17. Standard for the 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.
Introduction

(This introduction is not part of APTA RT-VIM-S-017-03, Standard for the Calibration of Inspection and Maintenance Precision Measuring Devices and 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 document 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.
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Standard for the Calibration of Inspection and Maintenance Precision Measuring Devices and Tools

1. Overview

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

1.1 Scope

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. Measurement devices that are permanently attached to the rail vehicle are outside the scope of this document.

Note: Other rail transit systems’ inspection and maintenance departments may universally apply this standard.

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 (NIST), Original Equipment Manufacturers’ recommended calibration cycles, and a RTS’s specifications.

1.2 Purpose

This standard is intended for use by the vehicle maintenance department within a RTS. 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.

1.3 Alternate practices

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
- 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)

2. References

Original Equipment Manufacturer’s specifications for calibration of precision measuring devices and tools.

RTS procedures for the calibration of precision measuring devices and tools.


ANSI Z540-1 Calibration Laboratories and Measuring and Test Equipment - General Requirements

3. Definitions, abbreviations, and acronyms

3.1 Definitions

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

3.1.1 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.

3.1.2 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.

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

3.1.4 special gauging: Gauges used to verify OEM specifications. A special gauge may be considered a precision measuring device.
3.2 Abbreviations and acronyms

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

4. Frequency of conduct

This section provides guidance to the RTS to develop initial calibration and audit programs. Implementing this Standard, frequencies for individual tasks shall be established based on a number of factors, including but not limited to:

- 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.

4.1 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 re-calibration 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.

NOTE: Normal operating conditions do not include:
- Dropping,
- Overloading,
- Working outside the environmental conditions specified by the OEM,
- Working in a severe operating condition.
In the event 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 operating conditions more frequently than the guidelines in Table 1.

Data obtained from the calibration process and confirmation histories may be used to determine subsequent calibration intervals. The intervals in Table 1 shall be reviewed and adjusted as required for the tools to stay in calibration.

Table 1 – Calibration Intervals

<table>
<thead>
<tr>
<th>Description</th>
<th>Maximum initial intervals between calibration under normal operating conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical/pneumatic devices, and analog gauges</td>
<td>1 year¹</td>
</tr>
<tr>
<td>Transducers</td>
<td>1 year¹</td>
</tr>
<tr>
<td>Portable Analog Instruments</td>
<td>1 year</td>
</tr>
<tr>
<td>Portable Digital Instruments</td>
<td>2 years</td>
</tr>
<tr>
<td>Portable Electrical/Electronic devices</td>
<td>1 year</td>
</tr>
<tr>
<td>Electrical/Electronic bench devices</td>
<td>2 years</td>
</tr>
<tr>
<td>Special tools</td>
<td>As required by the OEM</td>
</tr>
<tr>
<td>Special gauges</td>
<td>As required by the OEM</td>
</tr>
</tbody>
</table>

¹ The calibration interval should be halved if the RTS does not have documentation demonstrating the tool has the ability to stay in calibration for the intervals shown in Table 1.

4.2 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 will be documented in accordance with the RTS’s procedures.
Table 2 – Audit Intervals

<table>
<thead>
<tr>
<th>Periodic Audit</th>
<th>Initial intervals between audits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring devices and tools for the presence of required and current calibration labels.</td>
<td>6 months</td>
</tr>
<tr>
<td>In-house proof testing process.</td>
<td>12 months</td>
</tr>
<tr>
<td>All calibration facilities, and the procedures and personnel who perform the calibrations.</td>
<td>2 years</td>
</tr>
</tbody>
</table>

5. Requirements and specific tasks

5.1 Safety/personal protective equipment

Appropriate personal protective equipment, meeting minimum 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.

5.2 Training requirements

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

5.3 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.

Tools that do not successfully pass the self-calibration process shall not be used.

5.3.1 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. There shall also be 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.
5.3.2 Calibration Categories

The RTS may develop two calibration categories: “Calibration Required” and “No Calibration Required”. The RTS’s manager of quality assurance or 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.”

NOTE: It would improve control and traceability if the location of each piece of calibrated equipment were assigned to a person or department and this information was recorded on the Precision Measuring Device and Tool List as described in Section 5.3.1.

5.3.2.1 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 proof testing. Typical devices requiring proof testing are Go gauges, No-Go gauges, Pin gauges and Blocks. After a proof test the appropriate calibration label as required in Section 5.4.2 of this standard shall be applied.

5.3.2.2 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.

5.3.3 Calibration recall notification

Each RTS shall develop procedures to issue a recall notification and to verify that all devices and tools requiring calibration are re-calibrated 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.

