



CALIFORNIA DEPARTMENT OF
FOOD & AGRICULTURE

Extracts from the
CALIFORNIA CODE OF REGULATIONS
TITLE 4, DIVISION 9

WEIGHTS AND MEASURES FIELD REFERENCE MANUAL (2023)

Field Reference Manual Table of Contents
Field Reference Manual Revision Index
NIST Handbook 44 Amendments
NIST Handbook 44 Editorial Changes
NIST Handbook 130 UPLR Amendments
NIST Handbook 130 Editorial Changes
NIST Handbook 133 Amendments
NIST Handbook 133 Editorial Changes



CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE
DIVISION OF MEASUREMENT STANDARDS

DISCLAIMER

This document represents the Division of Measurement Standards' field manual for enforcing regulations pertaining to weights and measures in California. This field manual is not to be considered as the official Code of Regulations, as published by Barclays Law Publishers.

To find the latest online version of the California Code of Regulations (CCR) Title 4, Division 9, visit the California Office of Administration Law (OAL) at:

<http://ccr.oal.ca.gov/linkedslice/default.asp?SP=CCR-1000&Action=Welcome>

The CCR may also be accessed at <http://oal.ca.gov/> bby clicking the "Publications" tab at the top of the OAL home page.

For information concerning the contents of this document, please contact the Division of Measurement Standards by e-mail at dms@cdfa.ca.gov.

REFERENCED PUBLICATIONS

NIST Handbook 44 (2023 Edition) - Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices as adopted by the 104th National Conference on Weights and Measures in July 2023 is available at:

<https://www.nist.gov/pml/weights-and-measures/publications/nist-handbooks/handbook-44>

NIST Handbook 130 (2023 Edition) - Uniform Laws and Regulations in the Areas of Legal Metrology and Engine Fuel Quality as adopted by the 107th National Conference on Weights and Measures in July 2023 is available at:

<https://www.nist.gov/pml/weights-and-measures/publications/nist-handbooks/handbook-130>

NIST Handbook 133 (2020 Edition) - Checking the Net Contents of Packaged Goods as adopted by the 104th National Conference on Weights and Measures in July 2019 is available at:

<https://www.nist.gov/pml/weights-and-measures/publications/nist-handbooks/handbook-133>

THIS INFORMATION IS AVAILABLE ON THE DIVISION OF MEASUREMENT BY SELECTING THE "PUBLICATIONS" TAB STANDARDS WEBSITE AT:

www.cdfa.ca.gov/dms

**FIELD REFERENCE MANUAL
CALIFORNIA CODE OF REGULATIONS - TITLE 4, DIVISION 9**

**Division of Measurement Standards
Department of Food and Agriculture**

Table of Contents

**Chapter 1. Tolerances and Specifications for Commercial Weighing and
Measuring Devices**

Article 1. National Uniformity, Exceptions and Additions

Sections 4000. – 4002.9. National Uniformity and California Type Evaluation Fees

Handbook 44 Introduction.

Section 1.10. General Code

Section 2.20. Scales

Section 2.21. Belt-Conveyor Scale Systems

Section 2.22. Automatic Bulk Weighing Systems

Section 2.23. Weights

Section 2.24. Automatic Weighing Systems

Section 2.25. Weigh-in-Motion Systems Used for Vehicle Enforcement Screening–
Tentative Code **(NOT PUBLISHED)**

Section 3.30. Liquid-Measuring Devices

Section 3.31. Vehicle-Tank Meters

Section 3.32. Liquefied Petroleum Gas and Anhydrous Ammonia Liquid-Measuring
Devices

Section 3.33. Hydrocarbon Gas Vapor-Measuring Devices

Section 3.34. Cryogenic Liquid-Measuring Devices

Section 3.35. Milk Meters

Section 3.36. Water Meters

Section 3.37. Mass Flow Meters

Section 3.38. Carbon Dioxide Liquid–Measuring Devices

Section 3.39. Hydrogen Gas–Measuring Devices

Section 3.40. Electric Vehicle Fueling Systems – Tentative Code

Section 4.40. Vehicle Tanks Used as Measures

Section 4.41. Liquid Measures

Section 4.42. Farm Milk Tanks

Section 4.43. Measure-Containers

Section 4.44. Graduates

Section 4.45. Dry Measures

Table of Contents Continued

- Section 4.46. Berry Baskets and Boxes
- Section 5.50. Fabric-Measuring Devices
- Section 5.51. Wire- and Cordage-Measuring Devices
- Section 5.52. Linear Measures
- Section 5.53. Odometers
- Section 5.54. Taximeters
- Section 5.55. Timing Devices
- Section 5.56.(a) Grain Moisture Meters **(NOT PUBLISHED)**
- Section 5.56 (b) Grain Moisture Meters **(NOT PUBLISHED)**
- Section 5.57. Near-Infrared Grain Analyzers **(NOT PUBLISHED)**
- Section 5.58. Multiple Dimension Measuring Devices
- Section 5.59. Electronic Livestock, Meat, and Poultry Evaluation Systems and/or Devices **(NOT PUBLISHED)**
- Section 5.60. Transportation Network Measurement Systems – Tentative Code

Handbook 44 Appendices

- Appendix A. Fundamental Considerations
- Appendix B Units and Systems of Measurement
- Appendix C. General Tables of Units of Measurement
- Appendix D. Definition

Article 2. Specifications and Tolerances and Other Technical Requirements for Commercial Weighing and Measuring Devices Not Included in Handbook 44

Article 2.1. Liquefied Petroleum Gas Tanks When Mounted on Highway Vehicles and Used as Measures

Article 2.2. Electric Watt-Hour Meters

Article 2.3. Carbon Dioxide Liquid Measuring Devices

Chapter 2. Special Equipment

Article 1. Compressed Gas in Cylinders

Article 2. Procedures for Type Approval and Field Compliance Testing of Vapor Recovery Systems

Table of Contents Continued

Chapter 3. Device Inspection

Article 1. Frequency of Inspection

Article 2. Alternatives to Specified Frequency of Inspection

Article 3. Annual Device Administrative Fee

Chapter 4. Registered Service Agencies

Chapter 5. Billing for Utility Services

Chapter 6. Automotive Products Specifications

Article 1. Brake Fluid Standards

Article 2. Brake Fluid Labeling - **4110-4111 Repealed 11-19-85**

Article 3. Automatic Transmission Fluid Standards - **4120-4126 Repealed 8-18-87**

Article 4. Automatic Transmission Fluid Registration - **4130 Repealed 11-19-85**

Article 5. Engine Fuel Standards

Article 6. Engine Oil Labeling and Exemptions

Article 7. Labeling and Specifications of Antifreezes and Coolants

Article 8. Hydrogen

Article 9. Specifications for Dimethyl Ether Used as a Motor Vehicle Fuel

Chapter 7. Advertising of Gasoline and Other Motor Vehicle Fuels

Chapter 8. Motor Oil Fee

Chapter 9. Weighmaster Enforcement

Article 1. General Provisions

Article 2. Weighmaster Certificates

Article 3. Predetermined Individual Tare Weights

Article 4. Seasonal Tare Weights

Article 5. Common Tare Weights

Article 6. Limits of Permissible Error

Article 7. Average Tare Weights

Article 8. Volumetric Conversion to Weight of Squid

Article 9. Director's Approval of Inspection of Weighmaster Records

Article 10. Timber Tare Weights

Article 11. Multiple Draft Weighing Operations

Article 12. Unattended Weighing Systems

Table of Contents Continued

Chapter 10. Quantity Control

Article 1. General

Introduction

Article 2. Uniform Packaging and Labeling Regulation

Appendix A. SI/U.S. Customary Conversion Factors

Appendix B. Converting U.S. Customary Units to SI Units

Article 3. Fireplace and Stove Wood and CHAPTER 11. Section 4600. National Uniformity, NIST Handbook 133 Paragraph 3.14. Firewood – Volumetric Test Procedure for Packaged Firewood with a Labeled Volume of 113 L [4 ft³] or Less and Stacked Firewood Sold by the Cord or Fractions of a Cord.

Chapter 11. Sampling and Testing Procedures for Determining the Net Contents of Packaged Commodities.

Article 1. Definitions

Article 2. Sampling and Testing Procedures for Determining the Net Contents of Packaged Commodities [Repealed]

Chapter 12. Administration

Article 1. Permit Reform Act

Article 2. Weights and Measures Penalty Guidelines

**2022 Amendments for the 2023 Edition of Handbook 44
2023 Revision Index**

No California Code of Regulations were enacted in 2022

**NIST Handbooks - Amendments and Editorial Changes:
See the 2022 changes to NIST Handbooks 44, 130 and 133**

NIST HB 44, 2023 Current Edition – Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices

[2023 Amendments/Editorial Changes PDF](#)

NIST HB 130, 2023 Current Edition – IV. Uniform Packaging and Labeling Regulation – Chapter 4, Uniform Regulations

[2023 Amendments/Editorial Changes PDF](#)

NIST HB 133, 2020 Edition – Checking the Net Contents of Packaged Goods

[2023 Amendments/Editorial Changes PDF](#)

The following table lists the codes, paragraphs, and pages in which the 107th National Conference on Weights and Measures adopted amendments. In the column headed “Action,” changes are noted as “added,” “amended,” “deleted,” or “renumbered.” Each code, section, or paragraph that has been changed will be noted as “Added 2022” or “Amended 2022.”

2022 Amendments for 2023 Handbook 44

SECTION	CODE	S&T ITEM NUMBER	PARAGRAPH	ACTION	HB-44 PAGE
1.10.	General	GEN-22.1	G-A.1.	Amended	1-3
3.30	Liquid-Measuring Devices	LMD-21.1	Table S.2.2.	Amended	3.13
3.30	Liquid-Measuring Devices	LMD-22.1	Table T.2.	Amended	3-21
3.32.	LPG and Anhydrous Ammonia LMDs	LPG-22.1	A.1.	Amended	3-47
3.37.	Mass Flow Meters	MFM 22.1	Table T.2.	Amended	3-119

Amendments and Editorial Changes to the Field Reference Manual

SECTION	CODE	S&T ITEM NUMBER	PARAGRAPH	ACTION	HB-44 PAGE
3.40.	Electric Vehicle Fueling Systems (EVFS)	EVF-22.1 (Priority Item Added to Committee Agenda June 24, 2022)	Entire Code	Code Upgraded from tentative to permanent and preamble modified	3-151 to 3-164
3.40.	EVFS	EVF-20.1	S.1.3.1., S.1.3.2	Amended	3-154
3.40.	EVFS	EVF-22.1 (Priority Item Added to Committee Agenda June 24, 2022)	S.2.7., N.5.2., and T.2.1.	Amended	3-156, 3-160, 3-161
5.54	Taximeters	TXI-22.1	Table S.5.	Amended	5-32
Appendix D	Definitions	EVF-22.1 (Priority Item Added to Committee Agenda June 24, 2022)	alternating current (AC); ampere; creep; current; direct current (DC); electric vehicle, plug - in; electric vehicle supply equipment (EVSE); electricity as vehicle fuel; energy; energy flow; EVSE field reference standard; hertz (Hz); kilowatt (kW); kilowatt-hour (kWh); load, full; load, light; master meter, electric; megajoule (MJ); meter, electricity; metrological components; nationally recognized testing laboratory (NRTL); ohm (Ω);		

Amendments and Editorial Changes to the Field Reference Manual

SECTION	CODE	S&T ITEM NUMBER	PARAGRAPH	ACTION	HB-44 PAGE
			percent registration; power factor; serving utility; starting load; submeter; test accuracy – in - service; test amperes (TA); thermal overload protector; vehicle connector; Amendments and Editorial Changes Handbook 44 – 2023 x This publication is available free of charge from: https://doi.org/10.6028/NIST.HB.44-2023 vehicle coupler; vehicle inlet; volt; watt; watthour (Wh)		
Appendix D	Definitions	EVF-22.1 (Priority Item Added to Committee Agenda June 24, 2022)	audit trail; calibration parameter; configuration parameter; equipment, commercial; event counter; event logger; face; minimum measured quantity (MMQ); non-resettable totalizer; primary indicating element or recording element; remote configuration capability; retail device; unit price	Amended by adding “3.40” to the list of applicable codes to which the definition applies	D-7 to D-32
Appendix D	Definitions	EVF-22.1 (Priority Item Added to Committee Agenda	recorded representation; and recording element	Added new definitions applicable to Section 3.40	D-27

Amendments and Editorial Changes to the Field Reference Manual

SECTION	CODE	S&T ITEM NUMBER	PARAGRAPH	ACTION	HB-44 PAGE
		June 24, 2022)			
Appendix D	Definitions	EVF-22.1 (Priority Item Added to Committee Agenda June 24, 2022)	face	Amended	D-15
Appendix D	Definitions	EVF-22.1 (Priority Item Added to Committee Agenda June 24, 2022)	liquefied petroleum gas retail motor-fuel device	Added	D-18
Appendix D	Definitions	EVF-22.1 (Priority Item Added to Committee Agenda June 24, 2022)	motor-fuel device or motor-fuel dispenser or retail motor-fuel device	Amended	D-21

2022 Editorial Changes for 2023 Handbook 44

Section	Code	Paragraph	Action	Page
1.10	General Code	G-S.5.6.1. Indicated and Recorded Representation of Units. – Appropriate abbreviations.	Note: SP 811 can be viewed or downloaded at www.nist.gov/pml/special-publication-811 or by going to www.nist.gov/pml/owm and selecting Weights and Measures “Publications”, then selecting “NIST Special Publications,” and then clicking on the link below “NIST (SP 811): Guide for the Use of the International System of	1-8

Amendments and Editorial Changes to the Field Reference Manual

Section	Code	Paragraph	Action	Page
			Units (SI)” showing the year of the current edition.	
2.20	Scales	Table 1M. Minimum Travel of Weighbeam of Beam Scale Between Limiting Stops	<p>< 30 or less</p> <p>> 30+ to 50, inclusive</p> <p>> 50+ to 100, inclusive</p> <p>> Over 100</p>	2-10
2.20	Scales	Table 1. Minimum Travel of Weighbeam of Beam Scale Between Limiting Stops	<p>< 12 or less</p> <p>> 12+ to 20, inclusive</p> <p>> 20+ to 40, inclusive</p> <p>> Over 40</p>	2-10
2.20	Scales	Table 4. Minimum Test Weights and Test Loads	<p>> 20 001 kg+</p> <p>> 40 001 lb+</p>	2-35
2.20	Scales	Table 5. Maintenance and Acceptance Tolerances for Unmarked Postal and Parcel Post Scales	<p>0 to 4, inclusive*</p> <p>> over 4*</p> <p>0 to 1, inclusive</p> <p>> over 1</p> <p>0 to 7, inclusive</p> <p>> 7+ to 24, inclusive</p> <p>> 24+ to 30, inclusive</p> <p>> over 30</p>	2-41
3.33	Hydrocarbon Gas Vapor-Measuring Devices	UR.2.3. Correction for Elevation.	The appropriate altitude correction factor from Table 2M. Corrections for Altitude, Metric Units or Table 2. Corrections for Altitude, U.S. Customary Units shall be used. (The table is modified from NIST Handbook 117 NBS Handbook 117, Examination of Vapor-Measuring Devices for Liquefied Petroleum Gas.)	3-71

Amendments and Editorial Changes to the Field Reference Manual

Section	Code	Paragraph	Action	Page
3.39	Hydrogen Gas-Measuring Devices	Headers	Remove the word “Code” from the headers to be consistent with other codes in NIST Handbook 44.	3-139 to 3-150
3.39	Hydrogen Gas-Measuring Devices	A. Application	(a) Devices used for dispensing a hydrogen gas with a hydrogen fuel index lower than 99.97 % and concentrations of specified impurities that exceed level limits in the latest version of SAE International J2719 “Hydrogen Fuel Quality for Fuel Cell Vehicles.”	3-141
Appendix B	Units and Systems of Measurement – Their Origin, Development, and Present Status	Multiple	<ul style="list-style-type: none"> • Several references and citations were updated to provide URL links to NIST publications, Federal Register Notices, and federal statutes and code of regulations. • Clarified that the BIPM Consultative Committees of Units publish practical methods, known as <i>Mise en Pratique</i>, to realize the seven SI base units. • Added additional examples of derived units. • Additional information was added to fully describe the retirement of the U.S. survey foot. • Clarified it is incorrect to describe traditional units used in the United States as “Imperial” or “British” and that “U.S. customary” is the correct term. • Removed several unnecessary pronouns and replaced with specific nouns. 	B-6 to B-14

Amendments and Editorial Changes to the Field Reference Manual

Section	Code	Paragraph	Action	Page
			<ul style="list-style-type: none"> • Added references to NIST online calibration service resources. • Aligned content for length, mass, and capacity to better reflect current NIST and State Laboratory Program participant laboratories calibration services. 	
Appendix C	General Tables of Units	Multiple	<ul style="list-style-type: none"> • Information was expanded to fully describe the retirement of the U.S. survey foot, including 3 new tables that present U.S. survey unit conversion factors in terms of the International foot. Section 2 surveying length and area tables were reformatted to align with the U.S. survey foot retirement FRN. • Several NIST publications, Federal Register Notices, and federal statutes and code of regulations references were updated in the footnotes. Website URLs were verified and updated. • Unit symbols and abbreviations were added to the “starting units” column to improve usability. • Removed the ångström unit to align with the latest edition of the BIPM SI Brochure and NIST SP 330, as it was eliminated in 2019. • Added footnote guidance for users to consult federal/state laws and regulations and industry 	C-1 to C-30

Amendments and Editorial Changes to the Field Reference Manual

Section	Code	Paragraph	Action	Page
			documentary standards to confirm the barrel quantity used for a specific application.	

[NIST HB 130, 2023 Current Edition](#) – IV. Uniform Packaging and Labeling Regulation – Chapter 4, Uniform Regulations - Handbook-130 pages 51-98

2022 Amendments for 2023 Handbook 130 – Uniform Packaging and Labeling Regulation

Law or Regulation	L&R Committee Item No.	Section	Action	UPLR Page
Uniform Packaging and Labeling Regulation	PAL-19.1	2.8. Multiunit Package	Amended	58
Uniform Packaging and Labeling Regulation	PAL-22.3	8.2. Calculation of Area of Principal Display Panel for Purposes of Type Size	Amended	73

2022 Editorial Changes for 2023 NIST Handbook 130 – Uniform Packaging and Labeling Regulation

Law or Regulation	L&R Committee Item No.	Section	Action	UPLR Page
Introduction	Section	Section	Updated Form	4
Uniform Packaging and Labeling Regulation	PAL-19.1	2.8. Multiunit Package	Amended	58
Uniform Packaging and Labeling Regulation	PAL-22.3	8.2. Calculation of Area of Principal Display Panel for Purposes of Type Size	Amended	73

[NIST HB 133, 2023 Edition](#) - The following table indicates the items amended by the 107th (2022) National Conference on Weights and Measures (NCWM). As appropriate, the text on the cited pages indicates the changes to a Handbook 133 section, or paragraph as “Added 2022” or “Amended 2022.” Unless otherwise noted, the effective date of the regulations added or amended in 2022 is January 1, 2023.

2022 Amendments to the 2023 Handbook 133

Chapter	L&R Committee Item No.	Section	Action	Page
Chapter 1. General Information	NET-19.1	Section 1.2.4. Maximum Allowable Variation	Amended	7
Chapter 1. General Information	NET-19.1	1.2.4.1. Total Quantity MAV for Multiunit and Variety Packages	Added	8
Chapter 2. Test Procedures for Packages Labeled by Weight – Gravimetric Testing	NET-19.2	Section 2.1 Scope	Note Added	13
Chapter 2. Test Procedures for Packages Labeled by Weight – Gravimetric Testing	NET-19.2	Section 2.3.71 Maximum Allowable Variation (MAV) Requirement	Note Added	25
Chapter 2. Test Procedures for Packages Labeled by Weight – Gravimetric Testing	NET-19.2	Section 2.7.3. Evaluation of Results – Compliance Determinations	Note added	41
Chapter 3. Test Procedures – For Packages Labeled by Volume	NET-19.2	Section 3.1. Scope	Note added	45
Chapter 4. Test Procedures – Packages Labeled by Count, Linear Measure, Area, Thickness, and Combinations of Quantities	NET-19.2	Section 4.1. Scope	Note added	113

Amendments and Editorial Changes to the Field Reference Manual

Chapter	L&R Committee Item No.	Section	Action	Page
Chapter 5. Specialized Test Procedures	NET-19.3	Chapter 5	Added	149 - 154
Appendix F. Glossary	NET-19.4	Multiunit package	Added	249
Appendix F. Glossary	NET-19.4	Total quantity MAV	Added	252
Appendix F. Glossary	NET-19.4	Variety package	Added	233

2022 Editorial Changes to the 2023 Handbook 133

Chapter	Section	Action	Page
Chapter 2. Test Procedures – Packages Labeled by Weight - Gravimetric Testing	Table 2-3 Notes	The notes were included within the content of the table as opposed to after the table.	27
Chapter 3. Test Procedures – For Packages Labeled by Volume	3.2. Gravimetric Test Procedure for Non-Viscous Liquids	Example content updated and format switched to a table layout.	47
Chapter 3. Test Procedures – For Packages Labeled by Volume	3.2. Gravimetric Test Procedure for Non-Viscous Liquids	A p Partial immersion thermometer (or equivalent) with a range of – 35 °C to + 50 °C (30 °F to 120 °F), at least 1 °C (12 °F) graduations, and with a tolerance of – 35 °C to + 50 °C (– 30 °F to + 120 °F) accurate to ± 1 °C (± 2 °F).	47
Chapter 3. Test Procedures – For Packages Labeled by Volume	Example for Determining Scale Suitability	Formatted and clarified example content in a table	49
Chapter 3. Test Procedures – For Packages Labeled by Volume	3.3. Volumetric Test Procedure for Non-Viscous Liquids	A p Partial immersion thermometer (or equivalent) with a range of – 35 °C to + 50 °C (30 °F to 120 °F), at least 1 °C (12 °F) graduations, and with a tolerance of – 35 °C to + 50 °C (– 30 °F to + 120 °F) accurate to ± 1 °C (± 2 °F).	52

Amendments and Editorial Changes to the Field Reference Manual

Chapter	Section	Action	Page
Chapter 3. Test Procedures – For Packages Labeled by Volume	3.11.1. Test Equipment	A p Partial immersion thermometer (or equivalent) with a range of – 35 °C to + 50 °C (30 °F to 120 °F), at least 1 °C (12 °F) graduations, and with a tolerance of – 35 °C to + 50 °C (– 30 °F to + 120 °F) accurate to ± 1 °C (± 2 °F).	74
Chapter 3. Test Procedures – For Packages Labeled by Volume	3.14.2.b. Stacked Firewood	Clarified calculation Width of Stack. This dimension is calculated by averaging the length of individual pieces of wood in the stack and multiplying it by the number of rows. <i>Width of Stack = Average Piece Length (APL) × Number of Rows</i>	92
Chapter 3. Test Procedures – For Packages Labeled by Volume	3.14.3. Field Audit Procedure – Bundled and Bagged Firewood	After the bundle or bag is secured, use a flexible measuring tape to measure the circumference near each end of the bundle or bag of firewood as shown in (see Figure 3-13a. “Strapping the Ends of a Bundle”). Using one movement, extend the measuring tape around the end of the bundle or bag to obtain its circumference (see Figure 3-13b. “Measuring the Circumference of the Bundle”).	94
Chapter 4. Test Procedures – Packages Labeled by Count, Linear Measure, Area, Thickness, and Combinations of Quantities	4.8.1.2. Audit Test Procedure	Note: Graph paper of an appropriate size that allows for tracing of the entire chamois shall be used. However, if a single sheet of appropriate-sized graph paper is not available, it may be necessary to tape sheets of graph paper together to create an area sufficient in size to measure the area for a chamois (e.g., chamois greater than 23.22 dm ² [2.5 ft ²]).	134
Chapter 4. Test Procedures – Packages Labeled by Count, Linear Measure, Area, Thickness, and Combinations of Quantities	4.8.2.2. Test Procedure	6. Calculate the area of the rectangle cut from the pattern by multiplying the length by width and record as Area (A) in square centimeters or square inches.	134

Amendments and Editorial Changes to the Field Reference Manual

Chapter	Section	Action	Page
Appendix E. General Tables of Units of Measurement	Units of Capacity or Volume – Dry Volume Measure	Correct the equivalent for dry pint 1.12 33.600 312 5 cubic inches”	224
Appendix E. General Tables of Units of Measurement	General Tables of Units	<ul style="list-style-type: none"> • Information was expanded to fully describe the retirement of the U.S. survey foot, including three new tables that present U.S. survey unit conversion factors in terms of the International foot. Section 2 surveying length and area tables were reformatted to align with the U.S. survey foot retirement FRN. • Several NIST publications, Federal Register Notices, and federal statutes and code of regulations references were updated in the footnotes. Website URLs were verified and updated. • Unit symbols and abbreviations were added to the “starting units” column to improve usability. • Removed the ångström unit to align with the latest edition of the BIPM SI Brochure and NIST SP 330, as it was eliminated in 2019. • Added footnote guidance for users to consult federal/state laws and regulations and industry documentary standards to confirm the barrel quantity used for a specific application. 	197–225
Appendix G. Table of Acronyms		Added	251

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Extracts from the
CALIFORNIA CODE OF REGULATIONS
TITLE 4, DIVISION 9
WEIGHTS AND MEASURES FIELD REFERENCE MANUAL (2023)

Chapter 1, Article 1.
National Uniformity Exceptions and Additions
Part 1: Sections 4000. through 4002.11.

Article 1. National Uniformity, Exceptions and Additions
Sections 4000. Through 4002.11.

Introduction to NIST Handbook 44

Form 15: Proposal to Amend NIST Handbooks



CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE
DIVISION OF MEASUREMENT STANDARDS

Article 1. National Uniformity, Exceptions and Additions

§§ 4000. through 4002.11.

DISCLAIMER

This document represents the Division of Measurement Standards' field manual for enforcing regulations pertaining to weights and measures in California. This field manual is not to be considered as the official Code of Regulations, as published by Barclays Law Publishers.

NOTE: Language in Handbook 44 that is not adopted is annotated “[**NOT ADOPTED**]” in this document.

NOTE: Requirements that are different from, or in addition to, the requirements of Handbook 44 are included in the appropriate section this document. They are shaded, bordered, and numbered in the 4002 series to differentiate them from the Handbook 44 requirements.

To find the latest online version of the California Code of Regulations (CCR) Title 4, Division 9, visit the California Office of Administration Law (OAL) at:

<http://ccr.oal.ca.gov/linkedslice/default.asp?SP=CCR-1000&Action=Welcome>

The CCR may also be accessed at <http://oal.ca.gov/> by clicking the “Publications” tab at the top of the OAL home page.

For information concerning the contents of this document, please contact the Division of Measurement Standards by e-mail at dms@cdfa.ca.gov.

NIST Handbook 44 (2023 Edition) - Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices as adopted by the 107th National Conference on Weights and Measures in July 2022 is available at:

<https://www.nist.gov/pml/owm/publications/nist-handbooks/handbook-44-current-edition>

FIELD REFERENCE MANUAL
CALIFORNIA CODE OF REGULATIONS - TITLE 4, DIVISION 9

Department of Food and Agriculture
Division of Measurement Standards

CHAPTER 1.
TOLERANCES AND SPECIFICATIONS FOR
COMMERCIAL WEIGHING AND MEASURING
DEVICES

Article 1. National Uniformity, Exceptions and Additions

§ 4000. Application. See Barclays for actual Text

Commercial weighing and measuring devices shall, except where noted below, conform to the latest requirements set forth in the National Institute of Standards and Technology Handbook 44 "Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices", which is herein incorporated by reference, and to the Additional Requirements listed herein. Copies of Handbook 44 may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Note: Authority cited: Sections 12027 and 12107, Business and Professions Code. Reference: Section 12107, Business and Professions Code.

§ 4000.1. California Type Approval Fees.

Each person or business submitting for or seeking approval of a type or design of a weight, measuring, weighing, measuring or counting device or for a design or type of device used for commercial purposes, shall pay to the Department of Food and Agriculture, for deposit into the Food and Agriculture Fund, the following fees:

- (a) A nonrefundable application fee in the amount of \$500, submitted at the time of application. No evaluation work will begin until this fee is paid.
- (b) A deposit based on the evaluator's estimated time and per diem, travel and transportation costs, equipment needed, and type of tests to be performed. Any remaining costs not covered by the deposit(s) shall be charged and collected before the issuance of the Certificate of Approval.
- (c) At the time of issuance of a Certificate of Approval, all remaining deposit monies shall be refunded to the applicant.
- (d) An application will be considered abandoned after 90 days of inactivity, if an applicant has not paid the required deposit of fees or if the applicant is non-responsive to questions

Article 1. National Uniformity, Exceptions and Additions

§§ 4000. through 4002.11.

asked or submission of additional information as required to start or finish the type approval process, or for nonpayment of fees within 90 days, and the applicant will be required to reapply and pay the required fees again.

NOTE: Authority cited: Sections 12027, 12107 and 12500.9 Business and Professions Code.
Reference: Section 12107 and 12500.9 Business and Professions Code.

§ 4000.2. The fees for type evaluation are as follows:

- (a) Evaluator Time. The evaluator hourly rate (Department employee) is \$150 per hour. The overtime rate is one and a half times the hourly rate. If a non-Departmental evaluator is used, the applicant will be billed directly at a rate set by them.
- (b) Per Diem. The per diem rate shall be the current rate established by the California Department of General Services in the State Administrative Manual.
- (c) Travel and Transportation Costs. These shall be the actual round trip costs of transportation for the evaluator to and from the evaluator's home base and the test site, in the event that tests cannot be performed locally. Transportation costs include evaluator's time, airfare, rail or other fare, vehicle rental, tolls, parking and mileage costs.
- (d) Equipment.
 - (1) Environmental Chamber: \$600 per device per full cycle, which includes testing at four different temperatures at three hours per temperature. \$300 per device for less than a full cycle.
 - (2) Pickup Truck, Van, or other Light Duty Vehicle: \$48 per day plus \$0.55 per mile.
 - (3) Pickup Truck, Van, or other Light Duty Vehicle used for carrying or pulling standards or equipment: \$60 per day and \$0.72 per mile.
 - (4) Heavy Capacity Scale Test Truck, carrying standards up to 20,000 lb: \$200 minimum
Liquid Propane Prover Trailer, 25 and 100 gallon sizes: \$240 per day.
 - (5) Compressed Natural Gas Prover Bottle, (9.33 GGE or 53 lbs.): \$120 per day.
 - (6) Electric Watt-Hour Meter Test Unit: \$100 per day.
 - (7) One, Three, or Five Gallon Test Measure: \$40 per day per test measure.
 - (8) 50 Gallon Prover: \$100 per day.
 - (9) 305 Gallon Prover: \$125 per day.
 - (10) Gravimetric Test Equipment: \$125 per day.
 - (11) Stillman Bottle: \$100 per day.
 - (12) Nozzle Test Vessel: \$75 per evaluation
 - (13) Bell Prover: \$125 per vapor meter evaluated.
 - (14) Water Meter Test Bench: \$100 per water meter evaluation.
 - (15) Repetitive Load Tester: \$50 per device \leq 50 lb and \$75 per device $>$ 50 lb, per day.
 - (16) Other unspecified equipment necessary for the evaluation: \$100 per day.

Article 1. National Uniformity, Exceptions and Additions

§§ 4000. through 4002.11.

(e) Additional Tests: Utility Meters and Load Cells.

- (1) Utility Meter Laboratory Throughput: \$125 per device for each vapor meter, \$20 per day for each water meter, \$15 per day for each electric meter.
- (2) Load Cell Testing and Equipment: \$7,200 per evaluation and \$3,600 for each additional evaluation per application.

(f) Certificate fees and other charges.

- (1) Certificate of Approval: \$750 per application or device, up to two pages.
- (3) Additional Pages, Certificate Updates, Amendments: \$180 per each page reviewed, modified, or changed.
- (17) charge, \$600 per day, plus \$3.60 per mile.
- (4) Letter of Certificate from California Air Resources Board: \$300 per device, component, or part reviewed.

NOTE: Authority cited: Sections 12027, 12107 and 12500.9 Business and Professions Code.
Reference: Section 12107 and 12500.9 Business and Professions Code.

§ 4000.3. Annual Administrative Fee

Each person or business having an approved type or design of a weight, measuring, weighing, measuring or counting device or for a design or type of device used for commercial purposes, shall pay to the Department of Food and Agriculture, for deposit into the Food and Agriculture Fund, an annual administrative fee for the reasonable costs incurred for the maintenance of type approval certificates in hard copy and electronic formats of \$200 per Certificate. The annual administrative fee shall be paid on the first anniversary after a Certificate is issued, and each year thereafter that the design or type of device is being manufactured.

NOTE: Authority cited: Sections 12027, 12107 and 12500.9 Business and Professions Code.
Reference: Section 12107 and 12500.9 Business and Professions Code.

§ 4001. – Exceptions. See Barclays for actual Text

NOTE: The following sections of Handbook 44 are not adopted and are annotated “**NOT ADOPTED**” in the text:

The following regulations in Handbook 44 are not adopted or incorporated by reference:

1.10. General Code.

G-S.1.2. Remanufactured Devices and Remanufactured Main Elements.

G.T.1. Acceptance Tolerances.

- (b) [NOT ADOPTED]
- (c) [NOT ADOPTED]
- (d) [NOT ADOPTED]

Article 1. National Uniformity, Exceptions and Additions

§§ 4000. through 4002.11.

2.20. Scales.

S.1.8.4. Customer's Indications.

N.3. Minimum Test Weights and Test Loads*.

UR.2.6.1. Vehicle Scales.

UR.3.7. Minimum Load on a Vehicle Scale.

3.30. Liquid Measuring Devices.

N.4.1.1. Wholesale Devices Equipped With Automatic Temperature Compensating Systems.

3.31. Vehicle-Tank Meters.

UR.2.2. Ticket Printer; Customer Ticket.

3.32. Liquefied Petroleum Gas and Anhydrous Ammonia Liquid-Measuring Devices.

S.2.6. Automatic Temperature Compensation.

N.4.1.1. Automatic Temperature Compensation.

UR.2.3. Vapor Return Line.

3.33. Hydrocarbon Gas Vapor - Measuring Devices.

S.4.3. Temperature Compensation.

3.37. Mass Flow Meters.

S.1.2. Compressed Natural Gas Dispensers.

S.1.3.1.1. Compressed Natural Gas Used as an Engine Fuel.

S.1.3.1.2. Liquefied Natural Gas Used as an Engine Fuel.

S.5.2. Marking of Volume Equivalent Conversion Factors for Compressed Natural Gas.

S.5.3. Marking of Equivalent Conversion Factor for Liquefied Natural Gas.

UR.3.1.1. Marking of Equivalent Conversion Factors for Compressed Natural Gas.

UR.3.1.2. Marking of Equivalent Conversion Factor for Liquefied Natural Gas.

3.39. Hydrogen Gas-Measuring Devices.

A.2. Exceptions. (c). Devices used for dispensing a hydrogen gas with a hydrogen fuel index lower than 99.97 % and concentrations of specified impurities that exceed level limits.

A.4. Type Evaluation.

T.2. Tolerances.

Table T.2.

3.40. Electric Vehicle Fueling Systems

Section 3.40. Electric Vehicle Fueling Systems – Tentative Code

Article 1. National Uniformity, Exceptions and Additions

§§ 4000. through 4002.11.

3.40. Electric Vehicle Fueling Systems - Tentative Code.

A.4. Type Evaluation.

S.1.3.2. EVSE Value of Smallest Unit.

S.2.4.1. Unit Price.

S.2.4.2. Equipment Capacity and Type of Voltage.

S.2.7. Indication of Delivery.

S.3.5. Temperature Range for System Components.

S.5.2. EVSE Identification and Marking Requirements.

N.2. Starting Load Test.

T.2. Load Test Tolerances.

T.2.1. EVSE Load Test Tolerances.

5.60. Transportation Network Measuring System

Section 5.60. Transportation Network Measuring System – Tentative Code (*Pending Rulemaking*)

Appendix D. Definitions for:

Remanufactured Devices.

Remanufactured Element.

Repaired Devices.

Repaired Element.

Diesel Gallon Equivalent (DGE).

Gasoline Gallon Equivalent (GGE).

Note: Authority cited: Sections 12027 and 12107, Business and Professions Code. Reference: Section 12107, Business and Professions Code.

§ 4002. Additional Requirements. See Barclays for actual Text.

NOTE: These requirements are different than, or in addition to, the requirements of Handbook 44 and are included in the appropriate section of the text. They are shaded, bordered, and numbered in the 4002 series to differentiate them from the Handbook 44 requirements.

§ 4002.1. General Code (1.10.)

(a) Type Approval Use.

§ 4002.2. Scales (2.20.)

(a) Minimum Load on a Vehicle Scale.

(b) Class III, Class III L and Unmarked Devices Used for Recycling.

(c) Livestock Scales Not Equipped with Balance Indicator.

Article 1. National Uniformity, Exceptions and Additions

§§ 4000. through 4002.11.

(d) Customer's Indications.

§ 4002.3. Vehicle-Tank Meters. (3.31.)

UR.2.2. Ticket Printer; Customer Ticket.

§ 4002.4. Liquefied Petroleum Gas and Anhydrous Ammonia Liquid-Measuring Devices (3.32.)

(a) Temperature Compensation.

(b) Non-applicable Provisions of Handbook 44, Section, 3.32., S.3.1 under certain conditions.

(c) Wholesale Devices Equipped With Automatic Temperature Compensating Systems.

(d) Vapor Return Line.

(e) Signs.

§ 4002.5. Hydrocarbon Gas Vapor-Measuring Devices. (3.33.) Temperature Compensation

(a) Leak Test.

(b) Temperature Compensation.

(c) Retention of Customer Invoices.

§ 4002.6. Water Meters (3.36.) [Repealed]

§ 4002.7. Farm Milk Tanks. (4.42.)

(a) Calibration and Installation.

§ 4002.8. Liquid-Measuring Devices. (3.30.)

(a) Wholesale Devices Equipped with Automatic Temperature Compensating Systems.

§ 4002.9. Hydrogen Gas-Measuring Devices. (3.39.)

A.4. Type Evaluation.

S.5.2. Location of Accuracy Class 2.0, 3.0, 5.0, 7.0, and 10.0 Information

T.2. Tolerances.

§ 4002.10. Mass Flow Meters

S.1.3.1.1. Compressed Natural Gas Used as an Engine Fuel.

S.1.3.1.2. Liquefied Natural Gas Used as an Engine Fuel.

S.5.2. Marking of Gasoline Volume Equivalent Conversion Factors for Compressed Natural Gas.

S.5.3. Marking of Diesel Volume Equivalent Conversion Factors for Liquefied Natural Gas.

Article 1. National Uniformity, Exceptions and Additions

§§ 4000. through 4002.11.

UR.3.1.1. Marking of Equivalent Conversion Factor for Compressed Natural Gas.

U.R.3.1.2. Marking of Equivalent Conversion Factor for Liquefied Natural Gas.

Appendix D – Definitions: diesel gallon equivalent (DGE).]

Appendix D – Definitions: gasoline gallon equivalent (GGE).

§ 4002.11. Electric Vehicle Fueling Systems.

Section 3.40. Electric Vehicle Fueling Systems. (TITLE)

A.1.1. Effective Date for AC EVSE.

S.1.3.2. EVSE Value of Smallest Unit.

S.2.4.1. Unit Price.

S.2.4.2. Equipment Capacity and Type of Voltage.

S.2.7. Indication of Delivery.

S.3.5. Temperature Range for System Components.

S.5.2. EVSE Identification and Marking Requirements.

T.2. Load Test Tolerances.

Table T.2. Accuracy Classes and Tolerances for EVSE

NOTE: Authority cited: Sections 12027 and 12107, Business and Professions Code.

Reference: Section 12107, Business and Professions Code.

Introduction (NIST Handbook 44)

A. Source.

The specifications, tolerances and other technical requirements in this handbook comprise all of those adopted by the National Conference on Weights and Measures, Inc. (NCWM).

Contact NCWM at:

1135 M Street, Suite 100 Phone: (402) 434-4880 E-mail: info@ncwm.com

Lincoln, NE 68508 Fax: (402) 434-4878 URL: www.ncwm.com

The NCWM is supported by the National Institute of Standards and Technology (NIST), which provides its Executive Secretary and publishes some of its documents. NIST also develops technical publications for use by weights and measures agencies; these publications may subsequently be endorsed or adopted by NCWM or its members.

All of the specifications, tolerances, and other technical requirements given herein are recommended by NCWM for official promulgation in and use by the states in exercising their control of commercial weighing and measuring apparatus. A similar recommendation is made with respect to the local jurisdictions within a state in the absence of the promulgation of specifications, tolerances, and other technical requirements at the state level.

Article 1. National Uniformity, Exceptions and Additions

§§ 4000. through 4002.11.

(Amended 2015)

B. Purpose.

The purpose of these technical requirements is to eliminate from use, weights and measures and weighing and measuring devices that give readings that are false, that are of such construction that they are faulty (that is, that are not reasonably permanent in their adjustment or will not repeat their indications correctly), or that facilitate the perpetration of fraud, without prejudice to apparatus that conforms as closely as practicable to the official standards.

C. Amendments.

Proposed amendments to NIST Handbook 44 are deliberated and developed by NCWM's Committee on Specifications and Tolerances before presentation to the general membership for a vote. In some instances, amendments that significantly affect other NIST Handbooks may be processed jointly by two or more committees.

Amendments to the handbooks are made in accordance with NCWM procedures and policies. The process begins at the regional weights and measures association meetings in the fall of each year and is culminated at the NCWM Annual Meeting in July. After passing through one or more of the regional associations the proposed amendment is placed on the agenda of the appropriate NCWM committee for consideration at NCWM's Interim Meeting in January and after final deliberation and development by the committee the amendment may be presented to the membership for a vote at the annual NCWM meeting in July. NCWM policy provides for exceptions to the process to accommodate urgent or priority items. NIST staff provides technical assistance and advice throughout the process.

The policy is available on the NCWM website at www.ncwm.com. For information on the regional weights and measures associations, visit www.ncwm.com/meetings/regions.

(Amended 2015)

D. System of Paragraph Designation.

In order that technical requirements of a similar nature, or those directed to a single characteristic, may be grouped together in an orderly fashion, and to facilitate the location of individual requirements, the paragraphs of each code are divided into sections. Each section is designated by a letter and a name, and each subsection is given a letter-number designation and a side title.

The letter that appears first in a paragraph designation has a specific meaning, as follows:

- G.** The letter G is a prefix and indicates that the requirement is part of the General Code.
- A. Application.** These paragraphs pertain to the application of the requirements of a code.

Article 1. National Uniformity, Exceptions and Additions

§§ 4000. through 4002.11.

- S. Specification.** These paragraphs relate to the design of equipment. Specification paragraphs are directed particularly to manufacturers of devices.
- N. Note.** These paragraphs apply to the official testing of devices.
- T. Tolerance.** Tolerances are performance requirements. They fix the limit of allowable error or departure from true performance or value.
Sensitivity. The sensitivity requirements, applicable only to nonautomatic-indicating scales, are performance requirements and are lettered with a “T.”
- UR. User Requirement.** These paragraphs are directed particularly to the owner and operator of a device. User requirements apply to the selection, installation, use, and maintenance of devices.
- D. Definitions of Terms.** A definitions section appears in Appendix D to provide the definition of the terms having a special meaning.

The numerical designation after a letter follows the decimal system of paragraph identification that fixes both the relationship and the limitation of the requirements of the paragraph. For example, in the Scales Code, under Specifications, the following numerical designations occur:

S. Specifications

S.1. Design of Indicating and Recording Elements and of Recorded Representations.

- S.1.1. Zero Indication.
 - S.1.1.1. Digital Indicating Elements.
 - S.1.1.2. No-Load Reference Value.
- S.1.2. Value of Scale Division Units.
 - S.1.2.1. Digital Indicating Scales.
- S.1.3. Graduations.
 - S.1.3.1. Length.
 - S.1.3.2. Width.
 - S.1.3.3. Clear Space Between Graduations.

In this example, paragraphs S.1.1., S.1.2., and S.1.3. are directed and limited to paragraph S.1., which pertains to the design of indicating and recording elements and of recorded representations. Paragraphs S.1.1.1. and S.1.1.2. are directly related to each other, but they are limited to the design of zero indication. Likewise, paragraphs S.1.3.1., S.1.3.2., and S.1.3.3. are directly related to each other, but they are limited to the design of graduations.

This handbook conforms to the concept of primary use of SI (metric) measurements recommended in the Omnibus Trade and Competitiveness Act of 1988 by citing SI metric units

Article 1. National Uniformity, Exceptions and Additions

§§ 4000. through 4002.11.

before U.S. customary units where both units appear together and placing separate sections containing requirements for metric units before corresponding sections containing requirements for customary units. Occasionally, a paragraph or table carries the suffix “M” because the requirement in SI units is shown as a separate statement, rather than combined with the U.S. customary units. In these few instances, separate requirements were judged to be more easily understood than attempting to combine SI and U.S. customary units in a single paragraph or table. In some cases, however, trade practice is currently restricted to the use of customary units; therefore, some requirements in this handbook will continue to specify only customary units until the Conference achieves a broad consensus on the permitted metric units.

E. Classification of Requirements.

The classification of requirements into “retroactive” and “nonretroactive” status is made in order that the requirements may be put into force and effect without unnecessary hardship and without wholesale condemnation of apparatus. Retroactive requirements are enforceable with respect to all equipment and are printed in upright roman type. Nonretroactive requirements are those that, while clearly desirable, are not so vital that they should at once be enforced with respect to all apparatus. Nonretroactive requirements are printed in *italic type*.

It is not expected that, after their promulgation in a given jurisdiction, nonretroactive requirements will always remain nonretroactive. It is entirely proper that a weights and measures official, following a careful analysis of existing conditions, fix reasonable periods for the continuance of the nonretroactive application of particular requirements, after which such requirements will become retroactive. These periods should be long enough to avoid undue hardship to the owners or operators of apparatus and, in the case of some requirements, should approximate the average useful life of the apparatus in question.

In order that all interested parties may have timely and ample notice of impending changes in the status of requirements, the following procedure is suggested for the official who plans to change the classification of requirements. If sufficient data are available to make such action feasible, publish in combination with the codes themselves the date or dates at which nonretroactive requirements are to become retroactive. In other cases, give equally effective notice at the earliest practicable date.

A nonretroactive requirement, in italic type, will indicate the year from which it should be enforced and, in some cases, the date the requirement shall be changed to retroactive status. For example, [*Nonretroactive as of 1978 and to become retroactive on January 1, 1985*]. As a general rule, each nonretroactive requirement is reviewed after it has been in effect for 10 years to determine the appropriateness of its nonretroactive status.

F. Using the Handbook.

Handbook 44 is designed to be a working tool for federal, state, and local weights and measures officials, the equipment manufacturers, installers, and service agencies/agents. As noted in Section 1.10. General Code paragraph G-A.1. Commercial and Law-Enforcement Equipment, applicable portions of Handbook 44 may be used by the weights and measures

Article 1. National Uniformity, Exceptions and Additions

§§ 4000. through 4002.11.

official to test noncommercial weighing and measuring equipment upon request. Additionally, applicable language in Handbook 44 may be cited as a standard in noncommercial applications, for example, when the handbook is referenced or cited as part of a quality system or in multiple-party contract agreements where noncommercial weighing or measuring equipment is used.

The section on Fundamental Considerations (Appendix A) should be studied until its contents are well known. The General Code, with general requirements pertaining to all devices, obviously must be well known to a user of the handbook. The makeup of the specific codes, the order of paragraph presentation, and particularly paragraph designation are worthy of careful study. It is not deemed advisable for a user to attempt to commit to memory tolerances or tolerance tables, even though these are used frequently. For the handbook to serve its purpose, it should be available when any of its requirements are to be applied. Direct reference is the only sure way to apply a requirement properly and to check whether other requirements may be applicable.

This handbook supplies criteria which enable the user to determine the suitability, accuracy, and repetitive consistency of a weighing or measuring device, both in the laboratory and in the field. However, not all code sections can be appropriately applied in both settings. Since some sections are designed to be applied specifically to tests performed under laboratory conditions, it would be impractical or unrealistic to apply them to field tests. Not all tests described in the "Notes" section of the handbook are required to be performed in the field as an official test. An inspector may officially approve or reject a device which has been tested in accordance with those sections applicable to the type of test being conducted.

(Paragraph added 1996)

Article 1. National Uniformity, Exceptions and Additions
§§ 4000. through 4002.11.

**National Conference on Weights and Measures / National Type
Evaluation Program**

**Form 15: Proposal to Amend NIST Handbooks, Guidance Documents,
NCWM Bylaws or NCWM Publication 14**



Figure 1 - NCWM -NTEP Logos

Submit proposals by August 15, 2023. See meeting dates at www.ncwm.com/meetings. If the item is deemed by a region to have merit, that region will forward the item to NCWM for national consideration. For more information on the Form 15 process, visit www.ncwm.com/standards-dev. [Link to Form 15 \(May 2021\)](#)

Submit in Microsoft Word Format to the NCWM Executive Director via email at don.onwiler@ncwm.com for review and dispersal to selected regions. Link to:

Submit Form via Email to: don.onwiler@ncwm.com

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CALIFORNIA DEPARTMENT OF
FOOD & AGRICULTURE

Extracts from the
CALIFORNIA CODE OF REGULATIONS
TITLE 4, DIVISION 9

WEIGHTS AND MEASURES FIELD REFERENCE MANUAL (2023)

**Chapter 1, Tolerances and Specifications for Commercial Weighing and
Measuring Devices**

Part 2: NIST Handbook 44

Sections:

- 1.10. General Code**
- 2.20. Scales**
- 2.21. Belt-Conveyor Scale Systems**
- 2.22. Automatic Bulk-Weighing Systems**
- 2.23. Weights**
- 2.24. Automatic Weighing Systems**
- 2.25. Weigh-in-Motion Systems Used for Vehicle Enforcement
Screening – Tentative Code (NOT PUBLISHED)**



**CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE
DIVISION OF MEASUREMENT STANDARDS**

California Department of Agriculture Division of Measurement Standards

DISCLAIMER

This document combines the 2023 Edition of National Institute of Standards and Technology, Handbook 44, Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices (NIST Handbook 44), Section 3.40. Electric Vehicle Fueling Systems and the California Code of Regulations, Title 4, Division 9, Chapter 1, Sections 4000, 4001, and 4002.11. It is intended to serve as a resource for officials enforcing weights and measures laws and regulations relating to commercial EVSE in California. This document is current until such time that changes are made to NIST Handbook 44, Section 3.40 or the California Code of Regulations, Sections 4000 - 4002.11.

Paragraphs not adopted from the 2023 Edition of NIST Handbook 44. are annotated in the text with the statement **[NOT ADOPTED]**.

Additional language in CCR Section 4002.X. can be identified in **gray shaded font**.

Sources: [NIST Handbook 44](#) and [4 CCR 4000, 4001 and 4002 .](#)

CCR Article 1, National Uniformity , Exceptions and Additions

§ 4000. Application. Commercial weighing and measuring devices shall, except where noted below, conform to the latest requirements set forth in the National Institute of Standards and Technology Handbook 44 “Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices”, which is herein incorporated by reference, and to the Additional Requirements listed herein. Copies of Handbook 44 may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. [Added 1994, 4 CCR 4000]

§ 4001. Exceptions. The following regulations in Handbook 44 are not adopted or incorporated by reference (click on § 4001. Exceptions).

§ 4002. Additional Requirements. The following sections apply to devices in addition to the Handbook 44 requirements that are incorporated by reference. The number in parenthesis following the section number and section title refers to the related section in Handbook 44; i.e., 4002.1. General Code (1.10.) refers to Section 1.10. General Code in Handbook 44.

§ 4002. Additional Language.

Note: Authority cited: Sections 12027 and 12107, Business and Professions Code. Reference: Section 12107, Business and Professions Code.

Table of Contents

Section 1.10. General Code	1
G-A. Application	1
G-A.1. Commercial and Law-Enforcement Equipment.....	1
G-A.2. Code Application.....	1
G-A.3. Special and Unclassified Equipment.....	1
G-A.4. Metric Equipment.....	1
G-A.5. Retroactive Requirements.	2
G-A.6. Nonretroactive Requirements.	2
G-A.7. Effective Enforcement Dates of Code Requirements.....	2
G-S. Specifications	2
G-S.1. Identification.....	2
G-S.1.1. <i>Location of Marking Information for Not-Built-For-Purpose, Software-Based Devices</i>	4
G-S.1.2. <i>Devices and Main Elements Remanufactured as of January 1, 2002. [NOT ADOPTED – CCR § 4001. Exceptions.]</i>	5
G-S.2. Facilitation of Fraud.	5
G-S.3. Permanence.	5
G-S.4. Interchange or Reversal of Parts.	5
G-S.5. Indicating and Recording Elements.	5
G-S.5.1. General.....	5
G-S.5.2. Graduations, Indications, and Recorded Representations.	5
G-S.5.3. Values of Graduated Intervals or Increments.	6
G-S.5.4. Repeatability of Indications.....	7
G-S.5.5. Money Values, Mathematical Agreement.....	7
G-S.5.6. Recorded Representations.....	7
G-S.5.7. Magnified Graduations and Indications.	8
G-S.6. <i>Marking Operational Controls, Indications, and Features</i>	8
G-S.7. Lettering.....	9
G-S.8. <i>Provision for Sealing Electronic Adjustable Components</i>	9
G-S.8.1. <i>Multiple Weighing or Measuring Elements that Share a Common Provision for Sealing</i>	9
G-S.8.2. <i>Devices and Systems Adjusted Using Removable Digital Storage Device</i>	9
G-S.9. Metrologically Significant Software Updates.....	10
G-N. Notes	10
G-N.1. Conflict of Laws and Regulations.....	10
G-N.2. Testing With Nonassociated Equipment.	10
G-T. Tolerances	10
G-T.1. Acceptance Tolerances.	10
G-T.1. (b) [NOT ADOPTED – CCR § 4001. Exceptions.]	11

G-T.1. (c) [NOT ADOPTED – CCR § 4001. Exceptions.].....	11
G-T.1. (d) [NOT ADOPTED – CCR § 4001. Exceptions.]	11
G-T.2. Maintenance Tolerances.....	11
G-T.3. Application.	11
G-T.4. For Intermediate Values.....	11
G-UR. User Requirements.....	11
G-UR.1. Selection Requirements.....	11
CCR § 4002.1. General Code (1.10.).....	11
G-UR.1.1. Suitability of Equipment.	11
G-UR.1.2. Environment.	11
G-UR.1.3. Liquid-Measuring Devices.	11
G-UR.2. Installation Requirements.	12
G-UR.2.1. Installation.	12
G-UR.2.2. Installation of Indicating or Recording Element.	12
G-UR.2.3. Accessibility for Inspection, Testing, and Sealing Purposes.....	12
G-UR.3. Use Requirements.	12
G-UR.3.1. Method of Operation.....	12
G-UR.3.2. Associated and Nonassociated Equipment.	13
G-UR.3.3. Position of Equipment.....	13
G-UR.3.4. Responsibility, Money-Operated Devices.....	13
G-UR.4. Maintenance Requirements.	13
G-UR.4.1. Maintenance of Equipment.....	13
G-UR.4.2. Abnormal Performance.....	13
G-UR.4.3. Use of Adjustments.	14
G-UR.4.4. Assistance in Testing Operations.	14
G-UR.4.5. Security Seal.	14
G-UR.4.6. Testing Devices at a Central Location.....	14

Section 1.10. General Code

G-A. Application

G-A.1. Commercial and Law-Enforcement Equipment. – These specifications, tolerances, and other technical requirements apply as follows:

- (1) To commercial weighing and measuring equipment; that is:
 - (a) To weights and measures and weighing and measuring devices used or employed:
 1. in establishing the size, quantity, extent, area, composition (limited to meat and poultry), constituent values (limited to grain), or measurement of quantities, things, produce, or articles for distribution or consumption, purchased, offered, or submitted for sale, hire, or award;
 2. when assessing a fee for the use of the equipment to determine a weight or measure;
 3. in determining the basis of an award using count, weight, or measure; or
 4. in computing any basic charge or payment for services rendered on the basis of weight or measure. (Amended 2008 and 2022)
 - (b) To any accessory attached to or used in connection with a commercial weighing or measuring device when such accessory is so designed that its operation affects the accuracy of the device.
- (2) To weighing and measuring equipment in official use for the enforcement of law or the collection of statistical information by government agencies.

(These requirements should be used as a guide by the weights and measures official when, upon request, courtesy examinations of noncommercial equipment are made.)

(Amended 2022)

G-A.2. Code Application. – This General Code shall apply to all classes of devices as covered in the specific codes. The specific code requirements supersede General Code requirements in all cases of conflict.

(Amended 1972)

G-A.3. Special and Unclassified Equipment. – Insofar as they are clearly appropriate, the requirements and provisions of the General Code and of specific codes apply to equipment failing, by reason of special design or otherwise, to fall clearly within one of the particular equipment classes for which separate codes have been established. With respect to such equipment, code requirements and provisions shall be applied with due regard to the design, intended purpose, and conditions of use of the equipment.

G-A.4. Metric Equipment. – Employment of the weights and measures of the metric system is lawful throughout the United States. These specifications, tolerances, and other requirements shall not be understood or construed as in any way prohibiting the manufacture, sale, or use of

equipment designed to give results in terms of metric units. The specific provisions of these requirements and the principles upon which the requirements are based shall be applied to metric equipment insofar as appropriate and practicable. The tolerances on metric equipment, when not specified herein, shall be equivalent to those specified for similar equipment constructed or graduated in the U.S. customary system.

G-A.5. Retroactive Requirements. – “Retroactive” requirements are enforceable with respect to all equipment. Retroactive requirements are printed herein in upright roman type.

G-A.6. Nonretroactive Requirements. – “Nonretroactive” requirements are enforceable on or after the effective date for devices:

- (a) manufactured within a state after the effective date;
- (b) both new and used, brought into a state after the effective date;
- (c) used in noncommercial applications which are placed into commercial use after the effective date; and
- (d) undergoing type evaluation, including devices that have been modified to the extent that a new NTEP Certificate of Conformance (CC) is required.

Nonretroactive requirements are not enforceable with respect to devices that are in commercial service in the state as of the effective date or to new equipment in the stock of a manufacturer or a dealer in the state as of the effective date.

[Nonretroactive requirements are printed in italic type.]

(Amended 1989 and 2011)

G-A.7. Effective Enforcement Dates of Code Requirements. – Unless otherwise specified, each new or amended code requirement shall not be subject to enforcement prior to January 1 of the year following the adoption by the National Conference on Weights and Measures and publication by the National Institute of Standards and Technology.

G-S. Specifications

G-S.1. Identification. – All equipment, except weights and separate parts necessary to the measurement process but not having any metrological effect, shall be clearly and permanently marked for the purposes of identification with the following information:

- (a) the name, initials, or trademark of the manufacturer or distributor;
- (b) a model identifier that positively identifies the pattern or design of the device;

(1) The model identifier shall be prefaced by the word “Model,” “Type,” or “Pattern.” These terms may be followed by the word “Number” or an abbreviation of that word. The abbreviation for the word “Number” shall, as a minimum, begin with the letter

“N” (e.g., No or No.). The abbreviation for the word “Model” shall be “Mod” or “Mod.” Prefix lettering may be initial capitals, all capitals, or all lower case.

[Nonretroactive as of January 1, 2003]

(Added 2000) (Amended 2001)

(c) *a nonrepetitive serial number, except for equipment with no moving or electronic component parts and software;*

[Nonretroactive as of January 1, 1968]

(Amended 2003 and 2016)

(1) *The serial number shall be prefaced by words, an abbreviation, or a symbol, that clearly identifies the number as the required serial number.*

[Nonretroactive as of January 1, 1986]

(2) *Abbreviations for the word “Serial” shall, as a minimum, begin with the letter “S,” and abbreviations for the word “Number” shall, as a minimum, begin with the letter “N” (e.g., S/N, SN, Ser. No., and S. No.).*

[Nonretroactive as of January 1, 2001]

(d) *the current software version or revision identifier for not-built-for-purpose, software-based devices manufactured as of January 1, 2004, and all software-based devices (or equipment) manufactured as of January 1, 2022;*

(Added 2003) (Amended 2016)

(1) *The version or revision identifier shall be:*

i. prefaced by words, an abbreviation, or a symbol, that clearly identifies the number as the required version or revision.

[Nonretroactive as of January 1, 2007]

(Added 2006)

Note: *If the equipment is capable of displaying the version or revision identifier, but is unable to meet the formatting requirements, through the NTEP type evaluation process, other options may be deemed acceptable and described in the CC.*

(Added 2016)

ii. continuously displayed or be accessible via the display. Instructions for displaying the version or revision identifier shall be described in the CC. As an alternative, permanently marking the version or revision identifier shall be acceptable providing the device does not always have an integral interface to communicate the version or revision identifier.

[Nonretroactive as of January 1, 2022]

(Added 2016)

(2) *Abbreviations for the word “Version” shall, as a minimum, begin with the letter “V” and may be followed by the word “Number.” Abbreviations for the word “Revision” shall, as a minimum, begin with the letter “R” and may be followed by the word “Number.” The abbreviation for the word “Number” shall, as a minimum, begin with the letter “N” (e.g., No or No.). Prefix lettering may be initial capitals, all capitals, or all lowercase.*

[Nonretroactive as of January 1, 2007]

(Added 2006) (Amended 2016)

(e) *a National Type Evaluation Program (NTEP) Certificate of Conformance (CC) number or a corresponding CC Addendum Number for devices that have a CC.*

[Nonretroactive as of January 1, 2003]

(Added 2001)(Amended 2016)

(1) *The CC Number or a corresponding CC Addendum Number shall be prefaced by the terms “NTEP CC,” “CC,” or “Approval.” These terms may be followed by the word “Number” or an abbreviation of that word. The abbreviation for the word “Number” shall, as a minimum, begin with the letter “N” (e.g., No or No.).*

[Nonretroactive as of January 1, 2003]

(Added 2001)(Amended 2016)

The required information shall be so located that it is readily observable without the necessity of the disassembly of a part requiring the use of any means separate from the device.

