phil Eberl
Marc Gagne
Mike Ghobrial
Dan Gornstein
John Green
Scott Grogan
Terry Heildebrandt
Ben Holland
Anthony Jones
John Kesich
Rick Kinding
Henry Kolesar
John Kortekaas
Paul Kovacs
David Kowalski
Joseph Krempasky
Brian Ley
John McEwen
Larry Nye
Frank Pearson
John Sadorra
Richard Seaton
Jay Shah
Melissa Shurland
George Shaffer
James Skaggs
Bill Steinmetz
Narayana Sundaram
Michele Swayzer
Tom Tarantino
Clive Thornes
Wilson Wallace
Michael Wetherell
Evalynn Williams
Cliff Woodbury
Hannie Woodson
Bob Young

Vacant, Secretary

Project consultant
Gordon S. Campbell,
Interfleet Technology, Inc.

Project team
Charles Joseph
American Public Transportation Association

Contents

Introduction

This introduction is not a part of APTA RT-VIM-RP-017-03 Second Revision January 6, 2016 *Standard* for Calibration of Inspection and Maintenance Precision Measuring Devices & Tools.

This *Standard* for the Calibration of Inspection and Maintenance Precision Measuring Devices and Tools for rail transit vehicles 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 rail 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 rail transit systems, may be either more or less restrictive than those given in this document.

This *Standard* describes the basic inspection and maintenance requirements for the calibration of rail transit precision measuring devices and tools. APTA recommends the use of this standard by individuals or organizations that use measuring devices and tools to make quantitative measurements to demonstrate compliance with a specified requirement.

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 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).

Calibration of Inspection and Maintenance Precision Measuring Devices and Tools

1. Frequency of conduct

This section provides guidance to the rail transit system (RTS) to develop initial calibration and audit programs. In implementing this *Standard,* frequencies for individual tasks shall be established based on a number of factors, including but not limited to the following:

- operating environment/conditions
- OEM-recommended intervals
- performance requirements
- historical data
- failure analysis
- reliability-centered maintenance programs
- industry experience
- rail transit system's testing and experience

NOTE: In the absence of experience, recommendations or history, initial calibration and audit intervals shall be as specified below.

1.1 Calibration intervals

Precision measuring devices and tools shall be inspected, repaired and calibrated at regular intervals for proper operation and accuracy. A periodic precision measuring device and tool recalibration program shall be developed based upon the measurement equipment's stability, purpose, usage and environmental conditions. **Table 1** establishes the initial calibration interval for equipment that has seen normal operating conditions.

TABLE 1
Calibration Intervals

Description	Maximum Initial Intervals Between Calibration Under Normal Operating Conditions
Mechanical/pneumatic devices and analog gauges	1 year
Transducers	1 year
Portable analog instruments	1 year
Portable digital instruments	2 years
Portable electrical/electronic devices	1 year
Electrical/electronic bench devices	2 years
Special tools	As required by the OEM
Special gauges	As required by the OEM

NOTE: Normal operating conditions do not include the following:

- dropping
- overloading
- working outside the environmental conditions specified by the OEM
- working in a severe operating condition

In the event that the device is suspected of being damaged, then the device shall be recalibrated immediately. In some instances damage is not readily discernable. Severe operating conditions involve a device being used in an operating environment that involves the potential for the device to lose its calibration due to frequent use, environmental conditions or rough handling. The RTS should develop a policy on recalibrating precision measuring devices that operate under severe conditions more frequently than the guidelines in **Table 1**.

1.2 Audit intervals

As part of the Quality Assurance Plan, the RTS shall develop and implement a procedure for auditing the correct implementation of the calibration system. **Table 2** establishes the initial audit intervals for the devices and facilities. Each audit should be documented in accordance with the RTS's procedures.

TABLE 2
Audit Intervals

Periodic Audit	Initial Intervals Between Audits
Measuring devices and tools for the presence of required and current calibration labels	6 months
In-house proof testing process	as required by RTS's Quality Assurance Plan
All calibration facilities and the procedures and personnel who perform the calibrations	2 years

2. Requirements and specific tasks

2.1 Safety/personal protective equipment

Appropriate personal protective equipment, meeting minimum American National Standards Institute (ANSI) standards and as required by the RTS, shall be worn at all times.