5.3.4 Qualified calibration and repair facilities

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

After repair, the RTS shall have the precision measuring device or tool calibrated.
5.4 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:

- Calibration database
- A certificate of calibration for each device that is calibrated
- Documentation for the repair and subsequent calibration of all equipment identified by this standard
- Calibration labels

5.4.1 Calibration database

The RTS shall develop a calibration database that includes:

- Device description, supplier, model number, serial number, and/or tool identification number
- The date the device was calibrated
- The calibration due date

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

5.4.2 Calibration labels

All precision measuring devices and tools shall have a current tamperproof calibration label firmly affixed to the tool in a conspicuous location. If the tool is too small to affix a label to it, the label shall be affixed to its container. Calibration labels must be completely filled out and not contain any empty fields.

Calibration Labels must be applied by an authorized individual and have the following minimal 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 5.3.2.2). Commercially available stickers which state there is no calibration required are also acceptable.
- Date affixed
- Serial number of the equipment

- Identification of classifying individual or department designated by the RTS.

5.4.3 Tool identification number

Each tool that is classified as “Calibration Required” shall have a unique tool 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.
# A. Annex A (Informative) Sample Calibration Database

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>MODEL</th>
<th>I. D. #</th>
<th>SERIAL #</th>
<th>Manufacturer</th>
<th>LOCATION</th>
<th>CALIBRATION FREQUENCY</th>
<th>STOCK #</th>
<th>CALIBRATION DATE</th>
<th>CALIBRATION DUE DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barco Speedometer</td>
<td>50-07084</td>
<td>W-044</td>
<td></td>
<td>CONSOLIDATED</td>
<td>CANOPY</td>
<td>1 YEAR</td>
<td>00-20-617</td>
<td>June 7, 2002</td>
<td>June 7, 2003</td>
</tr>
<tr>
<td>Caliper, Dial 0-6”</td>
<td>W-033</td>
<td>G-344014</td>
<td></td>
<td>AEROSPACE</td>
<td>LOCO INS. SHOP</td>
<td>1 YEAR</td>
<td>EXTERNAL</td>
<td>Dec. 5/2001</td>
<td>Dec. 5/2002</td>
</tr>
<tr>
<td>Caliper, Dial 0-8”</td>
<td>W-066</td>
<td>7919</td>
<td></td>
<td>MITUTOYO</td>
<td>PROJ. ADM.</td>
<td>1 YEAR</td>
<td>00-22-004</td>
<td>Jan. 8/2002</td>
<td>Jan. 8/2003</td>
</tr>
<tr>
<td>Caliper, Digital 0-6”</td>
<td>W-050</td>
<td>7021764</td>
<td></td>
<td>MITUTOYO</td>
<td>LOCO REPAIR SHOP</td>
<td>1 YEAR</td>
<td>EXTERNAL</td>
<td>At Pylon</td>
<td>Apr. 3/2002</td>
</tr>
<tr>
<td>Compression Tester Set</td>
<td>9572281</td>
<td>W146H</td>
<td></td>
<td>EMD</td>
<td>DIESEL REPAIR</td>
<td>1 YEAR</td>
<td>EXTERNAL</td>
<td>Dec. 5/2001</td>
<td>Dec. 5/2002</td>
</tr>
<tr>
<td>Digital Force Gauge</td>
<td>FGE-100X</td>
<td>W-147</td>
<td>Z9502B033</td>
<td>SHIMPO</td>
<td>PM</td>
<td>1 YEAR</td>
<td>Apr. 25/2002</td>
<td>April 25/2003</td>
<td></td>
</tr>
<tr>
<td>Digital Micron Gauge</td>
<td>9450D</td>
<td>W-007</td>
<td>12453</td>
<td>TIF</td>
<td>COACH SHOP</td>
<td>1 YEAR</td>
<td>00-00-372</td>
<td>Jan. 25/2002</td>
<td>Jan. 25/2003</td>
</tr>
<tr>
<td>Force Gauge</td>
<td>FGE-200H</td>
<td>W-141</td>
<td>E300H001</td>
<td>SHIMPO</td>
<td>Paul Elias</td>
<td>1 YEAR</td>
<td>00-21-550</td>
<td>Nov. 14/2001</td>
<td>Nov. 14/2002</td>
</tr>
<tr>
<td>Freon Charging Scale-1</td>