(Amended 1985, 1991, 1999, 2000, 2001, 2003, 2006, and 2016)

G-S.1.1. Location of Marking Information for Not-Built-For-Purpose, Software-Based Devices. – *For not-built-for-purpose, software-based devices either:*

(a) *The required information in G-S.1 Identification. (a), (b), (d), and (e) shall be permanently marked or continuously displayed on the device; or*

(b) *The Certificate of Conformance (CC) Number shall be:*

(1) *permanently marked on the device;*

(2) *continuously displayed; or*

(3) *accessible through an easily recognized menu and, if necessary, a submenu. Examples of menu and submenu identification include, but are not limited to, “Help,” “System Identification,” “G-S.1. Identification,” or “Weights and Measures Identification.”*

Note: For (b), clear instructions for accessing the information required in G-S.1. (a), (b), and (d) shall be listed on the CC, including information necessary to identify that the software in the device is the same type that was evaluated.

[Nonretroactive as of January 1, 2004]

(Added 2003) (Amended 2006)

G-S.1.2. Devices and Main Elements Remanufactured as of January 1, 2002. [NOT ADOPTED – CCR § 4001. Exceptions.]

G-S.2. Facilitation of Fraud. – All equipment and all mechanisms, software, and devices attached to or used in conjunction therewith shall be so designed, constructed, assembled, and installed for use such that they do not facilitate the perpetration of fraud.

(Amended 2007)

G-S.3. Permanence. – All equipment shall be of such materials, design, and construction as to make it probable that, under normal service conditions:

- (a) accuracy will be maintained;
- (b) operating parts will continue to function as intended; and
- (c) adjustments will remain reasonably permanent.

Undue stresses, deflections, or distortions of parts shall not occur to the extent that accuracy or permanence is detrimentally affected.

G-S.4. Interchange or Reversal of Parts. – Parts of a device that may readily be interchanged or reversed in the course of field assembly or of normal usage shall be:

- (a) so constructed that their interchange or reversal will not affect the performance of the device; or
- (b) so marked as to show their proper positions.

G-S.5. Indicating and Recording Elements.

G-S.5.1. General. – All weighing and measuring devices shall be provided with indicating or recording elements appropriate in design and adequate in amount. Primary indications and recorded representations shall be clear, definite, accurate, and easily read under any conditions of normal operation of the device.

G-S.5.2. Graduations, Indications, and Recorded Representations.

G-S.5.2.1. Analog Indication and Representation. – Graduations and a suitable indicator shall be provided in connection with indications designed to advance continuously.

G-S.5.2.2. Digital Indication and Representation. – Digital elements shall be so designed that:

- (a) All digital values of like value in a system agree with one another.
- (b) A digital value coincides with its associated analog value to the nearest minimum graduation.
- (c) A digital value “rounds off” to the nearest minimum unit that can be indicated or recorded.
- (d) *A digital zero indication includes the display of a zero for all places that are displayed to the right of the decimal point and at least one place to the left. When no decimal values are displayed, a zero shall be displayed for each place of the displayed scale division.*
[Nonretroactive as of January 1, 1986]

(Amended 1973 and 1985)

G-S.5.2.3. Size and Character. – In any series of graduations, indications, or recorded representations, corresponding graduations and units shall be uniform in size and character. Graduations, indications, or recorded representations that are subordinate to, or of a lesser value than others with which they are associated, shall be appropriately portrayed or designated.

[Made retroactive as of January 1, 1975]

G-S.5.2.4. Values. – If graduations, indications, or recorded representations are intended to have specific values, these shall be adequately defined by a sufficient number of figures, words, symbols, or combinations thereof, uniformly placed with reference to the graduations, indications, or recorded representations and as close thereto as practicable, but not so positioned as to interfere with the accuracy of reading.

G-S.5.2.5. Permanence. – Graduations, indications, or recorded representations and their defining figures, words, and symbols shall be of such character that they will not tend easily to become obliterated or illegible.

G-S.5.3. Values of Graduated Intervals or Increments. – In any series of graduations, indications, or recorded representations, the values of the graduated intervals or increments shall be uniform throughout the series.

G-S.5.3.1. On Devices That Indicate or Record in More Than One Unit. – On devices designed to indicate or record in more than one unit of measurement, the values indicated and recorded shall be identified with an appropriate word, symbol, or abbreviation.

(Amended 1978 and 1986)

G-S.5.4.Repeatability of Indications. – A device shall be capable of repeating, within prescribed tolerances, its indications and recorded representations. This requirement shall be met irrespective of repeated manipulation of any element of the device in a manner approximating normal usage (including displacement of the indicating elements to the full extent allowed by the construction of the device and repeated operation of a locking or relieving mechanism) and of the repeated performance of steps or operations that are embraced in the testing procedure.

G-S.5.5.Money Values, Mathematical Agreement. – Any recorded money value and any digital money-value indication on a computing-type weighing or measuring device used in retail trade shall be in mathematical agreement with its associated quantity representation or indication to the nearest 1 cent of money value. This does not apply to auxiliary digital indications intended for the operator’s use only, when these indications are obtained from existing analog customer indications that meet this requirement.

(Amended 1973)

G-S.5.6.Recorded Representations. – Insofar as they are appropriate, the requirements for indicating and recording elements shall also apply to recorded representations. All recorded values shall be printed digitally. In applications where recorded representations are required, the customer may be given the option of not receiving the recorded representation. For systems equipped with the capability of issuing an electronic receipt, ticket, or other recorded representation, the customer may be given the option to receive any required information electronically (e.g., via cell phone, computer, etc.) in lieu of or in addition to a hard copy.

(Amended 1975 and 2014)

G-S.5.6.1. Indicated and Recorded Representation of Units. – Appropriate abbreviations.

- (a) For equipment manufactured on or after January 1, 2008, the appropriate defining symbols are shown in NIST Special Publication SP 811 “Guide for the Use of International System of Units (SI)” and Handbook 44 Appendix C – General Tables of Units of Measurement.

Note: SP 811 can be viewed or downloaded at www.nist.gov/pml/special-publication-811 or by going to www.nist.gov/pml/owm and selecting “Publications,” then selecting “NIST Special Publications,” and then clicking on the link below “**NIST SP 811: Guide for the Use of the International System of Units (SI)**” showing the year of the current edition.

(Added 2007)

- (b) The appropriate defining symbols on equipment manufactured prior to January 1, 2008, with limited character sets are shown in Table 1.

Representation of SI Units on Equipment Manufactured Prior to January 1, 2008,
with Limited Character Sets.

(Added 1977) (Amended 2007)

**Table 1. Representation of SI Units on Equipment Manufactured Prior to
January 1, 2008, with Limited Character Sets**

Name of Unit	International Symbol (common use symbol)	Representation Form I (double case)	Representation Form II (single case lower)	Representation Form II (single case upper)
Base SI Units - meter	m	m	m	M
Base SI Units - kilogram	kg	kg	kg	KG
Derived SI Units - newton	N	N	n	N
Derived SI Units - pascal	Pa	Pa	pa	PA
Derived SI Units - watt	W	W	w	W
Derived SI Units - volt	V	V	v	V
Derived SI Units – degree Celsius	°C	°C	°c	°C
Other Units -liter	l or L	L	l	L
Other Units - gram	g	g	g	G
Other Units - metric ton	t	t	tne	TNE
Other Units - bar	bar	bar	bar	BAR

(Table Amended 2007)

G-S.5.7. Magnified Graduations and Indications. – All requirements for graduations and indications apply to a series of graduations and an indicator magnified by an optical system or as magnified and projected on a screen.

G-S.6. Marking Operational Controls, Indications, and Features. – All operational controls, indications, and features, including switches, lights, displays, push buttons, and other means,

shall be clearly and definitely identified. The use of approved pictograms or symbols shall be acceptable.

[Nonretroactive as of January 1, 1977]

(Amended 1978 and 1995)

G-S.7. Lettering. – All required markings and instructions shall be distinct and easily readable and shall be of such character that they will not tend to become obliterated or illegible.

G-S.8. Provision for Sealing Electronic Adjustable Components. – *A device shall be designed with provision(s) for applying a security seal that must be broken, or for using other approved means of providing security (e.g., data change audit trail available at the time of inspection), before any change that detrimentally affects the metrological integrity of the device can be made to any electronic mechanism.*

[Nonretroactive as of January 1, 1990]

A device may be fitted with an automatic or a semi-automatic calibration mechanism. This mechanism shall be incorporated inside the device. After sealing, neither the mechanism nor the calibration process shall facilitate fraud.

(Added 1985) (Amended 1989 and 1993)

G-S.8.1. Multiple Weighing or Measuring Elements that Share a Common Provision for Sealing. – *A change to any metrological parameter (calibration or configuration) of any weighing or measuring element shall be individually identified.*

[Nonretroactive as of January 1, 2010]

Note: For devices that utilize an electronic form of sealing, in addition to the requirements in G-S.8.1., any appropriate audit trail requirements in an applicable specific device code also apply. Examples of identification of a change to the metrological parameters of a weighing or measuring element include, but are not limited to:

- (1) a broken, missing, or replaced physical seal on an individual weighing, measuring, or indicating element or active junction box;
- (2) a change in a calibration factor or configuration setting for each weighing or measuring element;
- (3) a display of the date of calibration or configuration event for each weighing or measuring element; or
- (4) counters indicating the number of calibration and/or configuration events for each weighing or measuring element.

(Added 2007)

G-S.8.2. Devices and Systems Adjusted Using Removable Digital Storage Device. -

For devices and systems in which the configuration or calibration parameters can be

changed by use of a removable digital storage device*, such as a secure digital (SD) card, USB flash drive, etc., security shall be provided for those parameters using either:

- (1) an event logger in the device; or
- (2) a physical seal that must be broken in order to remove the digital storage device from the device (or system). If security is provided using an event logger, the event logger shall include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. A printed copy of the information must be available on demand through the device or through another on-site device. In addition to providing a printed copy of the information, the information may be made available electronically. The event logger shall have a capacity to retain records equal to 10 times the number of sealable parameters in the device, but not more than 1000 records are required. (Note: Does not require 1000 changes to be stored for each parameter.)

* Applies only to removable digital storage devices that must remain in the device or system for it to be operational.

(Added 2019)

G-S.9. Metrologically Significant Software Updates. – A software update that changes the metrologically significant software shall be considered a sealable event.

(Added 2016)

G-N. Notes

G-N.1. Conflict of Laws and Regulations. – If any particular provisions of these specifications, tolerances, and other requirements are found to conflict with existing state laws, or with existing regulations or local ordinances relating to health, safety, or fire prevention, the enforcement of such provisions shall be suspended until conflicting requirements can be harmonized. Such suspension shall not affect the validity or enforcement of the remaining provisions of these specifications, tolerances, and other requirements.

G-N.2. Testing With Nonassociated Equipment. – Tests to determine conditions, such as radio frequency interference (RFI) that may adversely affect the performance of a device shall be conducted with equipment and under conditions that are usual and customary with respect to the location and use of the device.

(Added 1976)

G-T. Tolerances

G-T.1. Acceptance Tolerances. – Acceptance tolerances shall apply to equipment:

- (a) to be put into commercial use for the first time;

G-T.1. (b) [NOT ADOPTED – CCR § 4001. Exceptions.]

G-T.1. (c) [NOT ADOPTED – CCR § 4001. Exceptions.]

G-T.1. (d) [NOT ADOPTED – CCR § 4001. Exceptions.]

(e) undergoing type evaluation.

(Amended 1989)

G-T.2. Maintenance Tolerances. – Maintenance tolerances shall apply to equipment in actual use, except as provided in G-T.1. Acceptance Tolerances.

G-T.3. Application. – Tolerances “in excess” and tolerances “in deficiency” shall apply to errors in excess and to errors in deficiency, respectively. Tolerances “on overregistration” and tolerances “on underregistration” shall apply to errors in the direction of overregistration and of underregistration, respectively. (Also see Appendix D, Definitions.)

G-T.4. For Intermediate Values. – For a capacity, indication, load, value, etc., intermediate between two capacities, indications, loads, values, etc., listed in a table of tolerances, the tolerances prescribed for the lower capacity, indication, load, value, etc., shall be applied.

G-UR. User Requirements

G-UR.1. Selection Requirements.

CCR § 4002.1. General Code (1.10.)

(a) Type Approval Use. Upon written authorization of the Secretary, a county sealer may allow a device to be used for commercial purposes during a type approval inspection period following initial testing.

(Adopted, 4 CCR 4002.1.)

G-UR.1.1. Suitability of Equipment. – Commercial equipment shall be suitable for the service in which it is used with respect to elements of its design, including but not limited to its weighing capacity (for weighing devices), its computing capability (for computing devices), its rate of flow (for liquid-measuring devices), the character, number, size, and location of its indicating or recording elements, and the value of its smallest unit and unit prices.

(Amended 1974)

G-UR.1.2. Environment. – Equipment shall be suitable for the environment in which it is used including, but not limited to, the effects of wind, weather, and RFI.

(Added 1976)

G-UR.1.3. Liquid-Measuring Devices. – To be suitable for its application, the minimum delivery for liquid-measuring devices shall be no less than 100 divisions, except that the

minimum delivery for retail analog devices shall be no less than 10 divisions. Maximum division values and tolerances are stated in the specific codes.

(Added 1995)

G-UR.2. Installation Requirements.

G-UR.2.1. Installation. – A device shall be installed in accordance with the manufacturer's instructions, including any instructions marked on the device. A device installed in a fixed location shall be installed so that neither its operation nor its performance will be adversely affected by any characteristic of the foundation, supports, or any other detail of the installation.

G-UR.2.1.1. Visibility of Identification. – Equipment shall be installed in such a manner that all required markings are readily observable.

(Added 1978)

G-UR.2.2. Installation of Indicating or Recording Element. – A device shall be so installed that there is no obstruction between a primary indicating or recording element and the weighing or measuring element; otherwise there shall be convenient and permanently installed means for direct communication, oral or visual, between an individual located at a primary indicating or recording element and an individual located at the weighing or measuring element. (Also see G-UR.3.3. Position of Equipment.)

G-UR.2.3. Accessibility for Inspection, Testing, and Sealing Purposes. – A device shall be located, or such facilities for normal access thereto shall be provided, to permit:

- (a) inspecting and testing the device;
- (b) inspecting and applying security seals to the device; and
- (c) readily bringing the testing equipment of the weights and measures official to the device by customary means and in the amount and size deemed necessary by such official for the proper conduct of the test.

Otherwise, it shall be the responsibility of the device owner or operator to supply such special facilities, including such labor as may be needed to inspect, test, and seal the device, and to transport the testing equipment to and from the device, as required by the weights and measures official.

(Amended 1991)

G-UR.3. Use Requirements.

G-UR.3.1. Method of Operation. – Equipment shall be operated only in the manner that is obviously indicated by its construction or that is indicated by instructions on the equipment.

G-UR.3.2. Associated and Nonassociated Equipment. – A device shall meet all performance requirements when associated or nonassociated equipment is operated in its usual and customary manner and location.

(Added 1976)

G-UR.3.3. Position of Equipment. – A device or system equipped with a primary indicating element and used in direct sales, except for prescription scales, shall be positioned so that its indications may be accurately read and the weighing or measuring operation may be observed from some reasonable “customer” and “operator” position. The permissible distance between the equipment and a reasonable customer and operator position shall be determined in each case upon the basis of the individual circumstances, particularly the size and character of the indicating element.

(Amended 1974 and 1998)

G-UR.3.4. Responsibility, Money-Operated Devices. – Money-operated devices, other than parking meters, shall have clearly and conspicuously displayed thereon, or immediately adjacent thereto, adequate information detailing the method for the return of monies paid when the product or service cannot be obtained. This information shall include the name, address, and phone number of the local responsible party for the device. This requirement does not apply to devices at locations where employees are present and responsible for resolving any monetary discrepancies for the customer.

(Amended 1977 and 1993)

G-UR.4. Maintenance Requirements.

G-UR.4.1. Maintenance of Equipment. – All equipment in service and all mechanisms and devices attached thereto or used in connection therewith shall be continuously maintained in proper operating condition throughout the period of such service. Equipment in service at a single place of business shall not be considered “maintained in a proper operating condition” if:

(a) predominantly, equipment of all types or applications are found to be in error in a direction favorable to the device user; or

(b) predominantly, equipment of the same type or application is found to be in error in a direction favorable to the device user.

(Amended 1973, 1991, and 2015)

G-UR.4.2. Abnormal Performance. – Unstable indications or other abnormal equipment performance observed during operation shall be corrected and, if necessary, brought to the attention of competent service personnel.

(Added 1976)

G-UR.4.3. Use of Adjustments. – Weighing elements and measuring elements that are adjustable shall be adjusted only to correct those conditions that such elements are designed to control, and shall not be adjusted to compensate for defective or abnormal installation or accessories or for badly worn or otherwise defective parts of the assembly. Any faulty installation conditions shall be corrected, and any defective parts shall be renewed or suitably repaired, before adjustments are undertaken. Whenever equipment is adjusted, the adjustments shall be so made as to bring performance errors as close as practicable to zero value.

G-UR.4.4. Assistance in Testing Operations. – If the design, construction, or location of any device is such as to require a testing procedure involving special equipment or accessories or an abnormal amount of labor, such equipment, accessories, and labor shall be supplied by the owner or operator of the device as required by the weights and measures official.

G-UR.4.5. Security Seal. – A security seal shall be appropriately affixed to any adjustment mechanism designed to be sealed.

G-UR.4.6. Testing Devices at a Central Location.

- (a) When devices in commercial service require special test facilities, or must be removed from service for testing, or are routinely transported for the purpose of use (e.g., vehicle-mounted devices and devices used in multiple locations), the official with statutory authority may require that the devices be brought to a central location for testing. The dealer or owner of these devices shall provide transportation of the devices to and from the test location.
- (b) When the request for removal and delivery to a central test location involves devices used in submetering (e.g., electric, hydrocarbon vapor, or water meters), the owner or operator shall not interrupt the utility service to the customer or tenant except for the removal and replacement of the device. Provisions shall be made by the owner or operator to minimize inconvenience to the customer or tenant. All replacement or temporary meters shall be tested and sealed by a weights and measures official or bear a current, valid approval seal prior to use.

(Added 1994)

Table of Contents

	Page
Section 2.20. Scales	1
A. Application	1
A.1. General.	1
A.2. Wheel-Load Weighers, Portable Axle-Load Weighers, and Axle-Load Scales.....	1
A.3. Additional Code Requirements.....	1
S. Specifications	1
S.1. Design of Indicating and Recording Elements and of Recorded Representations.	1
S.1.1. Zero Indication.....	1
S.1.2. <i>Value of Scale Division Units</i>	2
S.1.3. Graduations.....	4
S.1.4. Indicators.....	4
S.1.5. Weighbeams.	5
S.1.6. Poles.....	6
S.1.7. Capacity Indication, Weight Ranges, and Unit Weights.....	7
S.1.8. Computing Scales.	7
S.1.8.4. Customer's Indications. [NOT ADOPTED - CCR § 4001. Exceptions.].....	8
CCR § 4002.2. Scales (2.20.) (d) Customer's Indications.	8
(Adopted, 4 CCR §4002.2.....	8
S.1.9. Prepackaging Scales.....	9
S.1.10. Adjustable Components.	9
S.1.11. <i>Provision for Sealing</i>	9
S.1.12. <i>Manual Weight Entries</i>	10
S.1.13. Vehicle On-Board Weighing Systems: Vehicle in Motion.	11
S.1.14. Weigh-in-Motion (WIM) Vehicle Scales.....	11
S.2. Design of Balance, Tare, Level, Damping, and Arresting Mechanisms.....	11
S.2.1. Zero-Load Adjustment.	11
S.2.2. Balance Indicator.....	13
S.2.3. Tare.	14
S.2.4. Level-Indicating Means.....	14
S.2.5. Damping Means.	15
S.3. Design of Load-Receiving Elements.	15
S.3.1. Travel of Pans of Equal-Arm Scale.....	15
S.3.2. Drainage.....	16
S.3.3. Scoop Counterbalance.	16
S.3.4. Length of Weigh-In-Motion Vehicle Scales.	16
S.4. Design of Weighing Elements.	16
S.4.1. Antifriction Means.	16
S.4.2. Adjustable Components.	16
S.4.3. Multiple Load-Receiving Elements.	17
S.5. <i>Design of Weighing Devices, Accuracy Class</i>	17
S.5.1. <i>Designation of Accuracy Class</i>	17

CCR Title 4, Div. 9, CCR §§ 4000., 4001. and 4002.2.
2023 Edition of NIST HB 44 Section 2.20. Scales

S.5.2. <i>Parameters for Accuracy Class</i>	17
S.5.3. Multi-Interval and Multiple Range Scales, Division Value.....	17
S.5.4. <i>Relationship of Minimum Load Cell Verification Interval Value to the Scale Division</i>	17
S.6. Marking Requirements.....	20
S.6.1. <i>Nominal Capacity; Vehicle and Axle-Load Scales</i>	20
S.6.2. Location of Marking Information.....	20
S.6.3. Scales, Main Elements, and Components of Scales or Weighing Systems.....	20
Table S.6.3.a. Marking Requirements - Weighing Equipment.....	20
Table S.6.3.b. Notes for Table S.6.3.a. Marking Requirements.....	23
S.6.4. Railway Track Scales.....	26
Table S.6.4.M. - Railway Track Scale – Weigh Module Capacity.....	27
S.6.5. Livestock Scales.....	28
S.6.6. Counting Feature, Minimum Individual Piece Weight, and Minimum Sample Piece Count.....	28
N. Notes	28
N.1. Test Procedures.....	28
N.1.1. Increasing-Load Test.....	28
N.1.2. Decreasing-Load Test (Automatic Indicating Scales).....	28
N.1.3. Shift Test.....	29
N.1.4. Sensitivity Test.....	34
N.1.5. <i>Discrimination Test</i>	34
N.1.6. RFI Susceptibility Tests, Field Evaluation.....	34
N.1.7. Ratio Test.....	34
N.1.8. Material Tests.....	35
N.1.9. Zero-Load Balance Change.....	35
N.1.10. Counting Feature Test.....	35
N.1.11. Substitution Test.....	35
N.1.12. Strain-Load Test.....	35
N.2. Verification (Testing) Standards.....	35
N.3. Minimum Test Weights and Test Loads.(Entire).....	36
N.4. Coupled-in-Motion Railroad Weighing Systems.....	36
N.4.1. Weighing Systems Used to Weigh Trains of Less Than Ten Cars.....	36
N.4.2. Weighing Systems Placed in Service Prior to January 1, 1991, and Used to Weigh Trains of Ten or More Cars.....	36
N.4.3. Weighing Systems Placed in Service on or After January 1, 1991, and Used to Weigh Trains of Ten or More Cars.....	36
N.5. Uncoupled-in-Motion Railroad Weighing System.....	38
N.6. Nominal Capacity of Prescription Scales.....	38
N.7. Weigh-in-Motion Vehicle Scales.....	38
N.7.1. Reference Scale.....	38
N.7.2. Reference Vehicle.....	38
N.7.3. Test Speeds.....	39
N.7.4. Static Tests for Weigh-in-Motion Vehicle Scales.....	39
N.7.5. Dynamic Tests for Weigh-in-Motion Vehicle Scales.....	39

T.	Tolerances Applicable to Devices not Marked I, II, III, III L, or IIII	40
T.1.	Tolerance Values	40
T.1.1.	General	40
T.1.2.	Postal and Parcel Post Scales	40
Table 5.	Maintenance and Acceptance Tolerances for Unmarked Postal and Parcel Post Scales	43
	*Also see Table T.1.1. Tolerances for Unmarked Scales for scales designed and/or used to weigh loads less than 2 lb.	43
T.2.	Sensitivity Requirement (SR)	43
T.2.1.	Application	43
T.2.2.	General	43
T.2.3.	Prescription Scales	43
T.2.4.	Jewelers' Scales	43
T.2.5.	Dairy-Product Test Scales	43
T.2.6.	Grain Test Scales	43
T.2.7.	Vehicle, Axle-Load, Livestock, and Animal Scales	44
CCR § 4002.2. Scales (2.20.) (c) Livestock Scales Not Equipped With Balance Indicator		44
T.2.8.	Railway Track Scales	44
T.3.	Sensitivity Requirement, Equilibrium Change Required	44
T.N.	Tolerances Applicable to Devices Marked I, II, III, III L, and IIII	44
T.N.1.	Principles	44
T.N.1.1.	Design	44
T.N.1.2.	Accuracy Classes	45
T.N.1.3.	Scale Division	45
T.N.2.	Tolerance Application	45
T.N.2.1.	General	45
T.N.2.2.	Type Evaluation Examinations	45
T.N.2.3.	Subsequent Verification Examinations	45
T.N.2.4.	Multi-Interval and Multiple Range (Variable Division-Value) Scales	45
T.N.2.5.	Ratio Tests	45
T.N.3.	Tolerance Values	45
T.N.3.1.	Maintenance Tolerance Values	45
T.N.3.2.	Acceptance Tolerance Values	45
T.N.3.3.	Wheel-Load Weighers and Portable Axle-Load Weighers of Class IIII	45
T.N.3.4.	Crane and Hopper (Other than Grain Hopper) Scales	45
Table 6.	Maintenance Tolerances	46
T.N.3.5.	Separate Main Elements: Load Transmitting Element, Indicating Element, Etc	46
T.N.3.6.	Coupled-In-Motion Railroad Weighing Systems	46
T.N.3.7.	Uncoupled-in-Motion Railroad Weighing Systems	47
T.N.3.8.	Dynamic Monorail Weighing System	47
T.N.3.9.	Materials Test on Customer-Operated Bulk Weighing Systems for Recycled Materials	47
T.N.3.10.	Prescription Scales with a Counting Feature	47

CCR Title 4, Div. 9, CCR §§ 4000., 4001. and 4002.2.
2023 Edition of NIST HB 44 Section 2.20. Scales

T.N.3.11. Tolerances for Substitution Test.....	48
T.N.3.12. Tolerances for Strain-Load Test.....	48
T.N.4. Agreement of Indications.	48
T.N.4.1. Multiple Indicating/Recording Elements.	48
T.N.4.2. Single Indicating/Recording Element.	48
T.N.4.3. Single Indicating Element/Multiple Indications.	48
T.N.4.4. Shift or Section Tests.	48
T.N.4.5. Time Dependence.....	48
T.N.4.6. Time Dependence (Creep) for Load Cells during Type Evaluation.	50
T.N.4.7. Creep Recovery for Load Cells During Type Evaluation.	51
T.N.5. Repeatability.	51
T.N.6. Sensitivity.....	52
T.N.6.1. Test Load.	52
T.N.6.2. Minimum Change of Indications.	52
T.N.7. Discrimination.	52
T.N.7.1. Analog Automatic Indicating (i.e., Weighing Device with Dial, Drum, Fan, etc.).....	52
T.N.7.2. Digital Automatic Indicating.....	52
T.N.8. Influence Factors.	53
T.N.8.1. Temperature.....	53
T.N.8.2. Barometric Pressure.	54
T.N.8.3. Electric Power Supply.	54
T.N.9. Radio Frequency Interference (RFI) and Other Electromagnetic Interference Susceptibility.	54
UR. User Requirements.....	55
UR.1. Selection Requirements.....	55
UR.1.1. General.	55
UR.1.2. Grain Hopper Scales.....	56
UR.1.3. <i>Value of the Indicated and Recorded Scale Division</i>	56
UR.1.4. Grain-Test Scales: Value of the Scale Divisions.	57
UR.1.5. <i>Recording Element, Class III L Railway Track Scales</i>	57
UR.2. Installation Requirements.	57
UR.2.1. Supports.....	57
UR.2.2. Suspension of Hanging Scale.	57
UR.2.3. Protection From Environmental Factors.....	57
UR.2.4. Foundation, Supports, and Clearance.....	57
UR.2.5. Access to Weighing Elements.....	57
UR.2.6. Approaches.	58
UR.2.6.1. Vehicle Scales. – [NOT ADOPTED - CCR § 4001. Exceptions.]	58
UR.2.7. Stock Racks.	58
UR.2.8. Hoists.	58
UR.2.9. <i>Provision for Testing Dynamic Monorail Weighing Systems</i>	58
UR.2.10. <i>Primary Indicating Elements Provided by the User</i>	58

CCR Title 4, Div. 9, CCR §§ 4000., 4001. and 4002.2.
2023 Edition of NIST HB 44 Section 2.20. Scales

UR.3. Use Requirements.....	58
UR.3.1. Recommended Minimum Load.....	58
UR.3.2. Maximum Load.....	59
UR.3.3. Single-Draft Vehicle Weighing.....	62
UR.3.4. Wheel-Load Weighing.....	63
UR.3.4.1. Use in Pairs.....	63
UR.3.5. Special Designs.....	63
UR.3.6. Wet Commodities.....	63
UR.3.7. Minimum Load on a Vehicle Scale. [NOT ADOPTED - CCR § 4001. Exceptions.].....	64
CCR § 4002.2. Scales (2.20.) (a) Minimum Load on a Vehicle Scale.....	64
CCR § 4002.2. Scales (2.20.) (b) Class III, Class III L and Unmarked Devices Used For Recycling.....	64
UR.3.8. Minimum Load for Weighing Livestock.....	64
UR.3.9. Use of Manual Weight Entries.....	64
UR.3.10. Dynamic Monorail Weighing Systems.....	64
UR.3.11. Minimum Count.....	64
UR.3.12. Correct Stored Piece Weight.....	65
UR.3.13. Fault Indications for Weigh-in-Motion Vehicle Scales.....	65
UR.4. Maintenance Requirements.....	65
UR.4.1. Balance Condition.....	65
UR.4.2. Level Condition.....	65
UR.4.3. Scale Modification.....	65
UR.5. Coupled-in-Motion Railroad Weighing Systems.....	65
Scales Code Index.....	67

Section 2.20. Scales

A. Application

A.1. General. – This code applies to all types of weighing devices other than automatic bulk-weighing systems, belt-conveyor scales, and automatic weighing systems. The code comprises requirements that generally apply to all weighing devices, and specific requirements that are applicable only to certain types of weighing devices.

(Amended 1972 and 1983)

A.2. Wheel-Load Weighers, Portable Axle-Load Weighers, and Axle-Load Scales. – The requirements for wheel-load weighers, portable axle-load weighers, and axle-load scales apply only to such scales in official use for the enforcement of traffic and highway laws or for the collection of statistical information by government agencies.

A.3. Additional Code Requirements. – In addition to the requirements of this code, devices covered by the Scales code shall meet the requirements of Section 1.10. General Code.

S. Specifications

S.1. Design of Indicating and Recording Elements and of Recorded Representations.

S.1.1. Zero Indication.

- (a) On a scale equipped with indicating or recording elements, provision shall be made to either indicate or record a zero-balance condition.
- (b) On an automatic-indicating scale or balance indicator, provision shall be made to indicate or record an out-of-balance condition on both sides of zero.
- (c) A zero-balance condition may be indicated by other than a continuous digital zero indication, provided that an effective automatic means is provided to inhibit a weighing operation or to return to a continuous digital indication when the scale is in an out-of-balance condition.

(Added 1987) (Amended 1993)

(Amended 1987)

S.1.1.1. Digital Indicating Elements.

- (a) A digital zero indication shall represent a balance condition that is within $\pm \frac{1}{2}$ the value of the scale division.
- (b) *A digital indicating device shall either automatically maintain a “center-of-zero” condition to $\pm \frac{1}{4}$ scale division or less, or have an auxiliary or supplemental “center-of-zero” indicator that defines a zero-balance condition to $\pm \frac{1}{4}$ of a scale*

division or less. A “center-of-zero” indication may operate when zero is indicated for gross and/or net mode(s).

[Nonretroactive as of January 1, 1993]

(c) For electronic cash registers (ECRs) and point-of-sale systems (POS systems) the display of measurement units shall be a minimum of 9.5 mm (3/8 inch) in height.

[Nonretroactive as of January 1, 2021]

(Added 2019)

(Amended 1992, 2008, and 2019)

S.1.1.2. No-Load Reference Value. – On a single draft manually operated receiving hopper scale installed below grade, used to receive grain, and utilizing a no-load reference value, provision shall be made to indicate and record the no-load reference value prior to the gross load value.

(Added 1983)

S.1.2. Value of Scale Division Units. – *Except for batching scales and weighing systems used exclusively for weighing in predetermined amounts, the value of a scale division “d” expressed in a unit of weight shall be equal to:*

(a) 1, 2, or 5; or

(b) a decimal multiple or submultiple of 1, 2, or 5; or

Examples: scale divisions may be 10, 20, 50, 100; or 0.01, 0.02, 0.05; or 0.1, 0.2, 0.5, etc.

(c) a binary submultiple of a specific unit of weight.

Examples: scale divisions may be 1/2, 1/4, 1/8, 1/16, etc.

[Nonretroactive as of January 1, 1986]

S.1.2.1. Digital Indicating Scales, Units. – *Except for postal scales, a digital-indicating scale shall indicate weight values using only a single unit of measure. Weight values shall be presented in a decimal format with the value of the scale division expressed as 1, 2, or 5, or a decimal multiple or submultiple of 1, 2, or 5.*

The requirement that the value of the scale division be expressed only as 1, 2, or 5, or a decimal multiple or submultiple of only 1, 2, or 5 does not apply to net weight indications and recorded representations that are calculated from gross and tare weight indications where the scale division of the gross weight is different from the scale division of the tare weight(s) on multi-interval or multiple range scales.

For example, a multiple range or multi-interval scale may indicate and record tare weights in a lower weighing range (WR) or weighing segment (WS), gross weights in the higher weighing range or weighing segment, and net weights as follows:

55 kg	Gross Weight (WR2 d = 5 kg)	10.05 lb	Gross Weight (WS2 d = 0.05 lb)
– 4 kg	Tare Weight (WR1 d = 2 kg)	– 0.06 lb	Tare Weight (WS1 d = 0.02 lb)
= 51 kg	Net Weight (Mathematically Correct)	= 9.99 lb	Net Weight (Mathematically Correct)

[Nonretroactive as of January 1, 1989]

(Added 1987) (Amended 2008)

S.1.2.2. Verification Scale Interval.

S.1.2.2.1. Class I and II Scales and Dynamic Monorail Scales. – If $e \neq d$, the verification scale interval “e” shall be determined by the expression “d is less than e which is less than or equal to 10 d”:

$$d < e \leq 10 d$$

If the displayed division (d) is less than the verification division (e), then the verification division shall be less than or equal to 10 times the displayed division.

The value of e must satisfy the relationship, $e = 10^k$ of the unit of measure, where k is a positive or negative whole number or zero. This requirement does not apply to a Class I device with $d < 1$ mg where $e = 1$ mg. If $e \neq d$, the value of “d” shall be a decimal submultiple of “e,” and the ratio shall not be more than 10:1. If $e \neq d$, and both “e” and “d” are continuously displayed during normal operation, then “d” shall be differentiated from “e” by size, shape, color, etc. throughout the range of weights displayed as “d.”

(Added 1999)

S.1.2.2.2. Class III and III Scales. The value of “e” is specified by the manufacturer as marked on the device. Except for dynamic monorail scales, “e” must be less than or equal to “d.”

(Added 1999)

(Amended 2021)

S.1.2.3. Prescription Scale with a Counting Feature. – A Class I or Class II prescription scale with an operational counting feature shall not calculate a piece weight or total count unless the sample used to determine the individual piece weight meets the following conditions:

- (a) minimum individual piece weight is greater than or equal to 3 e; and
- (b) minimum sample piece count is greater than or equal to 10 pieces.

(Added 2003)

S.1.3. Graduations.

S.1.3.1. Length. – Graduations shall be so varied in length that they may be conveniently read.

S.1.3.2. Width. – In any series of graduations, the width of a graduation shall in no case be greater than the width of the clear space between graduations. The width of main graduations shall be not more than 50 % greater than the width of subordinate graduations. Graduations shall be not less than 0.2 mm (0.008 in) wide.

S.1.3.3. Clear Space Between Graduations. – The clear space between graduations shall be not less than 0.5 mm (0.02 in) for graduations representing money-values, and not less than 0.75 mm (0.03 in) for other graduations. If the graduations are not parallel, the measurement shall be made:

- (a) along the line of relative movement between the graduations at the end of the indicator; or
- (b) if the indicator is continuous, at the point of widest separation of the graduations.

S.1.4. Indicators.

S.1.4.1. Symmetry. – The index of an indicator shall be of the same shape as the graduations, at least throughout that portion of its length associated with the graduations.

S.1.4.2. Length. – The index of an indicator shall reach to the finest graduations with which it is used, unless the indicator and the graduations are in the same plane, in which case, the distance between the end of the indicator and the ends of the graduations, measured along the line of the graduations, shall be not more than 1.0 mm (0.04 in).

S.1.4.3. Width. – The width of the index of an indicator in relation to the series of graduations with which it is used shall be not greater than:

(a) *the width of the narrowest graduation;*
[Nonretroactive as of January 1, 2002]

(b) the width of the clear space between weight graduations; and

(c) three-fourths of the width of the clear space between money-value graduations.

When the index of an indicator extends along the entire length of a graduation, that portion of the index of the indicator that may be brought into coincidence with the graduation shall be of the same width throughout the length of the index that coincides with the graduation.

S.1.4.4. Clearance. – The clearance between the index of an indicator and the graduations shall in no case be more than 1.5 mm (0.06 in).

S.1.4.5. Parallax. – Parallax effects shall be reduced to the practicable minimum.

S.1.5. Weighbeams.

S.1.5.1. Normal Balance Position. – The normal balance position of the weighbeam of a beam scale shall be horizontal.

S.1.5.2. Travel. – The weighbeam of a beam scale shall have equal travel above and below the horizontal. The total travel of the weighbeam of a beam scale in a trig loop or between other limiting stops near the weighbeam tip shall be not less than the minimum travel shown in Tables 1M and 1 (below). When such limiting stops are not provided, the total travel at the weighbeam tip shall be not less than 8 % of the distance from the weighbeam fulcrum to the weighbeam tip.

Table 1. Minimum Travel of Weighbeam of Beam Scale Between Limiting Stops

Distance from Weighbeam Fulcrum to Limiting Stops (inches)	Minimum Travel Between Limiting Stops (inch)
≤ 12	0.4
> 12 to 20	0.5
> 20 to 40	0.7
> 40	0.9

Table 1M. Minimum Travel of Weighbeam of Beam Scale Between Limiting Stops

Distance from Weighbeam Fulcrum to Limiting Stops (centimeters)	Minimum Travel Between Limiting Stops (millimeter)
≤ 30	10
> 30 to 50	13
> 50 to 100	18
> 100	23

S.1.5.3. Subdivision. – A subdivided weighbeam bar shall be subdivided by scale division graduations, notches, or a combination of both. Graduations on a particular bar shall be of uniform width and perpendicular to the top edge of the bar. Notches on a

particular bar shall be uniform in shape and dimensions and perpendicular to the face of the bar. When a combination of graduations and notches is employed, the graduations shall be positioned in relation to the notches to indicate notch values clearly and accurately.

S.1.5.4. Readability. – A subdivided weighbeam bar shall be so subdivided and marked, and a weighbeam poise shall be so constructed, that the weight corresponding to any normal poise position can easily and accurately be read directly from the beam, whether or not provision is made for the optional recording of representations of weight.

S.1.5.5. Capacity. – On an automatic-indicating scale having a nominal capacity of 15 kg (30 lb) or less and used for direct sales to retail customers:

- (a) the capacity of any weighbeam bar shall be a multiple of the reading-face capacity;
- (b) each bar shall be subdivided throughout or shall be subdivided into notched intervals, each equal to the reading-face capacity; and
- (c) the value of any turnover poise shall be equal to the reading-face capacity.

S.1.5.6. Poise Stop. – Except on a steelyard with no zero graduation, a shoulder or stop shall be provided on each weighbeam bar to prevent a poise from traveling and remaining back of the zero graduation.

S.1.6. Poises.

S.1.6.1. General. – No part of a poise shall be readily detachable. A locking screw shall be perpendicular to the longitudinal axis of the weighbeam and shall not be removable. Except on a steelyard with no zero graduation, the poise shall not be readily removable from a weighbeam. The knife-edge of a hanging poise shall be hard and sharp and so constructed as to allow the poise to swing freely on the bearing surfaces in the weighbeam notches.

S.1.6.2. Adjusting Material. – The adjusting material in a poise shall be securely enclosed and firmly fixed in position; if softer than brass, it shall not be in contact with the weighbeam.

S.1.6.3. Pawl. – A poise, other than a hanging poise, on a notched weighbeam bar shall have a pawl that will seat the poise in a definite and correct position in any notch, wherever in the notch the pawl is placed, and hold it there firmly and without appreciable movement. The dimension of the tip of the pawl that is transverse to the longitudinal axis of the weighbeam shall be at least equal to the corresponding dimension of the notches.

S.1.6.4. Reading Edge or Indicator. – The reading edge or indicator of a poise shall be sharply defined, and a reading edge shall be parallel to the graduations on the weighbeam.

S.1.7. Capacity Indication, Weight Ranges, and Unit Weights.

- (a) **Gross Capacity.** – An indicating or recording element shall not display nor record any values when the gross load (not counting the initial dead load that has been canceled by an initial zero-setting mechanism) is in excess of 105 % of scale capacity.
- (b) **Capacity Indication.** – *Electronic computing scales (excluding postal scales and weight classifiers) shall neither display nor record a gross or net weight in excess of scale capacity plus 9 d.*
[Nonretroactive as of January 1, 1993]

The total value of weight ranges and of unit weights in effect or in place at any time shall automatically be accounted for on the reading face and on any recorded representation.

This requirement does not apply to: (1) single-revolution dial scales, (2) multi-revolution dial scales not equipped with unit weights, (3) scales equipped with two or more weighbeams, nor (4) devices that indicate mathematically derived totalized values.

(Amended 1990, 1992, and 1995)

S.1.8. Computing Scales.

S.1.8.1. Money-Value Graduations, Metric Unit Prices. – The value of the graduated intervals representing money-values on a computing scale with analog indications shall not exceed:

- (a) 1 cent at all unit prices of 55 cents per kilogram and less;
- (b) 2 cents at unit prices of 56 cents per kilogram through \$2.75 per kilogram (special graduations defining 5-cent intervals may be employed but not in the spaces between regular graduations);
- (c) 5 cents at unit prices of \$2.76 per kilogram through \$7.50 per kilogram; or
- (d) 10 cents at unit prices above \$7.50 per kilogram.

Value figures and graduations shall not be duplicated in any column or row on the graduated chart. (Also see S.1.8.2. Money-Value Computation.)

S.1.8.2. Money-Value Graduations, U.S. Customary Unit Prices. – The value of the graduated intervals representing money-values on a computing scale with analog indications shall not exceed:

- (a) 1 cent at all unit prices of 25 cents per pound and less;
- (b) 2 cents at unit prices of 26 cents per pound through \$1.25 per pound (special graduations defining 5-cent intervals may be employed but not in the spaces between regular graduations);

- (c) 5 cents at unit prices of \$1.26 per pound through \$3.40 per pound; or
- (d) 10 cents at unit prices above \$3.40 per pound.

Value figures and graduations shall not be duplicated in any column or row on the graduated chart. (Also see S.1.8.2. Money-Value Computation.)

S.1.8.3. Money-Value Computation. – A computing scale with analog quantity indications used in retail trade may compute and present digital money-values to the nearest quantity graduation when the value of the minimum graduated interval is 0.005 kg (0.01 lb) or less. (Also see Sec. 1.10. General Code G-S.5.5. Money-Values, Mathematical Agreement.)

S.1.8.4. Customer's Indications. [NOT ADOPTED - CCR § 4001. Exceptions.]

CCR § 4002.2. Scales (2.20.) (d) Customer's Indications. Weight indications shall be shown on the customer's side of computing scales when these are used for direct sales to retail customers. Computing scales equipped on the operator's side with digital indications, such as net weight, unit price, or total price, shall be similarly equipped on the customer's side. *Unit price displays visible to the customer shall be in terms of whole units of weight, and not in common or decimal fractions. (Nonretroactive May 9, 1996)*

(Adopted, 4 CCR §4002.2.)

S.1.8.4.1. *Scales that will function as either a normal round off scale or as a weight classifier shall be provided with a sealable means for selecting the mode of operation and shall have a clear indication (annunciator), adjacent to the weight display on both the operator's and customer's side whenever the scale is operating as a weight classifier.*

[Nonretroactive as of January 1, 2001]

(Added 1999)

S.1.8.5. Recorded Representations, Point-of-Sale Systems. – The sales information recorded by cash registers when interfaced with a weighing element shall contain the following information for items weighed at the checkout stand:

- (a) the net weight;
- (b) the unit price;(c) the total price;
- (d) the product class or, in a system equipped with price look-up capability, the product name or code number, and
- (e) *the tare weight.*

[Nonretroactive as of January 1, 2025]

Weight values shall be identified as tare and net, or gross if applicable. The unit of weight shall be identified as kilograms, kg, grams, g, ounces, oz, pounds, or lb.

For devices interfaced with scales indicating in metric units, the unit price may be expressed in price per 100 grams.

(Amended 1995, 2005, and 2021)

S.1.9. Prepackaging Scales.

S.1.9.1. Value of the Scale Division. – On a prepackaging scale, the value of the intervals representing weight values shall be uniform throughout the entire reading face. The recorded weight values shall be identical with those on the indicator.

S.1.9.2. Label Printer. – A prepackaging scale or a device that produces a printed ticket to be used as the label for a package shall print all values digitally and of such size, style of type, and color as to be clear and conspicuous on the label.

S.1.10. Adjustable Components. – An adjustable component such as a pendulum, spring, or potentiometer shall be held securely in adjustment and, except for a zero-load balance mechanism, shall be located within the housing of the element.

(Added 1986)

S.1.11. Provision for Sealing.

S.1.11.1. Devices and Systems Adjusted Using a Removable Digital Storage Device. - For devices and systems in which the calibration or configuration parameters, as defined in Appendix D, can be changed by use of a removable digital storage device, security shall be provided for those parameters as specified in G-S.8.2. Devices and Systems Adjusted Using Removable Digital Storage Devices.

S.1.11.2. All Other Devices. - *Except on Class I scales and devices specified in S.1.11.1., the following provisions for sealing apply:*

(a) *Except on Class I scales, provision shall be made for applying a security seal in a manner that requires the security seal to be broken before an adjustment can be made to any component affecting the performance of an electronic device.*

[Nonretroactive as of January 1, 1979]

(b) *Except on Class I scales, a device shall be designed with provision(s) for applying a security seal that must be broken, or for using other approved means of providing security (e.g., data change audit trail available at the time of inspection), before any change that detrimentally affects the metrological integrity of the device can be made to any electronic mechanism.*

[Nonretroactive as of January 1, 1990]

(c) *Except on Class I scales, audit trails shall use the format set forth in Table S.1.11. Categories of Device and Methods of Sealing.*

[Nonretroactive as of January 1, 1995]

A device may be fitted with an automatic or a semi-automatic calibration mechanism. This mechanism shall be incorporated inside the device. After sealing, neither the mechanism nor the calibration process shall facilitate fraud.

(Amended 1989, 1991, 1993, and 2019)

Table S.1.11. Categories of Device and Methods of Sealing

Categories of Device	Methods of Sealing
Category 1: No remote configuration capability.	<i>Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.</i>
<p>Category 2: Remote configuration capability, but access is controlled by physical hardware.</p> <p><i>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode.</i></p>	<p><i>The hardware enabling access for remote communication must be at the device and sealed using a physical seal or two event counters: one for calibration parameters and one for configuration parameters.</i></p>
<p>Category 3: Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password).</p>	<p><i>An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. A printed copy of the information must be available through the device or through another on-site device. The event logger shall have a capacity to retain records equal to 10 times the number of sealable parameters in the device, but not more than 1000 records are required. (Note: Does not require 1000 changes to be stored for each parameter.)</i></p>

[Nonretroactive as of January 1995]
(Table added 1993)

S.1.12. Manual Weight Entries. – A device when being used for direct sale shall accept an entry of a manual gross or net weight value only when the scale gross or net* weight indication is at zero. Recorded manual weight entries, except those on labels generated for packages of standard weights, shall identify the weight value as a manual weight entry by one of the following terms: “Manual Weight,” “Manual Wt,” or “MAN WT.” The use of a symbol to identify multiple manual weight entries on a single document is permitted, provided that the symbol is defined on the same page on which the manual weight entries appear and the definition of the symbol is automatically printed by the recording element as part of the document.

[Nonretroactive as of January 1, 1993] [*Nonretroactive as of January 1, 2005]
(Added 1992) (Amended 2004)

S.1.13. Vehicle On-Board Weighing Systems: Vehicle in Motion. – When the vehicle is in motion, a vehicle on-board weighing system shall either:

- (a) be accurate; or
- (b) inhibit the weighing operation.

(Added 1993)

S.1.14. Weigh-in-Motion (WIM) Vehicle Scales.

S.1.14.1. Identification of a Fault. – Fault conditions shall be presented to the customer and the operator in a clear and unambiguous manner. No weight values shall be indicated or recorded when a fault condition is detected. The following fault conditions shall be identified, if applicable:

- (a) Vehicle speed was below the minimum or above the maximum speed as specified by the manufacturer.
- (b) A change in vehicle speed greater than that specified by the manufacturer was detected.
- (c) Vehicle direction of travel was not valid for the installation.
- (d) The amount of time all vehicle axles were simultaneously on the scale was below the minimum data acquisition time.
- (e) Vehicle path of travel was outside the lateral side edges of the load-receiving element.

S.1.14.2. Information to be Recorded. – In addition to the information that is normally recorded for vehicle scales, the following shall also be printed and/or stored electronically for each vehicle weighment, if applicable:

- (a) Scale identification if more than one lane at the site has the ability to weigh a vehicle in motion.
- (b) Vehicle direction of travel if the weigh-in-motion vehicle scale is bi-directional.

(Added 2021)

S.2. Design of Balance, Tare, Level, Damping, and Arresting Mechanisms.

S.2.1. Zero-Load Adjustment.

S.2.1.1. General. – A scale shall be equipped with means by which the zero-load balance may be adjusted. Any loose material used for this purpose shall be enclosed so that it cannot shift in position and alter the balance condition of the scale.

Except for an initial zero-setting mechanism, an automatic zero adjustment outside the limits specified in S.2.1.3. Scales Equipped with an Automatic Zero-Tracking Mechanism is prohibited.
(Amended 2010)

S.2.1.2. Scales used in Direct Sales. – A manual zero-setting mechanism (except on a digital scale with an analog zero-adjustment mechanism with a range of not greater than one scale division) shall be operable or accessible only by a tool outside of and entirely separate from this mechanism, or it shall be enclosed in a cabinet. Except on Class I or II scales, a balance ball shall either meet this requirement or not itself be rotatable.

A semiautomatic zero-setting mechanism shall be operable or accessible only by a tool outside of and separate from this mechanism or it shall be enclosed in a cabinet, or it shall be operable only when the indication is stable within plus or minus:

- (a) 3.0 scale divisions for scales of more than 2000 kg (5000 lb) capacity in service prior to January 1, 1981, and for all axle load, railway track, and vehicle scales;
or
- (b) 1.0 scale division for all other scales.

S.2.1.3. Scales Equipped with an Automatic Zero-Tracking Mechanism.

S.2.1.3.1. Automatic Zero-Tracking Mechanism for Scales Manufactured Between January 1, 1981, and January 1, 2007. – The maximum load that can be “rezeroed,” when either placed on or removed from the platform all at once under normal operating conditions, shall be for:

- (a) bench, counter, and livestock scales: 0.6 scale division;
- (b) vehicle, axle load, and railway track scales: 3.0 scale divisions; and
- (c) all other scales: 1.0 scale division.

(Amended 2005)

S.2.1.3.2. Automatic Zero-Tracking Mechanism for Scales Manufactured on or after January 1, 2007. – The maximum load that can be “rezeroed,” when either placed on or removed from the platform all at once under normal operating conditions, shall be:

- (a) for vehicle, axle load, and railway track scales: 3.0 scale divisions; and
- (b) for all other scales: 0.5 scale division.

(Added 2005)

S.2.1.3.3. Means to Disable Automatic Zero-Tracking Mechanism on Class III L Devices. – *Class III L devices equipped with an automatic zero-tracking mechanism shall be designed with a sealable means that would allow zero tracking to be disabled during the inspection and test of the device.*

[Nonretroactive as of January 1, 2001]

(Added 1999) (Amended 2005)

S.2.1.4. Monorail Scales. – On a static monorail scale equipped with digital indications, means shall be provided for setting the zero-load balance to within 0.02 % of scale capacity. On a dynamic monorail weighing system, means shall be provided to automatically maintain these conditions.

(Amended 1999)

S.2.1.5. Initial Zero-Setting Mechanism. – Scales of accuracy Classes I, II, and III may be equipped with an initial zero-setting device.

(a) For weighing, load-receiving, and indicating elements in the same housing or covered on the same CC, an initial zero-setting mechanism shall not zero a load in excess of 20 % of the maximum capacity of the scale unless tests show that the scale meets all applicable tolerances for any amount of initial load compensated by this device within the specified range.

(b) *For indicating elements not permanently attached to weighing and load-receiving elements covered on a separate CC, the maximum initial zero-setting mechanism range of electronic indicators shall not exceed 20 % of the configured capacity.*

[Nonretroactive as of January 1, 2009]

(Added 2008)

(Added 1990) (Amended 2008)

S.2.1.6. Combined Zero-Tare (“0/T”) Key. – Scales not intended to be used in direct sales applications may be equipped with a combined zero and tare function key, provided that the device is clearly marked as to how the key functions. The device must also be clearly marked on or adjacent to the weight display with the statement “Not for Direct Sales.”

(Added 1998)

S.2.2. Balance Indicator. – On a balance indicator consisting of two indicating edges, lines, or points, the ends of the indicators shall be sharply defined. When the scale is in balance, the ends shall be separated by not more than 1.0 mm (0.04 in).

S.2.2.1. Dairy-Product Test, Grain-Test, Prescription, and Class I and II Scales. – Except on digital indicating devices, a dairy-product test, grain-test, prescription, or Class I or II scale shall be equipped with a balance indicator. If an indicator and a graduated scale are not in the same plane, the clearance between the indicator and the graduations shall be not more than 1.0 mm (0.04 in).

S.2.2.2. Equal-Arm Scale. – *An equal-arm scale shall be equipped with a balance indicator. If the indicator and balance graduation are not in the same plane, the*

clearance between the indicator and the balance graduation shall be not more than 1.0 mm (0.04 in).

[Nonretroactive as of January 1, 1989]

(Added 1988)

S.2.3. Tare. – *On any scale (except a monorail scale equipped with digital indications and multi-interval scales or multiple range scales when the value of tare is determined in a lower weighing range or weighing segment), the value of the tare division shall be equal to the value of the scale division.* The tare mechanism shall operate only in a backward direction (that is, in a direction of underregistration) with respect to the zero-load balance condition of the scale. A device designed to automatically clear any tare value shall also be designed to prevent the automatic clearing of tare until a complete transaction has been indicated. **

*[*Nonretroactive as of January 1, 1983]*

(Amended 1985 and 2008)

Note: *On a computing scale, this requires the input of a unit price, the display of the unit price, and a computed positive total price at a readable equilibrium. Other devices require a complete weighing operation, including tare, net, and gross weight determination.**

*[*Nonretroactive as of January 1, 1983]*

S.2.3.1. Monorail Scales Equipped with Digital Indications. – *On a static monorail weighing system equipped with digital indications, means shall be provided for setting any tare value of less than 5 % of the scale capacity to within 0.02 % of scale capacity. On a dynamic monorail weighing system, means shall be provided to automatically maintain this condition.*

(Amended 1999)

S.2.4. Level-Indicating Means. – *Except for portable wheel-load weighers and portable axle load scales, a portable scale shall be equipped with level-indicating means if its weighing performance is changed by an amount greater than the appropriate acceptance tolerance when it is tilted up to and including 5 % rise over run in any direction from a level position and rebalanced. The level-indicating means shall be readable without removing any scale parts requiring a tool.*

[This requirement is nonretroactive as of January 1, 1986, for prescription, jewelers', and dairy-product test scales and scales marked Class I and II.]

Note: *Portable wheel-load weighers and portable axle-load scales shall be accurate when tilted up to and including 5 % rise over run in any direction from a level position and rebalanced.*

(Amended 1991 and 2008)

S.2.4.1. Vehicle On-Board Weighing Systems. – *A vehicle on-board weighing system shall operate within tolerance when the weighing system is tilted up to and including 5 % rise over run in any direction from a level position and rebalanced. If the accuracy of the system is affected by out-of-level conditions normal to the use of the device, the*

system shall be equipped with an out-of-level sensor that inhibits the weighing operation when the system is out of level to the extent that the accuracy limits are exceeded.

(Added 1992) (Amended 2008)

S.2.5. Damping Means. – An automatic-indicating scale and a balance indicator shall be equipped with effective means to damp oscillations and to bring the indicating elements quickly to rest.

S.2.5.1. Digital Indicating Elements. – Digital indicating elements equipped with recording elements shall be equipped with effective means to permit the recording of weight values only when the indication is stable within plus or minus:

(a) 3.0 scale divisions for scales of more than 2000 kg (5000 lb) capacity in service prior to January 1, 1981, hopper (other than grain hopper) scales with a capacity exceeding 22 000 kg (50 000 lb), and for all vehicle, axle load, livestock, and railway track scales; and

(b) 1.0 scale division for all other scales.

The values recorded shall be within applicable tolerances.

(Amended 1995)

S.2.5.2. Jewelers', Prescription, and Class I, and Class II Scales. – A jewelers', prescription, Class I, or Class II scales shall be equipped with appropriate means for arresting the oscillation of the mechanism.

S.2.5.3. Class I and Class II Prescription Scales with a Counting Feature. – A Class I or Class II prescription scale shall indicate to the operator when the piece weight computation is complete by a stable display of the quantity placed on the load-receiving element.

(Added 2003)

S.3. Design of Load-Receiving Elements.

S.3.1. Travel of Pans of Equal-Arm Scale. – The travel between limiting stops of the pans of a nonautomatic-indicating equal-arm scale not equipped with a balance indicator shall be not less than the minimum travel shown in Table 2M. and Table 2.

Table 2. Minimum Travel of Pans of Nonautomatic Indicating Equal-Arm Scale without Balance Indicator

Nominal Capacity (pounds)	Minimum Travel of Pans (inch)
4 or less	0.35
4+ to 12, inclusive	0.5
12+ to 26, inclusive	0.75
Over 26	1.0

Table 2M. Minimum Travel of Pans of Nonautomatic Indicating Equal-Arm Scale without Balance Indicator

Nominal Capacity (kilograms)	Minimum Travel of Pans (millimeters)
2 or less	9
2+ to 5, inclusive	13
5+ to 12, inclusive	19
Over 12	25

S.3.2. Drainage. – A load-receiving element intended to receive wet commodities shall be so constructed as to drain effectively.

S.3.3. Scoop Counterbalance. – A scoop on a scale used for direct sales to retail customers shall not be counterbalanced by a removable weight. A permanently attached scoop-counterbalance shall indicate clearly on both the operator’s and customer’s sides of the scale whether it is positioned for the scoop to be on or off the scale.

S.3.4. Length of Weigh-In-Motion Vehicle Scales. – The load-receiving element shall be of sufficient length to allow the weighing of any vehicle intended to be weighed on the scale in a single draft (i.e., all axles of the vehicle are on the load-receiving element simultaneously during the weighing).

(Added 2021)

S.4. Design of Weighing Elements.

S.4.1. Antifriction Means. – Frictional effects shall be reduced to a minimum by suitable antifriction elements. Opposing surfaces and points shall be properly shaped, finished, and hardened. A platform scale having a frame around the platform shall be equipped with means to prevent interference between platform and frame.

S.4.2. Adjustable Components. – An adjustable component such as a nose-iron or potentiometer shall be held securely in adjustment. The position of a nose-iron on a scale of more than 1000 kg (2000 lb) capacity, as determined by the factory adjustment, shall be accurately, clearly, and permanently defined.

(Amended 1986)

S.4.3. Multiple Load-Receiving Elements. – Except for mechanical bench and counter scales, a scale with a single indicating or recording element, or a combination indicating-recording element, that is coupled to two or more load-receiving elements with independent weighing systems, shall be provided with means to prohibit the activation of any load-receiving element (or elements) not in use, and shall be provided with automatic means to indicate clearly and definitely which load-receiving element (or elements) is in use.

S.5. Design of Weighing Devices, Accuracy Class.

S.5.1. Designation of Accuracy Class. – Weighing devices are divided into accuracy classes and shall be designated as I, II, III, III L, or IIII.

[Nonretroactive as of January 1, 1986]

S.5.2. Parameters for Accuracy Class. – The accuracy class of a weighing device is designated by the manufacturer and shall comply with parameters shown in Table 3.

[Nonretroactive as of January 1, 1986]

S.5.3. Multi-Interval and Multiple Range Scales, Division Value. – On a multi-interval scale and multiple range scale, the value of “e” shall be equal to the value of “d.”¹

(Added 1986) (Amended 1995)

S.5.4. Relationship of Minimum Load Cell Verification Interval Value to the Scale Division. – The relationship of the value for the minimum load cell verification scale interval, v_{min} , to the scale division, d , for a specific scale using National Type Evaluation Program (NTEP) certified load cells shall comply with the following formulae where N is the number of load cells in a single independent¹ weighing/load-receiving element (such as hopper, railroad track, or vehicle scale weighing/load-receiving elements):

¹“Independent” means with a weighing/load-receiving element not attached to adjacent elements and with its own A/D conversion circuitry and displayed weight.