Established RTS safety practices, rules and procedures shall be followed at all times in the performance of these inspections and tests.

2.2 Training requirements

Rail transit systems and/or their maintenance contractors shall develop and execute training programs that provide employees with the knowledge and skills necessary to safely and effectively perform the tasks outlined in this standard.

2.3 Calibration of precision measuring devices

The RTS shall develop and implement a calibration procedure that is in compliance with ISO 10012 and this standard. The calibration procedure shall require employees to perform self-tests and self-calibration on equipment with built-in self-test and self-calibration routines prior to taking any measurements.

Measuring devices that do not successfully pass the self-test or self-calibration process shall not be used.

2.3.1 Precision measuring device and tool list

Each RTS shall develop procedures for creating, developing and maintaining a complete and up-to-date "calibration database" of precision measuring devices and tools requiring calibration. The procedure shall include a methodology to incorporate newly purchased precision measuring devices and tools to the calibration database prior to the equipment being used by the RTS. The RTS also shall develop a procedure for retiring equipment that is damaged beyond economic repair or obsolete. This equipment shall be disposed of to prevent further use by the RTS. A sample calibration database is provided in Annex A.

2.3.2 Calibration categories

The RTS may develop two calibration categories: "calibration required" and "no calibration required." The RTS's manager of quality assurance or the person identified by the RTS's Quality Assurance Plan shall approve the classification of individual devices into a specific calibration category.

The RTS shall develop a procedure for changing the designation of devices between the categories "calibration required" and "no calibration required."

2.3.2.1 Calibration required

This designation is for precision measuring devices and tools in regular use by the RTS to generate quantitative measurements or data that are used to demonstrate compliance with specified requirements. Rail transit systems have the option of sending these precision measuring devices to a qualified calibration facility or may use in-house personnel qualified on specific equipment to perform calibration.

2.3.2.2 No calibration required (NCR)

This designation is specifically for any device or tool that does not require an accuracy check, periodic maintenance or calibration as classified by the RTS's procedure.

Devices or tools with a status of "no calibration required" shall be classified and tracked in the RTS's database.

2.3.3 Calibration recall notification

Each RTS shall develop procedures to issue a recall notification and to verify that all devices and tools requiring calibration are recalibrated or removed from service on the expiration of the current calibration. When equipment is returned from calibration and/or repair, the department will document the repairs made and/or the calibration information in accordance with the RTS's procedure.

2.3.4 Qualified calibration and repair facilities

All organizations/departments performing calibrations to precision measuring devices and tools shall be certified to ISO 10012 or ANSI Z540-1. All standards used for calibrating precision measuring devices and tools shall be traceable to the National Institute of Science and Technology (NIST). Calibrations may be performed either internally or externally to the RTS.

After repair, the RTS shall have the precision measuring device or tool re-calibrated.

2.4 Calibration documentation

The RTS shall develop a procedure for documenting the calibration and repair of its precision measuring devices and tools. At a minimum, the calibration documentation shall include the following:

- calibration database
- a certificate of calibration for each device that is calibrated
- documentation for the repair and subsequent re-calibration of all equipment identified by this standard
- calibration labels

2.4.1 Calibration database

The RTS shall develop a calibration database that includes the following:

- device description, supplier, model number, serial number and/or tool identification number
- the date of calibration of the measuring device or tool
- the calibration due date

A sample calibration database is provided as a reference in Annex A.

2.4.2 Calibration labels

All precision measuring devices and tools shall have a current tamper-resistant calibration label affixed to the tool in a conspicuous location. If the tool is too small to affix a label to it, the RTS shall determine the appropriate location.

Calibration labels must be applied by an authorized individual and have the following minimum information:

- calibration due date
- identification of organization/department performing calibration

Test equipment that requires no calibration is required to have a label affixed to it with the following information:

- "NCR" in contrasting letters (see Section 2.3.2.2)
- date affixed
- serial number of the equipment
- identification of classifying individual or department designated by the RTS.

2.4.3 Measuring device and tool identification number

Each measuring device or tool that is classified as "calibration required" shall have a unique identification number permanently affixed or inscribed on the device, independent of the calibration label. The device identification number may be a manufacturer's serial number or a unique number assigned by the RTS.