<td>TIF 9010</td>
<td>W-005</td>
<td>30475</td>
<td>TIF</td>
<td>COACH SHOP</td>
<td>1 YEAR</td>
<td>00-00-007</td>
<td>Jan. 21/2002</td>
<td>Jan. 21/2003</td>
</tr>
<tr>
<td>Frequency Counter</td>
<td>1803</td>
<td>W-015</td>
<td>11807936</td>
<td>BK PRECISION</td>
<td>ELECTRONICS LAB</td>
<td>2 YEAR</td>
<td>EXTERNAL</td>
<td>June 21/2002</td>
<td>June 21/2003</td>
</tr>
<tr>
<td>Gono-Go Thread Plug Gauge</td>
<td>5/8-18 UNF</td>
<td>W-129</td>
<td></td>
<td>FRANK COX</td>
<td>PM/HEEL CART</td>
<td>1 YEAR</td>
<td>EXTERNAL</td>
<td>Out of service</td>
<td>May 02/02</td>
</tr>
<tr>
<td>Indicator, Test</td>
<td>711</td>
<td>W-037</td>
<td>T3</td>
<td>STARRETT</td>
<td>LOCO REPAIR SHOP</td>
<td>1 YEAR</td>
<td>00-21-403</td>
<td>At Pylon</td>
<td>June 14/2002</td>
</tr>
<tr>
<td>LCD Vacuum Gauge</td>
<td>69070</td>
<td>W-137</td>
<td></td>
<td>RITCHIE</td>
<td>A/C, C. Campbell</td>
<td>1 YEAR</td>
<td>00-20-806</td>
<td>Out of service</td>
<td>Trying to find a supplier</td>
</tr>
<tr>
<td>LCR Meter</td>
<td>878</td>
<td>W-020</td>
<td>23705931</td>
<td>BK PRECISION</td>
<td>ELECTRONICS LAB</td>
<td>2 YEAR</td>
<td>EXTERNAL</td>
<td>To Be Calibrated</td>
<td>extension 01/12/03</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>MODEL</td>
<td>I.D. #</td>
<td>SERIAL #</td>
<td>Manufacturer</td>
<td>LOCATION</td>
<td>CALIBRATION FREQUENCY</td>
<td>STOCK #</td>
<td>CALIBRATION DATE</td>
<td>CALIBRATION DUE DATE</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>----------</td>
<td>--------</td>
<td>----------</td>
<td>--------------</td>
<td>-------------------</td>
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<td>----------------------</td>
</tr>
<tr>
<td>MICROMETER 0-1&quot; .0001&quot;</td>
<td>FLUKE</td>
<td>W-105</td>
<td>GO 4-20</td>
<td>MITUTOYO</td>
<td>LOCO REPAIR SHOP</td>
<td>1 YEAR</td>
<td>EXTERNAL</td>
<td>June 21/2002</td>
<td>June 21/2003</td>
</tr>
<tr>
<td>MULTIMETER, DIGITAL</td>
<td>FLUKE 26-3</td>
<td>W-120</td>
<td>73020269</td>
<td>FLUKE</td>
<td>PM DAY SHIFT</td>
<td>1 YEAR</td>
<td>EXTERNAL</td>
<td>Dec. 5/2001</td>
<td>Dec. 5/2002</td>
</tr>
<tr>
<td>PRESSURE GAUGE</td>
<td>A551090</td>
<td>W-125</td>
<td>73020269</td>
<td>BEACON</td>
<td>PM DAY SHIFT</td>
<td>1 YEAR</td>
<td>EXTERNAL</td>
<td>Dec. 5/2001</td>
<td>Dec. 5/2002</td>
</tr>
<tr>
<td>PRESSURE GAUGE / MASTER</td>
<td>W-132</td>
<td></td>
<td></td>
<td>C.S. Silvio</td>
<td>LOCO REPAIR SHOP</td>
<td>1 YEAR</td>
<td>EXTERNAL</td>
<td>June 21/2002</td>
<td>June 21/2003</td>
</tr>
<tr>
<td>SOUND LEVEL METER</td>
<td>K7010</td>
<td>W-144</td>
<td>185522</td>
<td>KLETON</td>
<td>LOCO REPAIR SHOP</td>
<td>1 YEAR</td>
<td>EXTERNAL</td>
<td>Dec. 10/2001</td>
<td>Dec. 10/2002</td>
</tr>
<tr>
<td>TORQUE MULTIPLIER</td>
<td>GA 185</td>
<td>W-118</td>
<td>19434</td>
<td>SNAP ON</td>
<td>LOCO REPAIR SHOP</td>
<td>1 YEAR</td>
<td>EXTERNAL</td>
<td>Jan. 24/2002</td>
<td>Jan. 24/2003</td>
</tr>
<tr>
<td>TORQUE WRENCH 0-250 LBS</td>
<td>TW-12</td>
<td>W-075</td>
<td></td>
<td>WESTWARD</td>
<td>LOCO REPAIR SHOP</td>
<td>1 YEAR</td>
<td>EXTERNAL</td>
<td>May 24/2002</td>
<td>At Pylon</td>
</tr>
<tr>
<td>VELOCITY PICKUP</td>
<td>PMC258D</td>
<td>W-051-2</td>
<td>BALMAC211</td>
<td>PMC/BETA</td>
<td>LOCO REPAIR SHOP</td>
<td>1 YEAR</td>
<td>EXTERNAL</td>
<td>Dec. 15/2001</td>
<td>Dec. 15/2002</td>
</tr>
<tr>
<td>VIBRATION METER</td>
<td>211</td>
<td>W-051</td>
<td>840012</td>
<td>BALMAC</td>
<td>LOCO REPAIR SHOP</td>
<td>1 YEAR</td>
<td>EXTERNAL</td>
<td>Dec. 15/2001</td>
<td>Dec. 15/2002</td>
</tr>
</tbody>
</table>

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