The minimum load cell verification interval, v_{min} , shall be less than or equal to the value of d divided by the square root of the number of load cells in a single independent weighing/load receiving element for scales without lever systems.

$$v_{min} \leq \frac{d^*}{\sqrt{N}} \quad \text{for scales without lever systems}$$

Figure 1: (a) Equation to Determine the Suitability of Load Cells for Scales without Lever Systems

¹ Footnote 1 to Table 3 Parameters for Accuracy Classes.

$$v_{\min} \leq \frac{d^*}{\sqrt{N} \times (\text{scale multiple})} \quad \text{for scales with lever systems.}$$

Figure 2: (b) Equation to Determine the Suitability of a Load Cell for Scales with Lever Systems

The minimum load cell verification interval, v_{\min} , shall be less than or equal to the value of d divided by the square root of the load cell multiplied by the scale multiple in a single independent weighing/load receiving element for scales with lever systems.

[*When the value of the scale division, d , is different from the verification scale division, e , for the scale, the value of e must be used in the formulae above.]

This requirement does not apply to complete weighing/load-receiving elements or scales, which satisfy all the following criteria:

- the complete weighing/load-receiving element or scale has been evaluated for compliance with T.N.8.1. Temperature under the NTEP;
- the complete weighing/load-receiving element or scale has received an NTEP Certificate of Conformance; and
- the complete weighing/load-receiving element or scale is equipped with an automatic zero-tracking mechanism which cannot be made inoperative in the normal weighing mode. (A test mode which permits the disabling of the automatic zero-tracking mechanism is permissible, provided the scale cannot function normally while in this mode.

[Nonretroactive as of January 1, 1994]

(Added 1993) (Amended 1996 and 2016)

Table 3. Parameters for Accuracy Classes SI Units

Class	Value of the Verification Scale Division (d or e^1)	Minimum Number of Scale⁴ Divisions (n)	Maximum Number of Scale⁴ Divisions (n)
<i>I</i>	equal to or greater than 1 mg	50 000	--
<i>II</i>	1 to 50 mg, inclusive	100	100 000
	equal to or greater than 100 mg	5 000	100 000
<i>III</i> ^{2,5}	0.1 to 2 g, inclusive	100	10 000
	equal to or greater than 5 g	500	10 000
<i>III L</i> ³	equal to or greater than 2 kg	2 000	10 000
<i>IIII</i>	equal to or greater than 5 g	100	1 200

Table 3. Parameters for Accuracy Classes U.S. Customary Units

CCR Title 4, Div. 9, CCR §§ 4000., 4001. and 4002.2.
2023 Edition of NIST HB 44 Section 2.20. Scales

Class	Value of the Verification Scale Division (d or e¹)	Minimum Number of Scale⁴ Divisions (n)	Maximum Number of Scale⁴ Divisions (n)
<i>III⁵</i>	<i>0.0002 lb to 0.005 lb, inclusive</i>	<i>100</i>	<i>10 000</i>
	<i>0.005 oz to 0.125 oz, inclusive</i>	<i>100</i>	<i>10 000</i>
	<i>equal to or greater than 0.01 lb</i>	<i>500</i>	<i>10 000</i>
	<i>equal to or greater than 0.25 oz</i>	<i>500</i>	<i>10 000</i>
<i>III L³</i>	<i>equal to or greater than 5 lb</i>	<i>2 000</i>	<i>10 000</i>
<i>IIII</i>	<i>greater than 0.01 lb</i>	<i>100</i>	<i>1 200</i>
	<i>greater than 0.25 oz</i>	<i>100</i>	<i>1 200</i>

NOTES for Table 3: Parameters for Accuracy Classes

<p>1. For Class I and II devices equipped with auxiliary reading means (i.e., a rider, a vernier, or a least significant decimal differentiated by size, shape, or color), the value of the verification scale division “e” is the value of the scale division immediately preceding the auxiliary means.</p>
<p>2. A Class III scale marked “For prescription weighing only” may have a verification scale division (e) not less than 0.01 g. (Added 1986) (Amended 2003)</p>
<p>3. The value of a scale division for crane and hopper (other than grain hopper) scales shall be not less than 0.2 kg (0.5 lb). The minimum number of scale divisions shall be not less than 1000.</p>
<p>4. On a multiple range or multi-interval scale, the number of divisions for each range independently shall not exceed the maximum specified for the accuracy class. The number of scale divisions, n, for each weighing range is determined by dividing the scale capacity for each range by the verification scale division, e, for each range. On a scale system with multiple load receiving elements and multiple indications, each element considered shall not independently exceed the maximum specified for the accuracy class. If the system has a summing indicator, the n_{max} for the summed indication shall not exceed the maximum specified for the accuracy class. (Added 1997)</p>
<p>5. The minimum number of scale divisions for a Class III Hopper Scale used for weighing grain shall be 2000.)</p>

[Nonretroactive January 1, 1986]

(Amended 1985,1987, 1997, 1998, 1999, 2003, and 2004)

S.6. Marking Requirements. – (Also see G-S.1. Identification, G-S.4. Interchange or Reversal of Parts, G-S.6. Marking Operational Controls, Indications, and Features, G-S.7. Lettering, G-UR.2.1.1. Visibility of Identification, and UR.3.4.1. Use in Pairs.)

S.6.1. Nominal Capacity; Vehicle and Axle-Load Scales. – *For all vehicle and axle-load scales, the marked nominal capacity shall not exceed the concentrated load capacity (CLC) times the quantity of the number of sections in the scale minus 0.5.*

As a formula, this is stated as: nominal capacity \leq CLC \times (N - 0.5) where N = the number of sections in the scale.

[Nonretroactive as of January 1, 1989]

Note: When the device is used in a combination railway track and vehicle weighing application, the above formula shall apply only to the vehicle scale application.

(Added 1988) (Amended 1999 and 2002)

S.6.2. Location of Marking Information. – Scales that are not permanently attached to an indicating element, and for which the load-receiving element is the only part of the weighing/load-receiving element visible after installation, may have the marking information required in Section 1.10. General Code, G-S.1. Identification and Section 2.20. Scales Code, S.6. Marking Requirements located in an area that is accessible only through the use of a tool; provided that the information is easily accessible (e.g., the information may appear on the junction box under an access plate). The identification information for these scales shall be located on the weighbridge (load-receiving element) near the point where the signal leaves the weighing element or beneath the nearest access cover.

(Added 1989)

S.6.3. Scales, Main Elements, and Components of Scales or Weighing Systems. – Scales, main elements of scales when not contained in a single enclosure for the entire scale, load cells for which Certificates of Conformance (CC) have been issued under the National Type Evaluation Program (NTEP), and other equipment necessary to a weighing system, but having no metrological effect on the weighing system, shall be marked as specified in Table S.6.3.a. Marking Requirements and explained in the accompanying notes in Table S.6.3.b. Notes for Table S.6.3.a.

(Added 1990)

Table S.6.3.a. Marking Requirements - Weighing Equipment

CCR Title 4, Div. 9, CCR §§ 4000., 4001. and 4002.2.
2023 Edition of NIST HB 44 Section 2.20. Scales

To Be Marked With ↓	Weighing, Load-Receiving, and Indicating Element in Same Housing or Covered on the Same CC ¹	Indicating Element not Permanently Attached to Weighing and Load-Receiving Element or Covered by a Separate CC	Weighing and Load-Receiving Element Not Permanently Attached to Indicating Element or Covered by a Separate CC	Load Cell with CC (11)	Other Equipment or Device (10)
Manufacturer's ID (1)	X	X	X	X	X
Model Designation and Prefix (1)	X	X	X	X	X
Serial Number and Prefix(2)	X	X	X	X	X (16)
Certificate of Conformance Number (CC) (23)	X	X	X	X	X (23)
Accuracy Class (17)	X	X (8)	X (19)	X	na
Nominal Capacity(3)(18)(20)	X	X	X	na	na
Value of Scale Division, "d" (3)	X	X	na	na	na
Value of "e" (4)	X	X	na	na	na
Temperature Limits (5)	X	X	X	X	na
Concentrated Load Capacity (CLC) (12)(20)(22)		X	X (9)	na	na
Special Application (13)	X	X	X	na	na
Maximum Number of Scale Divisions (n_{max}) (6)	na	X (8)	X (19)	X	na
Minimum Verification Scale Division (e_{min})	na	na	X (19)	na	na
"S" or "M" (7)	na	na	na	X	na
Direction of Loading (15)	na	na	na	X	na
Minimum Dead Load	na	na	na	X	na
Maximum Capacity	na	na	na	X	na
Minimum and Maximum Speed (25)	na	na	X	na	na
Maximum Speed Change (26)	na	na	X	na	na

To Be Marked With ↓	Weighing, Load-Receiving, and Indicating Element in Same Housing or Covered on the Same CC ¹	Indicating Element not Permanently Attached to Weighing and Load-Receiving Element or Covered by a Separate CC	Weighing and Load-Receiving Element Not Permanently Attached to Indicating Element or Covered by a Separate CC	Load Cell with CC (11)	Other Equipment or Device (10)
Vehicle Direction Restriction (27)	na	na	X	na	na
Safe Load Limit	na	na	na	X	na
Load Cell Verification Interval (V _{min}) (21)	na	na	na	X	na
Section Capacity and Prefix (14)(20)(22)(24)	na	X	X	na	na

Note: For applicable notes, Table S.6.3.b.

¹ Weighing/load-receiving elements and indicators which are in the same housing or which are permanently attached will generally appear on the same CC. If not in the same housing, elements shall be hard-wired together or sealed with a physical seal or an electronic link. This requirement does not apply to peripheral equipment that has no input or effect on device calibrations or configurations.

(Added 1990) (Amended 1992, 1999, 2000, 2001, 2002, 2004, and 2021)

Table S.6.3.b. Notes for Table S.6.3.a. Marking Requirements

1. Manufacturer's identification and model designation and *model designation prefix*.*
[*Nonretroactive as of January 1, 2003]
(Also see G-S.1. Identification.) [*Prefix lettering may be initial capitals, all capitals or all lower case*]
(Amended 2000)
2. *Serial number* [Nonretroactive as of January 1, 1968] and *prefix*
[Nonretroactive as of January 1, 1986]. (Also see G-S.1. Identification.)
3. The device shall be marked with the nominal capacity. *The nominal capacity shall be shown together with the value of the scale division (e.g., 15 × 0.005 kg, 30 × 0.01 lb, or capacity = 15 kg, d = 0.005 kg) in a clear and conspicuous manner and be readily apparent when viewing the reading face of the scale indicator unless already apparent by the design of the device. Each scale division value or weight unit shall be marked on multiple range or multi-interval scales.*
[Nonretroactive as of January 1, 1983]
(Amended 2005)
4. *Required only if different from “d.”*
[Nonretroactive as of January 1, 1986]
5. *Required only on Class III, III L, and IIII devices if the temperature range on the NTEP CC is narrower than and within – 10 °C to 40 °C (14 °F to 104 °F).* [Nonretroactive as of January 1, 1986]
(Amended 1999)
6. *This value may be stated on load cells in units of 1000; e.g., n: 10 is 10 000 divisions.*
[Nonretroactive as of January 1, 1988]
7. *Denotes compliance for single or multiple load cell applications. It is acceptable to use a load cell with the “S” or Single Cell designation in multiple load cell applications as long as all other parameters meet applicable requirements. A load cell with the “M” or Multiple Cell designation can be used only in multiple load cell applications.*
[Nonretroactive as of January 1, 1988]
(Amended 1999)
8. *An indicating element not permanently attached to a weighing element shall be clearly and permanently marked with the accuracy Class of I, II, III, III L, or IIII, as appropriate, and the maximum number of scale divisions, n_{max} , for which the indicator complies with the applicable requirement. Indicating elements that qualify for use in both Class III and III L applications may be marked III/III L and shall be marked with the maximum number of scale divisions for which the device complies with the applicable requirements for each accuracy class.*

[Nonretroactive as of January 1, 1988]

9. *For vehicle and axle-load scales only. The CLC shall be added to the load-receiving element of any such scale not previously marked at the time of modification.*

[Nonretroactive as of January 1, 1989]

(Amended 2002)

10. Necessary to the weighing system but having no metrological effect, e.g., auxiliary remote display, keyboard, etc.

11. *The markings may be either on the load cell or in an accompanying document; except that, if an accompanying document is provided, the serial number shall appear both on the load cell and in the document. [Nonretroactive as of January 1, 1988] The manufacturer's name or trademark, the model designation, and identifying symbols for the model and serial numbers as required by paragraph G-S.1. Identification shall also be marked both on the load cell and in any accompanying document.*

[Nonretroactive as of January 1, 1991]

12. Required on the indicating element *and the load-receiving element* of vehicle and axle-load scales. *Such marking shall be identified as "concentrated load capacity" or by the abbreviation "CLC."**

*[*Nonretroactive as of January 1, 1989]*

(Amended 2002)

13. *A scale designed for a special application rather than general use shall be conspicuously marked with suitable words, visible to the operator and to the customer, restricting its use to that application, e.g., postal scale, prepack scale, weight classifier, etc.** When a scale is installed with an operational counting feature, the scale shall be marked on both the operator and customer sides with the statement "The counting feature is not legal for trade," except when a Class I or Class II prescription scale complies with all Handbook 44 requirements applicable to counting features.

*[*Nonretroactive as of 1986]*

(Amended 1994 and 2003)

14. Required on *livestock** and railway track scales. When marked on vehicle and axle-load scales manufactured before January 1, 1989, it may be used as the CLC. For livestock scales manufactured between January 1, 1989, and January 1, 2003, required markings may be either CLC or section capacity.

*[*Nonretroactive as of January 1, 2003]*

(Amended 2002)

15. *Required if the direction of loading the load cell is not obvious.*

[Nonretroactive as of January 1, 1988]

16. *Serial number [Nonretroactive as of January 1, 1968] and prefix [Nonretroactive as of January 1, 1986]. (Also see G-S.1. Identification.)* Modules without "intelligence" on a

modular system (e.g., printer, keyboard module, cash drawer, and secondary display in a point-of-sale system) are not required to have serial numbers.

17. *The accuracy class of a device shall be marked on the device with the appropriate designation as I, II, III, III L, or IIII.*

[Nonretroactive as of January 1, 1986]

18. The nominal capacity shall be conspicuously marked as follows:

- (a) on any scale equipped with unit weights or weight ranges;
- (b) on any scale with which counterpoise or equal-arm weights are intended to be used;
- (c) on any automatic-indicating or recording scale so constructed that the capacity of the indicating or recording element, or elements, is not immediately apparent;
- (d) on any scale with a nominal capacity less than the sum of the reading elements; and
- (e) *on the load-receiving element (weighbridge) of vehicle, axle-load, and livestock scales.**

*[*Nonretroactive as of January 1, 1989]*

(Amended 1992)

19. *For weighing and load-receiving elements not permanently attached to indicating element or covered by a separate CC.*

[Nonretroactive as of January 1, 1988]

(Amended 1992)

20. *Combination vehicle/railway track scales must be marked with both the nominal capacity and CLC for vehicle weighing and the nominal capacity and section capacity for railway weighing. All other requirements relating to these markings will apply.*

[Nonretroactive as of January 1, 2000]

(Added 1999)

21. *The value of the load cell verification interval (v_{min}) must be stated in mass units. In addition to this information, a device may be marked with supplemental representations of v_{min} .*

[Nonretroactive as of January 1, 2001]

(Added 1999)

22. *Combination vehicle/livestock scales must be marked with both the CLC for vehicle weighing and the section capacity for livestock weighing. All other requirements relative to these markings will apply.*

[Nonretroactive as of January 1, 2003]

(Added 2002) (Amended 2003)

Note: *The marked section capacity for livestock weighing may be less than the marked CLC for vehicle weighing.*

(Amended 2003)

23. *Required only if a CC has been issued for the device or equipment.*

[Nonretroactive as of January 1, 2003]

(G-S.1. Identification (e) Added 2001)

24. *The section capacity shall be prefaced by the words “Section Capacity” or an abbreviation of that term. Abbreviations shall be “Sec Cap” or “Sec C.” All capital letters and periods may be used.*

[Nonretroactive as of January 1, 2005]

(Added 2004)

25. Weigh-in-motion vehicle scales must be marked with minimum and maximum vehicle speed limitations.

(Added 2021)

26. Weigh-in-motion vehicle scales must be marked with the maximum vehicle speed change allowed during the weighment.

(Added 2021)

27. Weigh-in-motion vehicle scales must be marked as “uni-directional” if the travel direction is restricted.

(Added 2021)

S.6.4. Railway Track Scales. – A railway track scale shall be marked with the maximum capacity of each section of the load-receiving element of the scale. Such marking shall be accurately and conspicuously presented on, or adjacent to, the identification or nomenclature plate that is attached to the indicating element of the scale. The nominal capacity marking shall satisfy the following:

(a) For scales manufactured from January 1, 2002, through December 31, 2013:

(1) the nominal capacity of a scale with more than two sections shall not exceed twice its rated section capacity; and

(2) the nominal capacity of a two-section scale shall not exceed its rated section capacity.

(b) For scales manufactured on or after January 1, 2014, the nominal scale capacity shall not exceed the lesser of:

(1) the sum of the Weigh Module Capacities as shown in Table S.6.4.M. and Table S.6.4.; or

(2) the Rated Section Capacity (RSC) multiplied by the Number of Sections (Ns) minus the Number of Dead Spaces (Nd) minus 0.5. As a formula this is stated as:

$$RSC \times (Ns - Nd - 0.5); \text{ or}$$

(3) 290 300 kg (640 000 lb).

(Amended 1988, 2001, 2002, and 2013)

Table S.6.4.M. - Railway Track Scale – Weigh Module Capacity

Weigh Module Length (meters)	Weigh Module Capacity (kilograms)
< 1.5	36 300
1.5 to < 3.0	72 600
3.0 to < 4.5	108 900
4.5 to < 7.0	145 100
7.0 to < 9.0	168 700
9.0 to < 10.5	192 300
10.5 to < 12.0	234 100
12.0 to < 17.0	257 600

Note for Table S.6.4.M.: The capacity of a particular module is based on its length as shown above. To determine the “sum of the weigh module capacities” referenced in paragraph S.6.4.(b)(1): (1) determine the length of each individual weigh module in the scale; (2) find its corresponding “weigh module capacity” in the table above; and (3) add all of the individual weigh module capacities.”

(Table Added 2013)

Table S.6.4. Railway Track Scale – Weigh Module Capacity

Weigh Module Length (feet)	Weigh Module Capacity (pounds)
< 5	80 000
5 to < 10	160 000
10 to < 15	240 000
15 to < 23	320 000
23 to < 29	372 000
29 to < 35	424 000
35 to < 40	516 000
40 to < 56	568 000

(Table Added 2013)

Note for Table S.6.4.: The capacity of a particular module is based on its length as shown above. To determine the “sum of the weigh module capacities” referenced in paragraph S.6.4.(b)(1): (1) determine the length of each individual weigh module in the scale; (2) find its corresponding “weigh module capacity” in the table above; and (3) add all of the individual weigh module capacities.”

S.6.5. Livestock Scales. – A livestock scale manufactured prior to January 1, 1989, or after January 1, 2003, shall be marked with the maximum capacity of each section of the load-receiving element of the scale. Livestock scales manufactured between January 1, 1989, and January 1, 2003, shall be marked with either the Concentrated Load Capacity (CLC) or the Section Capacity. Such marking shall be accurately and conspicuously presented on, or adjacent to the identification or nomenclature plate that is attached to the indicating element of the scale. *The nominal capacity of a scale with more than two sections shall not exceed twice its rated section capacity. The nominal capacity of a two-section scale shall not exceed its rated section capacity.**

[*Nonretroactive as of January 1, 2003]

(Added 2002)

Also see Note 14 in Table S.6.3.b. Notes for Table S.6.3.a.

S.6.6. Counting Feature, Minimum Individual Piece Weight, and Minimum Sample Piece Count. – A Class I or Class II prescription scale with an operational counting feature shall be marked with the minimum individual piece weight and minimum number of pieces used in the sample to establish an individual piece weight.

(Added 2003)

N. Notes

N.1. Test Procedures.

N.1.1. Increasing-Load Test. – The increasing-load test shall be conducted on all scales with the test loads approximately centered on the load-receiving element of the scale, except on a scale having a nominal capacity greater than the total available known test load. When the total test load is less than the nominal capacity, the test load is used to greatest advantage by concentrating it, within prescribed load limits, over the main load supports of the scale.

N.1.2. Decreasing-Load Test (Automatic Indicating Scales). – The decreasing-load test shall be conducted with the test load approximately centered on the load-receiving element of the scale.

N.1.2.1. Scales Marked I, II, III, or IIII. – Except for portable wheel load weighers, decreasing-load tests shall be conducted on scales marked I, II, III or IIII and with “n” equal to or greater than 1000 with test loads equal to the maximum test load at each tolerance value. For example, on a Class III scale, at test loads equal to 4000 d, 2000 d, and 500 d; for scales with n less than 1000, the test load shall be equal to

one-half of the maximum load applied in the increasing-load test. (Also see Table 6. Maintenance Tolerances.)

(Amended 1998)

N.1.2.2. All Other Scales. – On all other scales, except for portable wheel load weighers, the decreasing-load test shall be conducted with a test load equal to one-half of the maximum load applied in the increasing-load test.

(Amended 1998)

N.1.3. Shift Test.

N.1.3.1. Dairy-Product Test Scales. – A shift test shall be conducted with a test load of 18 g successively positioned at all points on which a weight might reasonably be placed in the course of normal use of the scale. the front, left, back, and right edges of each pan as shown in the diagrams below. An equal test load shall be centered on the other pan.

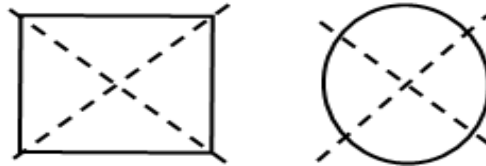


Figure 3 - Image of square and round pans for conducting a shift test.

N.1.3.2. Equal-Arm Scales. – A shift test shall be conducted with a half-capacity test load centered successively at four points positioned equidistance between the center and the front, left, back, and right edges of each pan as shown in the diagrams below. An equal test load shall be centered on the other pan.

N.1.3.3. Vehicle Scales, Axle-Load Scales, and Livestock Scales.

N.1.3.3.1. Vehicle Scales, Axle-Load Scales, and Combination Vehicle/Livestock Scales.

(a) **Minimum Shift Test.** – At least one shift test shall be conducted with a minimum test load of 12.5 % of scale capacity, which may be performed anywhere on the load-receiving element using the prescribed test patterns and maximum test loads specified below. (Combination Vehicle/Livestock Scales shall also be tested consistent with N.1.3.3.2. Prescribed Test Pattern and Test Loads for Livestock Scales with More Than Two Sections and Combination Vehicle/Livestock Scales.)

(Amended 1991, 2000, and 2003)

(b) **Prescribed Test Pattern and Loading for Vehicle Scales, Axle-Load Scales, and Combination Vehicle/Livestock Scales.** – The normal prescribed test pattern shall be an area of 1.2 m (4 ft) in length and 3.0 m

(10 ft) in width or the width of the scale platform, whichever is less. Multiple test patterns may be utilized when loaded in accordance with paragraph (c), (d), or (e) as applicable. An example of a possible test pattern is shown in the diagram below.

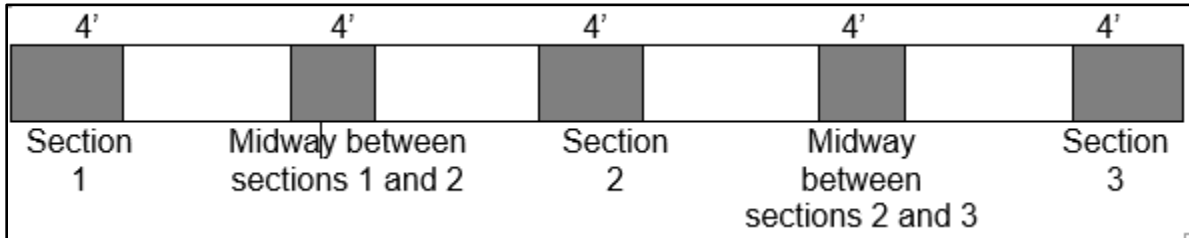


Figure 4 - Image of Test Patterns on a Vehicle of Combinations Vehicle/Livestock Scale.

(Amended 1997, 2001, and 2003)

(c) Loading Precautions for Vehicle Scales, Axle-Load Scales, and Combination Vehicle/Livestock Scales. – When loading the scale for testing, one side of the test pattern shall be loaded to no more than half of the concentrated load capacity or test load before loading the other side. The area covered by the test load may be less than 1.2 m (4 ft) × 3.0 m (10 ft) or the width of the scale platform, whichever is less; for test patterns less than 1.2 m (4 ft) in length the maximum loading shall meet the formula: [(wheel base of test cart or length of test load divided by 48 in) × 0.9 × CLC]. The maximum test load applied to each test pattern shall not exceed the concentrated load capacity of the scale. When the test pattern exceeds 1.2 m (4 ft), the maximum test load applied shall not exceed the concentrated load capacity times the largest “r” factor in Table UR.3.2.1. Span Maximum Load for the length of the area covered by the test load. For load-receiving elements installed prior to January 1, 1989, the rated section capacity may be substituted for concentrated load capacity to determine maximum loading. An example of a possible test pattern is shown above.

(Amended 1997 and 2003)

(d) Multiple Pattern Loading. – To test to the nominal capacity, multiple patterns may be simultaneously loaded in a manner consistent with the method of use.

(e) Other Designs. – Special design scales and those that are wider than 3.7 m (12 ft) shall be tested in a manner consistent with the method of use but following the principles described above.

(Amended 1988, 1991, 1997, 2000, 2001, and 2003)

(Amended 2003)

N.1.3.3.2. Prescribed Test Pattern and Test Loads for Livestock Scales with More Than Two Sections and Combination Vehicle/Livestock Scales. – A minimum test load of 5 000 kg (10 000 lb) or one-half of the rated section capacity,

whichever is less, shall be placed, as nearly as possible, successively over each main load support as shown in the diagram below. For livestock scales manufactured between January 1, 1989, and January 1, 2003, the required loading shall be no greater than one-half CLC.

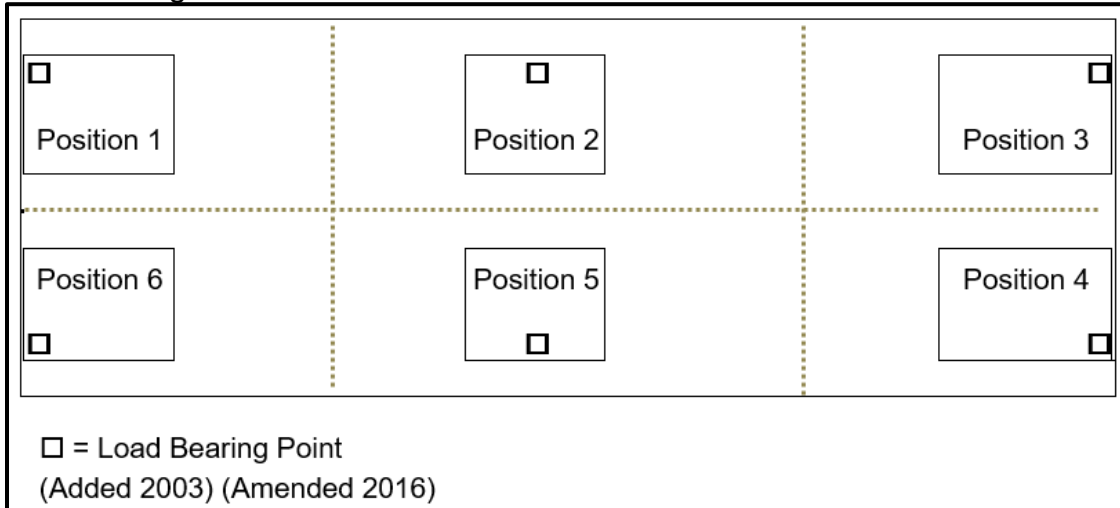


Figure 5 - Prescribed Test Pattern and Test Loads for Livestock Scales with More Than Two Sections and Combination Vehicle/Livestock Scales

N.1.3.3.3. Prescribed Test Patterns and Test Loads for Two-Section Livestock Scales. – A shift test shall be conducted using the following prescribed test loads and test patterns: 1) When a single field standard weight is used, the prescribed test load shall be applied centrally in the prescribed test pattern; or 2) When multiple field standard weights are used as the prescribed test load, the load shall be applied in a consistent pattern in the shift test positions throughout the test and applied in a manner that does not concentrate the load in a test pattern that is less than when the same load is a single field standard weights on the load-receiving element.

The shift test load shall not exceed one-half the rated section capacity or one-half the rated concentrated load capacity whichever is applicable, using either:

- (a) A one-half nominal capacity test load centered as nearly as possible, successively at the center of each quarter of the load-receiving element as shown in N.1.3.7. All Other Scales Except Crane Scales, Hanging Scales, Hopper Scales, Wheel-Load Weighers, and Portable Axle-Load Weighers Figure 1; or
- (b) A one-quarter nominal capacity test load centered as nearly as possible, successively over each main load support as shown in N.1.3.7. All Other Scales Except Crane Scales, Hanging Scales, Hopper Scales, Wheel-Load Weighers, and Portable Axle-Load Weighers Figure 2.

(Added 2007) (Amended 2016)

N.1.3.4. Railway Track Scales Weighing Individual Cars in Single Drafts. – A shift test shall be conducted with at least two different test loads, if available, distributed over, to the right and left of, each pair of main levers or other weighing elements supporting each section of the scale.

N.1.3.5. Monorail Scales, Static Test. – A shift test shall be conducted with a test load equal to the largest load that can be anticipated to be weighed in a given installation, but never less than one-half scale capacity. The load shall be placed successively on the right end, the left end, and the center of the live rail.

(Added 1985)

N.1.3.5.1. Dynamic Monorail Weighing Systems. – Dynamic tests with livestock carcasses or portions of carcasses shall be conducted during normal plant production. No less than 20 test loads using carcasses or portions of carcasses of the type normally weighed shall be used in the dynamic test. If the plant conveyor chain does not space or prevent the carcasses or portions of carcasses from touching one another, dynamic tests shall not be conducted until this condition has been corrected.

All carcasses or portions of carcasses shall be individually weighed statically on either the same scale being tested dynamically or another monorail scale with the same or smaller divisions and in close proximity. (The scale selected for static weighing of the carcasses or portions of carcasses shall first be tested statically with certified test weights that have been properly protected from the harsh environment of the packing plant to ensure they maintain accuracy.)

If the scale being tested is used for weighing freshly slaughtered animals (often referred to as a “hot scale”), care must be taken to get a static weighment as quickly as possible before or following the dynamic weighment to avoid loss due to shrink. If multiple dynamic tests are conducted using the same carcasses or portions of carcasses, static weights shall be obtained before and after multiple dynamic tests. If the carcass or portion of a carcass changes weight between static tests, the amount of weight change shall be taken into account, or the carcass or portion of a carcass shall be disregarded for tolerance purposes.

Note: For a dynamic monorail test, the reference scale shall comply with the principles in the Fundamental Considerations paragraph 3.2. Tolerances for Standards.

(Added 1996) (Amended 1999 and 2007)

N.1.3.6. Vehicle On-Board Weighing Systems. – The shift test for a vehicle on-board weighing system shall be conducted in a manner consistent with its normal use. For systems that weigh as part of the lifting cycle, the center of gravity of the load may be shifted in the vertical direction as well as from side to side. In other cases, the center of gravity may be moved to the extremes of the load-receiving element using loads of a magnitude that reflect normal use (i.e., the load for the shift test may exceed one-half scale capacity), and may, in some cases, be equal to the capacity of the scale. The

shift test may be conducted when the weighing system is out of level to the extent that the weighing system remains operational.

(Added 1992)

N.1.3.7. All Other Scales Except Crane Scales, Hanging Scales, Hopper Scales, Wheel-Load Weighers, and Portable Axle-Load Weighers. – A shift test shall be conducted using the following prescribed test loads and test patterns. A single field standard weight used as the prescribed test load shall be applied centrally in the prescribed test pattern. When multiple field standard weights are used as the prescribed test load, the load shall be applied in a consistent pattern in the shift test positions throughout the test and applied in a manner that does not concentrate the load in a test pattern that is less than when that same load is a single field standard weight on the load-receiving element.

- (a) For scales with a nominal capacity of 500 kg (1000 lb) or less, a shift test shall be conducted using a one-third nominal capacity test load (defined as test weights in amounts of at least 30 % of scale capacity, but not to exceed 35 % of scale capacity) centered as nearly as possible at the center of each quadrant of the load-receiving element using the prescribed test pattern as shown in Figure 1.
- (b) For scales with a nominal capacity greater than 500 kg (1000 lb), a shift test may be conducted by either using a one-third nominal capacity test load (defined as test weights in amounts of at least 30 % of scale capacity, but not to exceed 35 % of scale capacity) centered as nearly as possible at the center of each quadrant of the load-receiving element using the prescribed test pattern as shown in Figure 1, or by using a one-quarter nominal capacity test load centered as nearly as possible, successively, over each corner of the load-receiving element using the prescribed test pattern as shown in Figure 2.

N.1.4. Sensitivity Test. – A sensitivity test shall be conducted on nonautomatic-indicating (weighbeam) scales only, with the weighing device in equilibrium at zero-load and at maximum test load.

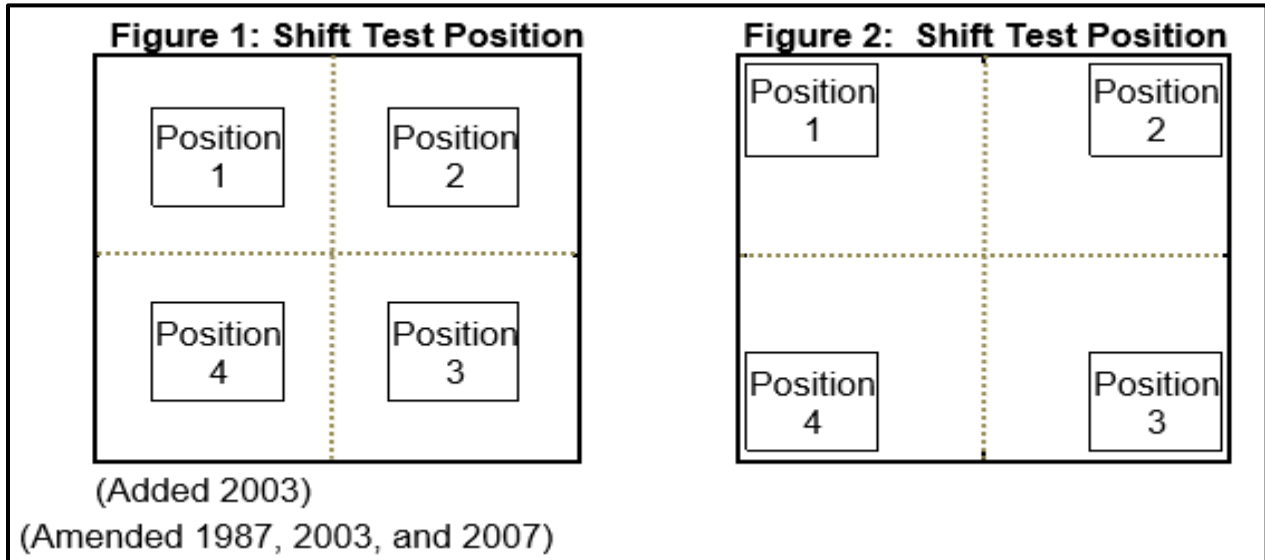


Figure 6 - Image of Shift Test Positions in Paragraph N.1.3.7.

The test shall be conducted by increasing or decreasing the test load in an amount equal to the applicable value specified in T.2. Sensitivity Requirement (SR) or T.N.6. Sensitivity.

N.1.5. Discrimination Test. – *Except for digital electronic scales designated Accuracy Class I or II in which the value of $e = d$ and is less than 5 mg, a discrimination test shall be conducted on all automatic indicating scales with the weighing device in equilibrium at or near zero load and at or near maximum test load, and under controlled conditions in which environmental factors are reduced to the extent that they will not affect the results obtained. For scales equipped with an Automatic Zero-Tracking Mechanism (AZT), the discrimination test may be conducted at a range outside of the AZT range.*

[Nonretroactive as of January 1, 1986]

(Added 1985) (Amended 2004 and 2021)

N.1.5.1. Digital Device. – On a digital device, this test is conducted from just below the lower edge of the zone of uncertainty for increasing load tests, or from just above the upper edge of the zone of uncertainty for decreasing-load tests.

N.1.6. RFI Susceptibility Tests, Field Evaluation. – An RFI test shall be conducted at a given installation when the presence of RFI has been verified and characterized if those conditions are considered “usual and customary.”

(Added 1986)

N.1.7. Ratio Test. – A ratio test shall be conducted on all scales employing counterpoise weights and on nonautomatic-indicating equal-arm scales.

N.1.8. Material Tests. – A material test shall be conducted on all customer-operated bulk weighing systems for recycled materials using bulk material for which the device is used. Insert into the device, in a normal manner, several accurately pre-weighed samples (free of foreign material) in varying amounts approximating average drafts.

N.1.9. Zero-Load Balance Change. – A zero-load balance change test shall be conducted on all scales after the removal of any test load. The zero-load balance should not change by more than the minimum tolerance applicable. (Also see G-UR.4.2. Abnormal Performance.)

N.1.10. Counting Feature Test. – A test of the counting function shall be conducted on all Class I and Class II prescription scales having an active counting feature used in “legal for trade” applications. The test should verify that the scale will not accept a sample with less than either the minimum sample piece count or the minimum sample weight of 30 e. Counting feature accuracy should be verified at a minimum of two test loads. Verification of the count calculations shall be based upon the weight indication of the test load.

Note:

- (1) The minimum sample weight is equal to the marked minimum individual piece weight times the marked minimum sample piece count.
- (2) Test load as used in this section refers to actual calibration test weights selected from an appropriate test weight class.

(Added 2003)

N.1.11. Substitution Test. – In the substitution test procedure, material or objects are substituted for known test weights, or a combination of known test weights and previously quantified material or objects, using the scale under test as a comparator. Additional test weights or other known test loads may be added to the known test load to evaluate higher weight ranges on the scale.

(Added 2003)

N.1.12. Strain-Load Test. – In the strain-load test procedure, an unknown quantity of material or objects are used to establish a reference load or tare to which test weights or substitution test loads are added.

(Added 2003)

N.2. Verification (Testing) Standards. – Field standard weights used in verifying weighing devices shall comply with requirements of NIST Handbook 105-Series standards (or other suitable and designated standards) or the tolerances expressed in Fundamental Considerations, paragraph 3.2. (i.e., one-third of the smallest tolerance applied).

(Amended 1986)

N.3. Minimum Test Weights and Test Loads.(Entire) [NOT ADOPTED - CCR § 4001. Exceptions.]

N.4. Coupled-in-Motion Railroad Weighing Systems.²

N.4.1. Weighing Systems Used to Weigh Trains of Less Than Ten Cars. – These weighing systems shall be tested using a consecutive-car test train consisting of the number of cars weighed in the normal operation run over the weighing system a minimum of five times in each mode of operation following the final calibration.

(Added 1990) (Amended 1992)

N.4.2. Weighing Systems Placed in Service Prior to January 1, 1991, and Used to Weigh Trains of Ten or More Cars. – The minimum test train shall be a consecutive-car test train of no less than ten cars run over the scale a minimum of five times in each mode of operation following final calibration.

(Added 1990) (Amended 1992)

N.4.3. Weighing Systems Placed in Service on or After January 1, 1991, and Used to Weigh Trains of Ten or More Cars.

- (a) These weighing systems shall be tested using a consecutive-car test train of no less than ten cars run over the scale a minimum of five times in each mode of operation following final calibration; or
- (b) if the official with statutory authority determines it necessary, the As-Used Test Procedures outlined in N.4.3.1. shall be used.

(Added 1990) (Amended 1992)

N.4.3.1. As-Used Test Procedures. – A weighing system shall be tested in a manner that represents the normal method of operation and length(s) of trains normally weighed. The weighing systems may be tested using either a:

- (a) consecutive-car test train of a length typical of train(s) normally weighed; or
- (b) distributed-car test train of a length typical of train(s) normally weighed.

However, a consecutive-car test train of a shorter length may be used, provided that initial verification test results for the shorter consecutive-car test train agree with the test results for the distributed-car or full-length consecutive-car test train as specified in N.4.3.1.1. Initial Verification.

The official with statutory authority shall be responsible for determining the minimum test train length to be used on subsequent tests.

(Added 1990) (Amended 1992)

² A test weight car that is representative of one of the types of cars typically weighed on the scale under test may be used wherever reference weight cars are specified.

(Added 1991)

N.4.3.1.1. Initial Verification. – Initial verification tests should be performed on any new weighing system and whenever either the track structure or the operating procedure changes. If a consecutive-car test train of length shorter than trains normally weighed is to be used for subsequent verification, the shorter consecutive-car test train results shall be compared either to a distributed-car or to a consecutive-car test train of length(s) typical of train(s) normally weighed.

The difference between the total train weight of the train(s) representing the normal method of operation and the weight of the shorter consecutive-car test train shall not exceed 0.15 %. If the difference in test results exceeds 0.15 %, the length of the shorter consecutive-car test train shall be increased until agreement within 0.15 % is achieved. Any adjustments to the weighing system based upon the use of a shorter consecutive-car test train shall be offset to correct the bias that was observed between the full-length train test and the shorter consecutive-car test train.

(Added 1990) (Amended 1992 and 1993)

N.4.3.1.2. Subsequent Verification. – The test train may consist of either a consecutive-car test train with a length not less than that used in initial verification, or a distributed-car test train representing the number of cars used in the normal operation.

(Added 1990)

N.4.3.1.3. Distributed-Car Test Trains.

(a) The length of the train shall be typical of trains that are normally weighed.

(b) The reference weight cars shall be split into three groups, each group consisting of ten cars or 10 % of the train length, whichever is less.

(Amended 1991)

(c) The test groups shall be placed near the front, around the middle, and near the end of the train.

(d) Following the final adjustment, the distributed-car test train shall be run over the scale at least three times or shall produce 50 weight values, whichever is greater.

(e) The weighing system shall be tested in each mode of operation.

(Added 1990) (Amended 1992)

N.4.3.1.4. Consecutive-Car Test Trains.

(a) A consecutive-car test train shall consist of at least ten cars.

(b) If the consecutive-car test train consists of between ten and twenty cars, inclusive, it shall be run over the scale a minimum of five times in each mode of operation following the final calibration.

- (c) If the consecutive-car test train consists of more than twenty cars, it shall be run over the scale a minimum of three times in each mode of operation.

(Added 1990) (Amended 1992)

N.5. Uncoupled-in-Motion Railroad Weighing System. – An uncoupled-in-motion scale shall be tested statically before being tested in motion by passing railroad reference weight cars over the scale. When an uncoupled-in-motion railroad weighing system is tested, the car speed and the direction of travel shall be the same as when the scale is in normal use. The minimum in-motion test shall be three reference weight cars passed over the scale three times. The cars shall be selected to cover the range of weights that are normally weighed on the system and to reflect the types of cars normally weighed.

(Added 1993)

N.6. Nominal Capacity of Prescription Scales. – The nominal capacity of a prescription scale shall be assumed to be one-half apothecary ounce, unless otherwise marked. (Applicable only to scales not marked with an accuracy class.)

N.7. Weigh-in-Motion Vehicle Scales Test Procedures.

N.7.1. Reference Scale. – A static scale as approved by the local jurisdiction shall be used to establish the weight of reference vehicles used in this procedure.

N.7.1.1. Dimension. – The reference scale shall be of such dimension and spacing as to weigh reference vehicles in a single draft.

N.7.1.2. Location. – The reference scale should be located near the weigh-in-motion vehicle scale to minimize the effect of vehicle fuel consumption. The reference scale and the weigh-in-motion vehicle scale may be the same scale.

N.7.1.3. Timing. – The reference scale shall be tested immediately prior to using it to establish reference vehicle weights. A subsequent test of the reference scale may be performed immediately following the establishment of the reference vehicle weights to ensure its repeatability.

N.7.1.4. Qualification. – The reference scale shall comply with the principles in Appendix A, Fundamental Considerations, Paragraph 3.2. Tolerances for Standards.

N.7.2. Reference Vehicle. – One or more reference vehicles shall be used to provide varying weight conditions for testing. Reference vehicles should be representative of vehicles that are customarily weighed on the weigh-in-motion vehicle scale during normal operation. A motorized field standard weight cart with tests weights and a driver may be used as an additional reference vehicle.

N.7.2.1. Weight Conditions. – Reference vehicle(s) shall be selected to provide at least a high and a low weight condition. Different types of vehicles may be used.

N.7.2.2. Load Position. – Loads on the reference vehicle should be positioned equally side-to-side.

N.7.2.3. Static Weight. – Reference vehicle(s) shall be statically weighed on a reference scale as defined in N.7.1 Reference Scale immediately before being used to conduct the weigh-in-motion vehicle scale tests.

N.7.2.3.1. Rounding. – Error weights may be added to the reference vehicle to increase its weight to a whole scale division to minimize rounding errors.

N.7.2.3.2. Re-Weighing. – Reference vehicles may be re-weighed at the discretion of the testing authority.

N.7.3. Test Speeds. – The speed of the reference vehicle shall be maintained within the parameters as specified by the manufacturer during each test (see also paragraphs S.1.14.1.(a) Identification of a Fault, Vehicle Speed and S.1.14.1.(b) Identification of a Fault, Change in Vehicle Speed).

N.7.3.1. Range. – Various speeds of the reference vehicle shall be used between the minimum and maximum operating speeds specified for the weigh-in-motion vehicle scale. The minimum speed capability of the reference vehicle may be used as the minimum speed.

N.7.4. Static Tests for Weigh-in-Motion Vehicle Scales. – The weigh-in-motion vehicle scale shall comply with applicable vehicle scale tests defined in N.1. Test Procedures when tested statically.

N.7.5. Dynamic Tests for Weigh-in-Motion Vehicle Scales. – Test procedures shall simulate the normal intended use as closely as possible (i.e., test as used).

N.7.5.1. Vehicles. – The tests shall be performed using the reference vehicle(s) defined in N.7.2. Reference Vehicle.

N.7.5.2. Weighments. – Each reference vehicle shall have a minimum of five weighments at the speeds defined in N.7.3. Test Speeds.

N.7.5.3. Vehicle Position. – Reference vehicle(s) must stay within the defined roadway along the load-receiving element (see also S.1.14.1.(e) Identification of a Fault, Vehicle Path of Travel).

N.7.5.4. Travel Directions. – The tests shall be performed in both directions of travel unless travel direction is restricted by the marking.

N.7.5.5. Results. – At the conclusion of the weigh-in-motion tests, there shall be a minimum of 10 total weight readings for the reference vehicle(s) for each applicable

direction of travel. The tolerance for each weight reading shall be based on the gross vehicle weight and the applicable tolerance values for Class III L.

(Added 2021)

T. Tolerances Applicable to Devices not Marked I, II, III, III L, or IIII

T.1. Tolerance Values.

T.1.1. General. – The tolerances applicable to devices not marked with an accuracy class shall have the tolerances applied as specified in Table T.1.1. Tolerances for Unmarked Scales.

(Amended 1990)

T.1.2. Postal and Parcel Post Scales. – The tolerances for postal and parcel post scales are given in Table T.1.1. Tolerances for Unmarked Scales and Table 5. Maintenance and Acceptance Tolerances for Unmarked Postal and Parcel Post Scales.

(Amended 1990)

Table T.1.1. Tolerances for Unmarked Scales

Type of Device	Sub-category	Minimum Tolerance	Acceptance Tolerance	Maintenance Tolerance	Decreasing-Load Multiplier ¹	Other Applicable Requirements
Vehicle, axle-load, livestock, railway track (weighing statically), crane, and hopper (other than grain hopper)		Class III L, T.N.3.1 (Table 6) and T.N.3.2.			1.0	T.N.2., T.N.3., T.N.4.1., T.N.4.2., T.N.4.3., T.N.4.4., T.N.5., T.N.7.2., T.N.8.1.4.4, T.N.9.
Grain test scales	n ≤ 10 000 n > 10 000	Class III, T.N.3.1. (Table 6) and T.N.3.2. Class II, T.N.3.1. (Table 6) and T.N.3.2.			1.0	T.N.8.1.4.4, T.N.9.
Railway track scales weighing in motion		T.N.3.6. except that for T.N.3.6.2. (a), no single error shall exceed four times the maintenance tolerance.			1.0	T.N.8.1.4.4, T.N.9.
Monorail scales, in-motion		T.N.3.8.			1.0	T.N.8.1.4.4, T.N.9.
Customer-operated bulk-weighing systems for recycled materials		± 5 % of applied material test load. Average error on 10 or more test loads ≤ 2.5 %.			1.0	T.N.8.1.4.4, T.N.9.
Wheel-load weighers and portable axle-load scales	Tested individually or in pairs ²	0.5 d or 50 lb, whichever is greater	1 % of test load	2 % of test load	1.5 ³	T.N.8.1.4.4, T.N.9.
Prescription scales		0.1 grain (6 mg)	0.1 % of test load	0.1 % of test load	1.5	T.N.8.1.4.4, T.N.9.
Jewelers' scales	Graduated	0.5 d	0.05 % of test load	0.05 % of test load	1.5	T.N.8.1.4.4 ⁴ , T.N.9.
Jewelers' scales	Ungraduated	Sensitivity or smallest weight, whichever is less	0.05 % of test load	0.05 % of test load	1.5	T.N.8.1.4.4, T.N.9.

Table T.1.1. Tolerances for Unmarked Scales

Type of Device	Sub-category	Minimum Tolerance	Acceptance Tolerance	Maintenance Tolerance	Decreasing-Load Multiplier ¹	Other Applicable Requirements
Dairy-product test scale	Loads < 18 g 18 g load	0.2 grain 0.2 grain	0.2 grain 0.3 grain	0.2 grain 0.5 grain	1.5	<i>T.N.8.1.4.4</i> , T.N.9.
Postal and parcel post scales designed/used to weigh loads < 2 lb	Loads < 2 lb	15 grain, 1 g, ¹ / ₃₂ oz, 0.03 oz, or 0.002 lb	15 grain, 1 g, ¹ / ₃₂ oz, 0.03 oz, or 0.002 lb	15 grain, 1 g, ¹ / ₃₂ oz, 0.03 oz, or 0.002 lb	1.5	<i>T.N.8.1.4.4</i> , T.N.9.
Postal and parcel post scales designed/used to weigh loads < 2 lb	Loads ≤ 2 lb	Table 5	Table 5	Table 5	1.5	<i>T.N.8.1.4.4</i> , T.N.9.
Other postal and parcel post scales		Table 5	Table 5	Table 5	1.5	<i>T.N.8.1.4.4</i> , T.N.9.
All other scales (including grain hopper)	n > 5000	0.5 d or 0.05 % of scale capacity, whichever is less	0.05 % of test load	0.1 % of test load	1.5	T.N.2.5., T.N.4.1., T.N.4.2., T.N.4.3., T.N.5., T.N.7.2., <i>T.N.8.1.4.4</i> , T.N.9.
All other scales (including grain hopper)	n ≤ 5000	Class III, T.N.3.1., Table 6 and T.N.3.2.			1.0	T.N.2., T.N.3., T.N.4.1., T.N.4.2., T.N.4.3., T.N.5., T.N.7.2., <i>T.N.8.1.4.4</i> , T.N.9.
¹ The decreasing load test applies only to automatic indicating scales.			³ The decreasing load test does not apply to portable wheel load weighers.			
² If marked and tested as a pair, the tolerance shall be applied to the sum of the indication.			⁴ <i>T.N.8.1.4. Operating Temperature. is nonretroactive and effective for unmarked devices manufactured as of January 1, 1981.</i>			

(Table Added 1990) (Amended 1992, 1993, and 2012)

Table 5. Maintenance and Acceptance Tolerances for Unmarked Postal and Parcel Post Scales

Scale Capacity (lb)	Test Loads (lb)	Maintenance Tolerance (±)		Acceptance Tolerance (±)	
		(oz)	(lb)	(oz)	(lb)
0 to 4*	0 to 1	1/32	0.002	1/32	0.002
0 to 4*	> 1	1/8	0.008	1/16	0.004
> 4*	0 to 7	3/16	0.012	3/16	0.012
over 4*	> 7 to 24	3/8	0.024	3/16	0.012
over 4*	> 24 to 30	1/2	0.030	1/4	0.015
over 4*	> 30	0.1 % of Test Load		0.05 % of Test Load	

*Also see Table T.1.1. Tolerances for Unmarked Scales for scales designed and/or used to weigh loads less than 2 lb.

T.2. Sensitivity Requirement (SR).

T.2.1. Application. – The sensitivity requirement (SR) is applicable to all nonautomatic-indicating scales not marked I, II, III, III L, or IIII, and is the same whether acceptance or maintenance tolerances apply.

T.2.2. General. – Except for scales specified in paragraphs T.2.3. Prescription Scales through T.2.8. Railway Track Scales: 2 d, 0.2 % of the scale capacity, or 40 lb, whichever is least.

T.2.3. Prescription Scales. 6 mg (0.1 grain).

T.2.4. Jewelers' Scales.

T.2.4.1. With One-Half Ounce Capacity or Less. – 6 mg (0.1 grain).

T.2.4.2. With More Than One-Half Ounce Capacity. – 1 d or 0.05 % of the scale capacity, whichever is less.

T.2.5. Dairy-Product Test Scales.

T.2.5.1. Used in Determining Butterfat Content. – 32 mg (0.5 grain).

T.2.5.2. Used in Determining Moisture Content. – 19 mg (0.3 grain).

T.2.6. Grain Test Scales. – The sensitivity shall be as stated in T.N.6. Sensitivity. (Amended 1987)

T.2.7. Vehicle, Axle-Load, Livestock, and Animal Scales.

T.2.7.1. Equipped With Balance Indicators. – 1 d.

T.2.7.2. Not Equipped With Balance Indicators. – 2 d or 0.2 % of the scale capacity, whichever is less.

CCR § 4002.2. Scales (2.20.) (c) Livestock Scales Not Equipped With Balance Indicator. The Sensitivity Requirement for livestock scales not equipped with a balance indicator shall be 10 pounds, notwithstanding the requirements of Handbook 44, Section 2.20. Scales, T.2.7.2.

(Adopted, 4 CCR 4002.2.)

T.2.8. Railway Track Scales. – 3 d or 100 lb, whichever is less.

T.3. Sensitivity Requirement, Equilibrium Change Required. – The minimum change in equilibrium with test loads equal to the values specified in T.2. Sensitivity Requirements (SR) shall be as follows:

- (a) **Scale with a Trig Loop but without a Balance Indicator.** – The position of rest of the weighbeam shall change from the center of the trig loop to the top or bottom, as the case may be.
- (b) **Scale with a Single Balance Indicator and Having a Nominal Capacity of Less Than 250 kg (500 lb).** – The position of rest of the indicator shall change 1.0 mm (0.04 in) or one division on the graduated scale, whichever is greater.
- (c) **Scale with a Single Balance Indicator and Having a Nominal Capacity of 250 kg (500 lb) or Greater.** – The position of rest of the indicator shall change 6.4 mm (0.25 in) or one division on the graduated scale or the width of the central target area, whichever is greater. However, the indicator on a batching scale shall change 3.2 mm (0.125 in) or one division on the graduated scale, whichever is greater.
- (d) **Scale with Two Opposite-Moving Balance Indicators.** – The position of rest of the two indicators moving in opposite directions shall change 1.0 mm (0.04 in) with respect to each other.
- (e) **Scale with Neither a Trig Loop nor a Balance Indicator.** – The position of rest of the weighbeam or lever system shall change from the horizontal, or midway between limiting stops, to either limit of motion.

T.N. Tolerances Applicable to Devices Marked I, II, III, III L, and IIII.

T.N.1. Principles.

T.N.1.1. Design. – The tolerance for a weighing device is a performance requirement independent of the design principle used.

T.N.1.2. Accuracy Classes. – Weighing devices are divided into accuracy classes according to the number of scale divisions (n) and the value of the scale division (d).

T.N.1.3. Scale Division. – The tolerance for a weighing device is related to the value of the scale division (d) or the value of the verification scale division (e) and is generally expressed in terms of d or e.

T.N.2. Tolerance Application.

T.N.2.1. General. – The tolerance values are positive (+) and negative (–) with the weighing device adjusted to zero at no load. When tare is in use, the tolerance values are applied from the tare zero reference (zero net weight indication); the tolerance values apply to the net weight indication for any possible tare load using certified test loads.
(Amended 2008)

T.N.2.2. Type Evaluation Examinations. – For type evaluation examinations, the tolerance values apply to increasing and decreasing load tests within the temperature, power supply, and barometric pressure limits specified in T.N.8.

T.N.2.3. Subsequent Verification Examinations. – For subsequent verification examinations, the tolerance values apply regardless of the influence factors in effect at the time of the conduct of the examination. (Also see G-N.2. Testing with Nonassociated Equipment.)

T.N.2.4. Multi-Interval and Multiple Range (Variable Division-Value) Scales. – For multi-interval and multiple range scales, the tolerance values are based on the value of the scale division of the range in use.

T.N.2.5. Ratio Tests. – For ratio tests, the tolerance values are 0.75 of the applicable tolerances.

T.N.3. Tolerance Values.

T.N.3.1. Maintenance Tolerance Values. – The maintenance tolerance values are as specified in Table 6. Maintenance Tolerances.

T.N.3.2. Acceptance Tolerance Values. – The acceptance tolerance values shall be one-half the maintenance tolerance values.

T.N.3.3. Wheel-Load Weighers and Portable Axle-Load Weighers of Class III. – The tolerance values are two times the values specified in T.N.3.1. Maintenance Tolerance Values and T.N.3.2. Acceptance Tolerance Values.
(Amended 1986)

T.N.3.4. Crane and Hopper (Other than Grain Hopper) Scales. – The maintenance and acceptance tolerances shall be as specified in T.N.3.1. Maintenance Tolerance Values and T.N.3.2. Acceptance Tolerance Values for Class III L, except that the tolerance for crane

and construction materials hopper scales shall not be less than 1 d or 0.1 % of the scale capacity, whichever is less.
 (Amended 1986)

Table 6. - Maintenance Tolerances

Tolerance in Scale Divisions, (All values in this table are in scale divisions)

	1	2	3	5
Class	Test Load	Test Load	Test Load	Test Load
I	0 - 50 000	50 001 -200 000	200 001 +	
II	0 - 5 000	5 001 - 20 000	20 001 +	
III	0 - 500	501 - 2 000	2 001 - 4 000	4 001 +
III L	0 - 50	51 - 200	201 - 400	401 +
III L	0 - 500	501 -1 000	(Add 1 d for each additional 500 d or fraction thereof)	(Add 1 d for each additional 500 d or fraction thereof)

T.N.3.5. Separate Main Elements: Load Transmitting Element, Indicating Element, Etc. – If a main element separate from a complete weighing device is submitted for laboratory type evaluation, the tolerance for the main element is 0.7 that for the complete weighing device. This fraction includes the tolerance attributable to the testing devices used.

(Amended 2015)

T.N.3.6. Coupled-In-Motion Railroad Weighing Systems. – The maintenance and acceptance tolerance values for the group of weight values appropriate to the application must satisfy the following conditions:

(Amended 1990 and 1992)

T.N.3.6.1. – For any group of weight values, the difference in the sum of the individual in-motion car weights of the group as compared to the sum of the individual static weights shall not exceed 0.2 %.

(Amended 1990)

T.N.3.6.2. – If a weighing system is used to weigh trains of five or more cars, and if the individual car weights are used, any single weight value within the group must meet the following criteria:

(a) no single error may exceed three times the static maintenance tolerance;

(b) not more than 5 % of the errors may exceed two times the static maintenance tolerance; and

(c) not more than 35 % of the errors may exceed the static maintenance tolerance.

(Amended 1990 and 1992)

T.N.3.6.3. – For any group of weight values wherein the sole purpose is to determine the sum of the group, T.N.3.6.1. alone applies.

(Amended 1990)

T.N.3.6.4. – For a weighing system used to weigh trains of less than five cars, no single car weight within the group may exceed the static maintenance tolerance.

(Amended 1990 and 1992)

T.N.3.7. Uncoupled-in-Motion Railroad Weighing Systems. – The maintenance and acceptance tolerance values for any single weighment within a group of non-interactive (i.e., uncoupled) loads, the weighment error shall not exceed the static maintenance tolerance.

(Amended 1992)

T.N.3.8. Dynamic Monorail Weighing System. – Acceptance tolerance shall be the same as the maintenance tolerance shown in Table 6. Maintenance Tolerances. On a dynamic test of twenty or more individual test loads, 10 % of the individual test loads may be in error, each not to exceed two times the tolerance. The error on the total of the individual test loads shall not exceed ± 0.2 %. (Also see Note in N.1.3.5.1. Dynamic Monorail Weighing Systems.) *For equipment undergoing type evaluation, a tolerance equal to one-half the maintenance tolerance values shown in Table 6. Maintenance Tolerances shall apply.*

[Nonretroactive January 1, 2002]

(Added 1986) (Amended 1999 and 2001)

T.N.3.9. Materials Test on Customer-Operated Bulk Weighing Systems for Recycled Materials. – The maintenance and acceptance tolerance shall be ± 5 % of the applied materials test load except that the average error on ten or more test materials test loads shall not exceed ± 2.5 %.

(Added 1986)

T.N.3.10. Prescription Scales with a Counting Feature. – In addition to Table 6. Maintenance Tolerances (for weight), the indicated piece count value computed by a Class I or Class II prescription scale counting feature shall comply with the tolerances in Table T.N.3.10. Maintenance and Acceptance Tolerances in Excess and in Deficiency for Count. Table T.N.3.10. Maintenance and Acceptance Tolerances in Excess and in Deficiency for Count.

Indication of Count	Tolerance (piece count)
0 to 100	0
101 to 200	1
201 or more	0.5 %

(Added 2003)

T.N.3.11. Tolerances for Substitution Test. – Tolerances are applied to the scale based on the substitution test load.

(Added 2003)

T.N.3.12. Tolerances for Strain-Load Test. – Tolerances apply only to the test weights or substitution test loads.

(Added 2003)

T.N.4. Agreement of Indications.