2.5 Correction of deficiencies

Any deficiencies uncovered during these tasks should be corrected and documented in accordance with RTS procedures and OEM recommendations.

Related APTA Standards

None at this time.

References

This standard should be used in conjunction with the original equipment manufacturer's specifications for calibration of precision measuring devices and tools, RTS procedures for the calibration of precision measuring devices and tools and the following documents:

- American National Standards Institute, ANSI Z540-1-1994, "Calibration Laboratories and Measuring and Test Equipment – General Requirements," 1994.
- International Organization for Standardization, ISO 10012-1:1992, "Quality Assurance Requirements for Measuring Equipment – Part 1: Metrological Confirmation System for Measuring Equipment," 1992. http://www.iso.org/iso/catalogue_detail.htm?csnumber=17943
- International Organization for Standardization, ISO 10012-2:1997, "Quality Assurance for Measuring Equipment – Part 2: Guidelines for Control of Measurement Processes," 1997. http://www.iso.org/iso/catalogue_detail.htm?csnumber=17944

Definitions

For the purposes of this standard, the following terms and definitions apply:

precision measuring device: Any mechanical, electrical, electronic or pneumatic instrument that when utilized properly provides a measurement that is used to demonstrate compliance with specified requirements.

proof testing: An abbreviated calibration procedure performed by the RTS that compares a shop measuring device and tools to a known calibrated standard that is traceable to NIST and verifies that the shop measuring device's accuracy is within specified parameters.

special tool: A customized tool fabricated, purchased or supplied for a specific purpose. A special tool may be considered a precision measuring device.

special gauging: Gauges used to verify OEM specifications. A special gauge may be considered a precision measuring device.

Abbreviations and acronyms

ANSI	American National Standards Institute
ISO	International Standards Organization
OEM	original equipment manufacturer
NATSA	North American Transit Services Association
NCR	no calibration required
NIST	National Institute of Science and Technology
RTS	rail transit system

Summary of changes

1. Document formatted to the new APTA recommended practice format.
2. Sections have been moved and renumbered.
3. Scope and summary moved to the front page.
4. Sections of definitions, abbreviations and acronyms moved to the rear of the document.
5. Four new sections added: "Related APTA Standards", "Summary of document changes," "Note on Alternate Practices" and "Document history."
6. Some global changes to section headings and numberings resulted when sections dealing with references and acronyms were moved to the end of the document, along with other cosmetic changes, such as capitalization, punctuation, spelling, grammar and general flow of text.
7. Working Group membership updated.

Document history

Document Version	Working Group Vote	Public Comment	Rail CEO Approval	Rail Policy & Planning Approval	Published Date
First Published	Jan 14, 2003	-	-	Sep 28, 2003	Sep 28 2003
First Revision	-	-	-	-	Nov 2 2006
Second Revision	April 2015	-	-	-	Jan 6 2016

NOTE: This document was reaffirmed due to minor cosmetic changes and approved by the Rail Transit Vehicle Inspection & Maintenance Working Group at a meeting in Pittsburgh, PA November 3 & 4, 2015.