T.N.4.1. Multiple Indicating/Recording Elements. – In the case of a scale or weighing system equipped with more than one indicating element or indicating element and recording element combination, where the indicators or indicator/recorder combination are intended to be used independently of one another, tolerances shall be applied independently to each indicator or indicator/recorder combination.

(Amended 1986)

T.N.4.2. Single Indicating/Recording Element. – In the case of a scale or weighing system with a single indicating element or an indicating/recording element combination, and equipped with component parts such as unit weights, weighbeam and weights, or multiple weighbeams that can be used in combination to indicate a weight, the difference in the weight value indications of any load shall not be greater than the absolute value of the applicable tolerance for that load, and shall be within tolerance limits.

(Amended 1986)

T.N.4.3. Single Indicating Element/Multiple Indications. – In the case of an analog indicating element equipped with two or more indicating means within the same element, the difference in the weight indications for any load other than zero shall not be greater than one-half the value of the scale division (d) and be within tolerance limits.

(Amended 1986)

T.N.4.4. Shift or Section Tests. – The range of the results obtained during the conduct of a shift test or a section test shall not exceed the absolute value of the maintenance tolerance applicable and each test result shall be within applicable tolerances.

(Added 1986)

T.N.4.5. Time Dependence. – A time dependence test shall be conducted during type evaluation and may be conducted during field verification, provided test conditions remain constant.

(Amended 1989 and 2005)

T.N.4.5.1. Time Dependence: Class II, III, and IIII Non-Automatic Weighing Instruments. – A non-automatic weighing instrument of Classes II, III, and IIII shall meet the following requirements at constant test conditions. During type evaluation, this test shall be conducted at $20\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ ($68\text{ }^{\circ}\text{F} \pm 4\text{ }^{\circ}\text{F}$):

- (a) When any load is kept on an instrument, the difference between the indication obtained immediately after placing the load and the indication observed during the following 30 minutes shall not exceed 0.5 e. However, the difference between the indication obtained at 15 minutes and the indication obtained at 30 minutes shall not exceed 0.2 e.
- (b) If the conditions in (a) are not met, the difference between the indication obtained immediately after placing the load on the instrument and the indication observed during the following four hours shall not exceed the absolute value of the maximum permissible error at the load applied.

(Added 2005) (Amended 2006 and 2010)

T.N.4.5.2. Time Dependence: Class III L Non-Automatic Weighing Instruments. – A non-automatic weighing instrument of Class III L shall meet the following requirements:

- (a) When any load is kept on an instrument, the difference between the indication obtained immediately after placing the load and the indication observed during the following 30 minutes shall not exceed 1.5 e. However, the difference between the indication obtained at 15 minutes and the indication obtained at 30 minutes shall not exceed 0.6 e.
- (b) If the conditions in (a) are not met, the difference between the indication obtained immediately after placing the load on the instrument and the indication observed during the following four hours shall not exceed the absolute value of the maximum permissible error at the load applied.

(Added 2005) (Amended 2010)

T.N.4.5.3. Zero Load Return: Non-automatic Weighing Instruments. – A non-automatic weighing instrument shall meet the following requirements at constant test conditions. During type evaluation, this test shall be conducted at $20\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ ($68\text{ }^{\circ}\text{F} \pm 4\text{ }^{\circ}\text{F}$). The deviation on returning to zero as soon as the indication has stabilized, after the removal of any load which has remained on the instrument for 30 minutes shall not exceed:

- (a) 0.5 e for Class II and III devices,
- (b) 0.5 e for Class III devices with 4000 or fewer divisions,
- (c) 0.83 e for Class III devices with more than 4000 divisions, or
- (d) one-half of the absolute value of the applicable tolerance for the applied load for Class III L devices.

For a multi-interval instrument, the deviation shall not exceed $0.83 e_1$ (where e_1 is the interval of the first weighing segment of the scale).

On a multiple range instrument, the deviation on returning to zero from Max_i (load in the applicable weighing range) shall not exceed $0.83 e_i$ (interval of the weighing range). Furthermore, after returning to zero from any load greater than Max_1 (capacity of the first weighing range) and immediately after switching to the lowest weighing range, the indication near zero shall not vary by more than e_1 (interval of the first weighing range) during the following five minutes.

(Added 2010)

T.N.4.6. Time Dependence (Creep) for Load Cells during Type Evaluation. – A load cell (force transducer) marked with an accuracy class shall meet the following requirements at constant test conditions:

(a) Permissible Variations of Readings. – With a constant maximum load for the measuring range (D_{max}) between 90 % and 100 % of maximum capacity (E_{max}), applied to the load cell, the difference between the initial reading and any reading obtained during the next 30 minutes shall not exceed the absolute value of the maximum permissible error (mpe) for the applied load. (Also see Table T.N.4.6. Maximum Permissible Error (mpe) for Load Cells During Type Evaluation.) The difference between the reading obtained at 20 minutes and the reading obtained at 30 minutes shall not exceed 0.15 times the absolute value of the mpe. (Also see Table T.N.4.6. Maximum Permissible Error (mpe) for Load Cells During Type Evaluation)

(b) Apportionment Factors. – The mpe for creep shall be determined from Table T.N.4.6. Maximum Permissible Error (mpe) for Load Cells During Type Evaluation using the following apportionment factors (p_{LC}):

$p_{LC} = 0.7$ for load cells marked with S (single load cell applications),
 $p_{LC} = 1.0$ for load cells marked with M (multiple load cell applications), and
 $p_{LC} = 0.5$ for Class III L load cells marked with S or M.

(Added 2005, Amended 2006)

Table T.N.4.6. Maximum Permissible Error (mpe)* for Load Cells During Type Evaluation

Equation: mpe in Load Cell Verifications Divisions (v) = $p_{LC} \times$ Basic Tolerance in v

Class	$p_{LC} \times 0.5 v$	$p_{LC} \times 1.0 v$	$p_{LC} \times 1.0 v$	$p_{LC} \times 1.5 v$
I	0 - 50 000 v	50 001 -	200 000 v	200 001 v +
II	0 - 5 000 v	5 001v -	20 000 v	20 001 v +
III	0 - 500 v	501 v -	2 000 v	2 001 v +
IIII	0 - 50 v	50 v -	200 v	201 v +
III L	0 - 500 v	501 v -	1 000 v	(Add 0.5 v to the basic tolerance for each additional 500 v or fraction thereof up to a maximum load of 10 000 v)

(Table Added 2005) (Amended 2006)

NOTES:

- v represents the load cell verification interval
- p_{LC} represents the apportionment factors applied to the basic tolerance
- $p_{LC} = 0.7$ for load cells marked with S (single load cell applications)
- $p_{LC} = 1.0$ for load cells marked with M (multiple load cell applications)
- $p_{LC} = 0.5$ for Class III L load cells marked with S or M
- * mpe = $p_{LC} \times$ Basic Tolerance in load cell verifications divisions (v)

T.N.4.7. Creep Recovery for Load Cells During Type Evaluation. – The difference between the initial reading of the minimum load of the measuring range (D_{min}) and the reading after returning to minimum load subsequent to the maximum load (D_{max}) having been applied for 30 minutes shall not exceed:

- (a) 0.5 times the value of the load cell verification interval (0.5 v) for Class II and IIII load cells;
- (b) 0.5 times the value of the load cell verification interval (0.5 v) for Class III load cells with 4000 or fewer divisions;
- (c) 0.83 times the value of the load cell verification interval (0.83 v) for Class III load cells with more than 4000 divisions; or
- (d) 2.5 times the value of the load cell verification interval (2.5 v) for Class III L load cells.

(Added 2006) (Amended 2009 and 2011)

T.N.5. Repeatability. – The results obtained from several weighings of the same load under reasonably static test conditions shall agree within the absolute value of the maintenance tolerance for that load, and shall be within applicable tolerances.

T.N.6. Sensitivity. – This section is applicable to all nonautomatic-indicating scales marked I, II, III, III L, or IIII.

T.N.6.1. Test Load.

- (a) The test load for sensitivity for nonautomatic-indicating vehicle, axle-load, livestock, and animal scales shall be 1 d for scales equipped with balance indicator, and 2 d or 0.2 % of the scale capacity, whichever is less, for scales not equipped with balance indicators.
- (b) For all other nonautomatic-indicating scales, the test load for sensitivity shall be 1 d at zero and 2 d at maximum test load.

T.N.6.2. Minimum Change of Indications. – The addition or removal of the test load for sensitivity shall cause a minimum permanent change as follows:

- (a) for a scale with trig loop but without a balance indicator, the position of the weighbeam shall change from the center to the outer limit of the trig loop;
- (b) for a scale with balance indicator, the position of the indicator shall change one division on the graduated scale, the width of the central target area, or the applicable value as shown below, whichever is greater:

Scale of Class I or II: 1 mm (0.04 in),

Scale of Class III or IIII with a maximum capacity of 30 kg (70 lb) or less: 2 mm (0.08 in),

Scale of Class III, III L, or IIII with a maximum capacity of more than 30 kg (70 lb): 5 mm (0.20 in);

- (c) for a scale without a trig loop or balance indicator, the position of rest of the weighbeam or lever system shall change from the horizontal or midway between limiting stops to either limit of motion.

(Amended 1987)

T.N.7. Discrimination.

T.N.7.1. Analog Automatic Indicating (i.e., Weighing Device with Dial, Drum, Fan, etc.). – A test load equivalent to 1.4 d shall cause a change in the indication of at least 1.0 d. (Also see N.1.5. Discrimination Test.)

T.N.7.2. Digital Automatic Indicating. – A test load equivalent to 1.4 d shall cause a change in the indicated or recorded value of at least 2.0 d. This requires the zone of

uncertainty to be not greater than three-tenths of the value of the scale division. (Also see N.1.5.1. Digital Device.)

T.N.8. Influence Factors. – The following factors are applicable to tests conducted under controlled conditions only, provided that:

- (a) types of devices approved prior to January 1, 1986, and manufactured prior to January 1, 1988, need not meet the requirements of this section;
- (b) new types of devices submitted for approval after January 1, 1986, shall comply with the requirements of this section; and
- (c) all devices manufactured after January 1, 1988, shall comply with the requirements of this section.

(Amended 1985)

T.N.8.1. Temperature. – Devices shall satisfy the tolerance requirements under the following temperature conditions:

T.N.8.1.1. If not specified in the operating instructions for Class I or II scales, or if not marked on the device for Class III, III L, or IIII scales, the temperature limits shall be: – 10 °C to 40 °C (14 °F to 104 °F).

T.N.8.1.2. If temperature limits are specified for the device, the range shall be at least that specified in Table T.N.8.1.2. Temperature Range by Class.

Table T.N.8.1.2. Temperature Range by Class

Class	Temperature Range
I	5 °C (9 °F)
II	15 °C (27 °F)
III, III L, and IIII	30 °C (54 °F)

T.N.8.1.3. Temperature Effect on Zero-Load Balance. – The zero-load indication shall not vary by more than:

- (a) three divisions per 5 °C (9 °F) change in temperature for Class III L devices; or
- (b) one division per 5 °C (9 °F) change in temperature for all other devices.

(Amended 1990)

T.N.8.1.4. Operating Temperature. – Except for Class I and II devices, an indicating or recording element shall not display nor record any usable values until the operating temperature necessary for accurate weighing and a stable zero balance condition have been attained.

T.N.8.2. Barometric Pressure. – Except for Class I scales, the zero indication shall not vary by more than one scale division for a change in barometric pressure of 1 kPa over the total barometric pressure range of 95 kPa to 105 kPa (28 in to 31 in of Hg).

T.N.8.3. Electric Power Supply.

T.N.8.3.1. Power Supply, Voltage and Frequency.

(a) Weighing devices that operate using alternating current must perform within the conditions defined in paragraphs T.N.3. Tolerance Values through T.N.7. Discrimination, inclusive, when tested over the range of – 15 % to + 10 % of the marked nominal line voltage(s) at 60 Hz, or the voltage range marked by the manufacturer, at 60 Hz.

(Amended 2003)

(b) Battery operated instruments shall not indicate nor record values outside the applicable tolerance limits when battery power output is excessive or deficient.

T.N.8.3.2. Power Interruption. – A power interruption shall not cause an indicating or recording element to display or record any values outside the applicable tolerance limits.

T.N.9. Radio Frequency Interference (RFI) and Other Electromagnetic Interference Susceptibility. – The difference between the weight indication due to the disturbance and the weight indication without the disturbance shall not exceed one scale division (d); or the equipment shall:

(a) blank the indication; or

(b) provide an error message; or

(c) the indication shall be so completely unstable that it cannot be interpreted, or transmitted into memory or to a recording element, as a correct measurement value.

The tolerance in T.N.9. Radio Frequency Interference (RFI) and Other Electromagnetic Interference Susceptibility is to be applied independently of other tolerances. For example, if indications are at allowable basic tolerance error limits when the disturbance occurs, then it is acceptable for the indication to exceed the applicable basic tolerances during the disturbance. (Amended 1997)

UR. User Requirements

UR.1. Selection Requirements. – Equipment shall be suitable for the service in which it is used with respect to elements of its design, including but not limited to, its capacity, number of scale divisions, value of the scale division or verification scale division, minimum capacity, and computing capability.³

UR.1.1. General.

- (a) For devices marked with a class designation, the typical class or type of device for particular weighing applications is shown in Table 7a. Typical Class or Type of Device for Weighing Applications.
- (b) For devices not marked with a class designation, Table 7b. Applicable to Devices not Marked with a Class Designation applies.

Table 7a. Typical Class or Type of Device for Weighing Applications

Class	Weighing Application or Scale Type
I	Precision laboratory weighing
II	Laboratory weighing, precious metals and gem weighing, grain test scales
III	All commercial weighing not otherwise specified, grain test scales, retail precious metals and semi-precious gem weighing, grain-hopper scales, animal scales, postal scales, vehicle on-board weighing systems with a capacity less than or equal to 30 000 lb, and scales used to determine laundry charges
III L	Vehicle scales (including weigh-in-motion vehicle scales), vehicle on-board weighing systems with a capacity greater than 30 000 lb, axle-load scales, livestock scales, railway track scales, crane scales, and hopper (other than grain hopper) scales
IIII	Wheel-load weighers and portable axle-load weighers used for highway weight enforcement
	Note: A scale with a higher accuracy class than that specified as “typical” may be used.

(Amended 1985, 1986, 1987, 1988, 1992, 1995, 2012, and 2021)

³ Purchasers and users of scales such as railway track, hopper, and vehicle scales should be aware of possible additional requirements for the design and installation of such devices. (Footnote Added 1995)

Table 7b. Applicable to Devices Not Marked with a Class Designation

Scale Type or Design	Maximum Value of d
Retail Food Scales, 50 lb capacity and less	1 oz
Animal Scales	1 lb
Grain Hopper Scales Capacity up to and including 50 000 lb Capacity over 50 000 lb	10 lb (not greater than 0.05 % of capacity) 20 lb
Crane Scales	not greater than 0.2 % of capacity
Vehicle and Axle-Load Scales Used in Combination Capacity up to and including 200 000 lb Capacity over 200 000 lb	20 lb 50 lb
Railway Track Scales With weighbeam Automatic indicating	20 lb 100 lb
Scales with capacities greater than 500 lb except otherwise specified	0.1 % capacity (but not greater than 50 lb)
Wheel-Load Weighers	0.25 % capacity (but not greater than 50 lb)
Note: For scales not specified in this table, G-UR.1.1. and UR.1. apply.	

(Added 1985) (Amended 1989)

UR.1.2. Grain Hopper Scales. – Hopper scales manufactured as of January 1, 1986, that are used to weigh grain shall be Class III and have a minimum of 2000 scale divisions.

(Amended 2012)

UR.1.3. Value of the Indicated and Recorded Scale Division. – *The value of the scale division as recorded shall be the same as the division value indicated.*

[Nonretroactive as of January 1, 1986]

(Added 1985) (Amended 1999)

UR.1.3.1. Exceptions. – The provisions of UR.1.3. Value of the Indicated and Recorded Scale Division shall not apply to:

(a) Class I scales, or

(b) Dynamic monorail weighing systems when the value of d is less than the value of e.

(Added 1999)

UR.1.4. Grain-Test Scales: Value of the Scale Divisions. – The scale division for grain-test scales shall not exceed 0.2 g for loads through 500 g, and shall not exceed 1 g for loads above 500 g through 1000 g.

(Added 1992)

UR.1.5. Recording Element, Class III L Railway Track Scales. – *Class III L Railway Track Scales must be equipped with a recording element.*

[Nonretroactive as of January 1, 1996]

(Added 1995)

UR.2. Installation Requirements.

UR.2.1. Supports. – A scale that is portable and that is being used on a counter, table, or the floor shall be so positioned that it is firmly and securely supported.

UR.2.2. Suspension of Hanging Scale. – A hanging scale shall be freely suspended from a fixed support when in use.

UR.2.3. Protection From Environmental Factors. – The indicating elements, the lever system or load cells, and the load-receiving element of a permanently installed scale, and the indicating elements of a scale not intended to be permanently installed, shall be adequately protected from environmental factors such as wind, weather, and RFI that may adversely affect the operation or performance of the device.

UR.2.4. Foundation, Supports, and Clearance. – The foundation and supports of any scale installed in a fixed location shall be such as to provide strength, rigidity, and permanence of all components, and clearance shall be provided around all live parts to the extent that no contacts may result when the load-receiving element is empty, nor throughout the weighing range of the scale. An in-motion railway track scale is not required to provide clearance using rail gaps to separate the live rail portion of the weighing/load-receiving element from that which is not live if the scale is designed to be installed and operated using continuous rail. *On vehicle and livestock scales, the clearance between the load-receiving elements and the coping at the bottom edge of the platform shall be greater than at the top edge of the platform.**

*[*Nonretroactive as of January 1, 1973]*

(Amended 2014)

UR.2.5. Access to Weighing Elements. – Adequate provision shall be made for ready access to the pit of a vehicle, livestock, animal, axle-load, or railway track scale for the purpose of inspection and maintenance. Any of these scales without a pit shall be installed with adequate means for inspection and maintenance of the weighing elements.

(Amended 1985)

UR.2.6. Approaches.

UR.2.6.1. Vehicle Scales. – [NOT ADOPTED - CCR § 4001. Exceptions.]

UR.2.6.2. Axle-Load Scales. – At each end of an axle-load scale there shall be a straight paved approach in the same plane as the platform. The approaches shall be the same width as the platform and of sufficient length to insure the level positioning of vehicles during weight determinations.

UR.2.7. Stock Racks. – A livestock or animal scale shall be equipped with a suitable stock rack, with gates as required, which shall be securely mounted on the scale platform. Adequate clearances shall be maintained around the outside of the rack.

UR.2.8. Hoists. – On vehicle scales equipped with means for raising the load-receiving element from the weighing element for vehicle unloading, means shall be provided so that it is readily apparent to the scale operator when the load-receiving element is in its designed weighing position.

UR.2.9. Provision for Testing Dynamic Monorail Weighing Systems. – *Provisions shall be made at the time of installation of a dynamic monorail weighing systems for testing in accordance with N.1.3.5.1. Dynamic Monorail Weighing Systems (a rail around or other means for returning the test carcasses to the scale being tested).*

[Nonretroactive as of January 1, 1998]

(Added 1997) (Amended 1999)

UR.2.10. Primary Indicating Elements Provided by the User. – *Video display terminals and other user-provided indicating elements on scales interfaced with a cash register in a point-of-sale (POS) system shall comply with the minimum height requirements specified in part (c) of paragraph S.1.1.1. Digital Indicating Elements.*

[Nonretroactive as of January 1, 2021]

(Added 2019)

UR.3. Use Requirements.

UR.3.1. Recommended Minimum Load. – A recommended minimum load is specified in Table 8 since the use of a device to weigh light loads is likely to result in relatively large errors.

Table 8. - Recommended Minimum Load

Class	Value of Scale Division (d or e*)	Recommended Minimum Load (d or e*)
I	equal to or greater than 0.001 g	100
II	0.001 g to 0.05 g, inclusive	20
	equal to or greater than 0.1 g	50
III	All**	20
III L	All	50
IIII	All	10

*For Class I and II devices equipped with auxiliary reading means (i.e., a rider, a vernier, or a least significant decimal differentiated by size, shape or color), the value of the verification scale division “e” is the value of the scale division immediately preceding the auxiliary means. For Class III and IIII devices the value of “e” is specified by the manufacturer as marked on the device; “e” must be less than or equal to “d.”

**A minimum load of 10 d is recommended for a weight classifier marked in accordance with a statement identifying its use for special applications.

(Amended 1990)

UR.3.1.1. Minimum Load, Grain Dockage Determination. – When determining the quantity of foreign material (dockage) in grain, the weight of the sample shall be equal to or greater than 500 scale divisions.

(Added 1985)

UR.3.2. Maximum Load. – A scale shall not be used to weigh a load of more than the nominal capacity of the scale.

UR.3.2.1. Maximum Loading for Vehicle Scales. – A vehicle scale shall not be used to weigh loads exceeding the maximum load capacity of its span as specified in Table UR.3.2.1. Span Maximum Load.

(Added 1996)

**Table UR.3.2.1. Span Maximum Load
Ratio of CLC to Maximum Load (“r” factor) Carried on Any
Group of Two or More Consecutive Axles.**

INSTRUCTIONS:

1. Determine the scale’s CLC.
2. Count the number of axles on the vehicle in a given span and determine the distance in feet between the first and last axle in the span.
3. Multiply the CLC by the corresponding multiplier in the table.*
4. The resulting number is the scale’s maximum concentrated load for a single span based on the vehicle configuration.

Note: This table was developed based upon the following formula. Values may be rounded in some cases for ease of use.

$$W = r \times 500 \left[\left(\frac{LN}{N-1} \right) + 12N + 36 \right]$$

- ¹ Tandem Axle Weight.
- ² Exception – These values in the third column correspond to the maximum loads in which the inner bridge dimensions of 36, 37, and 38 ft are considered to be equivalent to 39 ft. This allows a weight of 68 000 lb on axles 2 through 5.
- ³ Corresponds to the Interstate Gross Weight Limit.

Distance in Feet Between the Extremes of any Two or More Consecutive Axles	2 axles	3 axles	4 axles	5 axles	6 axles	7 axles	8 axles	9 axles
4 ¹	1.000							
5 ¹	1.000							
6 ¹	1.000							
7 ¹	1.000							
8 and less ¹	1.000	1.000						
More the 8	1.118	1.235						
9	1.147	1.257						
10	1.176	1.279						
11	1.206	1.301						
12	1.206	1.301						

CCR Title 4, Div. 9, CCR §§ 4000., 4001. and 4002.1.
 2023 Edition of NIST HB 44 Section 2.20. Scales

Distance in Feet Between the Extremes of any Two or More Consecutive Axles	2 axles	3 axles	4 axles	5 axles	6 axles	7 axles	8 axles	9 axles
12	1.235	1.324	1.471	1.632				
13	1.265	1.346	1.490	1.651				
14	1.294	1.368	1.510	1.669				
15	1.324	1.390	1.529	1.688	1.853			
16	1.353	1.412	1.549	1.706	1.871			
17	1.382	1.434	1.569	1.724	1.888			
18	1.412	1.456	1.588	1.743	1.906			
19	1.441	1.478	1.608	1.761	1.924			
20	1.471	1.500	1.627	1.779	1.941			
21	1.500	1.522	1.647	1.798	1.959			
22	1.529	1.544	1.667	1.816	1.976			
23	1.559	1.566	1.686	1.835	1.994			
24	1.588	1.588	1.706	1.853	2.012	2.176		
25	1.618	1.610	1.725	1.871	2.029	2.194		
26		1.632	1.745	1.890	2.047	2.211		
27		1.654	1.765	1.908	2.065	2.228		
28		1.676	1.784	1.926	2.082	2.245	2.412	
29		1.699	1.804	1.945	2.100	2.262	2.429	
30		1.721	1.824	1.963	2.118	2.279	2.445	
31		1.743	1.843	1.982	2.135	2.297	2.462	
32		1.765	1.863	2.000	2.153	2.314	2.479	2.647
33			1.882	2.018	2.171	2.331	2.496	2.664
34			1.902	2.037	2.188	2.348	2.513	2.680
35			1.922	2.055	2.206	2.365	2.529	2.697
36			2.000 ²	2.074	2.224	2.382	2.546	2.713
37			2.000 ²	2.092	2.241	2.400	2.563	2.730

CCR Title 4, Div. 9, CCR §§ 4000., 4001. and 4002.1.
 2023 Edition of NIST HB 44 Section 2.20. Scales

Distance in Feet Between the Extremes of any Two or More Consecutive Axles	2 axles	3 axles	4 axles	5 axles	6 axles	7 axles	8 axles	9 axles
38			2.000 ²	2.110	2.259	2.417	2.580	2.746
39			2.000	2.129	2.276	2.434	2.597	2.763
40			2.020	2.147	2.294	2.451	2.613	2.779
41			2.039	2.165	2.312	2.468	2.630	2.796
42			2.059	2.184	2.329	2.485	2.647	2.813
43			2.078	2.202	2.347	2.502	2.664	2.829
44			2.098	2.221	2.365	2.520	2.681	2.846
45			2.118	2.239	2.38	2.537	2.697	2.862
46			2.137	2.257	2.400	2.554	2.714	2.879
47			2.157	2.276	2.418	2.571	2.731	2.895
48			2.176	2.294	2.435	2.588	2.748	2.912
49			2.196	2.313	2.453	2.605	2.765	2.928
50			2.216	2.331	2.471	2.623	2.782	2.945
51			2.235	2.349	2.488	2.640	2.798	2.961
52			2.255	2.368	2.506	2.657	2.815	2.978
53			2.275	2.368	2.524	2.674	2.832	2.994
54			2.294	2.404	2.541	2.691	2.849	3.011
55			2.314	2.423	2.559	2.708	2.866	3.028
56			2.333	2.441	2.576	2.725	2.882	3.004
57			2.353 ³	2.460	2.594	2.742	2.899	3.061
58				2.478	2.612	2.760	2.916	3.077
59				2.496	2.629	2.77	2.933	3.094
60				2.515	2.647	2.794	2.950	3.110

UR.3.3. Single-Draft Vehicle Weighing. – A vehicle or a coupled-vehicle combination shall be commercially weighed on a vehicle scale only as a single draft. That is, the total weight of such a vehicle or combination shall not be determined by adding together the

results obtained by separately and not simultaneously weighing each end of such vehicle or individual elements of such coupled combination. However, the weight of:

- (a) a coupled combination may be determined by uncoupling the various elements (tractor, semitrailer, trailer), weighing each unit separately as a single draft, and adding together the results; or
- (b) a vehicle or coupled-vehicle combination may be determined by adding together the weights obtained while all individual elements are resting simultaneously on more than one scale platform.

Note: This paragraph does not apply to highway-law-enforcement scales and scales used for the collection of statistical data.

(Added 1992)

UR.3.4. Wheel-Load Weighing.

UR.3.4.1. Use in Pairs. – When wheel-load weighers or portable axle-load weighers are to be regularly used in pairs, both weighers of each such pair shall be appropriately marked to identify them as weighers intended to be used in combination.

UR.3.4.2. Level Condition. – A vehicle of which either an axle-load determination or a gross-load determination is being made utilizing wheel-load weighers or portable axle-load weighers, shall be in a reasonably level position at the time of such determination.

UR.3.5. Special Designs. – A scale designed and marked for a special application (such as a prepackaging scale or prescription scale with a counting feature) shall not be used for other than its intended purpose.⁴

(Amended 2003)

UR.3.6. Wet Commodities. – Wet commodities not in watertight containers shall be weighed only on a scale having a pan or platform that will drain properly.

(Amended 1988)

⁴ Prepackaging scales and prescription scales with a counting feature (and other commercial devices) used for putting up packages in advance of sale are acceptable for use in commerce only if all appropriate provisions of NIST Handbook 44 are met. Users of such devices must be alert to the legal requirements relating to the declaration of quantity on a package. Such requirements are to the effect that, on the average, the contents of the individual packages of a particular commodity comprising a lot, shipment, or delivery must contain at least the quantity declared on the label. The fact that a prepackaging scale may overregister, but within established tolerances, and is approved for commercial service is not a legal justification for packages to contain, on the average, less than the labeled quantity.

(Amended 2003)

UR.3.7. Minimum Load on a Vehicle Scale. [NOT ADOPTED - CCR § 4001. Exceptions.]

CCR § 4002.2. Scales (2.20.) (a) Minimum Load on a Vehicle Scale. Except for weighments of ferrous metals, cardboard, paper, rags or plastic, and the weighing of vehicles for registration purposes, a vehicle scale shall not be used for weighing net loads less than the value of 20 scale divisions.

(Adopted, 4 CCR 4002.2.)

CCR § 4002.2. Scales (2.20.) (b) Class III, Class III L and Unmarked Devices Used For Recycling. Except for weighments of ferrous metals, cardboard, paper, rags, or plastic, Class III, Class III L and unmarked devices used in recycling shall not be used for weighing net loads less than the value of 20 scale divisions.

(Adopted, 4 CCR 4002.2.)

UR.3.8. Minimum Load for Weighing Livestock. – A scale with scale divisions greater than 2 kg (5 lb) shall not be used for weighing net loads smaller than 500 d.

(Amended 1989)

UR.3.9. Use of Manual Weight Entries. – Manual gross or net weight entries are permitted for use in the following applications only when:

- (a) a point-of-sale system interfaced with a scale is giving credit for a weighed item;
- (b) an item is pre-weighed on a legal for trade scale and marked with the correct net weight;
- (c) a device or system is generating labels for standard weight packages;
- (d) postal scales or weight classifiers are generating manifests for packages to be picked up at a later time; or
- (e) livestock and vehicle scale systems generate weight tickets to correct erroneous tickets.

(Added 1992) (Amended 2000 and 2004)

UR.3.10. Dynamic Monorail Weighing Systems. – When the value of d is different from the value of e, the commercial transaction must be based on e.

(Added 1999)

UR.3.11. Minimum Count. – A prescription scale with an operational counting feature shall not be used to count a quantity of less than 30 pieces weighing a minimum of 90 e.

(Added 2003)

Note: The minimum count as defined in this paragraph refers to the use of the device in the filling of prescriptions and is different from the minimum sample piece count as defined in S.1.2.3. and as required to be marked on the scale by S.6.6.

(Note Added 2004)

UR.3.12. Correct Stored Piece Weight. – For prescription scales with a counting feature, the user is responsible for maintaining the correct stored piece weight. This is especially critical when a medicine has been reformulated or comes from different lots.

(Added 2003)

UR.3.13. Fault Indications for Weigh-in-Motion Vehicle Scales. – The fault conditions defined in S.1.14.1. Identification of a Fault shall be presented to the customer and the operator in a clear and conspicuous manner.

(Added 2021)

UR.4. Maintenance Requirements.

UR.4.1. Balance Condition. – The zero-load adjustment of a scale shall be maintained so that, with no load on the load-receiving element and with all load-counterbalancing elements of the scale (such as poises, drop weights, or counterbalance weights) set to zero, the scale shall indicate or record a zero balance condition. A scale not equipped to indicate or record a zero-load balance shall be maintained in balance under any no-load condition.

UR.4.2. Level Condition. – If a scale is equipped with a level-condition indicator, the scale shall be maintained in level.

UR.4.3. Scale Modification. – The dimensions (e.g., length, width, thickness, etc.) of the load receiving element of a scale shall not be changed beyond the manufacturer's specifications, nor shall the capacity of a scale be increased beyond its design capacity by replacing or modifying the original primary indicating or recording element with one of a higher capacity, except when the modification has been approved by a competent engineering authority, preferably that of the engineering department of the manufacturer of the scale, and by the weights and measures authority having jurisdiction over the scale.

(Amended 1996)

UR.5. Coupled-in-Motion Railroad Weighing Systems.

(a) A coupled-in-motion weighing system placed in service on or after January 1, 1991, should be tested in the manner in which it is operated, with the locomotive either pushing or pulling the cars at the designed speed and in the proper direction. The cars used in the test train should represent the range of gross weights that will be used during the normal operation of the weighing system. Except as provided in N.4.2. Weighing Systems Placed in Service Prior to January 1, 1991, and Used to Weigh Trains of Ten or More Cars and N.4.3.(a) Weighing Systems Placed in Service on or After January 1, 1991, and Used to Weigh Trains of Ten or More Cars, normal operating

procedures should be simulated as nearly as practical. Approach conditions for a train length in each direction of the scale site are more critical for a weighing system used for individual car weights than for a unit-train-weights-only facility, and should be considered prior to installation.

- (b) For coupled-in-motion point-based weighing systems used only for dynamic weighing, the user shall provide an alternate certified scale to be used as a reference scale. The weights and measures authority having jurisdiction over the weighing system shall determine if the reference scale provided is suitable in terms of size, capacity, minimum division, performance requirements, and the proximity to the weighing system under evaluation. The reference weight cars weighed on the reference scale may then be used for calibration and annual inspection by the jurisdiction with statutory authority for the system.

(Added 1990) (Amended 1992 and 2021)

Scales Code Index

“	Class III .13, 17, 19, 24, 25, 26, 30, 41, 42, 44, 45, 46, 47, 49, 50, 53, 54, 56, 58, 60
“r” factor..... 61	Class III L 13, 17, 19, 24, 25, 26, 41, 42, 44, 45, 46, 47, 50, 53, 54, 56, 58, 60
A	Class IIII 17, 19, 24, 25, 26, 30, 41, 44, 45, 46, 47, 49, 50, 53, 54, 56, 60
Acceptance..... 14, 44, 46, 47, 48	CLC.....20, 21, 23, 25, 26, 32, 61
Acceptance tolerance..... 14, 46, 47, 48	Clearance..... 5, 14, 58
Accuracy13, 15, 17, 21, 23, 25, 26, 39, 41, 45, 56	Concentrated load capacity..... 21, 23
Accuracy class . 13, 17, 21, 23, 25, 39, 41, 45, 56	Consecutive-car test..... 37, 38, 39
Adjustable components 9, 17	Counting feature..3, 15, 25, 29, 36, 48, 63, 64, 65
Adjustment 9, 12, 17, 38, 65	Crane and hopper 46
Apportionment factor 51, 52	Creep 51
Approaches 59	D
Audit trail 9, 10	Dairy-product test.....14, 15, 30, 43, 44
Automatic zero-tracking mechanism..... 12, 13, 18, 35	Damping means 15
B	Decreasing load test..... 43, 46
Balance condition 1, 12, 14, 54, 65	Direct sales 6, 12, 13, 16
Balance indicator. 1, 14, 15, 16, 44, 45, 53	Discrimination test..... 35
Balance position 5	Distributed-car test..... 37, 38
Barometric pressure 46, 55	E
C	Electric power supply 55
Capacity ... 6, 7, 10, 12, 13, 14, 15, 16, 17, 20, 21, 22, 23, 24, 25, 26, 27, 30, 31, 32, 33, 34, 39, 43, 44, 45, 46, 53, 56, 57, 60, 65	Environmental factors..... 35, 58
Capacity indication 7	F
Center-of-zero 1	Field standard 37
Certificate of Conformance..... 18	Foundation 58
Class .. 3, 9, 10, 12, 13, 14, 15, 17, 19, 21, 23, 24, 25, 26, 30, 37, 42, 46, 47, 49, 50, 53, 54, 55, 57, 58, 60	G
Class I 3, 9, 10, 12, 13, 14, 15, 17, 19, 25, 26, 30, 41, 42, 44, 45, 47, 53, 54, 55, 56, 57, 60	Graduations..... 4, 5, 6, 7, 8, 14
Class II ... 3, 12, 13, 14, 15, 17, 19, 25, 26, 30, 41, 42, 44, 45, 47, 49, 50, 53, 54, 56, 60	Grain-test 14, 58
	H
	Hoists 59
	I
	Index of an indicator..... 4, 5
	Indicating element.....1, 15, 20, 21, 23, 25, 28, 29, 47, 49, 58

CCR Title 4, Div. 9, CCR §§ 4000., 4001. and 4002.1.
 2023 Edition of NIST HB 44 Section 2.20. Scales

Indicator.... 1, 4, 5, 6, 9, 14, 15, 16, 25, 45,
 49, 53, 65
 Influence factors 46, 54
 Initial verification 38
 Initial zero-setting mechanism 7, 13
 Installation requirements 58

J

Jewelers'..... 44

L

Level..... 12, 14, 34, 59, 63, 65
 Level condition 15, 63, 65
 Level-indicating means..... 14
 Load cell 17, 18, 21, 22, 24, 25, 26, 27, 51,
 58
 Load cell verification interval 17, 27, 52

M

Main elements 21, 47
 Maintenance 42, 44, 46, 47, 48, 49, 52, 58,
 65
 Maintenance requirements 65
 Maintenance tolerance . 42, 44, 46, 47, 48,
 49, 52
 Manual weight entries..... 11, 64
 Marking requirements..... 20
 Material test..... 36, 42
 Maximum permissible error (mpe).... 51, 52
 Minimum load 59, 60, 64
 Money-value computation 8
 Money-value graduations 7
 Multi-interval 17, 24, 46
 Multiple range..... 17, 46

N

No-load reference value 2
 Nominal capacity 6, 20, 21, 23, 24, 26, 30,
 32, 39, 45, 60
 Non-automatic 49, 50

O

On-board 11, 15, 34, 56
 Operating temperature 54

P

Parallax 5
 Piece 3, 48, 65
 Point-of-sale 8, 64
 Poise 6
 Portable axle-load weighers . 1, 34, 46, 56,
 63
 Power interruption 55
 Prescription . 14, 15, 25, 29, 36, 39, 42, 44,
 48, 63, 64, 65

R

Ratio test 36, 46
 Readability 6
 Recorded representations 8
 Recording elements 1, 15, 49
 Repeatability 52
 RFI 36, 55, 58

S

Scale modification 65
 Scales
 Automatic indicating 30, 35, 43
 Axle load 1, 14, 15, 25, 26, 31, 42, 53,
 56, 57, 59
 Belt-conveyor 1
 Computing..... 7
 Crane 34, 57
 Dairy-product test..... 15, 30, 44
 Gem weighing 56
 Grain test..... 42, 56
 Hanging..... 34, 58
 Hopper 34, 46, 56, 57
 Jewelers' 15, 42, 44
 Livestock .. 12, 15, 20, 26, 27, 29, 31, 32,
 53, 56, 58, 64
 Monorail 3, 13, 14, 33, 42
 Parcel post 41, 43
 Postal 2, 7, 25, 41, 43, 56, 64
 Prepackaging 9, 63
 Prescription 15, 36, 42, 48, 65
 Railway track .. 12, 13, 15, 26, 27, 33, 42,
 45, 56, 57, 58
 Vehicle 12, 15, 20, 25, 26, 27, 31, 39, 40,
 53, 56, 59, 60, 64, 65
 Weighbeam 5

CCR Title 4, Div. 9, CCR §§ 4000., 4001. and 4002.1.
2023 Edition of NIST HB 44 Section 2.20. Scales

Sealing 10
Security seal 9
Sensitivity requirement 44, 45
Sensitivity test 35
Shift test 30, 31, 33, 34, 49
Single-draft 63
Stock racks 59
Strain-load test 36, 49
Subsequent verification 38, 46
Substitution 36, 49
Supports 30, 58
Symmetry 4

T

Tare 12, 13, 14, 46
Temperature 18, 21, 23, 24, 46, 54
Test loads 30, 33, 42, 45, 46, 48
Test pattern 31, 32
Time dependence 49
Tolerances.. 13, 15, 37, 41, 42, 44, 45, 46,
49, 52, 55, 63
Travel 5, 16, 39
Type evaluation 21, 46, 47, 48, 49, 51

U

Unit prices 7, 8

Unit weights 7, 26, 49
Use requirements 59

V

Vehicle on-board weighing system. 11, 15,
34, 56
Verification scale interval 3, 17

W

Weighbeam 5
Weighing elements 16, 18, 32, 33, 58
Weighing systems
 Coupled-in-motion 37, 47, 65
 Uncoupled-in-motion 39
Weight classifier 7, 8, 25, 60, 64
Weight ranges 7, 26
Weight units 2
Wheel-load weighers. 1, 14, 15, 34, 46, 57,
63

Z

Zero indication 1, 55
Zero-load adjustment 12, 65
Zero-load balance 9, 12, 13, 14, 36, 54, 65
Zero-tracking mechanism... See Automatic
zero-tracking mechanism

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Table of Contents

Section 2.21. Belt-Conveyor Scale Systems	71
A. Application	71
A.1. General.	71
A.2. Exceptions.....	71
A.3. Additional Code Requirements.....	71
S. Specifications	71
S.1. Design of Indicating and Recording Elements.....	71
S.1.1. General.	71
S.1.2. Units.....	71
S.1.3. Value of the Scale Division.	71
<i>S.1.4. Recording Elements and Recorded Representations.</i>	<i>72</i>
<i>S.1.5. Rate of Flow Indicators and Recorders.....</i>	<i>72</i>
S.1.6. Advancement of Primary Indicating or Recording Elements.	73
<i>S.1.7. Master Weight Totalizer.</i>	<i>73</i>
S.1.8. Power Loss.....	73
<i>S.1.9. Zero-Ready Indicator.</i>	<i>73</i>
S.2. Design of Weighing Elements.	73
S.2.1. Speed Measurement.....	73
S.2.2. Adjustable Components.....	73
S.2.3. Overload Protection.	73
S.3. Zero Setting.....	74
S.3.1. Design of Zero-Setting Mechanism.....	74
<i>S.3.2. Sensitivity at Zero Load (For Type Evaluation).</i>	<i>74</i>
S.4. Accuracy Class.....	74
S.5. Marking Requirements.	74
S.6. Provision for Sealing.	75
N. Notes	76
N.1. General.	76
N.1.1. Official Test.....	76
N.1.2. Simulated Test.....	76
N.2. Conditions of Tests.....	76
N.2.1. Initial Verification.....	76
N.2.2. Subsequent Verification.	77
N.2.3. Minimum Test Load.	78
N.3. Test Procedures.	79
N.3.1. Zero-Load Tests.	79
N.3.2. Material Tests.	80
N.3.3. Simulated Load Tests.	81
T. Tolerances	82

CCR Title 4, Div. 9, CCR §§ 4000.
2023 Edition of NIST HB 44 Section 2.21. Belt-Conveyor Scale Systems

T.1. Tolerance Values.	82
T.1.1. Tolerance Values – Test of Zero Stability.	82
T.2. Tolerance Values, Repeatability and Linearity	83
T.2.1 Tolerance Values, Repeatability Tests. –.....	83
(Amended 2019).....	83
T.2.2. Linearity Tests, for Systems that Operate Using Multiple or Variable Flow Rates.....	83
T.3. Influence Factors.....	83
T.3.1. Temperature.	83
T.3.2. Power Supply, Voltage, and Frequency.....	84
UR. User Requirements.....	84
UR.1. Installation Requirements.	84
UR.1.1. Protection from Environmental Factors.	84
UR.1.2. Conveyor Installation.....	84
UR.1.3. <i>Material Test</i>	86
UR.1.4. Belt Travel (Speed or Velocity).....	86
UR.2. Use Requirements.	86
UR.2.1. Rate of Operation.....	86
UR.2.2. Minimum Totalized Load.	86
UR.2.3. Security Means.	86
UR.2.4. Loading.	86
UR.2.5. Diversion or Loss of Measured Product.	86
UR.2.6. Retention of Maintenance, Test, and Analog or Digital Recorder Information.....	86
UR.3. Maintenance Requirements – Scale and Conveyor Maintenance.	87
UR.4. Compliance.....	90

Section 2.21. Belt-Conveyor Scale Systems

A. Application

A.1. General. - This code applies to belt-conveyor scale systems and weigh-belt systems used for the weighing of bulk materials.

(Amended 2015)

A.2. Exceptions. – The code does not apply to the following:

- (a) Devices used for discrete weighing while moving on conveyors.
- (b) Devices that measure quantity on a time basis.
- (c) Checkweighers.
- (d) Controllers or other auxiliary devices except as they may affect the weighing performance of the belt-conveyor scale.

A.3. Additional Code Requirements. – In addition to the requirements of this code, Belt-Conveyor Scale Systems shall meet the requirements of Section 1.10. General Code.

S. Specifications

S.1. Design of Indicating and Recording Elements.

S.1.1. General. – A belt-conveyor scale shall be equipped with a primary indicating element in the form of a master weight totalizer *and shall also be equipped with a recording element, and a rate of flow indicator and recorder (which may be analog).** An auxiliary indicator shall not be considered part of the master weight totalizer.

*[*Nonretroactive as of January 1, 1986]*

(Amended 1986)

S.1.2. Units. – A belt-conveyor scale shall indicate and record weight units in terms of pounds, tons, long tons, metric tons, or kilograms. The value of a scale division (d) expressed in a unit of weight shall be equal to:

- (a) 1, 2, or 5; or
- (b) a decimal multiple or submultiples of 1, 2, or 5.

S.1.3. Value of the Scale Division.

S.1.3.1. For Scales Not Marked with an Accuracy Class and Installed After January 1, 1986. – *The value of the scale division shall not be greater than 0.125 % (1/800) of the minimum totalized load.*

[Nonretroactive as of January 1, 1986]

(Added 1985)(Amended 2009 and 2019)

S.1.3.2. For Scales Installed Before January 1, 1986. – The value of the scale division shall not be greater than 1/1200 of the rated capacity of the device. However, provision shall be made so that compliance with the requirements of the zero-load test as prescribed in N.3.1. Zero Load Tests may be readily and accurately determined in 20 minutes of operation.

S.1.3.3. For Scales Marked with an Accuracy Class. - *The value of the scale division shall not be greater than:*

(a) 0.125 % (1/800) of the minimum totalized load for scales marked Class 0.25; and

(b) 0.05 % (1/2000) of the minimum totalized load for scales marked Class 0.1.

[Nonretroactive as of January 1, 2020]

(Added 2019)

S.1.4. Recording Elements and Recorded Representations. – *The value of the scale division of the recording element shall be the same as that of the indicating element.*

a) The belt-conveyor scale system shall record the unit of measurement (i.e., kilograms, tonnes, pounds, tons, etc.), the date, and the time.

*b) The belt-conveyor scale system shall record the initial indication and the final indication of the master weight totalizer and the quantity.**

*All of the information in (a) and (b) must be recorded for each delivery.**

[Nonretroactive as of January 1, 1986]

*[*Nonretroactive as of January 1, 1994]*

(Amended 1993)

S.1.4.1. *The belt-conveyor scale system shall be capable of recording the results of automatic or semi-automatic zero load tests.***

*[**Nonretroactive as of January 1, 2004]*

(Added 2002)

S.1.5. Rate of Flow Indicators and Recorders. - *A belt-conveyor scale shall be equipped with a rate of flow indicator and an analog or digital recorder. Permanent means shall be provided to produce an audio or visual signal when the rate of flow is equal to or less than 20 % and when the rate of flow is equal to or greater than 100 % of the rated capacity of the scale. The type of alarm (audio or visual) shall be determined by the individual installation.*

[Nonretroactive as of January 1, 1986]

(Amended 1989 and 2004)

S.1.6. Advancement of Primary Indicating or Recording Elements. – The master weight totalizer shall advance only when the belt conveyor is in operation and under load.
(Amended 1989)

S.1.7. Master Weight Totalizer. – *The master weight totalizer shall not be resettable without breaking a security means.*
[Nonretroactive as of January 1, 1986]

S.1.8. Power Loss. – *In the event of a power failure of up to 24 hours, the accumulated measured quantity on the master weight totalizer of an electronic digital indicator shall be retained in memory during the power loss.*
[Nonretroactive as of January 1, 1986]
(Amended 1989)

S.1.9. Zero-Ready Indicator. – *A belt-conveyor scale shall be equipped with a zero-ready indicator that produces an audio or visual signal during an unloaded belt condition when the zero balance is within:*

- (a) ± 0.12 % of the rated capacity of the scale for scales not marked with an accuracy class;*
- (a) ± 0.12 % of the rated capacity of the scale for scales marked Class 0.25; and*
- (b) ± 0.05 % for scales marked Class 0.1.*

The type of indication (audio or visual) shall be determined by the individual installation.
[Nonretroactive as of January 1, 2014]
(Added 2012) (Amended 2019)

S.2. Design of Weighing Elements. – A belt-conveyor scale system shall be designed to combine automatically belt travel with belt load to provide a determination of the weight of the material that has passed over the scale.

S.2.1. Speed Measurement. – A belt-conveyor scale shall be equipped with a belt speed or travel sensor that will accurately sense the belt speed or travel whether the belt is empty or loaded.

S.2.2. Adjustable Components. – An adjustable component that can affect the performance of the device (except as prescribed in S.3.1. Design of Zero-Setting Mechanism) shall be held securely in adjustment.
(Amended 1998)

S.2.3. Overload Protection. – The load-receiving elements shall be equipped with means for overload protection of not less than 150 % of rated capacity. The accuracy of the scale in its normal loading range shall not be affected by overloading.

S.3. Zero Setting.

S.3.1. Design of Zero-Setting Mechanism. – Automatic and semiautomatic zero-setting mechanisms shall be so constructed that the resetting operation is carried out only after a whole number of belt revolutions and the completion of the setting or the whole operation is indicated. *An audio or visual signal shall be given when the automatic and semiautomatic zero-setting mechanisms reach the limit of adjustment of the zero-setting mechanism.**
(Amended 1999 and 2002)

*Except for systems that record the zero-load reference at the beginning and end of a delivery, the range of the zero-setting mechanism shall not be greater than $\pm 2\%$ of the rated capacity of the scale without breaking the security means. For systems that record the zero-load reference at the beginning and end of a delivery, the range of zero-setting mechanism shall not be greater than $\pm 5\%$ without breaking the security means.***

*[*Nonretroactive as of January 1, 1990]*

*[**Nonretroactive as of January 1, 2004]*

(Amended 1989 and 2002)

S.3.1.1. Automatic Zero-Setting Mechanism. – *The automatic zero-setting mechanism shall indicate or record any change in the zero reference.*

[Nonretroactive as of January 1, 2010]

(Added 2009)

S.3.2. Sensitivity at Zero Load (For Type Evaluation). – *When a system is operated for a time period equal to the time required to deliver the minimum test load and with a test load calculated to indicate two scale divisions applied directly to the weighing element, the totalizer shall advance not less than one or more than three scale divisions. An alternative test of equivalent sensitivity, as specified by the manufacturer, shall also be acceptable.*
[Nonretroactive as of January 1, 1986]

S.4. Accuracy Class. – *Weighing devices shall be marked with an appropriate accuracy class as either Class 0.25 or as Class 0.1. This designation is determined by the manufacturer.*
[Nonretroactive as of January 1, 2020]

(Added 2019)

S.5. Marking Requirements. – Belt-conveyor scale systems and weigh-belt systems shall be marked with the following: (Also see also G-S.1. Identification.)

- (a) the rated capacity in units of weight per hour (minimum and maximum);
- (b) the value of the scale division;
- (c) the belt speed in terms of feet (or meters) per minute at which the belt will deliver the rated capacity, or the maximum and minimum belt speeds at which the conveyor system will be operated for variable speed belts;

(d) the load in terms of pounds per foot or kilograms per meter (determined by material tests);

(e) *the operational temperature range if other than – 10 °C to 40 °C (14 °F to 104 °F);** and

(f) *the accuracy classification as declared by the manufacturer.***

*[*Nonretroactive as of January 1, 1986][**Nonretroactive as of January 1, 2020]*

(Amended 2015 and 2019)

S.6. Provision for Sealing. – For devices and systems in which the configuration or calibration parameters can be changed by use of a removable digital storage device, security shall be provided for those parameters as specified in G-S.8.2. Devices and Systems Adjusted Using Removable Digital Storage Devices.

All other devices shall be designed using the format set forth in Table S.6. with provision(s) for applying a security seal that must be broken, or for using other approved means of providing security (e.g. data change audit trail available at the time of inspection), before any change that affects the metrological integrity of the device can be made to any electronic mechanism.

[Nonretroactive as of January 1, 1999]

(Added 1998) (Amended 2019)

Table S.6. - Categories of Device and Methods of Sealing

<p>Category 1: <i>No remote configuration capability.</i></p>	<p><i>Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.</i></p>
<p>Category 3: <i>Remote configuration capability.</i></p>	<p><i>An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. A printed copy of the information must be available through the device or through another on-site device. The event logger shall have a capacity to retain records equal to 10 times the number of sealable parameters in the device, but not more than 1000 records are required. (Note: Does not require 1000 changes to be stored for each parameter.)</i></p>

[Nonretroactive as of January 1, 1999]

(Table Added 1998) (Renumbered 2019)

N. Notes

N.1. General. –The performance of belt-conveyor scales can be detrimentally affected by the conditions of the installation. (Also see User Requirements.) The performance of the equipment is not to be determined by averaging the results of the individual tests. The results of all tests shall be within the tolerance limits.
(Amended 2002 and 2019)

N.1.1. Official Test. – An official test of a belt-conveyor scale system shall include tests specified in N.3.1. Zero Load Tests, N.3.2. Material Tests, and, if applicable, N.3.3. Simulated Load Tests.
(Amended 2006)

N.1.2. Simulated Test. – Simulated loading conditions as recommended by the manufacturer and approved by the official with statutory authority may be used to properly monitor the system operational performance between official tests, but shall not be used for official certification.
(Amended 1991)

N.2. Conditions of Tests. – A belt-conveyor scale shall be tested after it is installed on the conveyor system with which it is to be used and under such environmental conditions as may normally be expected. Each test shall be conducted with test loads no less than the minimum test load. Before each test run, the inspector shall check the zero setting and adjust as necessary.
(Amended 1986, 2004, and 2009)

N.2.1. Initial Verification. – A belt-conveyor scale system or a weigh-belt system shall be tested using test runs as indicated in Table N.2.1. Initial Verification.

The minimum testing shall be two test runs performed consecutively and under the same (or practically identical) test conditions; the range of the results of those test runs shall not exceed the absolute value of the tolerance as specified in T.2.1. Tolerance Values, Repeatability Tests. The results of each individual test shall be within the tolerance as specified in T.1. Tolerance Values.

Test runs may also be conducted at any other rate of flow that may be used at the installation to establish linearity of the system.

A minimum of four test runs may be conducted at only one flow rate if evidence is provided that the system is used at a constant speed/constant loading setting and that rate does not vary by an amount more than plus or minus (+/-) 10 % of the normal flow rate that can be developed at the installation for at least 80 % of the time.

(Added 2004)(Amended 2009, 2015, and 2019)

Table N.2.1. Initial Verification

Device Configuration	Minimum of Two Test Runs at Each of the Following Settings	Total Tests (Minimum)
Constant Belt Speed and Variable Loading	<ul style="list-style-type: none"> - Belt Loading: high (normal) - Belt Loading: medium (intermediate) - Belt Loading: low (35 %) 	6
Variable Belt Speed and Constant Loading	<ul style="list-style-type: none"> - Belt Speed: maximum - Belt Speed: medium - Belt Speed: minimum 	6
Variable Belt Speed and Variable Loading	<ul style="list-style-type: none"> - Belt Speed: maximum; Belt Loading: high (normal) - Belt Speed: maximum; Belt Loading: medium (intermediate) - Belt Speed: maximum; Belt Loading: low (35 %) - Belt Speed: minimum; Belt Loading: high (normal) - Belt Speed: minimum; Belt Loading: medium (intermediate) - Belt Speed: minimum; Belt Loading: low (35 %) 	12
Constant Belt Speed and Constant Loading	<ul style="list-style-type: none"> - When the system is operated only at a single flow rate, minimum of four test runs at the flowrate used in normal operation 	*4

NOTES: Table N.2.1. Initial Verification

1. Use the device configurations in the left-hand column to identify the scale being tested.
2. Perform two test runs (minimum) at each of the settings shown in the center column.
3. The following terminology applies to “Belt Loading”:

- Low: 35 % of the maximum rated capacity of the system.
- Medium: an intermediate rate between the high and low settings.
- High: maximum (normal use) operational rate.

*As provided in N.2.1. Initial Verification; for single flow rate systems, a minimum of four test runs at a single flow rate are required

(Table Added 2015)

N.2.2. Subsequent Verification. – Subsequent testing shall include testing at the normal use flow rate and other flow rates used at the installation using a minimum of two consecutive test runs performed at each flow rate. The official with statutory authority may determine that testing only at the normal use flow rate is necessary for subsequent verifications if evidence is provided that the system is used to operate:

- (a) at no less than 70 % of the maximum rated capacity for at least 80 % of the time (excluding time that the belt is unloaded); or
- (b) with a normal use flow rate that does not vary by more than plus or minus (+/-) 10 % of the maximum rated capacity.

Example: If a belt-conveyor scale system has a maximum rated capacity of 200 tons per hour (tph), and the normal use flow rate is 150 tph (75 % of the maximum rated capacity), no testing at additional flow rates is required provided the flow rates remain above 140 tph for more than 80 % of the time. If the same device were operating with a normal use flow rate of 130 tph, it is operating at 65 % of the maximum rated capacity. In this case, testing at flow rates in addition to the normal use flow rate would be required if the normal use flow rate varies by more than 20 tph (10 % of the maximum rated capacity).

(Added 2004)(Amended 2019)

N.2.3. Minimum Test Load.

N.2.3.1. Minimum Test Load, Weigh-Belt Systems. – The minimum test load shall not be less than the largest of the following values:

- (a) 800 scale divisions for systems not marked with an accuracy class, 800 scale divisions for systems marked Class 0.25, and 2000 scale divisions for systems marked Class 0.1;
- (b) the load obtained at maximum flow rate in one revolution of the belt; or
- (c) the load obtained during at least one minute of operation.

(Amended 2015 and 2019)

N.2.3.2. Minimum Test Load, All Other Belt-Conveyor Scale Systems. – Except for applications where a normal weighment is less than ten minutes, the minimum test load shall not be less than the largest of the following values:

- (a) 800 scale divisions for systems not marked with an accuracy class, 800 scale divisions for systems marked Class 0.25, and 2000 scale divisions for systems marked Class 0.1; or
- (b) the load obtained at maximum flow rate in one revolution of the belt; or
- (c) the load obtained during at least ten minutes of operation.

For applications where a normal weighment is less than ten minutes (e.g., belt-conveyor scale systems used exclusively to issue net weights for material conveyed by individual vehicles and railway track cars) the minimum test load shall be the normal weighment that also complies with N.2.3.2.(a) and (b).

The official with statutory authority may determine that a smaller minimum totalized load down to 2 % of the load totalized in one hour at the maximum flow rate may be used for subsequent tests, provided that:

1. the smaller minimum totalized load is greater than the quantities specified in N.2.3.2.(a) and (b); and
2. consecutive official testing with the minimum totalized loads described in N.2.3.2.(a), (b), or (c) and the smaller minimum test load has been conducted that demonstrates the system complies with applicable tolerances for repeatability, acceptance, and maintenance.

(Added 2004) (Amended 2008, 2015, and 2019)

N.3. Test Procedures.

N.3.1. Zero-Load Tests. – A zero-load test shall be conducted to establish that the belt scale system (including the conveyor) is capable of holding a stable, in-service zero.

(Amended 1989 and 2002)

N.3.1.1. Determination of Zero. – A zero-load test is a determination of the error in zero, expressed as an internal reference, a percentage of the full-scale capacity, or a change in a totalized load over a whole number of complete belt revolutions. A zero-load test shall be performed as follows:

- (a) For belt-conveyor scales with electronic integrators, the test must be performed over a period of at least three minutes and with a whole number of complete belt revolutions.
- (b) For belt-conveyor scales with mechanical integrators, the test shall be performed with no less than three complete revolutions or ten minutes of operation, whichever is greater.
- (c) For weigh belt systems, the test must be performed over a period of at least one minute and at least one complete revolution of the belt.

(Added 2002)(Amended 2015)

N.3.1.2. Test of Zero Stability. – The conveyor system shall be operated to warm up the belt and the belt scale shall be zero adjusted as required. A series of zero-load tests shall be carried out immediately before conducting the simulated load or materials test until the three consecutive zero-load tests each indicate an error which does not exceed:

- (a) ± 0.06 % of the totalized load at full scale capacity for the duration of the test for scales not marked with an accuracy class;
- (b) ± 0.06 % of the totalized load at full scale capacity for the duration of the test for scales marked Class 0.25; or

- (c) ± 0.03 % of the totalized load of full scale capacity for the duration of the test for scales that are marked Class 0.1.

No adjustments can be made during the three consecutive zero-load test readings.

(Added 2002) (Amended 2004, 2009, and 2019)

N.3.1.3. Check for Consistency of the Conveyor Belt along Its Entire Length. –

During a zero-load test with any operational low-flow lock-out disabled, the absolute value of the difference between the maximum and minimum totalizer readings indicated on the totalizer during any complete revolution of the belt shall not exceed 0.12 % of the minimum test load.

Note: The end value of the zero-load test must meet the values referenced in N.3.1.2.

Test for Zero Stability of:

- (1) ± 0.06 % for scales not marked with an accuracy class;
- (2) ± 0.06 % for scales marked Class 0.25; or
- (3) ± 0.03 % for scales marked Class 0.1.

(Added 2002) (Amended 2004, 2011 and 2019)

N.3.2. Material Tests. – Material tests should be conducted using actual belt loading conditions. These belt loading conditions shall include but are not limited to conducting materials tests using different belt loading points, all types and sizes of products weighed on the scale, at least one other belt speed, and in both directions of weighing.

On subsequent verifications, at least two individual tests shall be conducted as specified in N.2.2. Subsequent Verification. The results of all these tests shall be within the tolerance limits.

Either pass a quantity of pre-weighed material over the belt-conveyor scale in a manner as similar as feasible to actual loading conditions or weigh all material that has passed over the belt-conveyor scale. Means for weighing the material test load will depend on the capacity of the belt-conveyor scale and availability of a suitable scale for the test. To assure that the test load is accurately weighed and determined, the following precautions shall be observed:

- (a) The containers, whether railroad cars, trucks, or boxes, must not leak, and shall not be overloaded to the point that material will be lost.
- (b) The actual empty or tare weight of the containers shall be determined at the time of the test. Stenciled tare weight of railway cars or trucks shall not be used. Gross and tare weights shall be determined on the same scale.
- (c) When a pre-weighed test load is passed over the scale, the belt-loading hopper shall be examined before and after the test to assure that the hopper is empty and that only the material of the test load has passed over the scale.

- (d) Where practicable, a reference scale should be tested within 24 hours preceding the determination of the weight of the test load used for a belt-conveyor scale material test.

A reference scale which is not “as found” within maintenance tolerance should have its accuracy re-verified after the belt-conveyor test with a suitable known weight load if the “as found” error of the belt-conveyor scale material test exceeds maintenance tolerance values.*

- (e) If any suitable known weight load other than a certified test weight load is used for re-verification of the reference scale accuracy, its weight shall be determined on the reference scale after the reference scale certification and before commencing the belt scale material test.*
- (f) The test shall not be conducted if the weight of the test load has been affected by environmental conditions.

***Note:** Even if the reference scale is within maintenance tolerance it may require adjusting to be able to meet paragraph N.3.2.1. Accuracy of Material.

(Amended 1986, 1989, 1998, 2000, 2002, 2009, and 2019)

N.3.2.1. Accuracy of Material.

- (a) For scales not marked with an accuracy class and those marked Class 0.25, the quantity of material used to conduct a material test shall be weighed on a reference scale to within an accuracy of 0.1 %.
- (b) For scales that are marked Class 0.1, the quantity of material used to conduct a material test shall be weighed on a reference scale to within an accuracy of 0.035 %.

Scales typically used for this purpose include Class III and III L scales or a scale without a class designation as described in Handbook 44, Section 2.20., Table T.1.1. Tolerances for Unmarked Scales.

(Added 1989)(Amended 1991, 1993, 1998, 2000, and 2019)

N.3.3. Simulated Load Tests.

- (a) As required by the official with statutory authority, simulated load tests as recommended by the manufacturer are to be conducted between material tests to monitor the system’s operational performance but shall not be used for official certification.

(Amended 1991)

- (b) A simulated load test consisting of at least three consecutive test runs shall be conducted as soon as possible, but not more than 12 hours after the completion of the material test, to establish the factor to relate the results of the simulated load test to the results of the material tests.

(Added 1990)

(c) The results of the simulated load test shall repeat within 0.1 %.

(Added 1990)

(Amended 1989 and 1990)

T. Tolerances

T.1. Tolerance Values.¹ – Maintenance and acceptance tolerances on material tests, relative to the weight of the material, shall be:

(a) ± 0.25 % of the test load for systems not marked with an accuracy class;

(b) ± 0.25 % of the test load for systems marked Class 0.25; and

(c) ± 0.1 % of the test load for systems marked Class 0.1.

(Amended 1993 and 2019)

T.1.1. Tolerance Values – Test of Zero Stability. – Immediately after material has been weighed over the belt-conveyor scale during the conduct of any material test run, the zero-load test shall be repeated. The change in the accumulated or subtracted weight during the zero-load test shall not exceed

(a) 0.12 % of the totalized load at full scale capacity for the duration of that test for scales that are not marked with an accuracy class;

(b) 0.12 % of the totalized load at full scale capacity for the duration of that test for scales marked Class 0.25; and

(c) 0.06 % of the totalized load at full scale capacity for the duration of the test for scales that are marked Class 0.1.

If the range of zero adjustments during a complete (official) verification test exceeds 0.18 % of the totalized load at full scale capacity for the duration of the zero-load test for unmarked scales and those marked Class 0.25 or 0.09 % of the totalized load at full scale capacity for the duration of the zero-load test for scales marked Class 0.1, the official with statutory authority may establish an interval for zero-load testing during normal operation.

(Added 2004)(Amended 2009 and 2019)

¹ The variables and uncertainties included in the relative tolerance represent only part of the variables that affect the accuracy of the material weighed on belt-conveyor scales. If this tolerance was based on an error analysis beginning with mass standards through all of the test processes and following the principle expressed in Section 3.2. of the Fundamental Considerations in Appendix A, the tolerance would be 0.5 %.

(Added 1993)

T.2. Tolerance Values, Repeatability and Linearity.

T.2.1 Tolerance Values, Repeatability Tests. – In any group of totalization operations performed consecutively and under the same (or practically identical) test conditions during the conduct of material tests, the variation in values shall not be greater than:

- (a) 0.25 % (1/400) for systems not marked with an accuracy class;
- (b) 0.25 % (1/400) for systems marked Class 0.25; and
- (c) 0.1 % (1/1000) for systems marked Class 0.1.

(Amended 2019)

T.2.2. Linearity Tests, for Systems that Operate Using Multiple or Variable Flow Rates. – For totalization operations performed consecutively under different test conditions (e.g., different flow rates, different test loads, different test material) during the conduct of material tests, the results relative to the weight of the reference material shall not exceed:

- (a) +/- 0.25 % (1/400) for systems not marked with an accuracy class;
- (b) +/- 0.25 % (1/400) for systems marked Class 0.25; and
- (c) +/- 0.1 % (1/1000) for systems marked Class 0.1.

(Added 2019)

T.3. Influence Factors. – The following factors are applicable to tests conducted under controlled conditions only, provided that:

- (a) types of devices approved prior to January 1, 1986, and manufactured prior to January 1, 1988, need not meet the requirements of this section;
- (b) new types of devices submitted for approval after January 1, 1986, shall comply with the requirements of the section; and
- (c) all devices manufactured after January 1, 1988, shall comply with the requirements of this section.

T.3.1. Temperature. – Devices shall satisfy the tolerance requirements at temperatures from – 10 °C to 40 °C (14 °F to 104 °F).

T.3.1.1. Effect on Zero-Load Balance. – The zero-load indication shall not change by more than 0.035 % of the rated capacity of the scale (without the belt) for a change in temperature of 10 °C (18 °F) at a rate not to exceed 5 °C (9 °F) per hour.

(Amended 2004)

T.3.1.2. Temperature Limits. – *If a temperature range other than – 10 °C to 40 °C (14 °F to 104 °F) is specified for the device, the range shall be at least 30 °C (54 °F). [Nonretroactive as of January 1, 1990]*

(Added 1989)

T.3.2. Power Supply, Voltage, and Frequency. – A belt-conveyor scale system shall satisfy the tolerance requirements over a range of 100 V to 130 V or 200 V to 250 V as appropriate and over a frequency range of 59.5 Hz to 60.5 Hz.

UR. User Requirements

UR.1. Installation Requirements.

UR.1.1. Protection from Environmental Factors. – The indicating elements, the lever system or load cells, and the load-receiving element of a belt-conveyor scale shall be adequately protected from environmental factors such as wind, moisture, dust, weather, and radio frequency interference (RFI) and electromagnetic interference (EMI) that may adversely affect the operation or performance of the device.

UR.1.2. Conveyor Installation. – The design and installation of the conveyor leading to and from the belt-conveyor scale is critical with respect to scale performance. Installation shall be in accordance with the scale manufacturer's instructions and the following:

- (a) Installation - General.** – A belt-conveyor scale shall be so installed that neither its performance nor operation will be adversely affected by any characteristic of the installation, including but not limited to, the foundation, supports, covers, or any other equipment.
(Amended 2002)
- (b) Live Portions of Scale.** – All live portions of the scale shall be protected with appropriate guard devices and clearances, as recommended by the scale manufacturer, to prevent accidental interference with the weighing operation. (Also see UR.3.1. Scale and Conveyor Maintenance.)
(Amended 2004)
- (c) Storage of Simulated Load Equipment.** – Suitable protection shall be provided for storage of any simulated load equipment.
- (d) Take-up Device.** – Any take-up device shall provide constant and consistent tension for the belt under all operating conditions.
(Amended 2014)
- (e) Scale Location and Training Idlers.** – The scale shall be so installed that the first weigh idler of the scale is at least 6 m (20 ft) or five idler spaces, whichever is greater, from loading point, skirting, head or tail pulley, or convex curve in the conveyor. Any training idler shall be located at least 18 m (60 ft) from the centerline of the weigh span of the scale. Training idlers shall not be restrained at any time in order to force belt alignment.
(Amended 1998)
- (f) Concave Curve.** – If there is a concave curve in the conveyor, before or after the scale, the scale shall be installed so that the belt is in contact with all the idler rollers

at all times for at least 6 m (20 ft) or five idler spaces, whichever is greater, before and after the scale.² A concave curve shall start no closer than 12 m (40 ft) from the scale to the tangent point of the concave curve.

(Amended 1998)

- (g) Tripper and Movable Pulleys.** – There shall be no tripper or movable head pulleys in the conveyor.
- (h) Conveyor Orientation.** – The conveyor may be horizontal or inclined, but, if inclined, the angle shall be such that slippage of material along the belt does not occur.
- (i) Conveyor Stringers.** – Conveyor stringers at the scale and for not less than 6 m (20 ft) before and beyond the scale shall be continuous or securely joined and of sufficient size and so supported as to eliminate relative deflection between the scale and adjacent idlers when under load. The conveyor stringers should be so designed that the deflection between any two adjacent idlers within the weigh area does not exceed 0.6 mm (0.025 in) under load.
- (j) Identification of Scale Area.** – The scale area and five idlers on both ends of the scale shall be of a contrasting color, or other suitable means shall be used to distinguish the scale from the remainder of the conveyor installation, and the scale shall be readily accessible.
(Amended 1998)
- (k) Belt Composition and Maintenance.** – In a loaded or unloaded condition, the belt shall make constant contact with horizontal and wing rollers of the idlers in the scale area. Splices shall not cause any undue disturbance in scale operation. (Also see N.3. Test Procedures.)
(Amended 1998, 2000, 2001, and 2015)
- (l) Uniformity of Belt Loading and Flow.** – The conveyor loading mechanism shall be designed to provide uniform belt loading. The distance from the loading point to the scale shall allow for adequate settling time of the material on the belt before it is weighed. Feeding mechanisms shall have a positive closing or stopping action so that material leakage does not occur. Feeders shall provide an even flow over the scale through the full range of scale operation. Sufficient impact idlers shall be

² Installing the belt scale five-idler spaces from the tail pulley or the infeed skirting will be in the area of least belt tension on the conveyor and should produce the best accuracy. The performance of a belt-conveyor scale may be adversely affected by a concave curve in the conveyor that is located between the loading point and the scale. Therefore, whenever possible, a belt-conveyor scale should not be installed with a concave curve in the conveyor between the loading point and the scale.

(Amended 1995 and 1998)

provided in the conveyor under each loading point to prevent deflection of the belt during the time material is being loaded.

(m) Belt Alignment. – The belt shall not extend beyond the edge of the outermost roller of any carry side (top) roller in any area of the conveyor nor touch the conveyor structure on the return (bottom) side of the conveyor.

(Amended 1998 and 2008)

(Amended 2002, 2012, 2013, 2014, and 2015)

UR.1.3. Material Test. – *A belt-conveyor scale shall be installed so that a material test can be conveniently conducted.*

[Nonretroactive as of January 1, 1981]

UR.1.4. Belt Travel (Speed or Velocity). – The belt travel sensor shall be so positioned that it accurately represents the travel of the belt over the scale for all flow rates between the maximum and minimum values. The belt travel sensor shall be so designed and installed that there is no slip.

(Amended 2012)

UR.2. Use Requirements.

UR.2.1. Rate of Operation. – A belt-conveyor scale system shall be operated between 20 % and 100 % of its rated capacity.

(Amended 2004)

UR.2.2. Minimum Totalized Load. – Delivered quantities of less than the minimum test load shall not be considered a valid weighment.

UR.2.3. Security Means. – When a security means has been broken, it shall be reported to the official with statutory authority.

(Amended 1991)

UR.2.4. Loading. – The feed of material to the scale shall be controlled to assure that, during normal operation, the material flow is in accordance with the manufacturer's recommendation for rated capacity.

UR.2.5. Diversion or Loss of Measured Product. – There shall be no operation(s) or condition(s) of use that result in loss or diversion that adversely affects the quantity of measured product.

(Added 2005)

UR.2.6. Retention of Maintenance, Test, and Analog or Digital Recorder Information. – Records of calibration and maintenance, including conveyor alignment, analog or digital recorder, zero-load test, and material test data shall be maintained on site for at least the three concurrent years as a history of scale performance. Copies of any report as a result of a test or repair shall be mailed to the official with statutory authority as required. The

current date and correction factor(s) for simulated load equipment shall be recorded and maintained in the scale cabinet.

(Added 2002)

(Amended 2012)

UR.3. Maintenance Requirements – Scale and Conveyor Maintenance. – Weighing systems and idlers shall be maintained and serviced in accordance with manufacturer's instructions and the following:

(a) Zero Balance. – The zero-balance condition of a belt-conveyor scale shall be maintained such that, prior to beginning any commercial transaction, with no load on the belt, the zero-balance condition is within:

- i. ± 0.12 % of the scale's rated capacity for systems marked Class 0.25; and
- ii. ± 0.05 % of the scale's rated capacity for systems marked Class 0.1.

(Added 2012) (Amended 2019)

(b) Scale Clearance. – The scale and area surrounding the scale shall be kept clean of debris or other foreign material that can detrimentally affect the performance of the system.

(c) Weighed Material. – There shall be provisions to ensure that weighed material does not adhere to the belt and return to the scale system area.

(Added 2004)

(d) Simulated and Zero-Load Test Intervals. – Zero-load tests and simulated load or material tests shall be conducted at periodic intervals between official tests and after a repair or mechanical adjustment to the conveyor system in order to provide reasonable assurance that the device is performing correctly. The minimum interval for periodic zero-load tests and simulated load tests shall be established by the official with statutory authority or according to manufacturer recommendations.

- (1) The actions to be taken as a result of the zero-load test are shown in the following table.

Table UR.3. (d) (i) - Zero-Load Test Intervals and Actions

Change in Zero ($\Delta 0$)	Actions to be Taken
If the change in zero is less than $\pm 0.25\%$ ($\Delta 0 < 0.25\%$)	Perform zero adjustment and proceed to simulated load test.
If the change in zero is $\pm 0.25\%$ to $\pm 0.5\%$ ($0.25\% \leq \Delta 0 \leq 0.5\%$)	Inspect the conveyor and weighing area for compliance with UR.1. Installation Requirements and repeat the zero-load test.
If the change in zero is greater than $\pm 0.5\%$ ($\Delta 0 > 0.5\%$)	Inspect the conveyor and weighing area for compliance with UR.1. Installation Requirements, repeat the zero-load test, and reduce the interval between zero-load tests.

(2) The action to be taken as a result of the simulated load or material tests is shown in the following table.

Table UR.3. (d) (ii) - Simulated Load or Material Test Intervals and Actions

Change in Factor (Reference) Established in N.3.3.(b) [Δ N.3.3.(b)]	Action to be Taken
For scales not marked with an accuracy class and those marked Class 0.25, if the error is less than 0.25 %: (Δ N.3.3.(b) < 0.25 %)	No Action
For scales marked Class 0.1, if the error is less than 0.1%: (Δ N.3.3.(b) < 0.1%)	No Action
For scales not marked with an accuracy class and those marked Class 0.25, if the error is at least 0.25 % but not more than 0.6 %: ($0.25\% \leq \Delta$ N.3.3.(b) $\leq 0.6\%$)	Inspect the conveyor and weighing area for compliance with UR.1. Installation Requirements and, after compliance is verified, repeat the test. If the result of that test remains greater than $\pm 0.25\%$, for scales not marked with an accuracy class and those marked Class 0.25, or greater than $\pm 0.1\%$ for scales marked Class 0.1, a span correction shall be made and the official with statutory authority notified. (Amended 1991 and 2019)

CCR Title 4, Div. 9, CCR §§ 4000.
2023 Edition of NIST HB 44 Section 2.21. Belt-Conveyor Scale Systems

Change in Factor (Reference) Established in N.3.3.(b) [Δ N.3.3.(b)]	Action to be Taken
<p>For scales marked Class 0.1, if the error is at least 0.1% but not more than 0.25%:</p> <p>($0.1\% \leq \Delta$ N.3.3.(b) $\leq 0.25\%$)</p>	<p>Inspect the conveyor and weighing area for compliance with UR.1. Installation Requirements and, after compliance is verified, repeat the test.</p> <p>If the result of that test remains greater than $\pm 0.25\%$, for scales not marked with an accuracy class and those marked Class 0.25, or greater than $\pm 0.1\%$ for scales marked Class 0.1, a span correction shall be made and the official with statutory authority notified. (Amended 1991 and 2019)</p>
<p>For scales not marked with an accuracy class and those marked Class 0.25, if the error is greater than 0.6 % but does not exceed 0.75 %:</p> <p>($0.6\% < \Delta$ N.3.3.(b) $\leq 0.75\%$)</p>	<p>Inspect the conveyor and weighing area for compliance with UR.1. Installation Requirements and, after compliance is verified, repeat the test.</p> <p>If the result of that test remains greater than $\pm 0.6\%$, for scales not marked with an accuracy class and those marked Class 0.25, or greater than $\pm 0.25\%$ for scales marked Class 0.1, a span correction shall be made, the official with statutory authority shall be notified, and an official test shall be conducted. (Amended 1991 and 2019)</p>
<p>For scales marked Class 0.1, if the error is greater than 0.25% but does not exceed 0.3%:</p> <p>($0.25\% < \Delta$ N.3.3.(b) $\leq 0.3\%$)</p>	<p>Inspect the conveyor and weighing area for compliance with UR.1. Installation Requirements and, after compliance is verified, repeat the test.</p> <p>If the result of that test remains greater than $\pm 0.6\%$, for scales not marked with an accuracy class and those marked Class 0.25, or greater than $\pm 0.25\%$ for scales marked Class 0.1, a span correction shall be made, the official with statutory authority shall be notified, and an official test shall be conducted. (Amended 1991 and 2019)</p>
<p>For scales not marked with an accuracy class and those marked Class 0.25, if the error is greater than 0.75 %:</p> <p>(Δ N.3.3.(b) $> 0.75\%$)</p>	<p>An official test is required. (Amended 1987)</p>

CCR Title 4, Div. 9, CCR §§ 4000.
2023 Edition of NIST HB 44 Section 2.21. Belt-Conveyor Scale Systems

Change in Factor (Reference) Established in N.3.3.(b) [Δ N.3.3.(b)]	Action to be Taken
For scales marked Class 0.1, if the error is greater than 0.3%: (Δ N.3.3.(b) > 0.3 %)	An official test is required. (Amended 1987)

(Amended 2002, 2009, and 2019)

(e) Scale Alignment. – Alignment checks shall be conducted in accordance with the manufacturer’s recommendation. A material test is required after any realignment.
(Amended 1986, 2000, and 2015)

(f) Simulated Load Equipment. – Simulated load equipment shall be clean and properly maintained.

(g) Zero Load Reference Information. – When zero load reference information is recorded for a delivery, the information must be based upon zero load tests performed as a minimum both immediately before and immediately after the totalized load.

(Added 2002)

(Amended 1986, 2000, 2002, 2004, 2009, 2012, and 2015)

UR.4. Compliance. – Prior to initial verification, the scale manufacturer or installer shall certify to the owner that the scale meets code requirements. Prior to initial verification and each subsequent verification, the scale owner or his agent shall notify the official with statutory authority in writing that the belt-conveyor scale system is in compliance with this specification and ready for material testing.

(Amended 1991)

Table of Contents

Section 2.22. Automatic Bulk Weighing Systems	91
A. Application	91
A.1. General.	91
A.2. Exceptions.....	91
A.3. Additional Code Requirements.....	91
S. Specifications	91
S.1. Design of Indicating and Recording Elements and Recorded Representations.	91
S.1.1. Zero Indication.....	91
S.1.2. <i>Value of Scale Division (d)</i>	91
S.1.3. Capacity Indication and Recorded Representation.	92
S.1.4. Weighing Sequence.	92
S.1.5. Recording Sequence.	92
S.1.6. Provision for Sealing Adjustable Components on Electronic Devices.	92
S.2. Design of Balance and Damping Mechanism.....	92
S.2.1. Zero-Load Adjustment.	92
S.2.2. Damping Means.	92
S.3. Interlocks and Gate Control.....	93
S.3.1. Gate Position.	93
S.3.2. Interlocks.	93
S.3.3. Overfill Sensor.	93
S.4. Design of Weighing Elements.	94
S.4.1. Antifriction Means.	94
S.4.2. Adjustable Components.	94
S.4.3. Multiple Load-Receiving Elements.	94
S.4.4. Venting.	94
S.5. Marking Requirements.	94
S.5.1. Capacity and Value of the Scale Division.	94
S.5.2. Weighing Elements.....	94
S.5.3. <i>Temperature Limits</i>	94
S.5.4. <i>Accuracy Class</i>	94
N. Notes	95
N.1. Testing Procedures.	95
N.1.1. Test Weights.	95
N.1.2. Increasing-Load Test.....	95
N.1.3. Decreasing-Load Test.	95
N.1.4. Zero-Balance or No-Load Reference Value Change Test.	95
N.1.5. <i>Discrimination Test</i>	95
N.2. Verification (Testing) Standards.	95
T. Tolerances	96

CCR Title 4, Div. 9, CCR §§ 4000.
2023 Edition of NIST HB 44 Section 2.22 – Automatic Bulk Weighing Systems

T.1. Tolerance Application.....	96
T.1.1. To Errors of Underregistration and Overregistration.....	96
T.1.2. To Increasing-Load Tests.....	96
T.1.3. To Decreasing-Load Tests.	96
T.1.4. To Tests Involving Digital Indications or Representations.	96
T.2. Minimum Tolerance Values.....	96
T.2.1. For Systems Used to Weigh Construction Materials.	96
T.3. Basic Tolerance Values.	96
T.3.1. Acceptance Tolerance.....	96
T.3.2. For Systems Used to Weigh Grain.	96
T.3.3. For All Other Systems.	96
T.4. <i>Time Dependence</i>	97
T.5. Repeatability.	97
T.6. Discrimination, Digital Automatic Indicating Scales.....	97
T.7. <i>Influence Factors</i>	97
T.7.1. <i>Temperature</i>	97
T.7.2. <i>Barometric Pressure</i>	98
T.7.3. Electric Power Supply.....	98
UR. User Requirements	98
UR.1.Selection Requirements.....	98
<i>UR.1.1.For Systems used to Weigh Grain.</i>	98
<i>U.R.1.2. For Systems used to Weigh Commodities other than Grain.</i>	98
UR.2.Installation Requirements.....	98
UR.2.1.Protection from Environmental Factors.	98
UR.2.2.Foundation, Supports, and Clearance.....	99
UR.3.Loading Requirements.....	99
UR.3.1.For Systems Used to Weigh Grain.....	99
<i>UR.3.2.For Systems Used to Weigh Commodities Other than Grain.</i>	99
UR.4.System Modification.....	99

Section 2.22. Automatic Bulk Weighing Systems¹

A. Application

A.1. General. – This code applies to automatic bulk weighing systems, that is, weighing systems adapted to the automatic weighing of a commodity in successive drafts of predetermined amounts automatically recording the no-load and loaded weight values and accumulating the net weight of each draft.

(Amended 1987)

A.2. Exceptions. – This code does not apply to batching systems.

(Added 2018)

A.3. Additional Code Requirements. – In addition to the requirements of this code, Automatic Bulk Weighing Systems shall meet the requirements of Section 1.10. General Code.

S. Specifications

S.1. Design of Indicating and Recording Elements and Recorded Representations.

S.1.1. Zero Indication. – Provisions shall be made to indicate and record a no-load reference value and, if the no-load reference value is a zero value indication, to indicate and record an out-of-balance condition on both sides of zero.

S.1.1.1. Digital Zero Indication. – A digital zero indication shall represent a balance condition that is within $\pm \frac{1}{2}$ the value of the scale division.

S.1.2. Value of Scale Division (d). – *The value of the scale division (d), expressed in a unit of weight, shall be equal to:*

(a) 1, 2, or 5; or

(b) a decimal multiple or submultiple of 1, 2, or 5; or

(c) a binary submultiple of a unit of weight.

Examples: Scale divisions may be 0.01, 0.02, or 0.05; 0.1, 0.2, or 0.5; 1, 2, or 5; 10, 20, or 50; or $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{16}$, etc.

[Nonretroactive as of January 1, 1986]

(Amended 1987)

¹ (Title amended 1986)

S.1.3. Capacity Indication and Recorded Representation. – An indicating or recording element shall not indicate or record any values when the gross load is in excess of 105 % of the capacity of the system.

S.1.4. Weighing Sequence. – For systems used to receive (weigh in), the no-load reference value shall be determined and recorded only at the beginning of each weighing cycle. For systems used to deliver (weigh out), the no-load reference value shall be determined and recorded only after the gross load reference value for each weighing cycle has been indicated and recorded.

S.1.5. Recording Sequence. – Provision shall be made so that all weight values are indicated until the completion of the recording of the indicated value.

S.1.6. Provision for Sealing Adjustable Components on Electronic Devices. – For devices and systems in which the configuration or calibration parameters can be changed by use of a removable digital storage device, security shall be provided for those parameters as specified in G-S.8.2. Devices and Systems Adjusted Using Removable Digital Storage Devices. For parameters adjusted using other means, provision shall be made for applying a security seal in a manner that requires the security seal to be broken before an adjustment can be made to any component affecting the performance of the device.

(Amended 2019)

S.2. Design of Balance and Damping Mechanism.

S.2.1. Zero-Load Adjustment. – The weighing system shall be equipped with manual or semiautomatic means by which the zero-load balance or no-load reference value indication may be adjusted. Automatic zero-tracking and automatic zero-setting mechanisms are prohibited.

(Amended 2010)

S.2.1.1. Manual. – A manual zero-load or no-load reference value setting mechanism shall be operable or accessible only by a tool outside of or entirely separate from this mechanism or enclosed in a cabinet.

S.2.1.2. Semiautomatic. – A semiautomatic zero-load or no-load reference value setting mechanism shall meet the provisions of S.2.1.1. or shall be operable only when:

- (a) the indication is stable within ± 3 scale divisions; and
- (b) cannot be operated during a weighing operation.

S.2.2. Damping Means. – A system shall be equipped with effective means necessary to bring the indications quickly to a readable, stable equilibrium. Effective means shall also be provided to permit the recording of weight values only when the

indication is stable within plus or minus three scale divisions for devices with 10 000 scale divisions, or plus or minus one division for devices with less than 10 000 scale divisions.

S.3. Interlocks and Gate Control.

S.3.1. Gate Position. – Provision shall be made to clearly indicate to the operator the position of the gates leading directly to and from the weigh hopper.

S.3.2. Interlocks. – Each automatic bulk weighing system shall have operating interlocks to provide for the following:

- (a) Product cannot be cycled and weighed if the weight recording element is disconnected or subjected to a power loss.
- (b) The recording element cannot print a weight if either of the gates leading directly to or from the weigh hopper is open.
- (c) A “low paper” sensor, when provided, is activated.
- (d) The system will operate only in the proper sequence in all modes of operation.
- (e) When an overfill alarm is activated, the system shall indicate and record an overfill condition.

(Amended 1993)

S.3.3. Overfill Sensor.

- (a) The weigh hopper shall be equipped with an overfill sensor which will cause the feed gate to close, activate an alarm, and inhibit weighing until the overfill condition has been corrected.

(Added 1993)

- (b) *If the system is equipped with a lower garner or surge bin, that garner shall also be equipped with an overfill sensor which will cause the gate of the weigh hopper to remain open, activate an alarm, and inhibit weighing until the overfill condition has been corrected.*

[Nonretroactive as of January 1, 1998]

(Amended 1997)

S.4. Design of Weighing Elements.

S.4.1. Antifriction Means. – At all points at which a live part of the mechanism may come into contact with another part in the course of normal usage, frictional effects shall be reduced to a minimum by means of suitable antifriction means, opposing surfaces and points being properly shaped, finished, and hardened.

S.4.2. Adjustable Components. – An adjustable component, such as a potentiometer, shall be held securely in adjustment and, except for a component for adjusting level or a no-load reference value, shall not be adjustable from the outside of the device.

S.4.3. Multiple Load-Receiving Elements. – A system with a single indicating or recording element, or a combination indicating recording element, that is coupled to two or more load-receiving elements with independent weighing systems, shall be provided with means to prohibit the activation of any load-receiving element (or elements) not in use, and shall be provided with automatic means to indicate clearly and definitely which load-receiving element (or elements) is in use.

S.4.4. Venting. – All weighing systems shall be vented so that any internal or external pressure will not affect the accuracy or operation of the system.

S.5. Marking Requirements. (Also see Section 1.10. General Code paragraph G-S.1. Identification.)

S.5.1. Capacity and Value of the Scale Division. – The capacity of the weighing system and the value of the scale division shall be clearly and conspicuously marked on the indicating element near the weight value indications.

S.5.2. Weighing Elements. – On a weighing element not permanently attached to an indicating element, there shall be clearly and permanently marked for the purposes of identification, the name, initials, or trademark of the manufacturer, the manufacturer's designation that positively identifies the pattern or design, and the nominal capacity.

S.5.3. Temperature Limits. – *Unless the temperature range is – 10 °C to + 40 °C (14 °F to 104 °F), the temperature range shall be marked on the device.*

[Nonretroactive as of January 1, 1986]

(Added 1985)

S.5.4. Accuracy Class.

*(a) All systems used to weigh grain shall be marked Class III.**

*(b) All other systems shall be marked either Class III or III L.**

*(*Also see Section 2.20. Scales Code for the parameters for these accuracy classes for scales. The specific requirements for automatic bulk weighing systems apply to these devices when there is a conflict between the Scales Code and the Automatic Bulk Weighing Systems Code.)*

[Nonretroactive as of January 1, 1986]

(Added 1985) (Amended 1992)

N. Notes

N.1. Testing Procedures.

N.1.1. Test Weights. – The increasing load test shall be conducted using test weights equal to at least 10 % of the capacity of the system:

(a) on automatic grain bulk-weighing systems installed after January 1, 1984; and

(b) on other automatic bulk-weighing systems installed after January 1, 1986.

(Amended 1987)

N.1.2. Increasing-Load Test. – An increasing-load test consisting of substitution and strain-load tests shall be conducted up to the used capacity of the weighing system.

(Amended 1987)

N.1.3. Decreasing-Load Test. – A decreasing-load test shall be conducted on devices used to weigh out.

(Added 1986)

N.1.4. Zero-Balance or No-Load Reference Value Change Test. – A test for change of zero-balance or no-load reference value shall be conducted on all scales after the removal of any test load. The change shall not be more than the minimum tolerance applicable.

N.1.5. Discrimination Test. – *A discrimination test shall be conducted on all automatic indicating scales with the weighing device in equilibrium at zero-load and at maximum test load, and under controlled conditions in which environmental factors are reduced to the extent that they will not affect the results obtained.*

[Nonretroactive as of January 1, 1986]

N.1.5.1. Digital Device. – On a digital device, this test is conducted from just below the lower edge of the zone of uncertainty for increasing-load tests, or from just above the upper edge of the zone of uncertainty for decreasing-load tests.

(Added 1987)

N.2. Verification (Testing) Standards. – Standard weights and masses used in verifying weighing devices shall comply with requirements of NIST Handbook 105-1 (Class F) or

the tolerances expressed in Appendix A, Fundamental Considerations, paragraph 3.2. (i.e., one-third of the smallest tolerance applied).

T. Tolerances

T.1. Tolerance Application. – Tolerance values shall be applied to all indications and recorded representations of a weighing system.

T.1.1. To Errors of Underregistration and Overregistration. – The tolerances hereinafter prescribed shall be applied equally to errors of underregistration and errors of overregistration.

T.1.2. To Increasing-Load Tests. – Basic tolerances shall be applied.

T.1.3. To Decreasing-Load Tests. – Basic tolerances shall be applied to systems used to weigh out.

(Added 1986)

T.1.4. To Tests Involving Digital Indications or Representations. – To the tolerances that would otherwise be applied, there shall be added an amount equal to one-half the value of the scale division. This does not apply to digital indications or recorded representations that have been corrected for rounding using error weights.

(Added 1986)

T.2. Minimum Tolerance Values. – The minimum tolerance value shall not be less than half the value of the scale division.

T.2.1. For Systems Used to Weigh Construction Materials. – The minimum maintenance and acceptance tolerance shall be 0.1 % of the weighing capacity of the system, or the value of the scale division, whichever is less.

(Added 1986)

T.3. Basic Tolerance Values.

T.3.1. Acceptance Tolerance. – The basic acceptance tolerance shall be one-half the basic maintenance tolerance.

T.3.2. For Systems Used to Weigh Grain. – The basic maintenance tolerance shall be 0.1 % of test load.

T.3.3. For All Other Systems. – The basic maintenance tolerance shall be 0.2 % of test load.

(Amended 1986)

T.4. Time Dependence. – *At constant test conditions, the indication 20 seconds after the application of a load and the indication after one hour shall not differ by more than the absolute value of the applicable tolerance for the applied load.*

[Nonretroactive and enforceable as of January 1, 1987]

(Added 1986)

T.5. Repeatability. – *The results obtained by several weighings of the same load under reasonably static test conditions shall agree within the absolute value of the maintenance tolerance for that load, and shall be within applicable tolerances.*

(Added 1986)

T.6. Discrimination, Digital Automatic Indicating Scales. – *A test load equivalent to 1.4 d shall cause a change in the indicated or recorded value of at least 2.0 d. This requires the zone of uncertainty to be not greater than 0.3 times the value of the scale division.*

(Added 1985)

T.7. Influence Factors. – *The following factors are applicable to tests conducted under controlled conditions only, provided that:*

(a) types of devices approved prior to January 1, 1986, and manufactured prior to January 1, 1988, need not meet the requirements of this section; and

(b) new types of devices submitted for approval after January 1, 1986, shall comply with the requirements of this section; and

(c) all devices manufactured after January 1, 1988, shall comply with the requirements of this section.

[Nonretroactive as of January 1, 1986]

T.7.1. Temperature. – *Devices shall satisfy the tolerance requirements under the following temperature conditions:*

T.7.1.1. *If not marked on the device, the temperature limits shall be: – 10 °C to 40 °C (14 °F to 104 °F).*

T.7.1.2. *If temperature limits are specified for the device, the range shall be at least 30 °C (54 °F).*

T.7.1.3. Temperature Effect on Zero-Load Balance. – *The zero-load indicator shall not vary by more than one division per 5 °C (9 °F) change in temperature.*

T.7.1.4. Operating Temperature. – *An indicating or recording element shall not display or record any usable values until the operating temperature necessary for accurate weighing and a stable zero-balance condition has been attained.*

[Nonretroactive as of January 1, 1986]

T.7.2. Barometric Pressure. – *The zero indication shall not vary by more than one scale division for a change in barometric pressure of 1 kPa over the total barometric range of 95 kPa to 105 kPa (28 in to 31 in of mercury).*
[Nonretroactive as of January 1, 1986]

T.7.3. Electric Power Supply.

T.7.3.1. Power Supply, Voltage, and Frequency.

- (a) Weighing devices that operate using alternating current must perform within the conditions defined in paragraphs T.2. through T.7., inclusive over the line voltage range of 100 V to 130 V or 200 V to 250 V rms as appropriate and over the frequency range of 59.5 Hz to 60.5 Hz.
- (b) Battery-operated instruments shall not indicate nor record values outside the applicable tolerance limits when battery power output is excessive or deficient.

T.7.3.2. Power Interruption. – *A power interruption shall not cause an indicating or recording element to display or record any values outside the applicable tolerance limits.*

[Nonretroactive as of January 1, 1986]

(Added 1985)

UR. User Requirements

UR.1. Selection Requirements.

UR.1.1. For Systems used to Weigh Grain. – *The number of scale divisions of a weighing system shall not be less than 2 000 nor greater than 10 000 divisions.*

[Nonretroactive as of January 1, 1984]

(Amended 1986 and 1992)

U.R.1.2. For Systems used to Weigh Commodities other than Grain. – *The number of scale divisions shall not be less than 500 nor greater than 10 000.*

[Nonretroactive as of January 1, 1987]

(Added 1986)

UR.2. Installation Requirements.

UR.2.1. Protection from Environmental Factors. – The indicating elements, the lever system or load cells, the load-receiving element, and any permanently installed test weights shall be adequately protected from environmental factors such as wind, weather, and RFI that may adversely affect the operation or performance of the system.

UR.2.2. Foundation, Supports, and Clearance. – The foundation and supports of any system shall be such as to provide strength, rigidity, and permanence of all components, and clearance shall be provided around all live parts so that no contact can result before or during operation of the system.

UR.3. Loading Requirements.

UR.3.1. For Systems Used to Weigh Grain. – A system shall not be used to weigh drafts less than 40 % of the weighing capacity of the system except for a final partial draft. Loads shall not normally be retained on the weighing element for a period longer than a normal weighing cycle.

(Amended 1986)

UR.3.2. For Systems Used to Weigh Commodities Other than Grain. – *A system shall not be used to weigh drafts less than 20 % of the weighing capacity of the system except for a final partial draft. Loads shall not normally be retained on the weighing element for a period longer than a normal weighing cycle.*

[Nonretroactive as of January 1, 1987]

(Added 1986)

UR.4. System Modification. – The weighing system shall not be modified except when the modification has been approved by a competent engineering authority, preferably that of the engineering department of the manufacturer of the scale, and the official with statutory authority having jurisdiction over the scale.

(Amended 1991)

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Table of Contents

Section 2.23. Weights	101
A. Application	101
A.1. General.	101
A.2. Exceptions.....	101
A.3. Additional Code Requirements.....	101
S. Specifications	101
S.1. Material.	101
S.2. Design.	101
S.2.1. Surface.	101
S.2.2. Ring.	101
S.4. Marking Requirements.	101
S.4.1. General.	101
S.4.2. Apothecaries' Weights.	101
S.4.3. Troy Weights.....	101
S.4.4. Metric Weights.	102
S.4.5. Carat Weights.	102
S.4.6. Counterpoise Weight.	102
N. Notes	102
N.1. Testing Procedures	102
T. Tolerances	102
T.1. In Excess and In Deficiency.	102
T.3. On Metric Weights.....	104
T.4. On Carat Weights.....	104
T.5. On Apothecaries and Troy Weights.....	106

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Section 2.23. Weights

A. Application

- A.1. General.** – This code applies to commercial weights; that is, weights used in connection with commercial weighing devices.
- A.2. Exceptions.** – This code does not apply to test weights or to other “standards” of mass.
- A.3. Additional Code Requirements.** – In addition to the requirements of this code, Weights shall meet the requirements of Section 1.10. General Code.

S. Specifications

S.1. Material. – The material used for weights shall be as follows:

- (a) Weights of 6 g or 100 gr and larger shall be made of a metal, or a metal alloy, not softer than brass.
- (b) Weights of less than 6 g or 100 gr may be made of aluminum, but shall not be made of iron or of unplated steel, except stainless steel.

S.2. Design.

S.2.1. Surface. – The surface of a weight shall be smooth and shall not be coated with thick, soft, or brittle material. A weight of more than 2 grams or 30 grains or shall not have sharp edges, points, or corners.

S.2.2. Ring. – A ring on a weight shall not be split or removable.

S.3. Adjusting Material. – Adjusting material shall be securely positioned and shall not project beyond the surface of the weight.

S.4. Marking Requirements.

S.4.1. General. – A weight shall be marked to show clearly its nominal value, which shall include identification of the unit; however, the nominal value of a weight of 2 grams or 30 grains, or less, may be designated by dots, lines, figures, distinctive shape, or other appropriate means.

S.4.2. Apothecaries’ Weights. – On apothecaries’ dram, ounce, and pound weights, the letters “ap” shall be used in combination with the nominal value and the appropriate abbreviation of or symbol for the unit.

S.4.3. Troy Weights. – On troy ounce and pound weights, the letter “t” shall be used in combination with the nominal value and the appropriate symbol of the unit.

S.4.4. Metric Weights. – On metric weights, the symbols “kg,” “g,” and “mg” shall be used in combination with the nominal value of kilograms, grams, and milligrams, respectively.

S.4.5. Carat Weights. – On carat weights, the letter “c” shall be used in combination with the nominal value.

S.4.6. Counterpoise Weight. – A counterpoise weight shall be marked to show clearly both its nominal value and the value it represents when used on the multiplying-lever scale for which it is intended.

N. Notes

N.1. Testing Procedures. – Commercial weights should be tested on a precision balance using standard weights, the errors of which, when used without correction, do not exceed $\frac{1}{3}$ of the smallest tolerance to be applied. (Also see Appendix A, Fundamental Considerations, paragraphs 3.2. Tolerance for Standards and 3.3. Accuracy of Standards.)

T. Tolerances

T.1. In Excess and In Deficiency. – The tolerances hereinafter prescribed shall be applied equally to errors in excess and errors in deficiency.

T.2. On Avoirdupois Weights. – The maintenance tolerances shall be as shown in Table 1. Maintenance Tolerance for Avoirdupois Weights. Acceptance tolerances shall be one-half the maintenance tolerances.

Table 1. Maintenance Tolerance for Avoirdupois Weights Maintenance Tolerance

Nominal Value	Equal-Arm Weights	Equal-Arm Weights	Counterpoise Weights			
			for scales with multiples of less than 1000 grains	for scales with multiples of less than 1000 mg	for scales with multiples of 1000 or over grains	for scales with multiples of 1000 or over mg
oz	grains	mg				
1/64	0.1	6				
1/32	0.3	19				
1/16	0.4	26				
1/8	0.5	32				
1/4	1.0	65				
1/2	1.5	97	1.0	65		
1	1.7	110	1.0	65		
2	2.0	130	1.0	65		
3	2.0	130	1.5	97		
4	3.0	190	1.5	97	1.0	65
5	3.5	230	1.5	97	1.0	65
6	3.5	230	1.5	97		
8	4.0	260	2.0	130	1.5	97
10	4.0	260	2.5	160	2.0	130
12	5.0	320	2.5	160	2.0	130

Nominal Value	Equal-Arm Weights	Equal-Arm Weights	Counterpoise Weights			
			for scales with multiples of less than 1000 grains	for scales with multiples of less than 1000 mg	for scales with multiples of 1000 or over grains	for scales with multiples of 1000 or over mg
Lb	grains	mg				
1	5.0	320	3.0	190	2.5	160
2	7.0	450	6.0	390	4.0	260
3	9.0	580	9.0	580	5.0	320
4	11.0	710	11.0	710	6.0	390
5	15.0	970	12.0	780	6.5	420
6	17.0	1190				
7	19.0	1200				

CCR Title 4, Div. 9, CCR §§ 4000.
2023 Edition of NIST HB 44 Section 2.23. Weights

Nominal Value	Equal-Arm Weights	Equal-Arm Weights	Counterpoise Weights			
			for scales with multiples of less than 1000 grains	for scales with multiples of less than 1000 mg	for scales with multiples of 1000 or over grains	for scales with multiples of 1000 or over mg
Lb	grains	mg				
8	21.0	1400	15.0	970	9.0	580
9	23.0	1500				
10	25.0	1600	18.0	1160	10.0	650
15	28.0	1800				
20	30.0	1900				
25	35.0	2300				
30	40.0	2600				
40	45.0	2900				
50	50.0	3200				

T.3. On Metric Weights. – The maintenance tolerances shall be as shown in Table 2. Maintenance Tolerances for Metric Weights. Acceptance tolerances shall be one-half the maintenance tolerances.

T.4. On Carat Weights. – The maintenance tolerances shall be as shown in Table 2. Maintenance Tolerances for Metric Weights. Acceptance tolerances shall be one-half the maintenance tolerances.

Table 2. Maintenance Tolerances for Metric Weights

Nominal Value (mg)	Maintenance Tolerance (mg)	Nominal Value (g)	Maintenance Tolerance (mg)
5 or less	0.1	1	4
10	0.3	2	6
20	0.4	3	8
30	0.6	5	10
50	0.8	10	15
100	1.0	20	20
200	1.5	30	30
300	2.0	50	40
500	3.0	100	70
		200	100
		300	150
		500	175

Table 2. Maintenance Tolerances for Metric Weights (Continued)

Nominal Value (kg)	Maintenance Tolerance (mg)	Nominal Value (carats)	Maintenance Tolerance (mg)
1	250	0.25*	0.6
2	400	0.5**	1.0
3	500	1.0	1.5
5	800	2.0	2.0
10	1000	3.0	3.0
20	1500	5.0	4.0
		10.0	6.0
		20.0	10.0
		30.0	12.0
		50.0	15.0
		100.0	25.0
		*25 points or less	
		**50 points	

T.5. On Apothecaries and Troy Weights. – The maintenance tolerances shall be as shown in Table 3. Maintenance Tolerances for Apothecaries’ and Troy Weights. Acceptance tolerances shall be one-half the maintenance tolerances.

Table 3. Maintenance Tolerances for Apothecaries’ and Troy Weights

Nominal Value	Maintenance Tolerance		Nominal Value	Maintenance Tolerance	
grains	grains	mg	oz	grains	mg
1	0.01	0.6	1	0.4	25.0
2	0.02	1.3	2	0.6	40.0
3	0.03	2.0	3	1.0	65.0
5	0.03	2.0	4	1.5	100.0
10	0.04	2.5	5	1.6	105.0
20	0.06	4.0			
scruples	grains	mg	oz	grains	mg
1	0.06	4.0	6	1.8	115.0
2	0.10	6.5	7	1.9	125.0
			8	2.0	130.0
			9	2.1	135.0
			10	2.2	145.0
dr	grains	mg	oz	grains	mg
0.5	0.07	4.5	11	2.4	155.0
1.0	0.10	6.5	12	2.5	160.0
2.0	0.20	13.0	20	2.9	190.0
3.0	0.30	20.0	30	3.7	240.0
4.0	0.40	25.0	50	5.4	350.0
5.0	0.50	30.0			
6.0	0.60	40.0			
dwt	grains	mg	oz	grains	mg
1	0.06	4.0	100	7.7	500.0
2	0.10	6.5	200	12.3	800.0
3	0.15	10.0	300	15.4	1 000.0
4	0.20	13.0	500	23.1	1 500.0
5	0.30	20.0	1 000	38.6	2 500.0
10	0.40	25.0			

Table of Contents

A. Application	107
A.1. General.	107
A.2. Exceptions.....	108
A.3. Additional Code Requirements.....	108
S. Specifications	108
S.1. Design of Indicating and Recording Elements and of Recorded Representations.	108
S.1.1. Zero Indication.	108
S.1.2. Value of Division Units.....	109
S.1.3. Provision for Sealing.....	109
S.1.4. Automatic Calibration.....	110
S.1.5. Adjustable Components.....	111
S.2. Design of Zero and Tare Mechanisms.	111
S.2.1. Zero Load Adjustment.....	111
S.2.2. Tare.	111
S.3. Verification Scale Interval.....	111
S.3.1. Multiple Range and Multi-Interval Automatic Weighing System.....	111
S.3.2. Load Cell Verification Interval Value.	112
S.3.3. Value of “e”.	112
S.4. Weight Indicators, Weight Displays, Reports, and Labels.	112
S.4.1. Additional Digits in Displays.....	112
S.4.2. Damping.	113
S.4.3. Over Capacity Indication.....	113
S.4.4. Label Printer.	113
S.5. Accuracy Class.....	113
S.5.1. Marking.....	113
S.6. Parameters for Accuracy Classes.	113
S.7. Marking Requirements.	114
S.7.1. Location of Marking Information.....	114
S.7.2. Marking Required on Components of Automatic Weighing Systems.....	117
N. Notes	117
N.1. Test Requirements for Automatic Weighing Systems.	117
N.1.1. Test Pucks and Packages.	117
N.1.2. Accuracy of Test Pucks or Packages.....	117
N.1.3. Verification (Testing) Standards.....	117
N.1.4. Radio Frequency Interference (RFI) and Other Electromagnetic Interference Susceptibility, Field Evaluation.	117

CCR Title 4, Div. 9, CCR §§ 4000.
2023 Edition of NIST HB 44 Section 2.24. Automatic Weighing Systems

N.1.5. Tests Loads.	118
N.1.6. Influence Factor Testing.	118
N.2. Test Procedures - Weigh-Labelers.....	118
N.2.1. Non-Automatic Tests.	118
N.2.2. Automatic Test Procedures.....	119
N.3. Test Procedures - Automatic Checkweigher.	119
N.3.1. Tests Non-Automatic.	119
N.3.2. Automatic Tests.	119
T. Tolerances	120
T.1. Principles.....	120
T.1.1. Design.....	120
T.1.2. Scale Division.	120
T.2. Tolerance Application.....	120
T.2.1. General.....	120
T.2.2. Type Evaluation Examinations.....	120
T.2.3. Subsequent Verification Examinations.	120
T.2.4. Multiple Range and Multi-Interval Automatic Weighing System.....	120
T.3. Tolerance Values.	120
T.3.1. Tolerance Values – Class III Weigh-Labeler.....	121
T.3.2. Tolerance Values - Class IIIS Weigh-labelers in Package Shipping Applications.	121
T.3.3. Tolerance Values.....	122
T.4. Agreement of Indications.....	123
T.5. Repeatability.....	123
T.6. Discrimination.....	123
T.7. Influence Factors.....	123
T.7.1. Temperature.	123
T.7.2. Electric Power Supply.....	124
T.8. Radio Frequency Interference (RFI) and Other Electromagnetic Interference Susceptibility.	124
UR. User Requirements.....	125
UR.1. Selection Requirements.....	125
UR.1.1. General.	125
UR.1.2. Value of the Indicated and Recorded Scale Division.....	125
UR.2. Installation Requirements.	125
UR.2.1. Protection from Environmental Factors.	125
UR.2.2. Foundation, Supports, and Clearance.....	125
UR.2.3. Entry and Departure from Weighing Area.	125
UR.3. Use Requirements.....	125
UR.3.1. Minimum Load.....	125
UR.3.2. Maximum Load.....	126
UR.3.3. Special Designs.	126
UR.3.4. Use of Manual Gross Weight Entries.	126

CCR Title 4, Div. 9, CCR §§ 4000.
2023 Edition of NIST HB 44 Section 2.24. Automatic Weighing Systems

- UR.4. Maintenance Requirements.....126
 - UR.4.1. Balance Condition.....126
 - UR.4.2. Level Condition.126
 - UR.4.3. Automatic Weighing System Modification.126

Section 2.24 Automatic Weighing Systems

A. Application

A.1. General. – This code applies to devices used to automatically weigh pre-assembled discrete loads or single loads or loose materials in applications where automatic weighing systems¹ are used or employed in the determination of quantities, things, produce, or articles for distribution, for purchase, offered or submitted for sale, for distribution, purchase, or in computing any basic charge or payment for services rendered on the basis of weight, and in packaging plants subject to regulation by the USDA. Some weigh-labelers and checkweighers may also include a scale that is incorporated in a conveyor system that weighs packages in a static or non-automatic weighing mode.²

This includes:

- (a) Automatic weigh-labelers;
- (b) Combination automatic and non-automatic weigh-labelers;
- (c) Automatic checkweighers;
- (d) Combination automatic and non-automatic checkweighers; and
- (e) Automatic gravimetric filling machines that weigh discrete loads or single loads of loose materials and determine package and production lot compliance with net content representations.

(Amended 1997 and 2004)

¹ An automatic weighing system does not require the intervention of an operator during the weighing process. The necessity to give instructions to start a process or to release a load or the function of the instrument (static, dynamic, set-up, etc.) is not relevant in deciding the category of automatic or non-automatic instruments.

(Added 2004)

² Prepackaging scales (and other commercial devices) used for putting up packages in advance of sale are acceptable for use in commerce if all appropriate provisions of Handbook 44 are met. Users of such devices must be alert to the legal requirements relating to the declaration of quantity on a package. Such requirements are to the effect that, on the average, the contents of the individual packages of a particular commodity comprising a lot, shipment, or delivery must contain at least the quantity declared on the label. The fact that a scale or other commercial device may overregister, but within established tolerances, and is approved for commercial service is not a legal justification for packages to contain, on the average, less than the labeled quantity.

(Added 2004)

A.2. Exceptions. – This code does not apply to:

- (a) Belt-Conveyor Scale Systems;
- (b) Railway Track Scales;
- (c) Monorail Scales;
- (d) Automatic Bulk-Weighing Systems;
- (e) Devices that measure quantity on a time basis;
- (f) Controllers or other auxiliary devices except as they may affect the weighing performance; or
- (g) Automatic gravimetric filling machines and other automatic weighing systems employed in determining the weight of a commodity in a plant or business with a separate quantity control program (e.g., a system of statistical process control) using suitable weighing instruments and measurement standards traceable to national standards to determine production lot compliance with net content representations.³
(Added 2004)

A.3. Additional Code Requirements. – In addition to the requirements of this code, Automatic Weighing Systems shall meet the requirements of Section 1.10. General Code.

S. Specifications

S.1. Design of Indicating and Recording Elements and of Recorded Representations.

S.1.1. Zero Indication.

- (a) A weigh-labeler shall be equipped with an indicating or recording element. Additionally, a weigh-labeler equipped with an indicating or recording element shall either indicate or record a zero-balance condition and an out-of-balance condition on both sides of zero.
(Amended 2004)
- (b) An automatic checkweigher may be equipped with an indicating or recording element.
- (c) A zero-balance condition may be indicated by other than a continuous digital zero indication, provided that effective automatic means is provided to inhibit a weighing

³ See NIST Handbook 130, “Uniform Laws and Regulations in the Area of Legal Metrology and Engine Fuel Quality,” Interpretations and Guidelines, paragraph 2.6.11. Good Quantity Control Practices.

operation or to return to a continuous digital indication when the device is in an out-of-balance condition.

S.1.1.1. Digital Indicating Elements.

- (a) A digital zero indication shall represent a balance condition that is within $\pm \frac{1}{2}$ scale division.
- (b) A digital indicating device shall either automatically maintain a “center of zero” condition to $\pm \frac{1}{4}$ scale division or less or have an auxiliary or supplemental “center-of-zero” indicator that defines a zero-balance condition to $\pm \frac{1}{4}$ scale division or less.
- (c) Verification of the accuracy of the center of zero indication to $\pm \frac{1}{4}$ scale division or less during automatic operation is not required on automatic checkweighers.
(Amended 2004)

S.1.2. Value of Division Units. – The value of a division *d* expressed in a unit of weight shall be equal to:

- (a) 1, 2, or 5; or
- (b) a decimal multiple or submultiple of 1, 2, or 5.

The requirement that the value of the scale division be expressed only as 1, 2, or 5, or a decimal multiple or submultiple of only 1, 2, or 5 does not apply to net weight indications and recorded representations that are calculated from gross and tare weight indications where the scale division of the gross weight is different from the scale division of the tare weight(s) on multi-interval or multiple range scales. For example, a multiple range or multi-interval scale may indicate and record tare weights in a lower weighing range (WR) or weighing segment (WS), gross weights in the higher weighing range or weighing segment, and net weights as follows:

$\begin{array}{r} 55 \text{ kg Gross Weight (WR2 } d = 5 \text{ kg)} \\ - 4 \text{ kg Tare Weight (WR1 } d = 2 \text{ kg)} \\ \hline = 51 \text{ kg Net Weight} \\ \text{(Mathematically Correct)} \end{array}$	$\begin{array}{r} 10.05 \text{ lb Gross Weight (WS2 } d = 0.05 \text{ lb)} \\ - 0.06 \text{ lb Tare Weight (WS1 } d = 0.02 \text{ lb)} \\ \hline = 9.99 \text{ lb Net Weight} \\ \text{(Mathematically Correct)} \end{array}$
---	---

(Amended 2008)

S.1.2.1. Weight Units. – Except for postal scales, indicating and recording elements for shipping and postal applications, and scales used to print standard pack labels, a device shall indicate weight values using only a single unit of measure.

(Amended 2004)

S.1.3. Provision for Sealing.

- (a) **Automatic Weighing Systems, Except Automatic Checkweighers.** – For devices and systems in which the configuration or calibration parameters can be changed by

use of a removable digital storage device, security shall be provided for those parameters as specified in G-S.8.2. Devices and Systems Adjusted Using Removable Digital Storage Devices.

For parameters adjusted using other means, a device shall be designed with provision(s) as specified in Table S.1.3. Categories of Device and Methods of Sealing for applying a security seal that must be broken, or for using other approved means of providing security (e.g., data change audit trail available at the time of inspection), before any change that detrimentally affects the metrological integrity of the device can be made to any electronic mechanism.

(b) **For Automatic Checkweighers.** – Security seals are not required in applications where it would prohibit an authorized user from having access to the calibration functions of a device.

(Amended 2019)

Table S.1.3. Categories of Device and Methods of Sealing

Categories of Device	Methods of Sealing
<p>Category 1: No Remote configuration capability.</p>	<p>Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.</p>
<p>Category 2: Remote configuration capability, but access is controlled by physical hardware.</p> <p>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode.</p>	<p>The hardware enabling access for remote communication must be at the device and sealed using a physical seal or two event counters: one for calibration parameters and one for configuration parameters.</p>
<p>Category 3: Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password).</p>	<p>An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. A printed copy of the information must be available through the device or through another on-site device. The event logger shall have a capacity to retain records equal to 10 times the number of sealable parameters in the device, but not more than 1000 records are required. (Note: Does not require 1000 changes to be stored for each parameter.)</p>

S.1.4. Automatic Calibration. – A device may be fitted with an automatic or a semi-automatic calibration mechanism. This mechanism shall be incorporated inside the device. After sealing, neither the mechanism nor the calibration process shall facilitate fraud.

S.1.5. Adjustable Components. – Adjustable components shall be held securely in adjustment and, except for a zero-load balance mechanism, shall be located within the housing of the element.

S.2. Design of Zero and Tare Mechanisms.

S.2.1. Zero Load Adjustment.

S.2.1.1. Automatic Zero-Tracking Mechanism. – Except for automatic checkweighers, under normal operating conditions the maximum load that can be “rezeroed,” when either placed on or removed from the platform all at once, shall be 1.0 scale division.

Except for an initial zero-setting mechanism, an automatic zero adjustment outside these limits is prohibited.

(Amended 2004 and 2010)

S.2.1.2. Initial Zero-Setting Mechanism. – Except for automatic checkweighers, an initial zero-setting mechanism shall not zero a load in excess of 20 % of the maximum capacity of the automatic weighing system unless tests show that the scale meets all applicable tolerances for any amount of initial load compensated by this device within the specified range.

S.2.2. Tare. – On any automatic weighing system (except for multi-interval scales or multiple range scales when the value of tare is determined in a lower weighing range or weighing segment) the value of the tare division shall be equal to the value of the scale division. The tare mechanism shall operate only in a backward direction (i.e., in a direction of underregistration) with respect to the zero-load balance condition of the automatic weighing system. A device designed to automatically clear any tare value shall also be designed to prevent the automatic clearing of tare until a complete transaction has been indicated.

(Amended 2008)

Note: On a computing automatic weighing system, this requires the input of a unit price, the display of the unit price, and a computed positive total price at a readable equilibrium. Other devices require that a transaction or lot run be completed.

(Note Amended 2004)

S.3. Verification Scale Interval.

S.3.1. Multiple Range and Multi-Interval Automatic Weighing System. – The value of e shall be equal to the value of d .

S.3.2. Load Cell Verification Interval Value. – The relationship of the value for the load cell verification scale interval, v_{\min} , to the scale division d for a specific scale installation shall be:

$$v_{\min} \leq \frac{d}{\sqrt{N}} \quad \text{where } N \text{ is the number of load cells in the scale.}$$

Figure 1 - Load Cell Verification Interval Value Equation.

Note: When the value of the scale division d differs from the verification scale division e for the scale, the value of e must be used in the formula above.

This requirement does not apply to complete weighing/load-receiving elements or scales which satisfy all the following criteria:

- *the complete weighing/load-receiving element or scale has been evaluated for compliance with T.7.1. Temperature under the National Type Evaluation Program (NTEP);*
- *the complete weighing/load-receiving element or scale has received an NTEP Certificate of Conformance; and*
- *the complete weighing/load-receiving element or scale is equipped with an automatic zero-tracking mechanism which cannot be made inoperative in the normal weighing mode. (A test mode which permits the disabling of the automatic zero-tracking mechanism is permissible, provided the scale cannot function normally while in this mode.)*

[Nonretroactive as of 2020]

(Amended 2019)

S.3.3. Value of “e”. – For automatic checkweighers, the value of e shall be specified by the manufacturer and may be larger than d , but in no case can e be more than ten times the value of d .

S.4. Weight Indicators, Weight Displays, Reports, and Labels.

S.4.1. Additional Digits in Displays. – Auxiliary digital displays that provide additional digits for use during performance evaluation may be included on automatic checkweighers. However, in cases where these indications are not valid for determining the actual weight of a package (e.g., only appropriate for use in statistical process control programs by users) they shall be clearly and distinctly differentiated from valid weight displays by indicating them to the user.

For example, the additional digits may be differentiated by color, partially covered by placing crosshatch overlays on the display, or made visible only after the operator presses a button or turns a key to set the device in a mode which enables the additional digits.

S.4.2. Damping. – An indicating element equipped with other than automatic recording elements shall be equipped with effective means to permit the recording of weight values only when the indication is stable within plus or minus one scale division. The values recorded shall be within applicable tolerances.

S.4.3. Over Capacity Indication. – An indicating or recording element shall not display nor record any values when the scale capacity is exceeded by nine scale divisions.

S.4.4. Label Printer. – A device that produces a printed ticket to be used as the label for a package shall print all values digitally and of such size, style of type, and color as to be clear and conspicuous on the label.

S.4.4.1. Label Printing. – If an automatic checkweigher prints a label containing weight information that will be used in a commercial transaction, it must conform to all of the requirements specified for weigh-labelers so that the printed ticket meets appropriate requirements.

S.5. Accuracy Class.

S.5.1. Marking. – Weigh-labelers and automatic checkweighers shall be Class III devices and shall be marked accordingly, except that a weigh-labeler marked Class IIIS may be used in package shipping applications.

(Amended 1997)

S.6. Parameters for Accuracy Classes. – The number of divisions for device capacity is designated by the manufacturer and shall comply with parameters shown in Table S.6. Parameters for Accuracy Classes.