Annex A (informative): Sample calibration database

Description	Model	ID #	Serial #	Manufacturer	Location	Calibration Frequency	Stock #	Calibration Date	Calibration Due Date
Allen ground leak detector	SG-65M2B	W-111	R194	Ajax Consolidated	Coach shop	1 year	External	12/5/2001	12/5/2002
Barco speedometer	50-07084	W-044		Bach-Simpson	Canopy	1 year	00-20-617	6/7/2002	6/7/2003
Caliper, dial 0-6"		W-033	G-344014	Aerospace	Loco insp. shop	1 year	External	12/5/2001	12/5/2002
Caliper, dial 0-8"	500-197	W-066	7919	Mitutoyo	Proj. adm.	1 year	00-22-004	1/8/2002	1/8/2003
Caliper, digital 0-6"		W-050	7021764	Mitutoyo	Loco repair shop	1 year	External	At Pylon	4/3/2002
Capacitance meter	820	W-014	90-40948	BK Precision	Electronics lab	2 year	External	12/5/2001	12/5/2002
Compression tester set	9572281	W146H		EMD	Diesel repair	1 year	External	12/5/2001	12/5/2002
Dial indicator	697	W-069		Starrett	Loco repair shop	1 year	External	12/5/2001	12/5/2002
Digital back to back gauge	543-453B	W-067	5469	Mitutoyo	Proj. adm.	1 year	External	12/5/2001	12/5/2002
Digital force gauge	FGE-100X	W-147	Z9502B033	Shimpo	PM	1 year		4/25/2002	4/25/2003
Digital micron gauge	9450D	W-007	12453	TIF	Coach shop	1 year	00-00-372	1/25/2002	1/25/2003
Digital thermometer	50S/50D	W-135		Fluke	A/C, C. Campbell	1 year	00-21-388	6/21/2002	6/21/2003
Durometer, hardness gauge	1700	W-139	A-02543	Rex Gauge Co.	Paul Elias	2 year	00-21-539	10/5/2000	9/7/2002
Force gauge	FGE-200H	W-141	E300H001	Shimpo	Paul Elias	1 year	00-21-550	11/14/2001	11/14/2002
Freon charging scale-1	TIF 9010	W-005	30475	TIF	Coach shop	1 year	00-00-007	1/21/2002	1/21/2003
Frequency counter	1803	W-015	11807936	BK Precision	Electronics Lab	2 year	External	6/21/2002	6/21/2003
Go/no-go thread plug gauge	5/8-18 UNF	W-129		Frank Cox	PM/wheel cart	1 year	External	Out of service	5/2/2002
Hydraulic torque machine	70	W-061	7143DP	Tame Inc.	Loco/traction motors	2 year	External	1/6/2001	1/6/2003
Indicator, test	711	W-037	T3	Starrett	Loco repair shop	1 year	00-21-403	At Pylon	6/14/2002
LCD vacuum gauge	69070	W-137		Ritchie	A/C, C. Campbell	1 year	00-20-806	Out of service	Trying to find a supplier
LCR meter	878	W-020	23705931	BK Precision	Electronics lab	2 year	External	To be calibrated	Extension 1/12/03
Megohmeter	TES1601	W-148	990309874		Diesel repair	1 year	External	12/5/2001	12/5/2002
Micrometer 0-1" .0001"		W-105	GO 4-20	Mitutoyo	Loco repair shop	1 year	00-21-404	6/21/2002	6/21/2003
Multimeter, digital	Fluke 26-3	W-120	73020269	Fluke	PM day shift	1 year	External	12/5/2001	12/5/2002
Oscilloscope	1477b	W-018	12923	BK precision	Electronics lab	2 year	External	12/5/2001	12/5/2002
Pressure gauge	A551090	W-125		Beacon		1 year	00-99-548	12/5/2001	12/5/2002
Pressure gauge/ master		W-132		Beacon	C.S. Silvio	1 year	00-99-548	6/21/2002	6/21/2003

Description	Model	ID #	Serial #	Manufacturer	Location	Calibration Frequency	Stock #	Calibration Date	Calibration Due Date
Roughness meter	M3A	W-045	27174	Perthen	Loco repair shop	1 year	External	12/5/2001	12/ 5/2002
Signal receiver-Allen ground	SR-95M12B	W-130	R194	Ajax Consolidated	Coach shop	1 year	External	12/5/2001	12/5/2002
Sound level meter	K7010	W-144	185522	Kleton	Diesel repair	1 year	External	12/10/2001	12/10/2002
Tachometer, digital	3T2159	W-078		Cat	Loco repair shop	1 year	External	12/5/2001	12/5/2002
Test bridge	5305	W-068		Leeds & Northrup	Tool crib	1 year	External	12/5/2001	12/5/2002
Torque multiplier	GA 185	W-118	19434	Snap-On	Diesel repair	1 year	00-21-379	1/24/2002	1/24/2003
Torque wrench 0-250 lbs.	TW-12	W-075		Westward	Coach shop	1 year	00-21-274	At Pylon	5/24/2002
Velocity pickup	PMC258D	W-051-2	Balmac211	PMC/Beta	Loco repair shop	1 year	External	12/15/2001	12/15/2002
Vibration meter	211	W-051	840012	Balmac	Loco repair shop	1 year	External	12/15/2001	12/15/2002
Waveform generator	33120A	W-017	US-34015157	Hewlett-Packard	Electronics lab	2 year	00-22-011	2/11/2002	2/11/2003
Tape Measure				Stanley	Coach Shop	NCR		NCR	NCR