Table S.6. Parameters for Accuracy Classes

Class	Value of the Verification Division (e)	Minimum Number of Divisions (n)	Maximum Number of Divisions (n)
III	SI Units: 0.1 to 2 g, inclusive	100	10 000
III	SI Units: equal to or greater than 5 g	500	10 000
III	U.S. Units: 0.0002 lb to 0.005 lb, inclusive	100	10 000
III	U.S. Units: 0.005 oz to 0.125 oz, inclusive	100	10 000
III	U.S. Units: equal to or greater than 0.01 lb	500	10 000
III	U.S. Units: equal to or greater than 0.25 oz	500	10 000
IIIS	U.S. Units: greater than 0.01 lb	100	1 000
IIIS	U.S. Units: greater than 0.25 oz	100	1 000

For Class III devices, the value of e is specified by the manufacturer as marked on the device; d shall not be smaller than 0.1 e. e shall be differentiated from d by size, shape, or color.

(Amended 2004)

S.7. Marking Requirements. – [Also see G-S.1. Identification, G-S.4. Interchange or Reversal of Parts, G-S.6. Marking Operational Controls, Indications, and Features, G-S.7. Lettering, G-UR.2.1.1. Visibility of Identification, and UR.3.3. Special Designs]

S.7.1. Location of Marking Information. – Automatic weighing systems which are not permanently attached to an indicating element, and for which the load-receiving element is the only part of the weighing/load-receiving element visible after installation, may have the marking information required in Section 1.10. General Code, G-S.1. Identification, and Section 2.24. Automatic Weighing Systems Code, Table S.7.a. Marking Requirements and Table S.7.b. Notes for Table S.7.a. located in an area that is accessible only through the use of a tool; provided that the information is easily accessible (e.g., the information may appear on the junction box under an access plate). The identification information for these automatic weighing systems shall be located on the weighbridge (load-receiving element) near the point where the signal leaves the weighing element, or beneath the nearest access cover.

Table S.7.a. Marking Requirements – Weighing Equipment

To Be Marked With ↓	Weighing, load- receiving, and indicating element in same housing	Indicating element not permanently attached to weighing and load- receiving element	Weighing and load-receiving element not permanently attached to indicating element	Load cell with CC (10)	Other equipment or device (9)
Manufacturer's ID (1)	x	x	x	x	x
Model Designation (1)	x	x	x	x	x
Serial Number and Prefix (2)	x	x	x	x	x (13)
Certificate of Conformance (CC) Number (16)	x	x	x	x	x (16)
Accuracy Class (14)	x	x (8)	x	x	na
Nominal Capacity (3)(15)	x	x	x	na	na
Value of Division, d (3)	x	x	na	na	na
Value of e (4)	x	x	na	na	na

CCR Title 4, Div. 9, CCR §§ 4000.
2023 Edition of NIST HB 44 Section 2.24. Automatic Weighing Systems

To Be Marked With ↓	Weighing, load- receiving, and indicating element in same housing	Indicating element not permanently attached to weighing and load- receiving element	Weighing and load-receiving element not permanently attached to indicating element	Load cell with CC (10)	Other equipment or device (9)
Temperature Limits (5)	x	x	x	x	na
Special Application (11)	x	x	x	na	na
Maximum Number of Scale Divisions, n_{max} (6)	na	x (8)	x	x	na
Minimum Verification Division, (e_{min})	na	na	x	na	na
“S” or “M” (7)	na	na	na	x	na
Direction of Loading (12)	na	na	na	x	na
Minimum Dead Load	na	na	na	x	na
Maximum Capacity (Max)	x	na	na	x	na
Minimum Capacity (Min)	x	na	na	na	na
Safe Load Limit	na	na	na	x	na
Load Cell Verification Interval (v_{min})	na	na	na	x	na
Maximum Belt Speed (m/sec or m/min)	x	na	x	na	na

Note: Also see Table S.7.b. for applicable parenthetical notes.

(Amended 1999)

Table S.7.b. Notes for Table S.7.a.

1. Manufacturer’s identification and model designation. (Also see G-S.1. Identification)
2. Serial number and prefix. Also see G-S.1. Identification)
3. The nominal capacity and value of the automatic weighing system division shall be shown together (e.g., 50 000 × 5 kg, or 30 × 0.01 lb) adjacent to the weight display when the nominal capacity and value of the automatic weighing system division are not immediately apparent. Each division value or weight unit shall be marked on variable-division value or division-unit automatic weighing systems.

CCR Title 4, Div. 9, CCR §§ 4000.
2023 Edition of NIST HB 44 Section 2.24. Automatic Weighing Systems

4. Required only if different from d.
5. Required only on automatic weighing systems if the temperature range on the NTEP CC is narrower than and within $-10\text{ }^{\circ}\text{C}$ to $40\text{ }^{\circ}\text{C}$ ($14\text{ }^{\circ}\text{F}$ to $104\text{ }^{\circ}\text{F}$).
(Amended 2007)
6. This value may be stated on load cells in units of 1000; (e.g., $n_{\text{max}} 10$ is 10 000 divisions.)
7. Denotes compliance for single or multiple load cell applications.
8. An indicating element not permanently attached to a weighing element shall be clearly and permanently marked with the accuracy Class III, or IIIS and the maximum number of divisions, n_{max} .
9. Necessary to the weighing system but having no metrological effect (e.g., auxiliary remote display, keyboard, etc.).
10. The markings may be either on the load cell or in an accompanying document; except that, if an accompanying document is provided, the serial number shall appear both on the load cell and in the document. The manufacturer's name or trademark, the model designation, and identifying symbol for the serial number shall also be marked both on the load cell and in any accompanying document.
11. An automatic weighing system designed for a special application rather than general use shall be conspicuously marked with suitable words visible to the operator and customer restricting its use to that application.
12. Required if the direction of loading the load cell is not obvious.
13. Serial number and prefix (Also see G-S.1. Identification) modules without "intelligence" on a modular system (e.g., printer, keyboard module, cash drawer, and secondary display in a point-of-sale system) are not required to have serial numbers.
14. The accuracy class of a device shall be marked on the device with the appropriate designation.
15. The nominal capacity shall be conspicuously marked on any automatic-indicating or recording automatic weighing system so constructed that the capacity of the indicating or recording element, or elements, is not immediately apparent.
16. Required only if a CC has been issued for the equipment.

S.7.2. Marking Required on Components of Automatic Weighing Systems. – The following components of automatic weighing systems shall be marked as specified in Tables S.7.a. Marking Requirements and S.7.b. Notes for Table S.7.2.a.:

- (a) Main elements and components when not contained in a single enclosure for the entire automatic weighing system;
- (b) Load cells for which Certificates of Conformance (CC) have been issued under the National Type Evaluation Program; and
- (c) Other equipment necessary to a weighing system but having no metrological effect on the weighing system.

N. Notes

N.1. Test Requirements for Automatic Weighing Systems.

N.1.1. Test Pucks and Packages.

(a) Test pucks and packages shall be:

- (1) representative of the type, size, and weight ranges to be weighed on a device; and
- (2) stable while in motion, hence the length and width of a puck or package should be greater than its height.

(b) For type evaluation the manufacturer shall supply the test pucks or packages for each range of test loads.

(Amended 1997)

N.1.2. Accuracy of Test Pucks or Packages. – The error in any test puck or package shall not exceed one-fourth ($\frac{1}{4}$) of the acceptance tolerance. If packages are used to conduct field tests on automatic weighing systems, the package weights shall be determined on a reference scale or balance with an inaccuracy that does not exceed one-fifth ($\frac{1}{5}$) of the smallest tolerance that can be applied to the device under test.

N.1.3. Verification (Testing) Standards. – Field standard weights shall comply with requirements of NIST Handbook 105-1, “Specifications and Tolerances for Field Standard Weights (Class F)” or the tolerances expressed in Fundamental Considerations, paragraph 3.2. (i.e., one-third of the smallest tolerance applied).

N.1.4. Radio Frequency Interference (RFI) and Other Electromagnetic Interference Susceptibility, Field Evaluation. – An RFI test shall be conducted at a given installation when the presence of RFI has been verified and characterized if those conditions are considered “usual and customary.”

(Added 2004)

N.1.5. Tests Loads. – A performance test shall consist of four separate test runs conducted at different test loads according to Table N.1.5. Test Loads.

Table N.1.5. Test Loads

At or near minimum capacity
At or near maximum capacity
At two (2) critical points between minimum and maximum capacity
Test may be conducted at other loads if the device is intended for use at other specific capacities

N.1.6. Influence Factor Testing. – Influence factor testing shall be conducted statically.

N.2. Test Procedures - Weigh-Labelers. – If the device is designed for use in a non-automatic weighing mode, it shall be tested in the non-automatic mode according to NIST Handbook 44, Section 2.20. Scales Code.

Note: If the device is designed for only automatic weighing, it shall only be tested in the automatic weighing mode.

(Amended 2004)

N.2.1. Non-Automatic Tests.

N.2.1.1. Increasing-Load Test. – The increasing-load test shall be conducted with the test loads approximately centered on the load-receiving element of the scale.

N.2.1.2. Decreasing-Load Test. – The decreasing-load test shall be conducted with the test loads approximately centered on the load-receiving element of the scale.

N.2.1.3. Shift Test. – To determine the effect of off-center loading, a test load equal to one-half ($\frac{1}{2}$) maximum capacity shall be placed in the center of each of the four points equidistant between the center and front, left, back, and right edges of the load receiver.

N.2.1.4. Discrimination Test. – A discrimination test shall be conducted with the weighing device in equilibrium at zero-load and at maximum test load, and under controlled conditions in which environmental factors are reduced to the extent that they will not affect the results obtained. This test is conducted from just below the lower edge of the zone of uncertainty for increasing-load tests, or from just above the upper edge of the zone of uncertainty for decreasing-load tests.

N.2.1.5. Zero-Load Balance Change. – A zero-load balance change test shall be conducted on all automatic weighing systems after the removal of any test load. The zero-load balance should not change by more than the minimum tolerance applicable. (Also see G-UR.4.2. Abnormal Performance)

(Amended 2004)

N.2.2. Automatic Test Procedures.

N.2.2.1. Tests Non-Automatic. – If the automatic weighing system is designed to operate non-automatically, and is used in that manner, during normal use operation, it shall be tested non-automatically using mass standards. The device shall not be tested non-automatically if it is used only in the automatic mode.

N.2.2.2. Automatic Tests. – The device shall be tested at the normal operating speed using packages. Test runs should be conducted using at least two test loads distributed over its normal weighing range (e.g., near the lowest and highest ranges in which the device is typically operated.) Each test load should be run a minimum of ten consecutive times.

(Amended 2004)

N.3. Test Procedures - Automatic Checkweigher.

N.3.1. Tests Non-Automatic. – If the scale is designed to operate non-automatically during normal user operation, it shall be tested non-automatically according to paragraphs N.2.1.1. Increasing Load Test through N.2.1.5. Zero-Balance Change.

(Amended 2004)

N.3.2. Automatic Tests. – The device shall be tested at the highest speed in each weight range using standardized test pucks or packages. Test runs shall be conducted using two test loads. The number of consecutive test weighments shall be as specified in Table N.3.2. Number of Sample Weights per Test for Automatic Checkweighers.

(Amended 2004)

Table N.3.2. Number of Sample Weights per Test for Automatic Checkweighers

Weighing Range (m = mass of test load)	Number of Sample Weights per Test	
	Field	Type Evaluation
20 divisions $\leq m \leq 10$ kg 20 divisions $\leq m \leq 22$ lb	30	60
10 kg $< m \leq 25$ kg 22 lb $< m \leq 55$ lb	16	32
25 kg $< m \leq 100$ kg 55 lb $< m \leq 220$ lb	10	20
100 kg (220 lb) $< m$	10	10

T. Tolerances

T.1. Principles.

T.1.1. Design. – The tolerance for a weighing device is a performance requirement independent of the design principle used.

T.1.2. Scale Division. – The tolerance for a weighing device is related to the value of the scale division (d) or the value of the verification scale division (e) and is generally expressed in terms of d or e. The random tolerance for automatic checkweighers is expressed in terms of Maximum Allowable Variance (MAV).

T.2. Tolerance Application.

T.2.1. General. – The tolerance values are positive (+) and negative (–) with the weighing device adjusted to zero at no load. When tare is in use, the tolerance values are applied from the tare zero reference (zero net weight indication); the tolerance values apply to the net weight indication for any possible tare load using certified test loads.

(Amended 2008)

T.2.2. Type Evaluation Examinations. – For type evaluation examinations, the tolerance values apply to increasing and decreasing load tests within the temperature and power supply limits specified in T.7. Influence Factors.

(Amended 2004)

T.2.3. Subsequent Verification Examinations. – For subsequent verification examinations, the tolerance values apply regardless of the influence factors in effect at the time of the conduct of the examination. (Also see G-N.2. Testing with Nonassociated Equipment.)

(Added 2007)

T.2.4. Multiple Range and Multi-Interval Automatic Weighing System. – For multiple range and multi-interval devices, the tolerance values are based on the value of the scale division of the range in use.

T.3. Tolerance Values.

Table T.3. - Class III - Tolerance in Divisions (e)

Test Load in Divisions Class III	Acceptance Tolerance in Divisions	Maintenance Tolerance in Divisions
0 - 500	± 0.5	± 1
501 - 2000	± 1.0	± 2
2001 - 4000	± 1.5	± 3
4001 +	± 2.5	± 5

T.3.1. Tolerance Values – Class III Weigh-Labeler. (Also see Section T.3.2. Class IIIS Weigh-Labelers.)

T.3.1.1. Non-automatic Tests. – Tolerance values shall be as specified in Table T.3. Class III - Tolerance in Divisions (e).
(Amended 2004)

T.3.1.2. Automatic Tests. – Acceptance tolerance values shall be the same as maintenance tolerance values specified in Table T.3. Class III - Tolerance in Divisions (e).
(Amended 2004)

T.3.2. Tolerance Values - Class IIIS Weigh-labelers in Package Shipping Applications.
(Added 1997)

T.3.2.1. Non-automatic Tests. – Tolerance values shall be as specified in Table T.3.2.1. Non-automatic Tolerances for Class IIIS Weigh-labelers.
(Amended 2004)

T.3.2.2. Automatic Tests. – Tolerance values specified in Table T.3.2.2. Automatic Tolerances for Class IIIS Weigh-labelers shall be applied.
(Amended 2004)

Table T.3.2.1. - Non-Automatic Tolerances for Class IIIS Weigh-Labelers

Test Load in Divisions	Tolerance in Divisions	
	Acceptance	Maintenance
Class IIIS		
0 - 50	± 0.5	± 1
51 - 200	± 1.0	± 2
201 - 1000	± 1.5	± 3

(Added 1997) (Amended 2004)

Table T.3.2.2. - Automatic Tolerances - for Class IIIS Weigh-Labelers

Test Load in Divisions	Tolerance in Divisions	
	Acceptance	Maintenance
Class IIIS		
0 - 50	± 1.5	± 2
51 - 200	± 2.0	± 3
201 - 1000	± 2.5	± 4

(Added 1997) (Amended 2004)

T.3.3. Tolerance Values. – Automatic Checkweighers.

T.3.3.1. Laboratory Tests for Automatic Checkweighers.

T.3.3.1.1. Non-Automatic Tests. – The acceptance tolerance values specified in Table T.3. Class III - Tolerance in Divisions (e), shall be applied.
(Amended 2004)

T.3.3.1.2. Automatic Tests.

(a) The systematic error for each test run shall be within the acceptance tolerances specified in Table T.3. Class III - Tolerance in Divisions (e) for the test loads specified in Table N.1.5. Test Loads.

(Amended 2004)

(b) The standard deviation of the results shall not exceed one-ninth ($\frac{1}{9}$) of the MAV for specific package weights (which means that three standard deviations cannot exceed one-third ($\frac{1}{3}$) of the MAV value) as required in the latest edition of NIST Handbook 133, "Checking the Net Contents of Packaged Goods." This value does not change regardless of whether acceptance or maintenance tolerances are being applied to the device under test.

(Amended 2004)

(1) For U.S. Department of Agriculture (USDA) inspected meat and poultry products packaged at a plant subject to inspection by the USDA Food Safety and Inspection Service, use NIST Handbook 133, Appendix A. Tables, Table 2-9, U.S. Department of Agriculture, Meat and Poultry, Groups and Lower Limits for Individual Packages;

(2) for all other packages with a labeled net quantity in terms of weight, use NIST Handbook 133, Appendix A. Tables, Table 2-5, Maximum Allowable Variations (MAVs) for Packages Labeled by Weight; or

(3) for all packages with a labeled net quantity in terms of liquid or dry volume use NIST Handbook 133, Appendix A. Tables, Table 2-6, Maximum Allowable Variations (MAVs) for Packages Labeled by Liquid or Dry Volume.

(Amended 2004)

T.3.3.2. Field Tests for Automatic Checkweighers.

T.3.3.2.1. Non-Automatic Test. – The tolerance values shall be as specified in Table T.3. Class III – Tolerance in Divisions (e).

(Amended 2004)

T.3.3.2.2. Automatic Test.

- (a) The systematic error requirement is not applied in a field test.
- (b) The standard deviation of the test results shall not exceed one-ninth ($\frac{1}{9}$) of the MAV for specific package weights (which means that three standard deviations cannot exceed one-third ($\frac{1}{3}$) of the MAV value) as required in the latest Edition of NIST Handbook 133. This value does not change regardless of whether acceptance or maintenance tolerances are being applied to the device under test.
(Amended 2004)
 - (1) For USDA inspected meat and poultry products packaged at a plant subject to inspection by the USDA Food Safety and Inspection Service, use NIST Handbook 133, Appendix A, Tables, Table 2-9, U.S. Department of Agriculture, Meat and Poultry, Groups and Lower Limits for Individual Packages;
 - (2) for all other packages with a labeled net quantity in terms of weight, use NIST Handbook 133, Appendix A. Tables, Table 2-5, Maximum Allowable Variations (MAVs) for Packages Labeled by Weight; or
 - (3) for all packages with a labeled net quantity in terms of liquid or dry volume use NIST Handbook 133, Appendix A. Tables, Table 2-6. Maximum Allowable Variations (MAVs) for Packages Labeled by Liquid or Dry Volume.

T.4. Agreement of Indications. – In the case of a weighing system equipped with more than one indicating element or indicating element and recording element combination, the difference in the weight value indications of any load shall not be greater than the absolute value of the applicable tolerance for that load and shall be within tolerance limits.

T.5. Repeatability. – The results obtained from several weighings of the same load under reasonably constant test conditions shall agree within the absolute value of the maintenance tolerance for that load and shall be within applicable tolerances.
(Amended 2004)

T.6. Discrimination. – A test load equivalent to 1.4 d shall cause a change in the indicated or recorded value of at least 2.0 d. This requires the zone of uncertainty to be not greater than 0.3 d (See N.2.1.4. Discrimination Test).
(Amended 2004)

T.7. Influence Factors. – The following factors are applicable to tests conducted under controlled conditions only.

T.7.1. Temperature. – Devices shall satisfy the tolerance requirements under the following temperature conditions:

T.7.1.1. if not specified in the operating instructions or if not marked on the device, the temperature limits shall be: $-10\text{ }^{\circ}\text{C}$ to $40\text{ }^{\circ}\text{C}$ ($14\text{ }^{\circ}\text{F}$ to $104\text{ }^{\circ}\text{F}$).

T.7.1.2. if temperature limits are specified for the device, the range shall be at least $30\text{ }^{\circ}\text{C}$ ($54\text{ }^{\circ}\text{F}$).

T.7.1.3. Temperature Effect on Zero-Load Balance. – The zero-load indication shall not vary by more than one division per $5\text{ }^{\circ}\text{C}$ ($9\text{ }^{\circ}\text{F}$) change in temperature.

T.7.1.4. Operating Temperature. – The indicating or recording element shall not display nor record any usable values until the operating temperature necessary for accurate weighing and a stable zero balance condition have been attained.

T.7.2. Electric Power Supply.

T.7.2.1. Range of Voltages.

(a) Automatic weighing systems that operate using alternating current must perform within the conditions defined in paragraphs T.3. Tolerance Values through T.6. Discrimination, inclusive, when tested over the range of -15% to $+10\%$ of the marked nominal line voltage(s) at 60 Hz, or the voltage range marked by the manufacturer, at 60 Hz.

(b) Automatic weighing systems that operate using DC current must perform within the conditions defined in paragraphs T.3. Tolerance Values through T.6. Discrimination, inclusive, when tested over the range from minimum operating voltage⁴ to $+20\%$ of the voltage marked on the instrument (nominal voltage).

(c) Battery-operated electronic automatic weighing systems with external or plug-in power supply (AC or DC) shall either continue to function correctly or not indicate any weight values if the voltage is below the manufacturer's specified value, the latter being larger than or equal to the minimum operating voltage.⁴

Note: This requirement applies only to metrologically significant voltage supplies.
(Amended 2001)

(Amended 2004)

T.7.2.2. Power Interruption. – A power interruption shall not cause an indicating or recording element to display or record any values outside the applicable tolerance limits.

T.8. Radio Frequency Interference (RFI) and Other Electromagnetic Interference

Susceptibility. – The difference between the weight indication with the disturbance and the weight indication without the disturbance (also see N.1.4. Radio Frequency Interference (RFI))

⁴ The minimum operating voltage is defined as the lowest possible operating voltage before the automatic weighing system no longer indicates nor records weight values.

(Added 2004)

and Other Electromagnetic Interference Susceptibility, Field Evaluation) shall not exceed one scale division (d) or the equipment shall:

- (a) blank the indication;
- (b) provide an error message; or
- (c) the indication shall be so completely unstable that it could not be interpreted, or transmitted into memory or to a recording element, as a correct measurement value.

(Amended 2004)

UR. User Requirements

UR.1. Selection Requirements. – Equipment shall be suitable for the service in which it is used with respect to elements of its design, including but not limited to, its capacity, number of scale divisions, value of the scale division or verification scale division, minimum capacity, and computing capability.

UR.1.1. General. – Automatic Weighing Systems shall be designated by the manufacturer for that service.

UR.1.2. Value of the Indicated and Recorded Scale Division. – The value of the division as recorded shall be the same as the division value indicated.

UR.2. Installation Requirements.

UR.2.1. Protection from Environmental Factors. – The indicating elements, the lever system or load cells, and the load-receiving element of a permanently installed scale, and the indicating elements of a scale not intended to be permanently installed, shall be adequately protected from environmental factors such as wind, weather, and RFI that may adversely affect the operation or performance of the device.

UR.2.2. Foundation, Supports, and Clearance. – The foundation and supports of any scale installed in a fixed location shall be such as to provide strength, rigidity, and permanence of all components, and clearance shall be provided around all live parts to the extent that no contacts may result when the load-receiving element is empty, nor throughout the weighing range of the scale.

UR.2.3. Entry and Departure from Weighing Area. – The belt or other conveyance that introduces the weighed load to the weighing zone and that carries the weighed load away from the weighing zone shall be maintained per the manufacturer's recommendations.

UR.3. Use Requirements.

UR.3.1. Minimum Load. – The minimum load shall be as specified by the manufacturer, but not less than twenty divisions since the use of a device to weigh light loads is likely to result in relatively large errors.

UR.3.1.1. Minimum Load for Class IIIS Weigh-Labelers. – The minimum load shall be as specified by the manufacturer, but not less than ten divisions since the use of a device to weigh light loads is likely to result in relatively large errors.

(Added 1997)

UR.3.2. Maximum Load. – An automatic weighing system shall not be used to weigh a load of more than its maximum capacity.

(Amended 2004)

UR.3.3. Special Designs. – An automatic weighing system designed and marked for a special application shall not be used for other than its intended purpose.

UR.3.4. Use of Manual Gross Weight Entries. – Manual entries are permitted only when a device or system is generating labels for standard weight packages.

UR.4. Maintenance Requirements.

UR.4.1. Balance Condition. – If an automatic weighing system is equipped with a zero-load display, the zero-load adjustment of an automatic weighing system shall be maintained so that the device indicates or records a zero-balance condition.

UR.4.2. Level Condition. – If an automatic weighing system is equipped with a level-condition indicator, the automatic weighing system shall be maintained in level.

UR.4.3. Automatic Weighing System Modification. – The length or the width of the load-receiving element of an automatic weighing system shall not be increased beyond the manufacturer's design dimension, nor shall the capacity of an automatic weighing system be increased beyond its design capacity by replacing or modifying the original primary indicating or recording element with one of a higher capacity, except when the modification has been approved by competent engineering authority, preferably that of the engineering department of the manufacturer of the automatic weighing system, and by the weights and measures authority having jurisdiction over the automatic weighing system.

NOTE: NIST HANDBOOK 44 SECTION 25 (TENTATIVE CODE) HAS NOT BEEN PUBLISHED

Section 2.25 Weigh-In-Motion Systems Used for Vehicle Enforcement Screening – Tentative Code is not Published in the Division of Measurement Standards Field Reference Manual. A copy of the Tentative Code can be viewed and downloaded from the National Institute of Standards and Technology (NIST) Office of Weights and Measures at.

2.25. Weigh-In-Motion Systems – Used for Vehicle Enforcement Screening – Tentative Code [PDF](#),

or

<https://www.nist.gov/pml/owm/publications/nist-handbooks/handbook-44-current-edition>

This tentative code has a trial or experimental status and is not intended to be enforced. The requirements are designed for study prior to the development and adoption of a final code. Officials wanting to conduct an official examination of a device or system are advised to see paragraph G-A.3. Special and Unclassified Equipment.

(Tentative Code Added 2015)

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CALIFORNIA DEPARTMENT OF
FOOD & AGRICULTURE

Extracts from the
CALIFORNIA CODE OF REGULATIONS

TITLE 4, DIVISION 9

WEIGHTS AND MEASURES FIELD REFERENCE MANUAL (2023)

**Chapter 1, Tolerances and Specifications for Commercial Weighing and
Measuring Devices**

Part 3: NIST Handbook 44

Sections:

- 3.30. Liquid-Measuring Devices**
- 3.31. Vehicle-Tank Meters**
- 3.32. LPG & Anhydrous Ammonia Liquid-Measuring Devices**
- 3.33. Hydrocarbon Gas Vapor-Measuring Devices**
- 3.34. Cryogenic Liquid-Measuring Devices**
- 3.35. Milk Meters**
- 3.36. Water Meters**
- 3.37. Mass Flow Meters**
- 3.38. Carbon Dioxide Liquid-Measuring Devices**
- 3.39. Hydrogen Gas-Measuring Devices**
- 3.40. Electric Vehicle Fueling Systems**



**CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE
DIVISION OF MEASUREMENT STANDARDS**

**California Department of Agriculture
Division of Measurement Standards**

DISCLAIMER

This document combines the 2023 Edition of National Institute of Standards and Technology, Handbook 44, Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices (NIST Handbook 44), Section 3.40. Electric Vehicle Fueling Systems and the California Code of Regulations, Title 4, Division 9, Chapter 1, Sections 4000, 4001, and 4002.11. It is intended to serve as a resource for officials enforcing weights and measures laws and regulations relating to commercial EVSE in California. This document is current until such time that changes are made to NIST Handbook 44, Section 3.40 or the California Code of Regulations, Sections 4000 - 4002.11.

Paragraphs not adopted from the 2023 Edition of NIST Handbook 44. are annotated in the text with the statement **[NOT ADOPTED]**.

Additional language in the CCR section 4002 can be identified in **gray shaded font**.

Sources: [NIST Handbook 44](#) and [4 CCR 4000, 4001 and 4002.](#)

CCR Article 1, National Uniformity, Exceptions and Additions

§ 4000. Application. Commercial weighing and measuring devices shall, except where noted below, conform to the latest requirements set forth in the National Institute of Standards and Technology Handbook 44 “Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices”, which is herein incorporated by reference, and to the Additional Requirements listed herein. Copies of Handbook 44 may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. [Added 1994, 4 CCR 4000]

§ 4001. Exceptions. The following regulations in Handbook 44 are not adopted or incorporated by reference (click on § 4001. Exceptions).

§ 4002. Additional Requirements. The following sections apply to devices in addition to the Handbook 44 requirements that are incorporated by reference. The number in parenthesis following the section number and section title refers to the related section in Handbook 44; i.e., 4002.1. General Code (1.10.) refers to Section 1.10. General Code in Handbook 44.

§ 4002. Additional Language .

Note: Authority cited: Sections 12027 and 12107, Business and Professions Code. Reference: Section 12107, Business and Professions Code.

Table of Contents

Section 3.30. Liquid-Measuring Devices	1
A. Application	1
A.1. General.	1
A.2. Exceptions.....	1
A.3. Additional Code Requirements.....	1
S. Specifications	1
S.1. Indicating and Recording Elements and Recorded Representations.	1
S.1.1. General.....	1
S.1.2. Units.....	2
S.1.3. Advancement of Indicating and Recording Elements.	2
S.1.4. Graduations.	3
S.1.5. Indicators.	3
S.1.6. Additional Operating Requirements, Retail Devices (Except Slow-flow Meters).....	4
S.1.7. Additional Operating Requirements, Wholesale Devices Only.	10
S.2. Measuring Elements.....	11
S.2.1. Air/Vapor Elimination.	11
S.2.2. Provision for Sealing.....	11
S.2.3. Directional Flow Valves.....	12
S.2.4. Stop Mechanism.....	12
S.2.5. Zero-Set-Back Interlock for Retail Devices.	13
S.2.6. <i>Temperature Determination – Wholesale Devices</i>	13
S.2.7. Wholesale Devices Equipped with Automatic Temperature Compensators. .	14
S.2.8. Exhaustion of Supply, Lubricant Devices Other than Meter Types.	14
S.3. Discharge Lines and Valves.....	14
S.3.1. Diversion of Measured Liquid.	14
S.3.2. Exceptions.	15
S.3.3. Pump-Discharge Unit.....	15
S.3.4. Gravity-Discharge Unit.....	15
S.3.5. Discharge Hose, Reinforcement.	16
S.3.6. Discharge Valve.....	16
S.3.7. Anti-drain Means.....	16
S.4. Marking Requirements.	16
S.4.1. Limitation on Use.	16

CCR Title 4, Div. 9, CCR §§ 4000., 4001. and 4002.8.
2023 Edition of NIST HB 44 Section 3.30. Liquid-Measuring Devices

S.4.2.	Air Pressure.	16
S.4.3.	Wholesale Devices.	16
S.4.4.	<i>Retail Devices</i>	17
S.5.	<i>Totalizers for Retail Dispensers</i>	17
N.	Notes	17
N.1.	Test Liquid.	17
N.1.1.	Type of Liquid.	17
N.1.2.	Labeling.	18
N.2.	Volume Change.	18
N.3.	Test Drafts.	18
N.3.1.	Retail Piston-Type and Visible-Type Devices.	18
N.3.2.	Slow-flow Meters.	18
N.3.3.	Lubricant Devices.	18
N.3.4.	Other Retail Devices.	18
N.3.5.	Wholesale Devices.	18
N.4.	Testing Procedures.	18
N.4.1.	Normal Tests.	18
N.4.1.1.	Wholesale Devices Equipped with Automatic Temperature-Compensating Systems. [NOT ADOPTED - CCR § 4001. Exceptions.]	19
	CCR § 4002.8. Liquid-Measuring Devices. (3.30.). (a) Wholesale Device Equipped With Automatic Temperature Compensating Systems.	19
N.4.2.	Special Tests.	19
N.4.3.	Money-Value Computation Tests.	20
N.4.4.	Pour and Drain Times.	21
N.4.5.	Verification of Linearization Factors.	21
N.4.6.	Repeatability Tests.	21
N.5.	Temperature Correction on Wholesale Devices.	21
T.	Tolerances	21
T.1.	Application to Underregistration and to Overregistration.	21
T.2.	Tolerance Values.	22
T.3.	Repeatability.	23
T.4.	<i>Automatic Temperature-Compensating Systems</i>	23
UR.	User Requirements	23
UR.1.	Selection Requirements.	23
UR.1.1.	Discharge Hose.	23

CCR Title 4, Div. 9, CCR §§ 4000., 4001. and 4002.8.
2023 Edition of NIST HB 44 Section 3.30. Liquid-Measuring Devices

UR.2. Installation Requirements.....	24
UR.2.1. Manufacturer’s Instructions.....	24
UR.2.2. Discharge Rate.....	24
UR.2.3. Suction Head.....	24
UR.2.4. Diversion of Liquid Flow.....	25
UR.2.5. Product Storage Identification.....	25
UR.3. Use of Device.....	25
UR.3.1. Return of Indicating and Recording Elements to Zero.....	25
UR.3.2. Unit Price and Product Identity.....	25
UR.3.3. Computing Device.....	26
UR.3.4. Printed Ticket.....	27
UR.3.5. Steps after Dispensing.....	27
UR.3.6. Temperature Compensation, Wholesale.....	27
U.R.4. Maintenance Requirements.....	29
UR.4.1. Use of Adjustments.....	29
UR.4.2. Security for Retail Motor-Fuel Devices (RMFD).....	29
Liquid-Measuring Device Code Index.....	30

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Section 3.30. Liquid-Measuring Devices

A. Application

A.1. General. – This code applies to:

- (a) devices used for the measurement of liquids; and
- (b) wholesale devices used for the measurement and delivery of agri-chemical liquids such as fertilizers, feeds, herbicides, pesticides, insecticides, fungicides, and defoliants.
(Added 1985)

A.2. Exceptions. – This code does not apply to:

- (a) meters mounted on vehicle tanks (Also see Section 3.31. Code for Vehicle-Tank Meters.);
- (b) devices used for dispensing liquefied petroleum gases (Also see Section 3.32. Code for Liquefied Petroleum Gas and Anhydrous Ammonia Liquid-Measuring Devices.);
- (c) devices used for dispensing other liquids that do not remain in a liquid state at atmospheric pressures and temperatures;
- (d) water meters;
- (e) devices used solely for dispensing a product in connection with operations in which the amount dispensed does not affect customer charges; or
- (f) mass flow meters. (Also see Section 3.37. Code for Mass Flow Meters.)
(Added 1994)

A.3. Additional Code Requirements. – In addition to the requirements of this code, liquid-measuring devices shall meet the requirements of Section 1.10. General Code.

S. Specifications

S.1. Indicating and Recording Elements and Recorded Representations.

S.1.1. General. – A liquid-measuring device:

- (a) shall be equipped with a primary indicating element; and
- (b) may be equipped with a primary recording element.

S.1.2. Units. – A liquid-measuring device shall indicate, and record if the device is equipped to record, its deliveries in liters, gallons, quarts, pints, fluid ounces, or binary-submultiples or decimal subdivisions of the liter or gallon.

(Amended 1987, 1994, and 2006)

S.1.2.1. Retail Motor-Fuel Devices. – Deliveries shall be indicated and recorded, if the device is equipped to record, in liters or gallons and decimal subdivisions or fractional equivalents thereof.

(Added 1979)

S.1.2.2. Agri-Chemical Liquid Devices.

S.1.2.2.1. Liquid Measure. – Deliveries shall be indicated and recorded in liters or gallons and decimal subdivisions or fractional equivalents thereof.

S.1.2.3. Value of Smallest Unit. – The value of the smallest unit of indicated delivery, and recorded delivery if the device is equipped to record, shall not exceed the equivalent of:

(a) 0.5 L (0.1 gal) on devices with a maximum rated flow rate of 750 L/min (200 gal/min) or less;

(b) 5 L (1 gal) on devices with a maximum rated flow of more than 750 L/min (200 gal/min); or

(c) 5 L (1 gal) on meters with a rated maximum flow rate of 375 L/min (100 gal/min) or more used for jet fuel aviation refueling systems.

(Added 2007)

This requirement does not apply to manually operated devices equipped with stops or stroke-limiting means.

(Amended 1983, 1986, and 2007)

S.1.3. Advancement of Indicating and Recording Elements. – It shall not be possible to advance primary indicating and recording elements except by the mechanical operation of the device. Clearing a device by advancing its elements to zero is permitted, but only if:

(a) once started, the advancement movement cannot be stopped until zero is reached; and

(b) in the case of indicating elements only, such elements are automatically obscured until the elements reach the correct zero position.

S.1.4. Graduations.

S.1.4.1. Length. – Graduations shall be varied in length so that they may be conveniently read.

S.1.4.2. Width. – In a series of graduations, the width of:

- (a) every graduation shall be at least 0.2 mm (0.008 in) but not greater than the minimum clear interval between graduations; and
- (b) main graduations shall be not more than 50 % greater than the width of subordinate graduations.

S.1.4.3. Clear Interval Between Graduations. – The clear interval between graduations shall be not less than 1.0 mm (0.04 in). If the graduations are not parallel, the measurement shall be made:

- (a) along the line of movement of the tip of the index of the indicator as it passes over the graduations; or
- (b) if the indicator extends over the entire length of the graduations, at the point of widest separation of the graduations.

S.1.5. Indicators.

S.1.5.1. Symmetry. – The portion of the index of an indicator associated with the graduations shall be symmetrical with respect to the graduations.

S.1.5.2. Length.

- (a) If the indicator and the graduations are in different planes, the index of the indicator shall extend to each graduation with which it is to be used.
- (b) If the indicator is in the same plane as the graduations, the distance between the index of the indicator and the ends of the graduations, measured along the line of the graduations, shall be not more than 1.0 mm (0.04 in).

S.1.5.3. Width.

- (a) *The index of an indicator shall not be wider than the width of the narrowest graduation.*
[Nonretroactive as of January 1, 2002]
(Amended 2000)

- (b) If the index of an indicator extends over the entire length of a graduation, it shall be of uniform width throughout the portion that coincides with the graduation.

S.1.5.4. Clearance. – If the indicator and the graduations are in different planes, the clearance between the index of an indicator and the plane of the graduations shall be no greater than 1.5 mm (0.06 in).

S.1.5.5. Parallax. – Parallax effects shall be reduced to the practical minimum.

S.1.6. Additional Operating Requirements, Retail Devices (Except Slow-flow Meters).

S.1.6.1. Indication of Delivery. – The device shall automatically show on its face the initial zero condition and the quantity delivered (up to the nominal capacity). However, the following requirements shall apply:

For electronic devices manufactured prior to January 1, 2006, the first 0.03 L (or 0.009 gal) of a delivery and its associated total sales price need not be indicated.

For electronic devices manufactured on or after January 1, 2006, the measurement, indication of delivered quantity, and the indication of total sales price shall be inhibited until the fueling position reaches conditions necessary to ensure that the delivery starts at zero.

[Nonretroactive as of January 1, 2006]

(Added 2005)

(Amended 1982 and 2005)

S.1.6.2. Provisions for Power Loss.

S.1.6.2.1. Transaction Information. – *In the event of a power loss, the information needed to complete any transaction in progress at the time of the power loss (such as the quantity and unit price, or sales price) shall be determinable for at least 15 minutes at the dispenser or at the console if the console is accessible to the customer.*

[Nonretroactive as of January 1, 1983]

S.1.6.2.2. User Information. – *The device memory shall retain information on the quantity of fuel dispensed and the sales price totals during power loss.*

[Nonretroactive as of January 1, 1983]

S.1.6.3. Return to Zero.

- (a) The primary indicating elements, and primary recording elements if the device is equipped to record, shall be readily returnable to a definite zero indication. However, a key-lock operated or other self-operated device

may be equipped with cumulative indicating or recording elements, provided that it is also equipped with a zero-return indicating element.

- (b) It shall not be possible to return primary indicating elements, or primary recording elements beyond the correct zero position.
- (c) Primary indicating elements shall not be resettable to zero during a delivery.

(Amended 1972 and 2016)

S.1.6.4. Display of Unit Price and Product Identity.

S.1.6.4.1. Unit Price.

- (a) A computing or money-operated device shall be able to display on each face the unit price at which the device is set to compute or to dispense.
- (b) *Except for dispensers used exclusively for fleet sales, other price contract sales, and truck refueling (e.g., truck stop dispensers used only to refuel trucks), whenever a grade, brand, blend, or mixture is offered for sale from a device at more than one unit price, then all of the unit prices at which that product is offered for sale shall meet the following conditions:*
 - (1) *For a system that applies a discount prior to the delivery, all unit prices shall be displayed or shall be capable of being displayed on the dispenser through a deliberate action of the customer prior to the delivery of the product. It is not necessary that all of the unit prices for all grades, brands, blends, or mixtures be simultaneously displayed prior to the delivery of the product.*
[Nonretroactive as of January 1, 1991]
 - (2) For a system that offers post-delivery discounts on fuel sales, display of pre-delivery unit price information is exempt from (b)(1), provided the system complies with S.1.6.8. Recorded Representations for Transactions Where a Post-Delivery Discount(s) is Provided.

(Added 2012)

Note: When a product is offered at more than one unit price, display of the unit price information may be through the deliberate action of the customer: 1) using controls on the device; 2) through the customer's use of personal or vehicle-mounted electronic equipment communicating with the system; or 3) verbal instructions by the customer.

(Added 2012)

(Amended 1989, 1997, and 2012)

S.1.6.4.2. Product Identity.

- (a) A device shall be able to conspicuously display on each side the identity of the product being dispensed.
- (b) A device designed to dispense more than one grade, brand, blend, or mixture of product also shall be able to display on each side the identity of the grade, brand, blend, or mixture being dispensed.

S.1.6.5. Money-Value Computations.

(a) A computing device shall compute the total sales price at any single-purchase unit price (i.e., excluding fleet sales, other price contract sales, and truck stop dispensers used only to refuel trucks) for which the product being measured is offered for sale at any delivery possible within either the measurement range of the device or the range of the computing elements, whichever is less.

[Nonretroactive as of January 1, 1991]

(b) The analog sales price indicated for any delivered quantity shall not differ from a mathematically computed price (quantity \times unit price = total sales price) by an amount greater than the value in Table 1. Money-Value Divisions and Maximum Allowable Variations for Money-Value Computations on Mechanical Analog Computers.

(Amended 1984, 1989, and 1993)

S.1.6.5.1. Money-Value Divisions, Analog. – The values of the graduated intervals representing money values on a computing type device shall be no greater than those in Table 1. Money-Value Divisions and Maximum Allowable Variations for Money-Value Computations on Mechanical Analog Computers.

(Amended 1991)

Table 1. Money-Value Divisions and Maximum Allowable Variations for Money-Value Computations on Mechanical Analog Computers

Unit Price From	Unit Price To and Including	Money-Value Division	Maximum Allowable Variation Design Test	Maximum Allowable Variation - Field Test
0	\$0.25/liter or \$1.00/gallon	1¢	± 1¢	± 1¢
\$0.25/liter or \$1.00/gallon	\$0.75/liter or \$3.00/gallon	1¢ or 2¢	± 1¢	± 2¢
\$0.75/liter or \$3.00/gallon	\$2.50/liter or \$10.00/gallon	1¢, 2¢ or 5¢	± 1¢ or ± 2½¢	± 2¢ or ± 5¢

S.1.6.5.2. Money-Value Divisions, Digital. – A computing type device with digital indications shall comply with the requirements of paragraph G.S.5.5. Money-Values, Mathematical Agreement, and the total price computation shall be based on quantities not exceeding 0.05 L for devices indicating in metric units and 0.01 gal intervals for devices indicating in U.S. customary units.

(Added 1980)

S.1.6.5.3. Auxiliary Elements. – *If a system is equipped with auxiliary indications, all indicated money-value divisions of the auxiliary element shall be identical with those of the primary element.*

[Nonretroactive as of January 1, 1985]

S.1.6.5.4. Selection of Unit Price. – A system shall not permit a change to the unit price during delivery of product. When a product or grade is offered for sale at more than one unit price through a computing device, the following conditions shall be met:

(a) *Except for a system only capable of applying a post-delivery discount(s), the selection of the unit price shall be made prior to delivery through a deliberate action of the customer to select the unit price for the fuel delivery.*

[Nonretroactive as of January 1, 1991]

(b) For a system only capable of applying a post-delivery discount(s), the selection of the unit price shall be made through a deliberate action of the customer to select the unit price for the fuel delivery.

(Added 2012)

Note: When a product is offered at more than one unit price, selection of the unit price may be through the deliberate action of the customer: 1) using controls on the device; 2) through the customer's use of personal or vehicle-mounted electronic equipment communicating with the system; or 3) verbal instructions by the customer.

(Added 2012)

The provisions in (a) and (b) do not apply to dispensers used exclusively for fleet sales, other price contract sales, and truck refueling (e.g., truck stop dispensers used only to refuel trucks).

(Added 1989) (Amended 1991, 1992, 1993, 1996, and 2012)

S.1.6.5.5. Display of Quantity and Total Price. – *Except for aviation refueling applications, when a delivery is completed, the total price and quantity for that transaction shall be displayed on the face of the dispenser for at least five minutes or until the next transaction is initiated by using controls on the device or other customer-activated controls.*

[Nonretroactive as of January 1, 1994]

(Added 1992) (Amended 1996 and 2007)

S.1.6.5.6. Display of Quantity and Total Price, Aviation Refueling Applications.

(a) The quantity shall be displayed throughout the transaction.

(b) The total price shall also be displayed under one of the following conditions:

(1) The total price can appear on the face of the dispenser or through a controller adjacent to the device.

(2) If a device is designed to continuously compute and display the total price, then the total price shall be computed and displayed throughout the transaction for the quantity delivered.

(c) The total price and quantity shall be displayed for at least five minutes or until the next transaction is initiated by using controls on the device or other customer-activated controls.

(d) A printed receipt shall be available and shall include, at a minimum, the total price, quantity, and unit price.

[Nonretroactive as of January 1, 2008]

(Added 2007)

S.1.6.6. Agreement Between Indications.

(a) When a quantity value indicated or recorded by an auxiliary element is a derived or computed value based on data received from a retail motor fuel dispenser, the value may differ from the quantity value displayed on the dispenser, provided the following conditions are met:

(1) all total money-values for an individual sale that are indicated or recorded by the system agree; and

(2) *within each element, the values indicated or recorded meet the formula (quantity × unit price = total sales price) to the closest cent.*
[Nonretroactive as of January 1, 1988]

(b) When a system applies a post-delivery discount(s) to a fuel's unit price through an auxiliary element, the following conditions shall apply for computed values:

(1) the total volume of the delivery shall be in agreement between all elements in the system.

(Added 2012)

(Added 1985) (Amended 1987, 1988, and 2012)

S.1.6.7. Recorded Representations. – *Except for fleet sales and other price contract sales and for transactions where a post-delivery discount is provided, a printed receipt providing the following information shall be available through a built-in or separate recording element for all transactions conducted with point-of-sale systems or devices activated by debit cards, credit cards, and/or cash:*

(a) the total volume of the delivery;

(b) the unit price;

(c) the total computed price; and

(d) the product identity by name, symbol, abbreviation, or code number.

[Nonretroactive as of January 1, 1986]

(Added 1985) (Amended 1997, 2012, and 2014)

S.1.6.8. Recorded Representations for Transactions Where a Post-Delivery Discount(s) is Provided. – Except for fleet sales and other price contract sales, a printed receipt providing the following information shall be available through a built-in or separate recording element that is part of the system for transactions involving a post-delivery discount:

CCR Title 4, Div. 9, CCR §§ 4000., 4001. and 4002.8.
2023 Edition of NIST HB 44 Section 3.30. Liquid-Measuring Devices

- (a) the product identity by name, symbol, abbreviation, or code number;
- (b) transaction information as shown on the dispenser at the end of the delivery and prior to any post-delivery discount(s), including the:
 - (1) total volume of the delivery;
 - (2) unit price; and
 - (3) total computed price of the fuel sale.
- (c) an itemization of the post-delivery discounts to the unit price; and
- (d) the final total price of the fuel sale after all post-delivery discounts are applied.

(Added 2012) (Amended 2014)

S.1.6.9. Lubricant Devices, Travel of Indicator. – The indicator shall move at least 2.5 cm (1 in) in relation to the graduations, if provided, for a delivery of 0.5 L (1 pt).

S.1.6.10. Automatic Timeout – Pay-At-Pump for Retail Devices. – *Once a device has been authorized, it must deauthorize within three minutes if not activated. Reauthorization of the device must be performed before any product can be dispensed. If the time limit to deauthorize the device is programmable, it shall not accept an entry greater than three minutes.*

[Nonretroactive as of January 1, 2017]

(Added 2016) (Amended 2019 and 2021)

S.1.7. Additional Operating Requirements, Wholesale Devices Only.

S.1.7.1. Travel of Indicator. – A wholesale device shall be readily operable to deliver accurately any quantity from 200 L (50 gal) to the capacity of the device. If the most sensitive element of the indicating system utilizes an indicator and graduations, the relative movement of these parts corresponding to a delivery of 4 L (1 gal) shall be not less than 5 mm (0.20 in).

(Amended 1987)

S.1.7.2. Money-Values – Mathematical Agreement. – Any digital money-value indication and any recorded money-value on a computing-type device shall be in mathematical agreement with its associated quantity indication or representation to within 1 cent of money-value.

S.2. Measuring Elements.

S.2.1. Air/Vapor Elimination. – A measuring system shall be equipped with an effective air/vapor eliminator or other automatic means to prevent the passage of air/vapor through the meter. Vent lines from the air/vapor eliminator shall be made of appropriate non-collapsible material.

(Amended 1975 and 2017)

S.2.1.1. Air/Vapor Elimination on Loading Rack Measuring Systems.

(a) A loading rack measuring system shall be equipped with an effective air/vapor eliminator or other automatic means to prevent the passage of air/vapor through the meter unless the system is designed or operationally controlled by a means such that air/vapor cannot enter the system.

(b) Vent lines from the air/vapor eliminator shall be made of appropriate non-collapsible material.

(Added 1994) (Amended 2017)

S.2.2. Provision for Sealing. – For devices and systems in which the configuration or calibration parameters can be changed by use of a removable digital storage device, security shall be provided for those parameters as specified in G-S.8.2. Devices and Systems Adjusted Using Removable Digital Storage Devices. For parameters adjusted using other means, the following applies.

Adequate provision shall be made for an approved means of security (e.g., data change audit trail) or for physically applying a security seal in such a manner that requires the security seal to be broken before an adjustment or interchange can be made of:

- (a) any measuring or indicating element;
- (b) any adjustable element for controlling delivery rate when such rate tends to affect the accuracy of deliveries; and
- (c) any metrological parameter that will affect the metrological integrity of the device or system.

When applicable, the adjusting mechanism shall be readily accessible for purposes of affixing a security seal.

*Audit trails shall use the format set forth in Table S.2.2.**

*[*Nonretroactive as of January 1, 1995]*

(Amended 1991, 1993, 1995, 2006, and 2019)

Table S.2.2. Categories of Device and Methods of Sealing

Categories of Device	Methods of Sealing
<p>Category 1: No remote configuration capability.</p>	<p>Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.</p>
<p>Category 2: Remote configuration capability, but access is controlled by physical hardware.</p> <p>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.</p>	<p>The hardware enabling access for remote communication must be on-site. The hardware must be sealed using a physical seal or an event counter for calibration parameters and an event counter for configuration parameters. The event counters may be located either at the individual measuring device or at the system controller; however, an adequate number of counters must be provided to monitor the calibration and configuration parameters of the individual devices at a location. If the counters are located in the system controller rather than at the individual device, means must be provided to generate a hard copy of the information through an on-site device.</p> <p>*Nonretroactive as of January 1, 1996.</p>
<p>Category 3: Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password). [Nonretroactive as of January 1, 1995]</p> <p>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode. [Nonretroactive as of January 1, 2001]</p>	<p>An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. A printed copy of the information must be available on demand through the device or through another on-site device. The information may also be available electronically. The event logger shall have a capacity to retain records equal to 10 times the number of sealable parameters in the device, but not more than 1000 records are required. (Note: Does not require 1000 changes to be stored for each parameter.)</p>

[Nonretroactive as of January 1, 1995]

(Table Added 2006) (Amended 1995, 1998, 1999, 2006, 2015, and 2022)

S.2.3. Directional Flow Valves. – Valves intended to prevent reversal of flow shall be automatic in operation.

S.2.4. Stop Mechanism.

S.2.4.1. Indication. – The delivery for which the device is set shall be conspicuously indicated.

(Amended 1983)

S.2.4.2. Stroke Limiting Elements. – Stops or other stroke limiting elements subject to direct pressure or impact shall be:

- (a) made secure by positive, nonfrictional engagement of these elements; and
 - (b) adjustable to provide for deliveries within tolerances.
- (Amended 1983)

S.2.4.3. Setting. – If two or more stops or other elements may be selectively brought into operation to permit predetermined quantities of deliveries:

- (a) the position for the proper setting of each such element shall be accurately defined; and
 - (b) any inadvertent displacement from the proper setting shall be obstructed.
- (Amended 1983)

S.2.5. Zero-Set-Back Interlock for Retail Devices. – A device shall be constructed so that:

- (a) after a delivery cycle has been completed by moving the starting lever to any position that shuts off the device, an automatic interlock prevents a subsequent delivery until the indicating elements, and recording elements if the device is equipped and activated to record, have been returned to their zero positions;
 - (b) the discharge nozzle cannot be returned to its designed hanging position (that is, any position where the tip of the nozzle is placed in its designed receptacle and the lock can be inserted) until the starting lever is in its designed shut-off position and the zero-set-back interlock has been engaged; and
 - (c) in a system with more than one dispenser supplied by a single pump, an effective automatic control valve in each dispenser prevents product from being delivered until the indicating elements on that dispenser are in a correct zero position.
- (Amended 1981, 1985, and 2019)

S.2.6. Temperature Determination – Wholesale Devices. – *For test purposes, means shall be provided (e.g., thermometer well) to determine the temperature of the liquid either:*

- (a) *in the liquid chamber of the meter; or*
 - (b) *in the meter inlet or discharge line immediately adjacent to the meter.*
- [Nonretroactive as of January 1, 1985]*
(Added 1984) (Amended 1986)

S.2.7. Wholesale Devices Equipped with Automatic Temperature Compensators.

S.2.7.1. Automatic Temperature Compensation. – A device may be equipped with an automatic means for adjusting the indication and registration of the measured volume of product to the volume at 15 °C (60 °F).

S.2.7.2. Provision for Deactivating. – On a device equipped with an automatic temperature-compensating mechanism that will indicate or record only in terms of gallons compensated to 15 °C (60 °F), provision shall be made for deactivating the automatic temperature-compensating mechanism so that the meter can indicate and record, if it is equipped to record, in terms of the uncompensated volume.

(Amended 1972)

S.2.7.3. Provision for Sealing Automatic Temperature-Compensating Systems. – Provision shall be made for applying security seals in such a manner that an automatic temperature-compensating system cannot be disconnected and that no adjustment may be made to the system without breaking the seal.

S.2.7.4. Temperature Determination with Automatic Temperature-Compensation. – For test purposes, means shall be provided (e.g., thermometer well) to determine the temperature of the liquid either:

(a) in the liquid chamber of the meter; or

(b) immediately adjacent to the meter in the meter inlet or discharge line.

(Amended 1987)

S.2.8. Exhaustion of Supply, Lubricant Devices Other than Meter Types. – When the level of the supply of lubricant becomes so low as to compromise the accuracy of measurement, the device shall:

(a) automatically become inoperable; or

(b) give a conspicuous and distinct warning.

S.3. Discharge Lines and Valves.

S.3.1. Diversion of Measured Liquid. – No means shall be provided by which any measured liquid can be diverted from the measuring chamber of the meter or its

discharge line. Two or more delivery outlets may be installed only if automatic means are provided to ensure that:

- (a) liquid can flow from only one outlet at a time; and
- (b) the direction of flow for which the mechanism may be set at any time is clearly and conspicuously indicated.

An outlet that may be opened for purging or draining the measuring system or for recirculating, if recirculation is required in order to maintain the product in a deliverable state, shall be permitted only when the system is measuring food products, agri-chemicals, biodiesel, or biodiesel blends. Effective automatic means shall be provided to prevent passage of liquid through any such outlet during normal operation of the measuring system and to inhibit meter indications (or advancement of indications) and recorded representations while the outlet is in operation.

(Amended 1991, 1995, 1996, and 2007)

S.3.2. Exceptions. – The provisions of S.3.1. Diversion of Measured Liquid shall not apply to truck refueling devices when diversion of flow to other than the receiving vehicle cannot readily be accomplished and is readily apparent. Allowable deterrents include, but are not limited to, physical barriers to adjacent driveways, visible valves, or lighting systems that indicate which outlets are in operation, and explanatory signs.

(Amended 1982, 1990, 1991, and 2002)

S.3.3. Pump-Discharge Unit. – A pump-discharge unit equipped with a flexible discharge hose shall be of the wet-hose type.

S.3.4. Gravity-Discharge Unit. – On a gravity-discharge unit:

- (a) the discharge hose or equivalent pipe shall be of the dry-hose type with no shutoff valve at its outlet end unless the hose or pipe drains to the same level under all conditions of use;
- (b) the dry-hose shall be sufficiently stiff and only as long as necessary to facilitate drainage;
- (c) an automatic vacuum breaker, or equivalent mechanism, shall be incorporated to prevent siphoning and to ensure rapid and complete drainage; and
- (d) the inlet end of the hose or outlet pipe shall be high enough to ensure complete drainage.

S.3.5. Discharge Hose, Reinforcement. – A discharge hose shall be reinforced so that the performance of the device is not affected by the expansion or contraction of the hose.

S.3.6. Discharge Valve. – A discharge valve may be installed in the discharge line only if the device is of the wet-hose type. Any other shutoff valve on the discharge side of the meter shall be of the automatic or semiautomatic predetermined-stop type or shall be operable only:

- (a) by means of a tool (but not a pin) entirely separate from the device; or
- (b) by mutilation of a security seal with which the valve is sealed open.

S.3.7. Anti-drain Means. – In a wet-hose pressure-type device, means shall be incorporated to prevent the drainage of the discharge hose.

(Amended 1990)

S.4. Marking Requirements.

S.4.1. Limitation on Use. – The limitations on its use shall be clearly and permanently marked on any device intended to measure accurately only:

- (a) products having particular properties;
- (b) under specific installation or operating conditions; or
- (c) when used in conjunction with specific accessory equipment.

S.4.2. Air Pressure. – If a device is operated by air pressure, the air pressure gauge shall show by special graduations or other means the maximum and minimum working pressures recommended by the manufacturer.

S.4.3. Wholesale Devices.

S.4.3.1. Discharge Rates. – A wholesale device shall be marked to show its designed maximum and minimum discharge rates. However, the minimum discharge rate shall not exceed 20 % of the maximum discharge rate.

S.4.3.2. Temperature Compensation. – If a device is equipped with an automatic temperature compensation, the primary indicating elements, recording elements, and recorded representation shall be clearly and conspicuously marked to show that the volume delivered has been adjusted to the volume at 15 °C (60 °F).

S.4.4. Retail Devices.

S.4.4.1. Discharge Rates. – *On a retail device with a designed maximum discharge rate of 115 L (30 gal) per minute or greater, the maximum and minimum discharge rates shall be marked in accordance with S.4.4.2. Location of Marking Information; Retail Dispensers. The marked minimum discharge rate shall not exceed 20 % of the marked maximum discharge rate.*

[Nonretroactive as of January 1, 1985]

(Added 1984) (Amended 2003 and 2019)

Example: With a marked maximum discharge rate of 230 L/min (60 gpm), the marked minimum discharge rate shall be 45 L/min (12 gpm) or less (e.g., 40 L/min [10 gpm] is acceptable). A marked minimum discharge rate greater than 45 L/min (12 gpm) (e.g., 60 L/min [15 gpm]) is not acceptable.

S.4.4.2. Location of Marking Information for Retail Dispensers. – *The marking information required in the General Code, paragraph G-S.1. Identification shall appear as follows:*

- (a) within 60 cm (24 in) to 150 cm (60 in) from the base of the dispenser (for a system in a dispenser);*
- (b) either internally and/or externally provided the information is permanent and easily read; and*
- (c) on a portion of the device that cannot be readily removed or interchanged (i.e., not on a service access panel).*

The use of a dispenser key or tool to access internal marking information is permitted for retail liquid-measuring devices.

[Nonretroactive as of January 1, 2003]

(Added 2002) (Amended 2004 and 2019)

S.5. Totalizers for Retail Dispensers. – *Retail dispensers shall be equipped with a non-resettable totalizer for the quantity delivered through the metering device.*

[Nonretroactive as of January 1, 1995]

(Added 1993) (Amended 1994 and 2019)

N. Notes

N.1. Test Liquid.

N.1.1. Type of Liquid. – The liquid used for testing a liquid-measuring device shall be the type the device is used to measure, or another liquid with the same general physical characteristics.

N.1.2. Labeling. – Following the completion of a successful examination of a wholesale device, the weights and measures official should attach a label or tag indicating the type of liquid used during the test.

N.2. Volume Change. – Care shall be taken to minimize changes in volume of the test liquid due to temperature changes and evaporation losses.

N.3. Test Drafts.

N.3.1. Retail Piston-Type and Visible-Type Devices. – Test drafts shall include the full capacity delivery and each intermediate delivery for which the device is designed.

N.3.2. Slow-flow Meters. – Test drafts shall be equal to at least four times the minimum volume that can be measured and indicated through either a visible indication or an audible signal.

N.3.3. Lubricant Devices. – Test drafts shall be 1 L (1 qt). Additional test drafts may include 0.5 L (1 pt), 4 L (4 qt), and 6 L (6 qt).

N.3.4. Other Retail Devices. – On devices with a designed maximum discharge rate of:

- (a) less than 80 L (20 gal) per minute, tests shall include drafts of one or more amounts, including a draft of at least 19 L (5 gal).
- (b) 80 L (20 gal) per minute or greater, tests shall include drafts of one or more amounts, including a draft of at least the amount delivered by the device in one minute at the maximum flow rate of the installation.

(Amended 1984)

N.3.5. Wholesale Devices. – The delivered quantity should be equal to at least the amount delivered by the device in one minute at its maximum discharge rate and shall in no case be less than 200 L (50 gal).

(Amended 1987 and 1996)

N.4. Testing Procedures.

N.4.1. Normal Tests. – The “normal” test of a device shall be made at the maximum discharge flow rate developed under the conditions of installation. Any additional tests conducted at flow rates down to and including one-half of the sum of the maximum discharge flow rate and the rated minimum discharge flow rate shall be considered normal tests.

(Amended 1991)

N.4.1.1. Wholesale Devices Equipped with Automatic Temperature-Compensating Systems. [NOT ADOPTED - CCR § 4001. Exceptions.]

CCR § 4002.8. Liquid-Measuring Devices. (3.30.). (a) Wholesale Device Equipped With Automatic Temperature Compensating Systems.

On wholesale devices equipped with automatic temperature compensating systems, normal tests:

(1) shall be conducted with the temperature compensating system connected and operating by comparing the compensated volume indicated or recorded to the actual delivered volume corrected to 60oF, and

(2) may be conducted with the temperature compensating system deactivated by comparing the uncompensated volume indicated or recorded to the actual delivered volume.

The first test shall be performed with the automatic temperature compensating system operating in the “as found” condition.

On devices that indicate or record both the compensated and uncompensated volume for each delivery, the tests in (1) and (2) may be performed as a single test.

Note: Authority cited: Sections 12027 and 12107, Business and Professions Code. Reference: Section 12107, Business and Professions Code.

N.4.2. Special Tests. – “Special” tests shall be made to develop the operating characteristics of a device and any special elements and accessories attached to or associated with the device. Any test except as set forth in N.4.1. Normal Tests shall be considered a special test.

N.4.2.1. Slow-Flow Meters. – A “special” test shall be made at a flow rate:

- (a) not larger than twice the actual minimum flow rate; and
- (b) not smaller than the actual minimum flow rate of the installation.

N.4.2.2. Retail Motor-Fuel Devices and DEF Devices

(a) Devices without a marked minimum flow rate shall have a “special” test performed at the slower of the following rates:

- (1) 19 L (5 gal) per minute; or
- (2) the minimum discharge rate at which the device will deliver when equipped with an automatic discharge nozzle set at its slowest setting.

- (b) Devices with a marked minimum flow rate shall have a “special” test performed at or near the marked minimum flow rate.

(Added 1984) (Amended 2005 and 2019)

N.4.2.3. Other Retail Devices. – “Special” tests of other retail devices shall be made at the slower of the following rates:

- (a) 50 % of the maximum discharge rate developed under the conditions of installation; or
- (b) the minimum discharge rate marked on the device.

N.4.2.4. Wholesale Devices. – “Special” tests shall be made to develop the operating characteristics of a measuring system and any special associated or attached elements and accessories. “Special” tests shall include a test at or slightly above the slower of the following rates:

- (a) 20 % of the marked maximum discharge rate; or
- (b) the minimum discharge rate marked on the device.

In no case shall the test be performed at a flow rate less than the minimum discharge rate marked on the device.

(Amended 2014)

N.4.3. Money-Value Computation Tests.

N.4.3.1. Laboratory Tests. – When testing the device in the laboratory:

- (a) compliance with paragraph S.1.6.5. Money-Value Computations, shall be determined by using the cone gear as a reference for the total quantity delivered;
- (b) the indicated quantity shall agree with the cone gear representation with the index of the indicator within the width of the graduation; and
- (c) the maximum allowable variation of the indicated sales price shall be as shown in Table 1. Money-Value Divisions and Maximum Allowable Variations for Money-Value Computations on Mechanical Analog Computers.

(Amended 1984)

N.4.3.2. Field Tests. – In the conduct of field tests to determine compliance with paragraph S.1.6.5. Money-Value Computations, the maximum allowable variation in the indicated sales price shall be as shown in Table 1. Money-Value Divisions

and Maximum Allowable Variations for Money-Value Computations on
Mechanical Analog Computers.

(Added 1982) (Amended 1984)

N.4.4. Pour and Drain Times.

N.4.4.1. Pour and Drain Times for Hand-held Test Measures. – Hand-held test measures require a 30-second (± 5 seconds) pour followed by a 10-second drain with the measure held at a 10-degree to 15-degree angle from vertical.

N.4.4.2. Drain Times for Bottom Drain Test Measures or Provers. – Bottom drain field standard provers require a 30-second drain time after main flow cessation.

(Added 2009)

N.4.5. Verification of Linearization Factors. – All enabled linearization factors shall be verified. The verification of enabled linearization factors shall be done through physical testing, or a combination of physical testing and empirical analysis at the discretion of the official with statutory authority.

(Added 2016)

N.4.6. Repeatability Tests. – Tests for repeatability should include a minimum of three consecutive test drafts of approximately the same size and be conducted under controlled conditions where variations in factors such as temperature, pressure, and flow rate are reduced to the extent that they will not affect the results obtained. When conducting the tests, the flow rates shall be within the minimum and maximum discharge rates as marked by the manufacturer. For devices with no marked minimum and maximum flow rates, the minimum discharge rates shall be as specified in N.4.2.1. or N.4.2.2. and the maximum discharge rates shall be the maximum discharge rate developed under the conditions of the installation. For devices equipped with an automatic temperature compensator, the results shall be based on the uncompensated (gross) volume (e.g., with the temperature compensator deactivated).

(Amended 2019)

N.5. Temperature Correction on Wholesale Devices. – Corrections shall be made for any changes in volume resulting from the differences in liquid temperatures between time of passage through the meter and time of volumetric determination in the prover. When adjustments are necessary, appropriate petroleum measurement tables should be used.

(Amended 1974)

T. Tolerances

T.1. Application to Underregistration and to Overregistration. – The tolerances hereinafter prescribed shall be applied to errors of underregistration and errors of

overregistration, whether or not a device is equipped with an automatic temperature compensator.

T.2. Tolerance Values. – Maintenance, acceptance, and special test tolerances shall be as shown in Table T.2. Accuracy Classes and Tolerances for Liquid Measuring Devices Covered in NIST Handbook 44, Section 3.30.

Table T.2. Accuracy Classes and Tolerances for Liquid Measuring Devices Covered in NIST Handbook 44, Section 3.30.

Accuracy Class	Application	Acceptance Tolerance	Maintenance Tolerance	Special Test Tolerance ¹
0.3	<ul style="list-style-type: none"> - Petroleum products delivered from large capacity (flow rates greater than 115 L/min or 30 gpm)** devices, including motor-fuel devices - Heated products (other than asphalt) at temperatures greater than 50 °C (122 °F) - Asphalt at temperatures equal to or below 50 °C (122 °F) - All other liquids not shown in the table where the typical delivery is over 200 L (50 gal) 	0.2 %	0.3 %	0.5 %
0.3A	<ul style="list-style-type: none"> - Asphalt at temperatures greater than 50 °C (122 °F) 	0.3 %	0.3 %	0.5 %
0.5*	<ul style="list-style-type: none"> - Petroleum products delivered from small capacity (at 4 L/min (1 gpm) through 115 L/min or 30 gpm)** motor-fuel devices - Agri-chemical liquids - All other applications not shown in the table where the typical delivery is ≤ 200 L (50 gal) 	0.3 %	0.5 %	0.5 %
1.1	<ul style="list-style-type: none"> - Petroleum products and other normal liquids from devices with flow rates** less than 1 gpm. - Devices designed to deliver less than 1 gal 	0.75 %	1.0 %	1.25 %

Accuracy Class	Application	Acceptance Tolerance	Maintenance Tolerance	Special Test Tolerance ¹
<p>* For test drafts ≤ 40 L or 10 gal, the tolerances specified for Accuracy Class 0.5 in the table above do not apply. For these test drafts, the following applies:</p> <p>(a) Maintenance tolerances on normal and special tests shall be 20 mL plus 4 mL per indicated liter or 1 in³ plus 1 in³ per indicated gallon.</p> <p>(b) Acceptance tolerances on normal and special tests shall be one-half the maintenance tolerance values.</p> <p>¹ Special test tolerances are not applicable to retail motor fuel and retail Diesel Exhaust Fluid (DEF) dispensers.</p> <p>** Flow rate refers to designed or marked maximum flow rate.</p>				

(Added 2002) (Amended 2006, 2013 and 2022)

T.3. Repeatability. – When multiple tests are conducted at approximately the same flow rate and draft size, the range of the test results for the flow rate shall not exceed 40 % of the absolute value of the maintenance tolerance and the results of each test shall be within the applicable tolerance. This tolerance does not apply to the test of the automatic temperature-compensating system. (Also see N.4.6. Repeatability Tests.)
 (Added 1992) (Amended 2001, 2002, and 2019)

T.4. Automatic Temperature-Compensating Systems. – *The difference between the meter errors (expressed as a percentage) determined with and without the automatic temperature-compensating system activated shall not exceed:*

- (a) 0.2 % for mechanical automatic temperature-compensating systems; and
- (b) 0.1 % for electronic automatic temperature-compensating systems.

The delivered quantities for each test shall be approximately the same size. The results of each test shall be within the applicable acceptance or maintenance tolerance.
 [Nonretroactive as of January 1, 1988]

(Added 1987) (Amended 1992, 1996, and 2002)

UR. User Requirements

UR.1. Selection Requirements.

UR.1.1. Discharge Hose.

UR.1.1.1. Length. – The length of the discharge hose on a retail motor-fuel device:

- (a) shall be measured from its housing or outlet of the discharge line to the inlet of the discharge nozzle;
- (b) shall be measured with the hose fully extended if it is coiled or otherwise retained or connected inside a housing; and
- (c) shall not exceed 5.5 m (18 ft) unless it can be demonstrated that a longer hose is essential to permit deliveries to be made to receiving vehicles or vessels.

An unnecessarily remote location of a device shall not be accepted as justification for an abnormally long hose.

(Amended 1972 and 1987)

UR.1.1.2. Marinas and Airports.

UR.1.1.2.1. Length. – The length of the discharge hose shall be as short as practicable, and shall not exceed 15 m (50 ft) unless it can be demonstrated that a longer hose is essential.

UR.1.1.2.2. Protection. – Discharge hoses exceeding 8 m (26 ft) in length shall be adequately protected from weather and other environmental factors when not in use.

(Made retroactive 1974 and Amended 1984)

UR.2. Installation Requirements.

UR.2.1. Manufacturer's Instructions. – A device shall be installed in accordance with the manufacturer's instructions, and the installation shall be sufficiently secure and rigid to maintain this condition.

(Added 1987)

UR.2.2. Discharge Rate. – A device shall be installed so that the actual maximum discharge rate will not exceed the rated maximum discharge rate. Automatic means for flow regulation shall be incorporated in the installation if necessary.

UR.2.3. Suction Head. – A piston-type device shall be installed so that the total effective suction head will not be great enough to cause vaporization of the liquid being dispensed under the highest temperature and lowest barometric pressure likely to occur.

UR.2.4. Diversion of Liquid Flow. – A device equipped with two delivery outlets used exclusively in the fueling of trucks shall be so installed that any diversion of flow to other than the receiving vehicle cannot be readily accomplished and is readily apparent. Allowable deterrents include, but are not limited to, physical barriers to adjacent driveways, visible valves, or lighting systems that indicate which outlets are in operation, and explanatory signs.

(Amended 1991 and 2019)

UR.2.5. Product Storage Identification.

(a) The fill connection for any petroleum product or other product storage tank or vessel supplying petroleum product or other products shall be permanently, plainly, and visibly marked as to product contained.

(b) When the fill connection device is marked by means of a color code, the color code key shall be conspicuously displayed at the place of business.

(Added 1975) (Amended 1976 and 2019)

UR.3. Use of Device.

UR.3.1. Return of Indicating and Recording Elements to Zero. – On any dispenser used in making retail deliveries, the primary indicating element, and recording element if so equipped, shall be returned to zero before each delivery.

Exceptions to this requirement are totalizers on key-lock-operated or other self-operated dispensers and the primary recording element if the device is equipped to record.

UR.3.2. Unit Price and Product Identity.

(a) The following information shall be conspicuously displayed or posted on the face of a retail dispenser used in direct sale:

(1) except for unit prices resulting from any post-delivery discount and dispensers used exclusively for fleet sales, other price contract sales, and truck refueling (e.g., truck stop dispensers used only to refuel trucks), all of the unit prices at which the product is offered for sale; and

(2) in the case of a computing type or money-operated type, the unit price at which the dispenser is set to compute.

Provided that the dispenser complies with S.1.6.4.1. Display of Unit Price, it is not necessary that all the unit prices for all grades, brands, blends, or mixtures be simultaneously displayed or posted.

(b) The following information shall be conspicuously displayed or posted on each side of a retail dispenser used in direct sale:

(1) the identity of the product in descriptive commercial terms; and

(2) the identity of the grade, brand, blend, or mixture that a multi-product dispenser is set to deliver.

(Amended 1972, 1983, 1987, 1989, 1992, 1993, and 2012)

UR.3.3. Computing Device. – Any computing device used in an application where a product or grade is offered for sale at one or more unit prices shall be used only for sales for which the device computes and displays the sales price for the selected transaction.

(Became retroactive 1999)

(Added 1989) (Amended 1992)

The following exceptions apply:

(a) Fleet sales and other price contract sales are exempt from this requirement.

(b) A truck stop dispenser used exclusively for refueling trucks is exempt from this requirement provided that:

(1) all purchases of fuel are accompanied by a printed receipt of the transaction containing the applicable price per gallon, the total gallons delivered, and the total price of the sale; and

(Added 1993)

(2) unless a dispenser complies with S.1.6.4.1. Display of Unit Price, the price posted on the dispenser and the price at which the dispenser is set to compute shall be the highest price for any transaction which may be conducted.

(Added 1993)

(c) A dispenser used in an application where a price per unit discount is offered following the delivery is exempt from this requirement, provided the following conditions are satisfied:

(1) the unit price posted on the dispenser and the unit price at which the dispenser is set to compute prior to the application of any discount shall be the highest unit price for any transaction;

(Amended 2014)

(2) all purchases of fuel are accompanied by a receipt recorded by the system. The receipt shall contain:

- a. the product identity by name, symbol, abbreviation, or code number;
- b. transaction information as shown on the dispenser at the end of the delivery and prior to any post-delivery discount including the:
 1. total volume of the delivery;
 2. unit price; and
 3. total computed price of the fuel sale prior to post-delivery discounts being applied.
- c. an itemization of the post-delivery discounts to the unit price; and
- d. the final total price of the fuel sale.

(Added 2012) (Amended 2014)

(Added 1989) (Amended 1992, 1993, 2012, and 2014)

UR.3.4. Printed Ticket. – The total price; the total volume of the delivery; the price per liter or gallon; *and a corresponding alpha or numeric dispenser designation** shall be shown, either printed by the device or in clear hand script, on any printed ticket issued by a device and containing any one of these values. Establishments where no product grades are repeated are exempt from the dispenser designation requirement.

**[Nonretroactive as of January 1, 2021]*

(Amended 2001, 2018, and 2019)

UR.3.5. Steps after Dispensing. – After delivery to a customer from a retail motor-fuel device:

- (a) the starting lever shall be returned to its shutoff position and the zero-set-back interlock engaged; and
- (b) the discharge nozzle shall be returned to its designed hanging position unless the primary indicating elements, and recording elements, if the device is equipped and activated to record, have been returned to a definite zero indication.

UR.3.6. Temperature Compensation, Wholesale.

UR.3.6.1. Automatic.

UR.3.6.1.1. When to be Used. – If a device is equipped with a mechanical automatic temperature compensator, it shall be connected, operable, and in use at all times. An electronic or mechanical automatic temperature-

compensating system may not be removed, nor may a compensated device be replaced with an uncompensated device, without the written approval of the responsible weights and measures jurisdiction.

Note: This requirement does not specify the method of sale for product measured through a meter.

(Amended 1989)

UR.3.6.1.2. Invoices.

- (a) A written invoice based on a reading of a device that is equipped with an automatic temperature compensator shall show that the volume delivered has been adjusted to the volume at 15 °C (60 °F).
- (b) The invoice issued from an electronic wholesale device equipped with an automatic temperature-compensating system shall also indicate:
 - (1) the API gravity, specific gravity or coefficient of expansion for the product;
 - (2) product temperature; and
 - (3) gross reading.

(Amended 1987)

UR.3.6.2. Nonautomatic.

UR.3.6.2.1. Temperature Determination. – If the volume of the product delivered is adjusted to the volume at 15 °C (60 °F), the product temperature shall be taken during the delivery in:

- (a) the liquid chamber of the meter; or
- (b) the meter inlet or discharge line adjacent to the meter; or
- (c) the compartment of the receiving vehicle at the time it is loaded.

UR.3.6.2.2. Invoices. – The accompanying invoice shall indicate that the volume of the product has been adjusted for temperature variations to a volume at 15 °C (60 °F) and shall also state the product temperature used in making the adjustment.

UR.3.6.3. Period of Use. – When fuel is bought or sold on an automatic or non-automatic temperature-compensated basis, it shall be bought or sold using this method over at least a consecutive 12-month period, unless otherwise agreed to by both the buyer and seller in writing.

(Added 2003)

U.R.4. Maintenance Requirements.

U.R.4.1. Use of Adjustments. – Whenever a device is adjusted, all enabled linearization factors shall be verified to determine that the errors are in tolerance and any adjustments which are made shall be made so as to bring performance errors as close as practicable to zero value. The verification of enabled linearization factors shall be done through physical testing or a combination of testing and empirical analysis.

(Added 2016)

UR.4.2. Security for Retail Motor-Fuel Devices (RMFD). – Any retail motor fuel device capable of conducting customer-initiated electronic financial transactions must be secured to substantially restrict the ability of unauthorized persons to manipulate it to obtain payment information that could be used to commit fraud. The following is a non-exhaustive list of ways that restriction of such manipulation may be accomplished:

- (a) A physical lock, locking device, or a physical securing device that will restrict access to the electronic financial transaction compartment of the RMFD. A lock, locking device, or securing device shall not be manipulated with commonly available tools. A lock shall not allow the use of a universal key. A universal key is a key that is readily available in the market or can be easily purchased in a hardware or common retail store. A single non-universal key for all of the like devices at a retail facility or for all of the like devices at a chain of retail facilities is acceptable; or
- (b) Electronic alarming or disabling of the equipment if unauthorized access is attempted; or
- (c) Advanced payment acceptance technologies that increase protections against the theft of payment information itself or do not allow access to such information in a form that may be used to commit fraud; or
- (d) Another security solution that has been approved by the local or state weights and measures jurisdiction with authority.

(Added 2021)

Liquid-Measuring Device Code Index

Acceptance	22, 23	Money value computation	20
Adjustable element.....	11	Money value divisions	7
Advancement	2	Money values - mathematical	
Agreement.....	7, 9, 10	agreement	10
Agri-chemical	1, 2, 22	Money-value computation	6, 20
Antidrain means	16	Money-value divisions	6, 7
Automatic 11, 12, 13, 14, 15, 16, 19, 22,		Motor-fuel device.....	22, 24
23, 24, 27, 28		Nonautomatic	28
Automatic temperature compensation 14		Normal tests	18
Automatic temperature compensators		Operating requirements.....	4, 10
.....	14, 16, 27	Parallax	4
Automatic temperature-compensating		Power loss.....	4
systems	14, 23	Price contract sales	6, 8, 9, 25
Automatic Timeout – Pay-At-Pump for		Primary indicating element	1, 4, 5, 16,
Retail Device	10	25, 27	
Auxiliary elements	7	Printed ticket	27
Blend	5, 6, 25	Product identity	5, 6, 9, 25
Clear interval	3	Pump-discharge unit	15
Clearance.....	4	Quantity.....	4, 6, 9, 10, 17, 18, 20
Computing device	6, 7, 26	Recording element ..	1, 2, 4, 5, 9, 13, 16,
Directional flow valves.....	12	25, 27	
Discharge hose	15, 16, 23, 24	Repeatability	21, 23
Discharge lines.....	14	Retail devices.....	4, 17, 18, 20
Discharge rate.....	16, 17, 18, 19, 20, 24	Retail motor-fuel device.....	2, 13, 19, 23,
Diversion	24	27, 29	
Dry-hose.....	15	Retail motor-fuel dispensers.....	17
Fleet sales.....	6, 8, 9, 25	Seal	11, 14, 16
Grade	5, 6, 7, 25, 26	Sealing	11, 14
Graduations.....	3, 4, 10, 16	Security	11, 14, 16
Gravity-discharge unit	15	Slow-flow meters.....	4, 18, 19
Index of an indicator	3, 4	Special tests.....	19
Indicating element	2, 5, 13	Stop mechanism	12
Indicators.....	3	Temperature compensation	14, 16
Installation requirements	24	Temperature compensators ...	14, 16, 27
Interlock.....	13	Temperature correction	21
Invoices	28	Temperature determination	13, 14, 28
Key-lock	4, 25	Temperature-compensating systems	14,
Lubricant devices	10, 14, 18	23	
Maintenance.....	22, 23	Test drafts	18
Marking requirements.....	16	Tolerances	13, 21
Mass.....	1	Total price	7, 26, 27
Mass flow meters	1	Totalizers.....	17, 25
Measuring element.....	11	Truck refueling	8, 15, 25

CCR Title 4, Div. 9, CCR §§ 4000., 4001. and 4002.8.
2023 Edition of NIST HB 44 Section 3.30. Liquid-Measuring Devices

Unit price	4, 5, 6, 7, 9, 25, 26	Wet-hose	15, 16
User information	4	Wholesale devices	1, 10, 13, 14, 16, 18, 20, 21, 27
Valves	12, 14, 15, 24	Zero-set-back interlock.....	13, 27
Vapor elimination	11		

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Table of Contents

Section 3.31. Vehicle-Tank Meters	33
A. Application.....	33
A.1. General.	33
A.2. Exceptions.....	33
A.3. Additional Code Requirements.....	33
S. Specifications	33
S.1. Design of Indicating and Recording Elements and of Recorded Representations. ...	33
S.1.1. Primary Elements.	33
S.1.2. Graduations.	35
S.1.3. Indicators.	35
S.1.4. Computing-Type Device.	36
S.2. Design of Measuring Elements.....	36
S.2.1. Air/Vapor Elimination.	36
S.2.2. Provision for Sealing.....	37
S.2.3. Directional Flow Valves.....	38
S.2.4. <i>Zero-Set-Back Interlock, Vehicle-Tank Meters, Electronic</i>	38
S.2.5. Automatic Temperature Compensation for Refined Petroleum Products.....	39
S.2.6. <i>Thermometer Well, Temperature Determination</i>	39
S.3. Design of Discharge Lines and Discharge Line Valves.	40
S.3.1. Diversion of Measured Liquid.	40
S.3.2. Pump-Discharge Unit.....	41
S.3.3. Gravity-Discharge Unit.....	41
S.3.4. Discharge Hose.	41
S.3.5. Discharge Valve.....	41
S.3.6. Antidrain Valve.....	41
S.4. Design of Intake Lines (for Milk-Metering Systems).	41
S.4.1. Diversion of Liquid to be Measured.	41
S.4.2. Intake Hose.....	41
S.5. Marking Requirements.	42
S.5.1. Limitation of Use.	42
S.5.2. Discharge Rates.	42
S.5.3. Measuring Components, Milk-Metering System.	42
S.5.4. Flood Volume, Milk-Metering System.	42
S.5.5. Conversion Factor.	42
S.5.6. Temperature Compensation for Refined Petroleum Products.	42
N. Notes	42
N.1. Test Liquid.....	42
N.2. Evaporation and Volume Change.....	43
N.3. Test Drafts.....	43

CCR Title 4, Div. 9, CCR §§ 4000., 4001. and 4002.3.
2023 Edition of NIST HB 44 Section 3.31. Vehicle Tank Meters

N.4. Testing Procedures.....	43
N.4.1. Normal Tests.....	43
N.4.2. Special Tests (Except Milk-Measuring Systems).....	44
N.4.3. Antidrain Valve Test.....	44
N.4.4. System Capacity.....	44
N.4.5. Product Depletion Test.....	44
N.4.6. Verification of Linearization Factors.....	44
N.4.7. Repeatability Tests.....	44
N.5. Temperature Correction for Refined Petroleum Products.....	45
(Added 2007).....	45
T. Tolerances.....	45
T.1. Application.....	45
T.1.1. To Underregistration and to Overregistration.....	45
T.2. Tolerance Values.....	45
T.2.1. Automatic Temperature-Compensating Systems.....	47
T.3. Repeatability.....	47
T.4. Product Depletion Test.....	47
UR. User Requirements.....	47
UR.1. Installation Requirements.....	47
UR.1.1. Discharge Rate.....	47
UR.1.2. Unit Price.....	47
UR.1.3. Intake Hose.....	47
UR.1.4. Liquid Measured.....	47
UR.2. Use Requirements.....	48
UR.2.1. Return of Indicating and Recording Elements to Zero.....	48
UR.2.2. Ticket Printer, Customer Ticket. [NOT ADOPTED - CCR § 4001. Exceptions.].....	48
CCR § 4002.3. Vehicle-Tank Meters. (3.31.). UR.2.2. Ticket Printer; Customer Ticket.....	48
UR.2.3. Ticket in Printing Device.....	48
UR.2.4. Credit for Flood Volume.....	48
UR.2.5. Automatic Temperature Compensation for Refined Petroleum Products.....	48
UR.2.6. Clearing the Discharge Hose.....	49
UR.3. Maintenance Requirements.....	49
UR.3.1. Use of Adjustments.....	49

Section 3.31. Vehicle-Tank Meters

A. Application

A.1. General. – This code applies to meters mounted on vehicle tanks including those used for the measurement and delivery of petroleum products or agri-chemical liquids such as fertilizers, feeds, pesticides, defoliant, and bulk deliveries of water.

(Amended 1985 and 1995)

A.2. Exceptions. – This code does not apply to the following devices:

- (a) Devices used for dispensing liquefied petroleum gases, or other liquids that do not remain in a liquid state at atmospheric pressures and temperatures. (Also see Section 3.32. Code for Liquefied Petroleum Gas and Anhydrous Ammonia Liquid-Measuring Devices.)
- (b) Devices used solely for dispensing a product in connection with operations in which the amount dispensed does not affect customer charges.
- (c) Vehicle tanks used as measures. (Also see Section 4.40. Code for Vehicle Tanks Used as Measures.)
- (d) Mass flow meters. (Also see Section 3.37. Code for Mass Flow Meters.)
(Added 1994)
- (e) Devices used to measure cryogenic liquids. (Also see Section 3.34. Code for Cryogenic Liquid-Measuring Devices.)
- (f) Devices used to measure carbon dioxide liquids. (Also see Section 3.38. Code for Carbon Dioxide Liquid-Measuring Devices.)

A.3. Additional Code Requirements. – In addition to the requirements of this code, Vehicle-Tank Meters shall meet the requirements of 1.10. General Code requirements.

S. Specifications

S.1. Design of Indicating and Recording Elements and of Recorded Representations.

S.1.1. Primary Elements.

S.1.1.1. General. – A meter shall be equipped with a primary indicating element and may also be equipped with a primary recording element.

Note: Except for systems used solely for the sale of aviation fuel into aircraft and for aircraft-related operations, vehicle-tank meters shall be equipped with a primary recording element as required by paragraph UR.2.2. Ticket Printer; Customer Ticket.

(Amended 1993)

S.1.1.2. Units.

- (a) A meter shall indicate, and record if the meter is equipped to record, its deliveries in terms of liters or gallons. Fractional parts of the liter or gallon shall be in terms of either decimal or binary subdivisions.
- (b) When it is an industry practice to purchase and sell milk by weight based upon 1.03 kg/L (8.6 lb/gal), the primary indicating element may indicate in kilograms or pounds and decimal kilograms or pounds. The weight value division shall be a decimal multiple or submultiple of 1, 2, or 5. (Also see Section S.5.5. Conversion Factor.)

S.1.1.3. Value of Smallest Unit. – The value of the smallest unit of indicated delivery, and recorded delivery if the meter is equipped to record, shall not exceed the equivalent of:

- (a) 0.5 L (0.1 gal) or 0.5 kg (1 lb) on milk-metering systems;
- (b) 0.5 L (0.1 gal) on meters with a rated maximum flow rate of 750 L/min (200 gal/min) or less;
- (c) 5 L (1 gal) on meters with a rated maximum flow of 375 L/min (100 gal/min) or more used for jet fuel aviation refueling systems; or
(Added 2006)
- (d) 5 L (1 gal) on other meters.

(Amended 1989, 1994 and 2006)

S.1.1.4. Advancement of Indicating and Recording Elements. – Primary indicating and recording elements shall be susceptible to advancement only by the mechanical operation of the meter. However, a meter may be cleared by advancing its elements to zero, but only if:

- (a) the advancing movement, once started, cannot be stopped until zero is reached;
or
- (b) in the case of indicating elements only, such elements are automatically obscured until the elements reach the correct zero position.

S.1.1.5. Return to Zero. – Primary indicating elements shall be readily returnable to a definite zero indication. Means shall be provided to prevent the return of primary indicating elements, and of primary recording elements if these are returnable to zero, beyond their correct zero position. Primary indicating elements shall not be resettable to zero during a delivery.

(Amended 2016)

S.1.2. Graduations.

S.1.2.1. Length. – Graduations shall be so varied in length that they may be conveniently read.

S.1.2.2. Width. – In any series of graduations, the width of a graduation shall in no case be greater than the width of the minimum clear interval between graduations, and the width of main graduations shall be not more than 50 % greater than the width of subordinate graduations. Graduations shall in no case be less than 0.2 mm (0.008 in) wide.

S.1.2.3. Clear Interval Between Graduations. – The clear interval shall be not less than 2.5 mm (0.10 in). If the graduations are not parallel, the measurement shall be made:

(a) along the line of relative movement between the graduations at the end of the indicator; or

(b) if the indicator is continuous, at the point of widest separation of the graduations.
(Amended 1986)

S.1.3. Indicators.

S.1.3.1. Symmetry. – The index of an indicator shall be symmetrical with respect to the graduations at least throughout that portion of its length associated with the graduations.

S.1.3.2. Length. – The index of an indicator shall reach to the finest graduations with which it is used, unless the indicator and the graduations are in the same plane, in which case the distance between the end of the indicator and the ends of the graduations, measured along the line of the graduations, shall be not more than 1.0 mm (0.04 in).

S.1.3.3. Width. – The width of the index of an indicator in relation to the series of graduations with which it is used shall be not greater than:

(a) *the width of the narrowest graduation;* and*
*[*Nonretroactive as of January 1, 2002]*
(Amended 2001)

(b) the width of the minimum clear interval between graduations.

When the index of an indicator extends along the entire length of a graduation, that portion of the index of the indicator that may be brought into coincidence with the graduation shall be of the same width throughout the length of the index that coincides with the graduation.

S.1.3.4. Clearance. – The clearance between the index of an indicator and the graduations shall in no case be more than 1.5 mm (0.06 in).

S.1.3.5. Parallax. – Parallax effects shall be reduced to the practicable minimum.

S.1.3.6. Travel of Indicator. – If the most sensitive element of the primary indicating element utilizes an indicator and graduations, the relative movement of these parts corresponding to the smallest indicated value shall not be less than 5 mm (0.20 in).

S.1.4. Computing-Type Device.

S.1.4.1. Display of Unit Price. – In a device of the computing type, means shall be provided for displaying, in a manner clear to the operator and an observer, the unit price at which the device is set to compute. The unit price is not required to be displayed continuously.

(Amended 1983 and 2005)

S.1.4.2. Printed Ticket. – If a computing-type device issues a printed ticket which displays the total computed price, the ticket shall also have printed clearly thereon the total quantity of the delivery, the appropriate fraction of the quantity, and the price per unit of quantity.

(Amended 1989)

S.1.4.3. Money-Value Computations. – Money-value computations shall be of the full-computing type in which the money-value at a single unit price, or at each of a series of unit prices, shall be computed for every delivery within either the range of measurement of the device or the range of the computing elements, whichever is less. Value graduations shall be supplied and shall be accurately positioned. The value of each graduated interval shall be one cent. On electronic devices with digital indications, the total price may be computed on the basis of the quantity indicated when the value of the smallest division indicated is equal to or less than 0.2 L (0.1 gal) or 0.2 kg (1 lb).

(Amended 1979 and 1989)

S.1.4.4. Money-Values, Mathematical Agreement. – Any digital money-value indication and any recorded money-value on a computing-type device shall be in mathematical agreement with its associated quantity indication or representation to within one cent of money-value.

S.2. Design of Measuring Elements.

S.2.1. Air/Vapor Elimination. – A measuring system shall be equipped with an effective air/vapor eliminator or other automatic means to prevent the passage of air/vapor through the meter. Vent lines from the air/vapor eliminator shall be made of appropriate non-collapsible material.

(Amended 1993 and 2017)

S.2.2. Provision for Sealing. – For devices and systems in which the configuration or calibration parameters can be changed by use of a removable digital storage device, security shall be provided for those parameters as specified in G-S.8.2. Devices and Systems Adjusted Using Removable Digital Storage Devices. For parameters adjusted using other means, the following applies.

Adequate provision shall be made for an approved means of security (e.g., data change audit trail) or for physically applying a security seal in such a manner that requires the security seal to be broken before a change or an adjustment or interchange can be made of:

- (a) any measuring or indicating element;
- (b) any adjustable element for controlling delivery rate when such rate tends to affect the accuracy of deliveries; and
- (c) any metrological parameter that will affect the metrological integrity of the device or system.

When applicable, the adjusting mechanism shall be readily accessible for purposes of affixing a security seal.

*Audit trails shall use the format set forth in Table S.2.2. Categories of Device and Methods Sealing.**

*[*Nonretroactive as of January 1, 1995]*

(Amended 2006 and 2019)

Table S.2.2. Categories of Device and Methods of Sealing

Categories of Device	Methods of Sealing
<p>Category 1: No remote configuration capability.</p>	<p>Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.</p>
<p>Category 2: Remote configuration capability, but access is controlled by physical hardware.</p> <p>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.</p>	<p>The hardware enabling access for remote communication must be on-site. The hardware must be sealed using a physical seal or an event counter for calibration parameters and an event counter for configuration parameters. The event counters may be located either at the individual measuring device or at the system controller; however, an adequate number of counters must be provided to monitor the calibration and configuration parameters of the individual devices at a location. If the counters are located in the system controller rather than at the individual device, means must be provided to generate a hard copy of the information through an on-site device.</p>
<p>Category 3: Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password).</p> <p>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.</p>	<p>An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. A printed copy of the information must be available on demand through the device or through another on-site device. The information may also be available electronically. The event logger shall have a capacity to retain records equal to 10 times the number of sealable parameters in the device, but not more than 1000 records are required. (Note: Does not require 1000 changes to be stored for each parameter.)</p>

[Nonretroactive as of January 1, 1995]
 (Table Added 2006) (Amended 2016)

S.2.3. Directional Flow Valves. – Valves intended to prevent reversal of flow shall be automatic in operation. However, on equipment used exclusively for fueling aircraft, such valves may be manual in operation.

S.2.4. Zero-Set-Back Interlock, Vehicle-Tank Meters, Electronic. – Except for vehicle-mounted metering systems used solely for the delivery of aviation fuel, a device shall be so constructed that after individual or multiple deliveries at one location have been completed, an automatic interlock system shall engage to prevent a subsequent delivery until the indicating and, if equipped, recording elements have been returned to their zero position. For individual deliveries, if there is no product flow for three minutes the transaction must

be completed before additional product flow is allowed. The three-minute timeout shall be a sealable feature of an indicator.

[Nonretroactive as of January 1, 2006]

(Added 2005)

S.2.5. Automatic Temperature Compensation for Refined Petroleum Products.

S.2.5.1. Automatic Temperature Compensation for Refined Petroleum Products. –

A device may be equipped with an automatic means for adjusting the indication and registration of the measured volume of product to the volume at 15 °C for liters or the volume at 60 °F for gallons and decimal subdivisions or fractional equivalents thereof where not prohibited by state law.

S.2.5.2. Provision for Deactivating. – On a device equipped with an automatic temperature-compensating mechanism that will indicate or record only in terms of liters compensated to 15°C or gallons compensated to 60 °F, provision shall be made for deactivating the automatic temperature-compensating mechanism so the meter can indicate and record, if it is equipped to record, in terms of the uncompensated volume.

S.2.5.3. Gross and Net Indications. – A device equipped with automatic temperature compensation shall indicate or record, if equipped to record, both the gross (uncompensated) and net (compensated) volume for testing purposes. It is not necessary that both net and gross volume be displayed simultaneously.

S.2.5.4. Provision for Sealing Automatic Temperature-Compensating Systems. – Adequate provision shall be made for an approved means of security (e.g., data change audit trail) or physically applying security seals in such a manner that an automatic temperature-compensating system cannot be disconnected and no adjustment may be made to the system.

S.2.5.5. Temperature Determination with Automatic Temperature Compensation. – For test purposes, means shall be provided (e.g., thermometer well) to determine the temperature of the liquid either:

(a) in the liquid chamber of the meter; or

(b) immediately adjacent to the meter in the meter inlet or discharge line.

(Added 2007)

S.2.6. Thermometer Well, Temperature Determination. – *For test purposes, means shall be provided (e.g., thermometer well) to determine the temperature of the liquid either in the:*

(a) liquid chamber of the meter; or

(b) meter inlet or discharge line immediately adjacent to the meter.

[Nonretroactive as of January 1, 2012]

(Added 2011)

S.3. Design of Discharge Lines and Discharge Line Valves.

(Not applicable to milk-metering systems.)

S.3.1. Diversion of Measured Liquid. – No means shall be provided by which any measured liquid can be diverted from the measuring chamber of the meter or the discharge line thereof. However, two or more delivery outlets may be installed if means are provided to ensure that:

- (a) liquid can flow from only one such outlet at one time; and
- (b) the direction of flow for which the mechanism may be set at any time is definitely and conspicuously indicated.

This paragraph does not apply to the following:

- (1) Equipment used exclusively for fueling aircraft.
- (2) Multiple-product, single-discharge hose metering systems that are equipped with systems designed to flush the discharge hose, provided the flushing system complies with the provisions of paragraph S.3.1.1. Means for Clearing the Discharge Hose.

(Amended 2018)

S.3.1.1. Means for Clearing the Discharge Hose. – Metering systems may be equipped with systems specifically designed to facilitate clearing of the discharge hose prior to delivery to avoid product contamination. In such systems, a valve to temporarily divert product from the measuring chamber of the meter to a storage tank shall be installed only if all the following are met:

- (a) the discharge hose remains of the wet hose type;
- (b) the valve and associated piping are approved by the weights and measures authority having jurisdiction over the system prior to commercial use;
- (c) the valve is permanently marked with its purpose (e.g., flush valve);
- (d) the valve is installed in a conspicuous manner and as far from the hose reel as practical;
- (e) the system clearly and automatically indicates the direction of product flow during operation of the flush system;
- (f) clear means, such as an indicator light or audible alarm, is used to identify when the valve is in use; and
- (g) no hoses or piping are connected to the inlet when it is not in use.

(Added 2018)

S.3.2. Pump-Discharge Unit. – On a pump-discharge unit, the discharge hose shall be of the wet-hose type with a shutoff valve at its outlet end. However, a pump-discharge unit may be equipped also with a dry-hose without a shutoff valve at its outlet end, but only if:

- (a) the dry-hose is as short as practicable; and
- (b) there is incorporated in the discharge piping, immediately adjacent to the meter, effective means to ensure that liquid can flow through only one of the discharge hoses at any one time and that the meter and the wet-hose remain full of liquid at all times.

S.3.3. Gravity-Discharge Unit. – On a gravity-discharge unit, the discharge hose or equivalent pipe shall be of the dry-hose type with no shutoff valve at its outlet end. The dry-hose shall be of such stiffness and only of such length as to facilitate its drainage. The inlet end of the hose or of an equivalent outlet pipe shall be of such height as to provide for proper drainage of the hose or pipe. There shall be incorporated an automatic vacuum breaker or equivalent means to prevent siphoning and to ensure the rapid and complete drainage.

S.3.4. Discharge Hose. – A discharge hose shall be adequately reinforced.

S.3.5. Discharge Valve. – A discharge valve may be installed in the discharge line only if the device is of the wet-hose type, in which case such valve shall be at the discharge end of the line. Any other shutoff valve on the discharge side of the meter shall be of the automatic or semiautomatic predetermined-stop type or shall be operable only:

- (a) by means of a tool (but not a pin) entirely separate from the device; or
- (b) by mutilation of a security seal with which the valve is sealed open.

S.3.6. Antidrain Valve. – In a wet-hose, pressure-type device, an effective antidrain valve shall be incorporated in the discharge valve or immediately adjacent thereto. The antidrain valve shall function so as to prevent the drainage of the discharge hose. However, a device used exclusively for fueling and defueling aircraft may be of the pressure type without an antidrain valve.

S.4. Design of Intake Lines (for Milk-Metering Systems).

S.4.1. Diversion of Liquid to be Measured. – No means shall be provided by which any liquid can be diverted from the supply tank to the receiving tank without being measured by the device.

S.4.2. Intake Hose. – The intake hose shall be:

- (a) of the dry-hose type;
- (b) adequately reinforced;

- (c) not more than 6 m (20 ft) in length, unless it can be demonstrated that a longer hose is essential to permit pickups from a supply tank; and
- (d) connected to the pump at horizontal or above, to permit complete drainage of the hose.

S.5. Marking Requirements.

S.5.1. Limitation of Use. – If a meter is intended to measure accurately only liquids having particular properties, or to measure accurately only under specific installation or operating conditions, or to measure accurately only when used in conjunction with specific accessory equipment, these limitations shall be clearly and permanently stated on the meter.

S.5.2. Discharge Rates. – A meter shall be marked to show its designed maximum and minimum discharge rates. However, the minimum discharge rate shall not exceed 20 % of the maximum discharge rate.

Note: Also see example in Section 3.30. Liquid-Measuring Devices Code, paragraph S.4.4.1. Discharge Rates.

(Added 2003)

S.5.3. Measuring Components, Milk-Metering System. – All components that affect the measurement of milk that are disassembled for cleaning purposes shall be clearly and permanently identified with a common serial number.

S.5.4. Flood Volume, Milk-Metering System. – When applicable, the volume of product necessary to flood the system when dry shall be clearly, conspicuously, and permanently marked on the air eliminator.

S.5.5. Conversion Factor. – When the conversion factor of 1.03 kg/L (8.6 lb/gal) is used to convert the volume of milk to weight, the conversion factor shall be clearly marked on the primary indicating element and recorded on the delivery ticket.

(Added 1989)

S.5.6. Temperature Compensation for Refined Petroleum Products. – If a device is equipped with an automatic temperature compensator, the primary indicating elements, recording elements, and recorded representations shall be clearly and conspicuously marked to show the volume delivered has been adjusted to the volume at 15 °C for liters or the volume at 60 °F for gallons and decimal subdivisions or fractional equivalents thereof.

(Added 2007)

N. Notes

N.1. Test Liquid.

- (a) A measuring system shall be tested with the liquid to be commercially measured or with a liquid of the same general physical characteristics. Following a satisfactory

examination, the weights and measures official should attach a seal or tag indicating the product used during the test.

(Amended 1975)

- (b) A milk-measuring system shall be tested with the type of milk to be measured when the accuracy of the system is affected by the characteristics of milk (e.g., positive displacement meters).

(Added 1989)

(Amended 1975 and 1989)

N.2. Evaporation and Volume Change. – Care shall be exercised to reduce to a minimum, evaporation losses and volume changes resulting from changes in temperature of the test liquid.

N.3. Test Drafts. – Test drafts should be equal to at least the amount delivered by the device in 1 minute at its maximum discharge rate and shall in no case be less than 180 L (50 gal) or 225 kg (500 lb).

(Amended 1989)

N.4. Testing Procedures.

N.4.1. Normal Tests. – The “normal” test of a measuring system shall be made at the maximum discharge rate that may be anticipated under the conditions of the installation. Any additional tests conducted at flow rates down to and including one-half of the sum of the maximum discharge flow rate and the rated minimum discharge flow rate shall be considered normal tests.

(Amended 1992)

N.4.1.1. Milk Measuring System. – The “normal” test shall include a determination of the effectiveness of the air elimination system.

N.4.1.2. Automatic Temperature-Compensating Systems for Refined Petroleum Products. – On devices equipped with automatic temperature-compensating systems, normal tests shall be conducted:

- (a) by comparing the compensated volume indicated or recorded to the actual delivered volume corrected to 15 °C for liters or 60 °F for gallons and decimal subdivisions or fractional equivalents thereof; and
- (b) with the temperature-compensating system deactivated, comparing the uncompensated volume indicated or recorded to the actual delivered volume.

The first test shall be performed with the automatic temperature-compensating system operating in the “as-found” condition. On devices that indicate or record both the

compensated and uncompensated volume for each delivery, the tests in (a) and (b) may be performed as a single test.

(Added 2007)

N.4.2. Special Tests (Except Milk-Measuring Systems). – “Special” tests shall be made to develop the operating characteristics of a measuring system and any special elements and accessories attached to or associated with the device. Any test except as set forth in N.4.1. Normal Tests and N.4.5. Product Depletion Test shall be considered a special test. Special tests of a measuring system shall be made at a minimum discharge rate of 20 % of the marked maximum discharge rate or at the minimum discharge rate marked on the device, whichever is less.

(Amended 1978 and 2005)

N.4.3. Antidrain Valve Test. – The effectiveness of the antidrain valve shall be tested after the pump pressure in the measuring system has been released and a valve between the supply tank and the discharge valve is closed.

N.4.4. System Capacity. – The test of a milk-measuring system shall include the verification of the volume of product necessary to flood the system as marked on the air eliminator.

N.4.5. Product Depletion Test. – Except for vehicle-mounted metering systems used solely for the delivery of aviation fuel, the effectiveness of the vapor eliminator or vapor elimination means shall be tested by dispensing product at the normal flow rate until the product supply is depleted and continuing until the lack of fluid causes the meter indication to stop completely for at least 10 seconds. If the meter indication fails to stop completely for at least 10 seconds, continue to operate the system for 3 minutes. Finish the test by switching to another compartment with sufficient product to complete the test on a multi-compartment vehicle or by adding sufficient product to complete the test to a single compartment vehicle. When adding product to a single compartment vehicle, allow appropriate time for any entrapped vapor to disperse before continuing the test. Test drafts shall be of the same size and run at approximately the same flow rate.

(Added 2005)

N.4.6. Verification of Linearization Factors. – All enabled linearization factors shall be verified. The verification of enabled linearization factors shall be done through physical testing or a combination of physical testing and empirical analysis at the discretion of the official with statutory authority.

(Added 2016)

N.4.7. Repeatability Tests. – Tests for repeatability should include a minimum of three consecutive test drafts of approximately the same size and be conducted under controlled conditions where variations in factors such as temperature, pressure, and flow rate are reduced to the extent that they will not affect the results obtained. When conducting the tests, the flow rates shall be within the minimum and maximum discharge rates as marked by the manufacturer. For devices equipped with an automatic temperature compensator,

the results shall be based on the uncompensated (gross) volume (e.g., with the temperature compensator deactivated).

(Amended 2019)

N.5. Temperature Correction for Refined Petroleum Products. – Corrections shall be made for any changes in volume resulting from the differences in liquid temperatures between the time of passage through the meter and the time of volumetric determination in the prover. When adjustments are necessary, appropriate petroleum measurement tables should be used. (Added 2007)

T. Tolerances

T.1. Application.

T.1.1. To Underregistration and to Overregistration. – The tolerances hereinafter prescribed shall be applied to errors of underregistration and errors of overregistration.

T.2. Tolerance Values. – Tolerances shall be as shown in Table 1. Accuracy Classes and Tolerances for Vehicle-Tank Meters Other Than Vehicle-Mounted Milk Meters and Table 2. Tolerances for Vehicle-Mounted Milk Meters.

(Amended 1995)

Table 1. Accuracy Classes and Tolerances for Vehicle Tank Meters Other Than Vehicle-Mounted Milk Meters

Accuracy Class	Application	Acceptance Tolerance	Maintenance Tolerance	Special Test Tolerance
0.3	<ul style="list-style-type: none"> - Petroleum products delivered from large capacity (flow rates over 115 L/min or 30 gpm)** devices, including motor-fuel devices - Heated products (other than asphalt) at temperatures greater than 50 °C (122 °F) - Asphalt at temperatures equal to or below 50 °C (122 °F) - All other liquids not shown in the table where the typical delivery is greater than 200 L (50 gal) 	0.15 %	0.3 %	0.45 %
0.3A	<ul style="list-style-type: none"> - Asphalt at temperatures greater than 50 °C (122 °F) 	0.3 %	0.3 %	0.5 %

CCR Title 4, Div. 9, CCR §§ 4000., 4001. and 4002.3.
2023 Edition of NIST HB 44 Section 3.31. Vehicle Tank Meters

Accuracy Class	Application	Acceptance Tolerance	Maintenance Tolerance	Special Test Tolerance
0.5*	- Petroleum products delivered from small capacity (at 4 L/min (1 gpm) through 115 L/min or 30 gpm)** motor-fuel devices - Agri-chemical liquids - All other applications not shown in the table where the typical delivery is \leq 200 L (50 gal)	0.3 %	0.5 %	0.5 %
1.1	- Petroleum products and other normal liquids from devices with flow rates** less than 4 L/min (1 gpm) and - Devices designed to deliver less than 4 L (1 gal)	0.75 %	1.0 %	1.25 %
1.5	- Water: Overregistration	1.5 %	1.5 %	1.5 %
	Water: Underregistration	1.5 %	1.5 %	5.0 %

* For 5 gal and 10 gal test drafts, the tolerances specified for Accuracy Class 0.5 in the table above do not apply. For these test drafts, the maintenance tolerances on normal and special tests for 5 gal and 10 gal test drafts are 6 in³ and 11 in³, respectively. Acceptance tolerances on normal and special tests are 3 in³ and 5.5 in³.

** Flow rate refers to designed or marked maximum flow rate.
(Added 2002) (Amended 2013)

Table 2. Tolerances for Vehicle-Mounted Milk Meters

Indication (gallons)	Maintenance Tolerance (gallons)	Acceptance Tolerance (gallons)
100	0.5	0.3
200	0.7	0.4
300	0.9	0.5
400	1.1	0.6
500	1.3	0.7
Over 500	Add 0.002 gallon per indicated gallon over 500	Add 0.001 gallon per indicated gallon over 500

(Added 1989)

T.2.1. Automatic Temperature-Compensating Systems. – The difference between the meter errors (expressed as a percentage) determined with and without the automatic temperature-compensating system activated shall not exceed:

- (a) 0.2 % for mechanical automatic temperature-compensating systems; and
- (b) 0.1 % for electronic automatic temperature-compensating systems.

The delivered quantities for each test shall be approximately the same size. The results of each test shall be within the applicable acceptance or maintenance tolerance.

(Added 2007) (Amended 2010)

T.3. Repeatability. – When multiple tests are conducted at approximately the same flow rate and draft size, the range of the test results for the flow rate shall not exceed 40 % of the absolute value of the maintenance tolerance and the results of each test shall be within the applicable tolerance. (Also see N.4.7. Repeatability Tests.)

(Added 1992) (Amended 2001, 2002, and 2019)

T.4. Product Depletion Test. – The difference between the test result for any normal test and the product depletion test shall not exceed 0.5 % of the volume delivered in one minute at the maximum flow rate marked on the meter for meters rated higher than 380 Lpm (100 gpm) or 0.6 % of the volume delivered in one minute at the maximum flow rate marked on the meter for meters rated 380 Lpm (100 gpm) or lower. Test drafts shall be of the same size and run at approximately the same flow rate.

Note: The result of the product depletion test may fall outside of the applicable test tolerance as specified in Table 1. Accuracy Classes and Tolerances for Vehicle-Tank Meters.

(Amended 2013)

UR. User Requirements

UR.1. Installation Requirements.

UR.1.1. Discharge Rate. – A meter shall be so installed that the actual maximum discharge rate will not exceed the rated maximum discharge rate. If necessary, means for flow regulation shall be incorporated in the installation, in which case this shall be fully effective and automatic in operation.

UR.1.2. Unit Price. – There shall be displayed on the face of a device of the computing type the unit price at which the device is set to compute.

UR.1.3. Intake Hose. – The intake hose in a milk-metering system shall be installed to permit complete drainage and ensure that all available product is measured following each pickup.

UR.1.4. Liquid Measured. – A vehicle-tank meter shall continue to be used to measure the same liquid or one with the same general physical properties as that used for calibration

and weights and measures approval unless the meter is recalibrated with a different product and tested by a registered service agency or a weights and measures official and approved by the weights and measures jurisdiction having statutory authority over the device.

(Added 2003)

UR.2. Use Requirements.

UR.2.1. Return of Indicating and Recording Elements to Zero. – The primary indicating elements (visual), and the primary recording elements, when these are returnable to zero, shall be returned to zero immediately before each delivery is begun and after the pump has been activated and the product to be measured has been supplied to the measuring system.

(Amended 1981)

UR.2.2. Ticket Printer, Customer Ticket. [NOT ADOPTED - CCR § 4001. Exceptions.]

CCR § 4002.3. Vehicle-Tank Meters. (3.31.). UR.2.2. Ticket Printer; Customer Ticket.

Vehicle-mounted metering systems shall be equipped with a ticket printer which shall be used for all sales where product is delivered through the meter. A copy of the ticket issued by the device shall be left with the customer at the time of delivery or as otherwise specified by the customer.

[Nonretroactive as of January 1, 1995.]

Note: Authority cited: Sections 12027 and 12107, Business and Professions Code.
Reference: Section 12107, Business and Professions Code

UR.2.2.1. Exceptions for the Sale of Aviation Fuel. – The provisions of UR.2.2. Ticket Printer, Customer Ticket shall not apply to vehicle-mounted metering systems used solely for the delivery of aviation fuel into aircraft and for aircraft-related operations.

(Added 1999)

UR.2.3. Ticket in Printing Device. – A ticket shall not be inserted into a device equipped with a ticket printer until immediately before a delivery is begun, and in no case shall a ticket be in the device when the vehicle is in motion while on a public street, highway, or thoroughfare.

UR.2.4. Credit for Flood Volume. – The volume of product necessary to flood the system as marked on the air eliminator shall be individually recorded on the pickup ticket of each seller affected.

UR.2.5. Automatic Temperature Compensation for Refined Petroleum Products.

UR.2.5.1. When to be Used. – In a state that does not prohibit, by law or regulation, the sale of temperature-compensated product, a device equipped with an activated automatic-temperature compensator shall be connected, operable, and in use at all

times. An electronic or mechanical automatic temperature-compensating device or system may not be removed or deactivated, nor may a compensated device be replaced with an uncompensated device or system, without the written approval of the responsible weights and measures jurisdiction.

Note: This requirement does not specify the method of sale for products measured through a meter.
(Amended 2009)

UR.2.5.2. Period of Use. – When fuel is bought or sold on an automatic temperature compensation basis, it shall be bought or sold using this basis over at least a consecutive 12-month period unless otherwise agreed to by both the buyer and seller in writing.

(Added 2009)

UR.2.5.3. Invoices. – An invoice based on a reading of a device that is equipped with an automatic temperature compensator shall show that the volume delivered has been adjusted to the volume at 15 °C for liters or the volume at 60 °F for gallons and decimal subdivisions or fractional equivalents thereof.

(Added 2007)

UR.2.6. Clearing the Discharge Hose.

UR.2.6.1. Records. – Whenever, prior to delivery, a different product is pumped through the discharge hose to avoid contamination, a record including the date, time, original product, new product, and gallons pumped shall be maintained. These records shall be kept for a period of 12 months and available for inspection by the weights and measures authority having jurisdiction over the system.

(Added 2018)

UR.3. Maintenance Requirements.

UR.3.1. Use of Adjustments. – Whenever a device is adjusted, all enabled linearization factors shall be verified to determine that the errors are in tolerance and any adjustments which are made shall be made so as to bring performance errors as close as practicable to zero value. The verification of enabled linearization factors shall be done through physical testing or a combination of physical testing and empirical analysis.

(Added 2016)

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Table of Contents

	Page
Section 3.32. Liquefied Petroleum Gas and Anhydrous Ammonia Liquid-Measuring Devices.....	53
A. Application.....	53
A.1. General.	53
A.2. Devices Used to Measure Other Liquid Products not Covered in Specific Codes....	53
A.3. Exceptions.....	53
A.4. Additional Code Requirements.....	53
S. Specifications	53
S.1. Design of Indicating and Recording Elements and of Recorded Representations. ..	53
S.1.1.Primary Elements.....	53
S.1.2.Graduations.....	54
S.1.3.Indicators.....	55
S.1.4.For Retail Devices Only.	55
S.1.5.For Stationary Retail Devices Only.	56
S.1.6.For Wholesale Devices Only.	59
S.2. Design of Measuring Elements.....	59
S.2.1.Air/Vapor Elimination.....	59
S.2.2.Provision for Sealing.	60
S.2.3.Directiona l Flow Valves.	62
S.2.4.Maintenance of Liquid State.....	62
S.2.5.Zero-Set-Back Interlock.	62
S.2.5.1. Zero-Set-Back Interlock, Electronic Stationary Meters (Other than Stationary Retail Motor- Fuel Dispensers) and Electronic Vehicle-Mounted Meters.	62
S.2.5.2. Zero-Set-Back Interlock for Stationary Retail Motor-Fuel Devices.	62
S.2.6.Automatic Timeout.	62
S.2.7.Thermometer Well.....	63
CCR § 4002.4. (3.32).§ 4002.4. Liquefied Petroleum Gas and Anhydrous Ammonia Liquid-Measuring Devices. (3.32.) (a) Temperature Compensation.	63
S.2.8.Automatic Temperature Compensation.....	63
(Adopted, 4 CCR 4002.4	63
S.3 Design of Discharge Lines and Discharge Line Valves.	63
S.3.1.Diversion of Measured Liquid.....	63
CCR § 4002.4. Liquefied Petroleum Gas and Anhydrous Ammonia Liquid-Measuring Devices. (3.32.). (b).	64
(Adopted, 4 CCR 4002.4)	64
S.3.2.Delivery Hose.....	64
S.4. Marking Requirements.	64
S.4.1.Limitation of Use.	64
S.4.2.Discharge Rates.....	64
S.4.3.Location of Marking Information; Retail Motor-Fuel Dispensers.....	64

S.4.4. Temperature Compensation.....	65
N. Notes	65
N.1. Test Liquid.....	65
N.2. Vaporization and Volume Change.....	65
N.3. Test Drafts.....	65
N.4. Testing Procedures.	65
N.4.1. Normal Tests.	65
(Adopted, 4 CCR 4002.4)	66
N.4.2. Special Tests.	66
N.4.3. Money-Value Computation Tests.....	66
N.4.4. Repeatability Tests	67
N.5. Temperature Correction.	67
T. Tolerances	67
T.1. Application.....	67
T.1.1. To Underregistration and to Overregistration.	67
T.2. Tolerance Values. –	67
T.3. Repeatability.....	68
T.4. Automatic Temperature-Compensating Systems.....	68
UR. User Requirements.....	68
UR.1. Installation Requirements.	68
UR.1.1. Discharge Rate.	68
UR.1.2. Length of Discharge Hose.....	68
UR.2. Use Requirements.	68
UR.2.1. Return of Indication and Recording Elements to Zero.....	68
UR.2.2. Condition of Fill of Discharge Hose.....	68
UR.2.3. Vapor-Return Line.....	69
CCR § 4002.4. Liquefied Petroleum Gas and Anhydrous Ammonia Liquid-Measuring Devices. (3.32.)(d).	69
(Adopted, 4 CCR 4002.4)	69
UR.2.4. Temperature Compensation.....	69
UR.2.5. Ticket in Printing Device.....	69
UR.2.6. Ticket Printer; Customer Ticket.....	69
UR.2.7. For Stationary Retail Computing-Type Systems Only, Installed After January 1, 2017.	70
CCR § 4002.4. Liquefied Petroleum Gas and Anhydrous Ammonia Liquid-Measuring Devices. (3.32.) (e) Signs.	70
(Adopted, 4 CCR 4002.4)	70

Section 3.32. Liquefied Petroleum Gas and Anhydrous Ammonia Liquid-Measuring Devices¹

A. Application

A.1. General. – This code applies to devices used for the measurement of liquefied petroleum gas and anhydrous ammonia in the liquid state, whether such devices are installed in a permanent location or mounted on a vehicle. For retail motor-fuel devices, see Appendix D, definition of “liquefied petroleum gas retail motor-fuel device.”

(Amended 2022)

A.2. Devices Used to Measure Other Liquid Products not Covered in Specific Codes. – Insofar as they are clearly appropriate, the requirements and provisions of the code may be applied to devices used for the measurement of other liquids that do not remain in a liquid state at atmospheric pressures and temperatures.

A.3. Exceptions. – This code does not apply to mass flow meters. (Also see Section 3.37. Code for Mass Flow Meters.)

(Added 1994)

A.4. Additional Code Requirements. – In addition to the requirements of this code, LPG and Anhydrous Ammonia Liquid-Measuring Devices shall meet the requirements of Section 1.10. General Code.

S. Specifications

S.1. Design of Indicating and Recording Elements and of Recorded Representations.

S.1.1. Primary Elements.

S.1.1.1. General. – A device shall be equipped with a primary indicating element and may also be equipped with a primary recording element.

Note: Vehicle-mounted metering systems shall be equipped with a primary recording element as required by paragraph UR.2.6. Ticket Printer; Customer Ticket.

S.1.1.2. Units. – A device shall indicate, and record if the device is equipped to record, its deliveries in terms of liters, gallons, quarts, pints, or binary-submultiple or decimal subdivisions of the liter or gallon.

(Amended 1987)

¹Title amended 1986.

S.1.1.3. Value of Smallest Unit. – The value of the smallest unit of indicated delivery, and recorded delivery if the device is equipped to record, shall not exceed the equivalent of:

(a) 0.5 L (1 pt) on retail devices; or

(b) 5 L (1 gal) on wholesale devices.

(Amended 1987)

S.1.1.4. Advancement of Indicating and Recording Elements. – Primary indicating and recording elements shall be susceptible to advancement only by the mechanical operation of the device. However, a device may be cleared by advancing its elements to zero, but only if:

(a) the advancing movement, once started, cannot be stopped until zero is reached;
or

(b) in the case of indicating elements only, such elements are automatically obscured until the elements reach the correct zero position.

S.1.1.5. Money-Values, Mathematical Agreement. – Any digital money-value indication and any recorded money-value on a computing-type device shall be in mathematical agreement with its associated quantity indication or representation to within 1 cent of money-value; except that a stationary retail computing-type device must compute and indicate to the nearest 1 cent of money-value. (Also see Section 1.10. General Code, G-S.5.5. Money-Values, Mathematical Agreement.)

(Amended 1984 and 1988)

S.1.1.6. Printed Ticket. – Any printed ticket issued by a device of the computing type on which there is printed the total computed price, shall have printed clearly thereon the total volume of the delivery in terms of liters or gallons, and the appropriate decimal fraction of the liter or gallon, and the corresponding price per liter or gallon.

(Added 1979) (Amended 1987)

S.1.2. Graduations.

S.1.2.1. Length. – Graduations shall be so varied in length that they may be conveniently read.

S.1.2.2. Width. – In any series of graduations:

(a) the width of a graduation shall in no case be greater than the width of the minimum clear interval between graduations;

(b) the width of main graduations shall be not more than 50 % greater than the width of subordinate graduations; and

(c) graduations shall in no case be less than 0.2 mm (0.008 in) in width.

S.1.2.3. Clear Interval between Graduations. – The clear interval shall be not less than 1.0 mm (0.04 in). If the graduations are not parallel, the measurement shall be made:

- (a) along the line of relative movement between the graduations at the end of the indicator; or
- (b) if the indicator is continuous, at the point of widest separation of the graduations.

S.1.3. Indicators.

S.1.3.1. Symmetry. – The index of an indicator shall be symmetrical with respect to the graduations, at least throughout that portion of its length associated with the graduations.

S.1.3.2. Length. – The index of an indicator shall reach to the finest graduations with which it is used, unless the indicator and the graduations are in the same plane, in which case the distance between the end of the indicator and the ends of the graduations, measured along the line of graduations, shall be not more than 1.0 mm (0.04 in).

S.1.3.3. Width. – The width of the index of an indicator in relation to the series of graduations with which it is used shall be not greater than:

- (a) *the width of the narrowest graduation;* and*
*[*Nonretroactive as of January 1, 2002]*
(Amended 2001)

- (b) the width of the minimum clear interval between graduations.

When the index of an indicator extends along the entire length of a graduation, that portion of the index of the indicator that may be brought into coincidence with the graduation shall be of the same width throughout the length of the index that coincides with the graduation.

S.1.3.4. Clearance. – The clearance between the index of an indicator and the graduations shall in no case be more than 1.5 mm (0.06 in).

S.1.3.5. Parallax. – Parallax effects shall be reduced to the practicable minimum.

S.1.4. For Retail Devices Only.

S.1.4.1. Indication of Delivery. – A retail device shall automatically show on its face the initial zero condition and the quantity delivered up to the nominal capacity of the device. However, the following requirements shall apply:

- (a) For electronic devices manufactured prior to January 1, 2006, the first 0.03 L (or 0.009 gal) of a delivery and its associated total sales price need not be indicated.

*(b) For electronic devices manufactured on or after January 1, 2006, the measurement, indication of delivered quantity, and the indication of total sales price shall be inhibited until the fueling position reaches conditions necessary to ensure that the delivery starts at zero.
[Nonretroactive as of January 1, 2006]*

(Amended 2016)

S.1.4.2. Return to Zero.

- (a) Primary indicating elements shall be readily returnable to a definite zero indication.
- (b) Primary recording elements on a stationary retail device shall be readily returnable to a definite zero indication if the device is equipped to record.
- (c) Means shall be provided to prevent the return of primary indicating elements and of primary recording elements if these are returnable to zero, beyond their correct zero position.
- (d) Primary indicating elements shall not be resettable to zero during a delivery.

(Amended 1990 and 2016)

S.1.5. For Stationary Retail Devices Only.

S.1.5.1. Display of Unit Price and Product Identity. – A device of the computing type shall display on each face the unit price at which the device is set to compute or to deliver, and there shall be conspicuously displayed on each side of the device the identity of the product that is being dispensed.

Except for dispensers used exclusively for fleet sales and other price contract sales, all of the unit prices at which that product is offered for sales shall meet the following conditions:

*(a) For a system that applies a discount prior to the delivery, all unit prices shall be displayed or shall be capable of being displayed on the dispenser through a deliberate action of the purchaser prior to the delivery of the product. It is not necessary that all of the unit prices be simultaneously displayed prior to the delivery of the product.
[Nonretroactive as of January 1, 2016]*

(b) For a system that offers post-delivery discounts on fuel sales, display of pre-delivery unit price information is exempt from (a) above, provided the system complies with S.1.5.5. Recorded Representations for Transactions Where a Post-Delivery Discount(s) is Provided.

Note: When a product is offered at more than one unit price, display of the unit price information may be through the deliberate action of the customer: 1) using controls on

the device; 2) through the customer's use of personal or vehicle-mounted electronic equipment communicating with the system; or 3) verbal instructions by the customer. (Amended 2016)

S.1.5.2. Money-Value Computations. – A computing device shall compute the total sales price at any single-purchase unit price (excluding fleet sales and other price contract sales) for which the product is offered for sale at any delivery possible within either the measurement range of the device or the range of the computing elements, whichever is less. The analog money-value indication shall not differ from the mathematically computed money-value (quantity × unit price = sales price), for any delivered quantity, by an amount greater than the values shown in Table 1. Money-Value Divisions and Maximum Allowable Variations for Money-Value Computations on Mechanical Analog Computers. (Amended 1995)

Table 1. Money-Value Divisions and Maximum Allowable Variations for Money-Value Computations on Mechanical Analog Computers

Unit Price From	Unit Price: To and Including	Money-Value Division	Maximum Allowable Variation: Design Test	Maximum Allowable Variation: Field Test
0	\$0.25/liter or \$1.00/gallon	1¢	± 1¢	± 1¢
\$0.25/liter or \$1.00/gallon	\$0.75/liter or \$3.00/gallon	1¢ or 2¢	± 1¢	± 2¢
\$0.75/liter or \$3.00/gallon	\$2.50/liter or \$10.00/gallon	1¢ or 2¢	± 1¢	± 2¢
\$0.75/liter or \$3.00/gallon	\$2.50/liter or \$10.00/gallon	5¢	± 2½¢	± 5¢

S.1.5.2.1. Money-Value Divisions, Analog. – The value of the graduated intervals representing money-values on a computing-type device with analog indications shall be as follows:

- (a) Not more than 1 cent at all unit prices up to and including \$0.25 per liter or \$1.00 per gallon.
- (b) Not more than 2 cents at unit prices greater than \$0.25 per liter or \$1.00 per gallon up to and including \$0.75 per liter or \$3.00 per gallon.
- (c) Not more than 5 cents at all unit prices greater than \$0.75 per liter or \$3.00 per gallon.

(Amended 1984)

S.1.5.2.2. Money-Value Divisions, Digital. – A computing-type device with digital indications shall comply with the requirements of paragraph G.-S.5.5. Money-Values, Mathematical Agreement, and the total price computation shall be based on quantities not exceeding 0.01 gal intervals for devices indicating in U.S. customary units and 0.05 L for devices indicating in metric units.

S.1.5.2.3. Money-Value Divisions, Auxiliary Indications. – *In a system equipped with auxiliary indications, all indicated money-value divisions shall be identical. [Nonretroactive as of January 1, 1985.]*

S.1.5.3. Agreement Between Indications.

(a) When a quantity value indicated or recorded by an auxiliary element is a derived or computed value based on data received from a device, the value may differ from the quantity value displayed on the dispenser, provided that the following conditions are met:

(1) All total values for an individual sale that are indicated or recorded by the system agree, and

(2) Within each element, the values indicated or recorded meet the formula (quantity × unit price = total sale price) to the closest cent.

(b) When a system applies a post-delivery discount(s) to a fuel's unit price through an auxiliary element, the total volume of the delivery shall be in agreement between all elements in the system.

[Nonretroactive as of January 1, 2016]

(Added 2016)

S.1.5.4. Recorded Representations. – Except for fleet sales and other price contract sales and for transactions where a post-delivery discount is provided, a receipt providing the following information shall be available through a built-in or separate recording element for all transactions conducted with point-of-sale systems or devices activated by debit cards, credit cards, and/or cash:

(a) the total volume of the delivery;

(b) the unit price;

(c) the total computed price; and

(d) the product identity by name, symbol, abbreviation, or code number.

(Added 2014) (Amended 2016)

S.1.5.5. Recorded Representations for Transactions Where a Post-Delivery Discount(s) is Provided. – Except for fleet sales and other price contract sales, a printed receipt providing the following information shall be available through a built-in or

separate recording element that is part of the system for transactions involving a post-delivery discount:

- (a) the product identity by name, symbol, abbreviation, or code number;
 - (b) transaction information as shown on the dispenser at the end of the delivery and prior to any post-delivery discount(s), including the:
 - (1) total volume of the delivery;
 - (2) unit price; and
 - (3) total computed price of the fuel sale.
 - (c) an itemization of the post-delivery discounts to the unit price; and
 - (d) the final total price of the fuel sale after all post-delivery discounts are applied.
- (Added 2016)

S.1.5.6. Transaction Information, Power Loss. – *In the event of a power loss, the information needed to complete any transaction in progress at the time of the power loss (such as the quantity and unit price, or sales price) shall be determinable for at least 15 minutes at the device or another on-site device accessible to the customer.*
[Nonretroactive as of January 1, 2017]

(Added 2016)

S.1.5.7. Totalizers for Retail Motor-Fuel Dispensers. – *Retail motor-fuel dispensers shall be equipped with a nonresettable totalizer for the quantity delivered through the metering device.*

[Nonretroactive as of January 1, 2017]

(Added 2016)

S.1.6. For Wholesale Devices Only.

S.1.6.1. Travel of Indicator. – A wholesale device shall be readily operable to deliver accurately any quantity from 180 L (50 gal) to the capacity of the device. If the most sensitive element of the indicating system uses an indicator and graduations, the relative movement of these parts corresponding to a delivery of 4 L (1 gal) shall be not less than 5 mm (0.20 in).

(Amended 1987)

S.2. Design of Measuring Elements.

S.2.1. Air/Vapor Elimination. – A measuring system shall be equipped with an effective air/vapor eliminator or other automatic means to prevent the passage of air/vapor through the meter. Vent lines from the air/vapor eliminator shall be made of appropriate non-collapsible material.

(Amended 2016 and 2018)

S.2.2. Provision for Sealing. – For devices and systems in which the configuration or calibration parameters can be changed by use of a removable digital storage device, security shall be provided for those parameters as specified in G-S.8.2. Devices and Systems Adjusted Using Removable Digital Storage Devices. For parameters adjusted using other means, the following applies.

Adequate provision shall be made for an approved means of security (e.g., data change audit trail) or for physically applying a security seal in such a manner that requires the security seal to be broken before an adjustment or interchange can be made of:

- (a) any measuring or indicating element;
- (b) any adjustable element for controlling delivery rate, when such rate tends to affect the accuracy of deliveries; and
- (c) any metrological parameter that will affect the metrological integrity of the device or system.

When applicable, the adjusting mechanism shall be readily accessible for purposes of affixing a security seal.

*Audit trails shall use the format set forth in Table S.2.2. Categories of Device and Methods of Sealing.**

*[*Nonretroactive as of January 1, 1995]*

(Amended 2006 and 2019)

Table S.2.2. Categories of Device and Methods of Sealing

Categories of Device	Methods of Sealing
<p>Category 1: No remote configuration capability.</p>	<p>Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.</p>
<p>Category 2: Remote configuration capability, but access is controlled by physical hardware.</p> <p>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.</p>	<p>The hardware enabling access for remote communication must be on-site. The hardware must be sealed using a physical seal or an event counter for calibration parameters and an event counter for configuration parameters. The event counters may be located either at the individual measuring device or at the system controller; however, an adequate number of counters must be provided to monitor the calibration and configuration parameters of the individual devices at a location. If the counters are located in the system controller rather than at the individual device, means must be provided to generate a hard copy of the information through an on-site device.</p>
<p>Category 3: Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password).</p> <p>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.</p>	<p>An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. A printed copy of the information must be available on demand through the device or through another on-site device. The information may also be available electronically. The event logger shall have a capacity to retain records equal to 10 times the number of sealable parameters in the device, but not more than 1000 records are required. (Note: Does not require 1000 changes to be stored for each parameter.)</p>

[Nonretroactive as of January 1, 1995]
 (Table Added 2006) (Amended 2016)

S.2.3. Directional Flow Valves. – A measuring system shall be equipped with a valve or other effective means, automatic in operation and installed in or adjacent to the measuring element, to prevent reversal of flow of the product being measured.

(Amended 1982)

S.2.4. Maintenance of Liquid State. – A device shall be so designed and installed that the product being measured will remain in a liquid state during the passage through the meter.

S.2.5. Zero-Set-Back Interlock.

S.2.5.1. Zero-Set-Back Interlock, Electronic Stationary Meters (Other than Stationary Retail Motor- Fuel Dispensers) and Electronic Vehicle-Mounted Meters.

- *A device shall be so constructed that after an individual delivery or multiple deliveries at one location have been completed, an automatic interlock system shall engage to prevent a subsequent delivery until the indicating element and, if equipped, recording element have been returned to their zero position.*

[Nonretroactive as January 1, 2021]

(Added 2019) (Amended 2021)

S.2.5.2. Zero-Set-Back Interlock for Stationary Retail Motor-Fuel Devices. – *A device shall be constructed so that:*

- (a) after a delivery cycle has been completed by moving the starting lever to any position that shuts off the device, an automatic interlock prevents a subsequent delivery until the indicating elements and recording elements, if the device is equipped and activated to record, have been returned to their zero positions;*
- (b) the discharge nozzle cannot be returned to its designed hanging position (that is, any position where the tip of the nozzle is placed in its designed receptacle and the lock can be inserted) until the starting lever is in its designed shut-off position and the zero-set-back interlock has been engaged; and*
- (c) in a system with more than one dispenser supplied by a single pump, an effective automatic control valve in each dispenser prevents product from being delivered until the indicating elements on that dispenser are in a correct zero position.*

[Nonretroactive as of January 1, 2017]

(Added 2016)

S.2.6. Automatic Timeout.

S.2.6.1. Electronic Stationary (Other than Stationary Retail Motor-Fuel Dispensers) and Electronic Vehicle-Mounted Meters. – *For individual deliveries, if there is no product flow for three minutes the transaction must be completed before additional product flow is allowed. The three-minute timeout shall be a sealable feature on an indicator.*

[Nonretroactive as of January 1, 2021]

(Added 2021)

S.2.6.2. Automatic Timeout Pay-at-Pump Retail Motor-Fuel Devices – Once a device has been authorized, it must deauthorize within three minutes if not activated. Reauthorization of the device must be performed before any product can be dispensed. If the time limit to deauthorize the device is programmable, it shall not accept an entry greater than three minutes.

[Nonretroactive as of January 1, 2022]

(Added 2021)

S.2.7. Thermometer Well. For test purposes, means shall be provided to determine the temperature of the liquid either:

(a) in the liquid chamber of the meter; or

(b) in the meter inlet or discharge line and immediately adjacent to the meter.

(Amended 1987) (Renumbered 2019)

S.2.8. Automatic Temperature Compensation. (Formerly CCR 4001.Exceptions.S.2.6.)

CCR § 4002.4. (3.32).§ 4002.4. Liquefied Petroleum Gas and Anhydrous Ammonia Liquid-Measuring Devices. (3.32.) (a) Temperature Compensation.

All liquefied petroleum gas measuring devices with a manufacturer's maximum rated flow capacity exceeding 20 gallons per minute shall be equipped with automatic means to correct the volume delivered to the volume at 60°F. The automatic temperature compensator shall be connected, operable and in use at all times.

(Adopted, 4 CCR 4002.4.)

S.3 Design of Discharge Lines and Discharge Line Valves.

S.3.1. Diversion of Measured Liquid. – No means shall be provided by which any measured liquid can be diverted from the measuring chamber of the meter or the discharge line therefrom. However, two or more delivery outlets may be permanently installed if means are provided to insure that:

(a) liquid can flow from only one such outlet at one time; and

(b) the direction of flow for which the mechanism may be set at any time is definitely and conspicuously indicated.

In addition, a manually controlled outlet that may be opened for the purpose of emptying a portion of the system to allow for repair and maintenance operations shall be permitted. Effective means shall be provided to prevent the passage of liquid through any such outlet

during normal operation of the device and to indicate clearly and unmistakably when the valve controls are so set as to permit passage of liquid through such outlet.

(Amended 1975)

CCR § 4002.4. Liquefied Petroleum Gas and Anhydrous Ammonia Liquid-Measuring Devices. (3.32.). (b).

The provisions of Handbook 44, Section 3.32., S.3.1, Liquefied Petroleum Gas and Anhydrous Ammonia Liquid-Measuring Devices Code shall not apply to equipment located at wholesale loading terminals when used exclusively for the purpose of filling transports utilizing the spray fill, or when the delivery is being made simultaneously to truck and trailer from one meter when the product being delivered into the truck and trailer is being purchased by the same person.

(Adopted, 4 CCR 4002.4)

S.3.2. Delivery Hose. – The delivery hose of a retail device shall be of the wet-hose type with a shutoff valve at its outlet end.

S.4. Marking Requirements.

S.4.1. Limitation of Use. – If a device is intended to measure accurately only products having particular properties, or to measure accurately only under specific installation or operating conditions, or to measure accurately only when used in conjunction with specific accessory equipment, these limitations shall be clearly and permanently stated on the device.

S.4.2. Discharge Rates. – A device shall be marked to show its designed maximum and minimum discharge rates. The marked minimum discharge rate shall not exceed:

(a) 20 L (5 gal) per minute for stationary retail devices; or

(b) 20 % of the marked maximum discharge rate for other retail devices and for wholesale devices.

(Amended 1987)

Note: Also see example in Section 3.30. Liquid-Measuring Devices Code, paragraph S.4.4.1. Discharge Rates. (Added 2003)

S.4.3. Location of Marking Information; Retail Motor-Fuel Dispensers. – *The marking information required in General Code, paragraph G-S.1. Identification shall appear as follows:*

(a) *within 60 cm (24 in) to 150 cm (60 in) from the base of the dispenser;*

(b) *either internally and/or externally provided the information is permanent and easily read; and*

(c) on a portion of the device that cannot be readily removed or interchanged (i.e., not on a service access panel).

The use of a dispenser key or tool to access internal marking information is permitted for retail motor-fuel dispensers.

[Nonretroactive as of January 1, 2003]

(Added 2006)

S.4.4. Temperature Compensation. – If a device is equipped with an automatic temperature compensator, the primary indicating elements, recording elements, and recorded representation shall be clearly and conspicuously marked to show that the volume delivered has been adjusted to the volume at 15 °C (60 °F).

N. Notes

N.1. Test Liquid. – A device shall be tested with the liquid to be commercially measured or with a liquid of the same general physical characteristics.

N.2. Vaporization and Volume Change. – Care shall be exercised to reduce to a minimum, vaporization and volume changes.

N.3. Test Drafts. – Test drafts should be equal to at least the amount delivered by the device in one minute at its normal discharge rate.

(Amended 1982)

N.4. Testing Procedures.

N.4.1. Normal Tests. – The “normal” test of a device shall be made at the maximum discharge flow rate developed under the conditions of the installation. Any additional tests conducted at flow rates down to and including one-half the sum of the maximum discharge flow rate and the rated minimum discharge flow rate shall be considered normal tests.

(Amended 1998)

N.4.1.1. Automatic Temperature Compensation. [NOT ADOPTED - CCR § 4001. Exceptions.]

CCR § 4002.4. Liquefied Petroleum Gas and Anhydrous Ammonia Liquid-Measuring Devices. (3.32.). (c).

Wholesale Deices Equipped With Automatic Temperature Compensating Systems. On wholesale devices equipped with automatic temperature compensating systems, normal tests:

(1) Shall be conducted with the temperature compensating system connected and operating by comparing the compensated volume indicated or recorded to the actual delivered volume corrected to 60°F; and

(2) May be conducted with the temperature compensating system deactivated, comparing the uncompensated volume indicated or recorded to the actual delivered volume.

The first test shall be performed with the automatic temperature compensating system operating in the “as found” condition. On devices that indicate or record both the compensated and uncompensated volume for each delivery, the tests in (1) and (2) may be performed as a single test.

(Adopted, 4 CCR 4002.4)

N.4.2. Special Tests. – “Special” tests shall be made to develop the operating characteristics of a device and any special elements and accessories attached to or associated with the device. Any test except as set forth in N.4.1. Normal Tests shall be considered a special test.

N.4.2.1. For Motor-Fuel Devices. – A motor-fuel device shall be so tested at a minimum discharge rate of:

- (a) 20 L (5 gal) per minute; or
- (b) the minimum discharge rate marked on the device, whichever is less.

N.4.2.2. For Other Retail Devices. – A retail device other than a motor-fuel device shall be tested at a minimum discharge rate of the:

- (a) minimum discharge rate that can be developed under the conditions of installation; or
- (b) minimum discharge rate marked on the device, whichever is greater.

(Amended 1973)

N.4.2.3. For Wholesale Devices. – “Special” tests on a wholesale device shall include a test at, or slightly above, the minimum discharge rate marked on the device. In no case shall the test be performed at a flow rate less than the minimum discharge rate marked on the device.

(Amended 1987 and 2017)

N.4.3. Money-Value Computation Tests.

N.4.3.1. Laboratory Design Evaluation Tests. – In the conduct of laboratory design evaluation tests, compliance with paragraph S.1.5.2. Money-Value Computations shall be determined by using the cone gear as a reference for the total quantity delivered. The indicated delivered quantity shall agree with the cone gear representation with the index of the indicator within the width of the graduation. The maximum allowable variation of the indicated sales price shall be as shown in Table 1. Money-Value Divisions and Maximum Allowable Variations for Money-Value Computations on Mechanical Analog Computers.

N.4.3.2. Field Tests. – In the conduct of field tests to determine compliance with paragraph S.1.5.2. Money-Value Computations the maximum allowable variation in the indicated sales price shall be as shown in Table 1. Money-Value Divisions and Maximum Allowable Variations for Money-Value Computations on Mechanical Analog Computers.

(Added 1984)

N.4.4. Repeatability Tests . – Tests for repeatability should include a minimum of three consecutive test drafts of approximately the same size and be conducted under controlled conditions where variations in factors such as temperature, pressure, and flow rate are reduced to the extent that they will not affect the results obtained. When conducting the tests, the discharge rates shall be within the minimum and maximum discharge rates as marked by the manufacturer. For devices equipped with an automatic temperature compensator, results shall be based on the uncompensated (gross) volume (e.g., with the temperature compensator deactivated).

(Amended 2019)

N.5. Temperature Correction. – Adjustments shall be made for any changes in volume resulting from the differences in liquid temperatures between time of passage through the meter and time of volumetric determination in the prover. When adjustments are necessary, appropriate petroleum measurement tables should be used.

T. Tolerances

T.1. Application.

T.1.1. To Underregistration and to Overregistration. – The tolerances hereinafter prescribed shall be applied to errors of underregistration and errors of overregistration, whether or not a device is equipped with an automatic temperature compensator.

T.2. Tolerance Values. – The maintenance and acceptance tolerances for normal and special tests shall be as shown in Table T.2. Accuracy Classes and Tolerances for LPG and Anhydrous Ammonia Liquid-Measuring Devices.

(Amended 2003)

Table T.2. Accuracy Classes and Tolerances for LPG and Anhydrous Ammonia Liquid-Measuring Devices

Accuracy Class	Application	Acceptance Tolerance	Maintenance Tolerance	Special Test Tolerance
1.0	Anhydrous ammonia, LPG (including vehicle-mounted meters)	0.6 %	1.0 %	1.0 %

(Added 2003)

T.3. Repeatability. – When multiple tests are conducted at approximately the same flow rate and draft size, the range of the test results for the flow rate shall not exceed 40 % of the absolute value of the maintenance tolerance and the results of each test shall be within applicable tolerance. (Also see N.4.4. Repeatability Tests)

(Added 1992) (Amended 1997, 2001, and 2019)

T.4. Automatic Temperature-Compensating Systems. – The difference between the meter errors (expressed as a percentage) determined with and without the automatic temperature-compensating system activated shall not exceed:

(a) 1.0 % for mechanical automatic temperature-compensating systems; and

(b) 0.5 % for electronic automatic temperature-compensating systems.

The delivered quantities for each test shall be approximately the same size. The results of each test shall be within the applicable acceptance or maintenance tolerance.

(Added 1991) (Amended 1992, 1996, and 1997)

UR. User Requirements

UR.1. Installation Requirements.

UR.1.1. Discharge Rate. – A device shall be so installed that the actual maximum discharge rate will not exceed the rated maximum discharge rate. If necessary, means for flow regulation shall be incorporated in the installation, in which case this shall be fully effective and automatic in operation.

UR.1.2. Length of Discharge Hose. – The length of the discharge hose on a stationary motor-fuel device shall not exceed 5.5 m (18 ft), measured from the outside of the housing of the device to the inlet end of the discharge nozzle, unless it can be demonstrated that a longer hose is essential to permit deliveries to be made to receiving vehicles or vessels. Unnecessarily remote location of a device shall not be accepted as justification for an abnormally long hose.

(Amended 1991)

UR.2. Use Requirements.

UR.2.1. Return of Indication and Recording Elements to Zero. – The primary indicating elements (visual), and the primary recording elements when these are returnable to zero, shall be returned to zero before each delivery.

UR.2.2. Condition of Fill of Discharge Hose. – The discharge hose shall be completely filled with liquid before the “zero” condition is established prior to the start of a commercial delivery, whether this condition is established by resetting the primary indicating elements to zero indication or by recording the indications of the primary indicating elements. (Also see UR.2.1. Return of Indication and Recording Elements to Zero.)

UR.2.3. Vapor-Return Line. – [NOT ADOPTED - CCR § 4001. Exceptions.]

CCR § 4002.4. Liquefied Petroleum Gas and Anhydrous Ammonia Liquid-Measuring Devices. (3.32.)(d).

Vapor-Return Line. During any metered delivery of liquefied petroleum gas from a supplier's tank to a receiving container, there shall be no vapor-return line from the receiving container to the supplier's tank.

(Adopted, 4 CCR 4002.4)

UR.2.4. Temperature Compensation.

UR.2.4.1. Use of Automatic Temperature Compensators. – If a device is equipped with an automatic temperature compensator, this shall be connected, operable, and in use at all times. Such automatic temperature compensator may not be removed, nor may a compensated device be replaced with an uncompensated device, without the written approval of the weights and measures authority having jurisdiction over the device.

UR.2.4.2. Temperature Compensated Sale. – All sales of liquefied petroleum gas in a liquid state, when the quantity is determined by an approved measuring system equipped with a temperature-compensating mechanism, or by weight and converted to liters or gallons, or by a calibrated container, shall be in terms of liters or the U.S. gallon of 231 in³ at 15 °C (60 °F).

(Added 1984)

UR.2.4.3. Invoices. – Any invoice based on a reading of a device that is equipped with an automatic temperature compensator or based on a weight converted to gallons, or based on the volume of a calibrated container, shall have shown thereon that the volume delivered has been adjusted to the volume at 15 °C (60 °F).

(Amended 1984)

UR.2.4.4. Automated Temperature-Compensating Systems. – Means for determining the temperature of measured liquid in an automatic temperature-compensating system shall be so designed and located that, in any “usual and customary” use of the system, the resulting indications and/or recorded representations are within applicable tolerances.

(Added 1987)

UR.2.5. Ticket in Printing Device. – A ticket shall not be inserted into a device equipped with a ticket printer until immediately before a delivery is begun, and in no case shall a ticket be in the device when the vehicle is in motion while on a public street, highway, or thoroughfare.

UR.2.6. Ticket Printer; Customer Ticket. – Vehicle-mounted metering systems shall be equipped with a ticket printer. The ticket printer shall be used for all sales; a copy of the

ticket issued by the device shall be left with the customer at the time of delivery or as otherwise specified by the customer.

(Added 1992)

UR.2.7. For Stationary Retail Computing-Type Systems Only, Installed After January 1, 2017.

UR.2.7.1. Unit Price and Product Identity.

(a) The following information shall be conspicuously displayed or posted on the face of a retail dispenser used in a direct sale:

(1) except for unit prices resulting from any post-delivery discount and dispensers used exclusively for fleet sales, other price contract sales, and truck refueling (e.g., truck stop dispensers used only to refuel trucks), all of the unit prices at which the product is offered for sale; and

(2) in the case of a computing-type device or money-operated type device, the unit price at which the dispenser is set to compute.

Provided that the dispenser complies with S.1.5.1. Display of Unit Price and Product Identity, it is not necessary that all the unit prices be simultaneously displayed or posted.

(b) The following information shall be conspicuously displayed or posted on each side of a retail dispenser used in a direct sale:

(1) The identity of the product in descriptive commercial terms; and

(2) The identity of the grade, brand, blend, or mixture that a multi-product dispenser is set to deliver.

(Added 2016)

CCR § 4002.4. Liquefied Petroleum Gas and Anhydrous Ammonia Liquid-Measuring Devices. (3.32.) (e) Signs.

Any retail liquefied petroleum gas dispenser, with the exception of those mounted on a motor vehicle, shall display a sign showing the price schedule of all transactions. The sign shall be where it is plainly discernable to the customer. All letters, figures or numerals used to express the price schedule shall be at least three-quarters of an inch in height.

(Adopted, 4 CCR 4002.4)

UR.2.7.2. Computing Device. – Any computing device used in an application where a product or grade is offered for sale at one or more unit prices shall be used only for sales for which the device computes and displays the sales price for the selected transaction. The following exceptions apply:

- (a) Fleet sales and other price contract sales are exempt from this requirement.
- (b) A truck stop dispenser used exclusively for refueling trucks is exempt from this requirement provided that:
 - (1) all purchases of fuel are accompanied by a printed receipt of the transaction containing the applicable price per unit of measure, the total quantity delivered, and the total price of the sale; and
 - (2) unless a dispenser complies with S.1.5.1. Display of Unit Price, the price posted on the dispenser and the price at which the dispenser is set to compute shall be the highest price for any transaction which may be conducted.
- (c) A dispenser used in an application where a price per unit discount is offered following the delivery is exempt from this requirement, provided the following conditions are satisfied:
 - (1) the unit price posted on the dispenser and the unit price at which the dispenser is set to compute shall be the highest unit price for any transaction;
 - (2) all purchases of fuel are accompanied by a receipt recorded by the system for the transaction containing:
 - a. the product identity by name, symbol, abbreviation, or code number;
 - b. transaction information as shown on the dispenser at the end of the delivery and prior to any post-delivery discount including the:
 - 1. total volume of the delivery;
 - 2. unit price; and
 - 3. total computed price of the fuel sale prior to post-delivery discounts being applied.
 - c. an itemization of the post-delivery discounts to the unit price; and
 - d. the final total price of the fuel sale after all post-delivery discounts are applied.

(Added 2016)

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Table of Contents

	Page
Section 3.33. Hydrocarbon Gas Vapor-Measuring Devices	73
A. Application.....	73
A.1. General.	73
A.2. Exceptions.....	73
A.3. Additional Code Requirements.....	73
S. Specifications	73
S.1. Design of Indicating and Recording Elements and of Recorded Representations. ..	73
S.1.1. Primary Elements.	73
S.1.2. Graduations.	74
S.1.3. Indicators.	75
S.2. Design of Measuring Elements.....	75
S.2.1. Pressure Regulation.	75
S.2.2. Provision for Sealing.....	76
S.2.3. Maintenance of Vapor State.	76
S.2.4. Automatic Temperature Compensation.	76
S.3. Design of Discharge Lines.	77
S.3.1. Diversion of Measured Vapor. – No means shall be provided by which any measured vapor can be diverted from the measuring chamber of the meter or the discharge line therefrom.	77
S.4. Marking Requirements.	77
S.4.1. Limitations of Use.	77
S.4.2. Discharge Rates.	77
S.4.3. Temperature Compensation. – [NOT ADOPTED - CCR § 4001. Exceptions.]	77
§4002.5. Hydrocarbon Gas Vapor-Measuring Device 3.33. Temperature Compensation.....	77
S.4.4. Badge.	77
N. Notes	77
N.1. Test Medium.....	77
N.2. Temperature and Volume Change.	77
N.3. Test Drafts.....	77
N.4. Test Procedures.	78
N.4.1. Normal Tests.	78
N.4.2. Special Tests.	78
N.4.3. Repeatability Tests	79
N.5. Temperature Correction.	79
N.6. Frequency of Test.	79
T. Tolerances	79

T.1. Tolerance Values on Normal Tests and on Special Tests Other Than Low-Flame Tests.	79
T.2. Repeatability.....	80
UR. User Requirements.....	80
UR.1. Installation Requirements.	80
UR.1.1.Capacity Rate.	80
UR.1.2.Leakage.....	80
§ 4002.5. Hydrocarbon Gas Vapor-Measuring Devices. 3.33. Leak Test.	80
UR.2. Use Requirements.	80
UR.2.1.Automatic Temperature Compensation.	80
UR.2.2.Invoices.	80
§ 4002.5. Hydrocarbon Gas Vapor-Measuring Devices. 3.33. Retention of Customer Invoices.....	81
UR.2.3.Correction for Elevation.	82
<i>UR.2.4.Valves and Test Tee</i>	82
UR.2.5.Use of Auxiliary Heated Vaporizer Systems.	82

Section 3.33. Hydrocarbon Gas Vapor-Measuring Devices¹

A. Application

A.1. General. – This code applies to devices used for the measurement of hydrocarbon gas in the vapor state, such as propane, propylene, butanes, butylenes, ethane, methane, natural gas, and any other hydrocarbon gas/air mix.

(Amended 1984, 1986, 1988, and 1991)

A.2. Exceptions. – This code does not apply to:

- (a) Liquid-measuring devices used for dispensing liquefied petroleum gases in liquid form. (Also see Section 3.32. Code for Liquefied Petroleum Gas and Anhydrous Ammonia Liquid-Measuring Devices.)
- (b) Natural, liquefied petroleum, and manufactured-gas-vapor meters when these are operated in a public utility system.
- (c) Mass flow meters. (Also see Section 3.37. Code for Mass Flow Meters.)
(Added 1994)

A.3. Additional Code Requirements. – In addition to the requirements of this code, Hydrocarbon Gas Vapor-Measuring Devices shall meet the requirements of Section 1.10. General Code.

S. Specifications

S.1. Design of Indicating and Recording Elements and of Recorded Representations.

S.1.1. Primary Elements.

S.1.1.1. General. – A device shall be equipped with a primary indicating element and may also be equipped with a primary recording element.

S.1.1.2. Units. – A volume-measuring device shall indicate, and record if equipped to record, its deliveries in terms of cubic meters or cubic feet, or multiple or decimal subdivisions of cubic meters or cubic feet.

(Amended 1972 and 1991)

S.1.1.3. Value of Smallest Unit. – The value of the smallest unit of indicated delivery, and recorded delivery if the device is equipped to record, shall not exceed:

¹Title changed 1986.

- (a) 1 m³ (1000 dm³) (100 ft³) when the maximum rated gas capacity is less than 280 m³/h (10 000 ft³/h);
- (b) 10 m³ (1000 ft³) when the maximum rated gas capacity is 280 m³/h (10 000 ft³/h) up to, but not including, 1700 m³/h (60 000 ft³/h); and
- (c) 100 m³ (10 000 ft³) when the maximum rated gas capacity is 1700 m³/h (60 000 ft³/h) or more.

(Amended 1972, 1988, and 1991)

S.1.1.4. Advancement of Indicating and Recording Elements. – Primary indicating and recording elements shall advance digitally or continuously and be susceptible to advancement only by the mechanical operation of the device.

S.1.1.5. Proving Indicator. – Devices rated less than 280 m³/h (10 000 ft³/h) gas capacity shall be equipped with a proving indicator measuring 0.025, 0.05, 0.1, 0.2, or 0.25 m³ per revolution, (1, 2, 5, or 10 ft³ per revolution) for testing the meter. Devices with larger capacities shall be equipped as follows:

- (a) Devices rated 280 m³ (10 000 ft³) up to but not including 1700 m³/h (60 000 ft³/h) gas capacity shall be equipped with a proving indicator measuring not greater than 1 m³ (100 ft³) per revolution.
- (b) Devices rated 1700 m³/h (60 000 ft³/h) gas capacity or more shall be equipped with a proving indicator measuring not more than 10 m³ (1000 ft³) per revolution.

The test circle of the proving indicator shall be divided into ten equal parts. Additional subdivisions of one or more of such equal parts may be made.

(Amended 1973 and 1988)

S.1.2. Graduations.

S.1.2.1. Length. – Graduations shall be so varied in length that they may be conveniently read.

S.1.2.2. Width. – In any series of graduations, the width of a graduation shall in no case be greater than the width of the minimum clear interval between graduations, and in no case should it exceed 1.0 mm (0.04 in) for indicating elements and 0.5 mm (0.02 in) for proving circles.

S.1.2.3. Clear Interval Between Graduations. – The clear interval shall be not less than 1.0 mm (0.04 in). If the graduations are not parallel, the measurement shall be made:

- (a) along the line of relative movement between the graduations at the end of the indicator; or
- (b) if the indicator is continuous, at the point of widest separation of the graduations.

S.1.3. Indicators.

S.1.3.1. Symmetry. – The index of an indicator shall be symmetrical with respect to the graduations, at least throughout that portion of its length associated with the graduations.

S.1.3.2. Length. – The index of an indicator shall reach to the finest graduations with which it is used.

S.1.3.3. Width. – The width of the index of an indicator in relation to the series of graduations with which it is used shall be not greater than the:

(a) *width of the narrowest graduation;** and
[*Nonretroactive as of January 1, 2002]
(Amended 2001)

(b) width of the minimum clear interval between graduations.

When the index of an indicator extends along the entire length of a graduation, that portion of the index of the indicator that may be brought into coincidence with the graduation shall be of the same width throughout the length of the index that coincides with the graduation.

S.1.3.4. Clearance. – The clearance between the index of an indicator and the graduations shall in no case be more than 1.5 mm (0.06 in).

S.1.3.5. Parallax. – Parallax effects shall be reduced to the practicable minimum.

S.2. Design of Measuring Elements.

S.2.1. Pressure Regulation. – The vapor should be measured at a normal gauge pressure (psig) of:
(Amended 1991)

(a) 2740 Pa \pm 685 Pa (11 in of water column (0.40 psig) \pm 2.75 in of water column (0.10 psig)) for liquefied petroleum gas vapor; or

(b) 1744 Pa \pm 436 Pa (7 in of water column (0.25 psig) \pm 1.75 in of water column (0.06 psig)) for natural and manufactured gas.

When vapor is measured at a pressure other than what is specified above for the specific product, a volume multiplier shall be applied within the meter or to the billing invoice based on the following equation:

Where:

VPM= Volume pressure multiplier

AAP = Assumed atmospheric pressure in Pa or psia

GP = Gauge pressure in Pa or psig

NGP= Normal gauge pressure in Pa or psig

$$VPM = \frac{AAP + GP}{AAP + NGP}$$

Figure 1 - Image of Equation to Determine the Volume Pressure Multiplier.

The assumed atmospheric pressure is to be taken from Table 2. Corrections for Altitude, U.S. Customary Units and Table 2M. Corrections for Altitude, Metric Units.

When liquefied petroleum gas vapor is measured at a pressure of 6900 Pa (1 psig) or more, the delivery pressure shall be maintained within ± 1725 Pa (± 0.25 psig).

Pressure variations due to regulator lock off shall not increase the operating pressure by more than 25 %.

(Amended 1980, 1984, and 1991)

S.2.2. Provision for Sealing. – For devices or systems in which the configuration or calibration parameters can be changed by use of a removable digital storage device, security shall be provided for those parameters as specified in G-S.8.2. Devices and Systems Adjusted Using Removable Digital Storage Devices. For parameters adjusted using other means, the following applies.

Adequate provision shall be made for applying security seals in such a manner that no adjustment or interchange can be made of any measurement element.

(Amended 2019)

S.2.3. Maintenance of Vapor State. – A device shall be so designed and installed that the product being measured will remain in a vapor state during passage through the meter.

S.2.4. Automatic Temperature Compensation. – A device may be equipped with an adjustable automatic means for adjusting the indication and registration of the measured volume of vapor product to the volume at 15 °C (60 °F).

S.3. Design of Discharge Lines.

S.3.1. Diversion of Measured Vapor. – No means shall be provided by which any measured vapor can be diverted from the measuring chamber of the meter or the discharge line therefrom.

S.4. Marking Requirements.

S.4.1. Limitations of Use. – If a device is intended to measure accurately only products having particular properties, or to measure accurately only under specific installation or operating conditions, or to measure accurately only when used in conjunction with specific accessory equipment, these limitations shall be clearly and permanently stated on the device.

S.4.2. Discharge Rates. – A device shall be marked to show its rated gas capacity in cubic meters per hour or cubic feet per hour.

S.4.3. Temperature Compensation. – [NOT ADOPTED - CCR § 4001. Exceptions.]

§4002.5. Hydrocarbon Gas Vapor-Measuring Device 3.33. Temperature Compensation.

If a device is equipped with an automatic temperature compensator, this shall be indicated on the badge or immediately adjacent to the badge of the device and on the register.

(Adopted, 4 CCR 4002.5.)

S.4.4. Badge. – A badge affixed in a prominent position on the front of the device shall show the manufacturer's name, serial number and model number of the device, and capacity rate of the device for the particular products that it was designed to meter as recommended by the manufacturer.

N. Notes

N.1. Test Medium. – The device shall be tested with air or the product to be measured.
(Amended 1991)

N.2. Temperature and Volume Change. – Care should be exercised to reduce to a minimum any volume changes. The temperature of the air, bell-prover oil, and the meters under test should be within 1 °C (2 °F) of one another. The devices should remain in the proving room for at least 16 hours before starting any proving operations to allow the device temperature to approximate the temperature of the proving device.

N.3. Test Drafts. – Except for low-flame tests, test drafts shall be at least equal to one complete revolution of the largest capacity proving indicator and shall in no case be less than 0.05 m³ or 2 ft³. All flow rates shall be controlled by suitable outlet orifices.
(Amended 1973 and 1991)

Table 1. Capacity of Low-Flow Test Rate Orifices with Respect to Device Capacity

Metric Units - Rated Capacity	Metric Units - Low-Flow Test Rate	U.S. Customary Units – Rated Capacity	U.S. Customary Units – Low-Flow Test Rate
Up to and including 7 m ³ /h	0.007 m ³ /h	Up to and including 250 ft ³ /h	0.25 ft ³ /h
Over 7 m ³ /h up to and including 14 m ³ /h	0.014 m ³ /h	Over 250 ft ³ /h up to and including 500 ft ³ /h	0.50 ft ³ /h
Over 14 m ³ /h	0.1 % of capacity rate	Over 500 ft ³ /h	0.1 % of capacity rate

N.4. Test Procedures. – If a device is equipped with an automatic temperature compensator, the proving device reading shall be corrected to 15 °C (60 °F), using an approved table.
(Amended 1972)

N.4.1. Normal Tests. – The normal test of a device shall be made at a rate not to exceed the capacity rate given on the badge of the meter.
(Amended 1988)

N.4.1.1. Automatic Temperature Compensation. – If a device is equipped with an automatic temperature compensator, the quantity of the test draft indication of the standard shall be corrected to 15 °C (60 °F).

N.4.2. Special Tests. – “Special” tests shall be made to develop the operating characteristics of a device and any special elements and accessories attached to or associated with the device. Any test except as set forth in N.4.1. Normal Tests shall be considered a special test.

N.4.2.1. Slow Test. – The device shall be tested at a rate not less than 20 % of the marked capacity rate, or (at the check rate) not less than the minimum flow rate if marked on the device, whichever is less.
(Amended 1988)

N.4.2.2. Low-Flame Test. – The device shall be tested at an extremely low-flow rate as given in Table 1 Capacity of Low-Flow Test Rate Orifices with Respect to Device Capacity. The test shall consist of passing air at a pressure of 375 Pa (1.5 in water column) through the meter for not less than 60 minutes. The meter shall continue to advance at the conclusion of the test period.
(Amended 1990 and 1991)

N.4.2.3. Pressure Regulation Test. – On devices operating at a pressure of 6900 Pa (1 psig) or more, a pressure regulation test shall be made at both the minimum and maximum use load to determine the proper operation of the regulator and the proper

sizing of the piping and dispensing equipment. These tests may include a test of 24 hours during which the pressure is recorded.

(Added 1984)

N.4.3. Repeatability Tests. – Tests for repeatability should include a minimum of three consecutive test drafts of approximately the same size and be conducted under controlled conditions where variations in factors such as temperature, pressure, and flow rate are reduced to the extent that they will not affect the results obtained. When conducting the tests, the minimum discharge rate shall be the minimum flow rate marked on the device or at least 20% of the marked capacity rate, whichever is less, and the maximum discharge rates shall not exceed the capacity rate as marked by the manufacturer.

Note: The repeatability test will not be performed at the low-flame flow rate for these devices as the time required would be unrealistic.

(Amended 2019)

N.5. Temperature Correction. – Corrections shall be made for any changes in volume resulting from the difference in air temperatures between time of passage through the device and time of volumetric determination in the proving device.

N.6. Frequency of Test. – A hydrocarbon gas vapor-measuring device shall be tested before installation and allowed to remain in service for 10 years from the time last tested without being retested, unless a test is requested by:

- (a) the purchaser of the product being metered;
- (b) the seller of the product being metered; or
- (c) the weights and measures official.

T. Tolerances

T.1. Tolerance Values on Normal Tests and on Special Tests Other Than Low-Flame Tests. - Maintenance and acceptance tolerances for normal and special tests for hydrocarbon gas vapor-measuring devices shall be as shown in Table T.1. Accuracy Classes and Tolerances for Hydrocarbon Gas Vapor-Measuring Devices.

(Amended 1981 and 2003)

Table T.1. - Accuracy Classes and Tolerances for Hydrocarbon Gas Vapor-Measuring Devices

Accuracy Class	Application	Acceptance Tolerance	Maintenance Tolerance
3.0	Gases at low pressure (for example, LPG vapor) - Overregistration	1.5 %	1.5 %
3.0	Gases at low pressure (for example, LPG vapor) - Underregistration	3.0 %	3.0 %

(Added 2003)

T.2. Repeatability. – When multiple tests are conducted at approximately the same flow rate and draft size, the range of the test results for the flow rate shall not exceed 0.9 % and the results of each test shall be within the applicable tolerance. Also see N.4.3. Repeatability Test.

(Added 2002) (Amended 2019)

UR. User Requirements

UR.1. Installation Requirements.

UR.1.1. Capacity Rate. – A device shall be so installed that the actual maximum flow rate will not exceed the capacity rate except for short durations. If necessary, means for flow regulation shall be incorporated in the installation, in which case this shall be fully effective and automatic in operation.

UR.1.2. Leakage. – The metering system shall be installed and maintained as a pressure-tight and leak-free system.

§ 4002.5. Hydrocarbon Gas Vapor-Measuring Devices. 3.33. Leak Test.

Leak Test Each meter shall be submitted to a pressure leak test not to exceed the manufacturer's maximum rated pressure.

(Adopted, 4 CCR 4002.5.)

UR.2. Use Requirements.

UR.2.1. Automatic Temperature Compensation. – A compensated device may not be replaced with an uncompensated device without the written approval of the weights and measures authority having jurisdiction over the device.

UR.2.2. Invoices. – A customer purchasing hydrocarbon gas measured by a vapor meter shall receive from the seller an invoice for each billing period. The invoice shall clearly and separately show the following:

- (a) The opening and closing meter readings and the dates of those readings.

- (b) The altitude correction factor.
- (c) The total cubic meters (cubic feet) billed, corrected for elevation.
- (d) The charge per cubic meter (cubic foot) after correction for elevation.
- (e) All periodic charges independent of the measured gas, such as meter charges, meter reading fees, service charges or a minimum charge for a minimum number of cubic meters (cubic feet).
- (f) The total charge for the billing period.

If the vapor meter is equipped with an automatic temperature compensator, or any other means are used to compensate for temperature, the invoice shall show that the volume has been adjusted to the volume at 15 °C (60 °F).

(Amended 1988 and 1991)

§ 4002.5. Hydrocarbon Gas Vapor-Measuring Devices. 3.33. Retention of Customer Invoices.

Any person engaging in the sale of hydrocarbon gas vapor shall retain a record of:

- (1) each individual hydrocarbon gas vapor meter billing invoice, and
- (2) the applicable rate schedule for a period of not less than 12 months and shall make them available at reasonable times for inspection and copying by the customer and the county sealer of weights and measures.

(Adopted, 4 CCR 4002.5.)

UR.2.3. Correction for Elevation. – The metered volume of gas shall be corrected for changes in the atmospheric pressure with respect to elevation to the standard pressure of 101.56 kPa (14.73 psia). The appropriate altitude correction factor from Table 2M. Corrections for Altitude, Metric Units or Table 2. Corrections for Altitude, U.S. Customary Units shall be used. ((The table is modified from NBS Handbook 117, Examination of Vapor-Measuring Devices for Liquefied Petroleum Gas.)
(Amended 1988)

Elevation correction factors (ACF) were obtained by using the following equation:

$$ACF = \frac{GP \text{ of gas} + AAP}{\text{base pressure}}$$

Figure 2 - Equation for Determining Elevation (Altitude) Correction Factors

GP = gauge pressure
AAP = assumed atmospheric pressure
base pressure = 101.560 kPa = 14.73 psia

2740 Pa = 11 in of water column = 0.397 psig

1744 Pa = 7 in of water column = 0.253 psig

(Amended 1988)

UR.2.4. Valves and Test Tee. – *All gas meter installations shall be provided with a shut-off valve located adjacent to and on the inlet side of the meter. In the case of a single meter installation utilizing a liquefied petroleum gas tank, the tank service valve may be used in lieu of the shut-off valve. All gas meter installations shall be provided with a test tee located adjacent to and on the outlet side of the meter.*

[Nonretroactive as of January 1, 1990]

(Added 1989)

UR.2.5. Use of Auxiliary Heated Vaporizer Systems. – Automatic temperature compensation shall be used on hydrocarbon gas vapor meters equipped with an auxiliary heated vaporizer system unless there is sufficient length of underground piping to provide gas at a uniform temperature to the meter inlet. When required by weights and measures officials, a thermometer well (appropriately protected against freezing) shall be installed immediately up-stream of the meter.

(Added 1990)

Table 2M. Corrections for Altitude, Metric Units

Elevation (meters)	Altitude Correction Factor: 2.74 kPa Gauge Pressure	Altitude Correction Factor: 1.74 kPa Gauge Pressure	Altitude Correction Factor (kPa)	Assumed Atmospheric Pressure Plus Gauge Pressure : 2.74 kPa	Assumed Atmospheric Pressure Plus Gauge Pressure : 1.74 kPa
-50 to 120	1.02	1.01	100.85	103.59	102.58
Above 120 to 300	1.00	0.99	98.82	101.56	100.54
Above 300 to 470	0.98	0.97	96.79	99.53	98.51
Above 470 to 650	0.96	0.95	94.76	97.50	96.48
Above 650 to 830	0.94	0.93	92.73	95.47	94.45
Above 830 to 1020	0.92	0.91	90.70	93.44	92.42
Above 1020 to 1210	0.90	0.89	88.66	91.40	90.39
Above 1210 to 1400	0.88	0.87	86.63	89.37	88.36
Above 1400 to 1590	0.86	0.85	84.60	87.34	86.33
Above 1590 to 1790	0.84	0.83	82.57	85.31	84.29
Above 1790 to 2000	0.82	0.81	80.54	83.28	82.26
Above 2000 to 2210	0.80	0.79	78.51	81.25	80.23
Above 2210 to 2420	0.78	0.77	76.48	79.22	78.20
Above 2420 to 2640	0.76	0.75	74.45	77.19	76.17
Above 2640 to 2860	0.74	0.73	72.41	75.15	74.15
Above 2860 to 3080	0.72	0.71	70.38	73.12	72.12
Above 3080 to 3320	0.70	0.69	68.35	71.09	70.08
Above 3320 to 3560	0.68	0.67	66.32	69.06	68.05
Above 3560 to 3800	0.66	0.65	64.29	67.03	66.01
Above 3800 to 4050	0.64	0.63	62.26	65.00	63.98
Above 4050 to 4310	0.62	0.61	60.23	62.97	61.95
Above 4310 to 4580	0.60	0.59	58.20	60.94	59.92

Table 2. Corrections for Altitude, U.S. Customary Units

Elevation (feet)	Altitude Correction Factor: 11 inch WC	Altitude Correction Factor: 7 inch WC	Assumed Atmospheric Pressure (psia)	Assumed Atmospheric Pressure Plus Gauge Pressure: 11 inch WC (psia)	Assumed Atmospheric Pressure Plus Gauge Pressure: 7 inch WC (psia)
-150 to 400	1.02	1.01	14.64	15.04	14.89
Above 400 to 950	1.00	0.99	14.35	14.74	14.60
Above 950 to 1,550	0.98	0.97	14.05	14.45	14.30
Above 1,550 to 2,100	0.96	0.95	13.76	14.15	14.01
Above 2,100 to 2,700	0.94	0.93	13.46	13.86	13.71
Above 2,700 to 3,300	0.92	0.91	13.17	13.56	13.42
Above 3,300 to 3,950	0.90	0.89	12.87	13.27	13.12
Above 3,950 to 4,550	0.88	0.87	12.58	12.97	12.83
Above 4,550 to 5,200	0.86	0.85	12.28	12.68	12.53
Above 5,200 to 5,850	0.84	0.83	11.99	12.38	12.24
Above 5,850 to 6,500	0.82	0.81	11.69	12.09	11.94
Above 6,500 to 7,200	0.80	0.79	11.40	11.79	11.65
Above 7,200 to 7,900	0.78	0.77	11.10	11.50	11.35
Above 7,900 to 8,600	0.76	0.75	10.81	11.20	11.06
Above 8,600 to 9,350	0.74	0.73	10.51	10.91	10.76
Above 9,350 to 10,100	0.72	0.71	10.22	10.61	10.47
Above 10,100 to 10,850	0.70	0.69	9.92	10.32	10.17
Above 10,850 to 11,650	0.68	0.67	9.63	10.03	9.88
Above 11,650 to 12,450	0.66	0.65	9.33	9.73	9.58
Above 12,450 to 13,250	0.64	0.63	9.04	9.44	9.29
Above 13,250 to 14,100	0.62	0.61	8.75	9.14	9.00
Above 14,100 to 14,950	0.60	0.59	8.45	8.85	8.70

Table of Contents

	Page
Section 3.34. Cryogenic Liquid-Measuring Devices	3-83
A. Application	3-83
A.1. General.	3-83
A.2. Exceptions.....	3-83
A.3. Additional Code Requirements.....	3-83
S. Specifications	3-83
S.1. Design of Indicating and Recording Elements and of Recorded Representations.....	3-83
S.1.1. Primary Elements.	3-83
S.1.2. Graduations.	3-84
S.1.3. Indicators.	3-85
S.1.4. Computing-Type Device.	3-86
S.2. Design of Measuring Elements.....	3-86
S.2.1. Air/Vapor Elimination.	3-86
S.2.2. Directional Flow Valves.....	3-86
S.2.3. Maintenance of Liquid State.	3-86
S.2.4. Automatic Temperature or Density Compensation.	3-86
S.2.5. Provision for Sealing.	3-87
S.3. Design of Discharge Lines and Discharge Line Valves.	3-88
S.3.1. Diversion of Measured Liquid.	3-89
S.3.2. Discharge Hose.	3-89
S.4. Marking Requirements.	3-89
S.4.1. Limitation of Use.	3-89
S.4.2. Discharge Rates.	3-89
S.4.3. Temperature or Density Compensation.	3-89
N. Notes	3-89
N.1. Test Liquid.....	3-89
N.2. Vaporization and Volume Change.....	3-89
N.3. Test Drafts.....	3-89
N.3.1. Gravimetric Test.	3-89
N.3.2. Transfer Standard Test.....	3-89
N.4. Density.	3-90
N.5. Testing Procedures.	3-91
N.5.1. Normal Tests.	3-91
N.5.2. Special Tests.	3-91
N.5.3. Repeatability Tests	3-91

N.6. Temperature Correction.	3-91
N.7. Automatic Temperature or Density Compensation.....	3-91
T. Tolerances	3-92
T.1. Application.....	3-92
T.1.1. To Underregistration and to Overregistration.....	3-92
T.2. Tolerance Values.	3-92
T.3. On Tests Using Transfer Standards.	3-92
T.4. Repeatability.....	3-92
UR. User Requirements.....	3-92
UR.1. Installation Requirements.	3-92
UR.1.1. Discharge Rate.	3-92
UR.1.2. Length of Discharge Hose.	3-92
UR.1.3. Maintenance of Liquid State.	3-92
UR.2. Use Requirements.	3-93
UR.2.1. Return of Indicating and Recording Elements to Zero.	3-93
UR.2.2. Condition of Discharge System.....	3-93
UR.2.3. Vapor Return Line.....	3-93
UR.2.4. Drainage of Discharge Line.	3-93
UR.2.5. Conversion Factors.....	3-93
UR.2.6. Temperature or Density Compensation.	3-94
UR.2.7. Pressure of Tanks with Volumetric Metering Systems without Temperature Compensation.....	3-94

Section 3.34. Cryogenic Liquid-Measuring Devices

A. Application

A.1. General. – This code applies to devices used for the measurement of cryogenic liquids such as, but not limited to oxygen, nitrogen, hydrogen, and argon.

(Amended 1986 and 1995)

A.2. Exceptions. – This code does not apply to the following:

(a) Devices used for dispensing liquefied petroleum gases (for which see Section 3.32. Code for Liquefied Petroleum Gas and Anhydrous Ammonia Liquid-Measuring Devices).

(b) Devices used solely for dispensing a product in connection with operations in which the amount dispensed does not affect customer charges.

(c) Devices used solely for dispensing liquefied natural gas.

(d) Mass flow meters. (Also see Section 3.37. Code for Mass Flow Meters.)

(Added 1994)

A.3. Additional Code Requirements. – In addition to the requirements of this code, Cryogenic Liquid- Measuring Devices shall meet the requirements of Section 1.10. General Code.

S. Specifications

S.1. Design of Indicating and Recording Elements and of Recorded Representations.

S.1.1. Primary Elements.

S.1.1.1. General. – A device shall be equipped with a primary indicating element and may also be equipped with a primary recording element.

S.1.1.2. Units. – A device shall indicate and record, if equipped to record, its deliveries in terms of: kilograms or pounds; liters or gallons of liquid at the normal boiling point of the specific cryogenic product; cubic meters (cubic feet) of gas at a normal temperature of 21 °C (70 °F) and an absolute pressure of 101.325 kPa (14.696 psia); or decimal subdivisions or multiples of the measured units cited above.

(Amended 2002)

S.1.1.3. Value of Smallest Unit. – The value of the smallest unit of indicated delivery, and recorded delivery, if the device is equipped to record, shall not exceed the equivalent of:

(a) for small delivery devices:

- (1) 1 L;
- (2) 0.1 gal;
- (3) 1 kg;
- (4) 1 lb;
- (5) 0.1 m³ of gas; or
- (6) 10 ft³ of gas.

(b) for large delivery devices:

- (1) 10 L;
- (2) 1 gal;
- (3) 10 kg;
- (4) 10 lb;
- (5) 1 m³ of gas; or
- (6) 100 ft³ of gas.

(Amended 2002)

S.1.1.4. Advancement of Indicating and Recording Elements. – Primary indicating and recording elements shall be susceptible to advancement only by the normal operation of the device. However, a device may be cleared by advancing its elements to zero, but only if:

- (a) the advancing movement, once started, cannot be stopped until zero is reached;
or
- (b) in the case of indicating elements only, such elements are automatically obscured until the elements reach the correct zero position.

S.1.1.5. Return to Zero. – Primary indicating and recording elements shall be readily returnable to a definite zero indication. Means shall be provided to prevent the return of primary indicating elements and of primary recording elements beyond their correct zero position.

S.1.2. Graduations.

S.1.2.1. Length. – Graduations shall be so varied in length that they may be conveniently read.

S.1.2.2. Width. – In any series of graduations, the width of a graduation shall in no case be greater than the width of the minimum clear interval between graduations, and the width of main graduations shall be not more than 50 % greater than the width of subordinate graduations. Graduations shall in no case be less than 0.2 mm (0.008 in) in width.

S.1.2.3. Clear Interval Between Graduations. – The clear interval shall be no less than 1.0 mm (0.04 in). If the graduations are not parallel, the measurement shall be made:

- (a) along the line of relative movement between the graduations at the end of the indicator; or
- (b) if the indicator is continuous, at the point of widest separation of the graduations.

(Also see S.1.3.6. Travel of Indicator.)

S.1.3. Indicators.

S.1.3.1. Symmetry. – The index of an indicator shall be symmetrical with respect to the graduations, at least throughout that portion of its length associated with the graduations.

S.1.3.2. Length. – The index of an indicator shall reach to the finest graduations with which it is used, unless the indicator and the graduations are in the same plane, in which case the distance between the end of the indicator and the ends of the graduations, measured along the line of the graduations, shall be not more than 1.0 mm (0.04 in).

S.1.3.3. Width. – The width of the index of an indicator in relation to the series of graduations with which it is used shall be not greater than the:

- (a) *width of the narrowest graduation,* and*
*[*Nonretroactive as of January 1, 2002]*
(Amended 2001)

- (b) width of the minimum clear interval between graduations.

When the index of an indicator extends along the entire length of a graduation, that portion of the index of the indicator that may be brought into coincidence with the graduation shall be of the same width throughout the length of the index that coincides with the graduation.
(Amended 2001)

S.1.3.4. Clearance. – The clearance between the index of an indicator and the graduations shall in no case be more than 1.5 mm (0.06 in).

S.1.3.5. Parallax. – Parallax effect shall be reduced to the practicable minimum.

S.1.3.6. Travel of Indicator. – If the most sensitive element of the primary indicating element uses an indicator and graduations, the relative movement of these parts corresponding to the smallest indicated value shall be not less than 0.5 mm (0.20 in).

S.1.4. Computing-Type Device.

S.1.4.1. Printed Ticket. – Any printed ticket issued by a device of the computing type on which there is printed the total computed price shall have printed clearly thereon also the total quantity of the delivery and the price per unit.

S.1.4.2. Money-Value Computations. – Money-value computations shall be of the full-computing type in which the money-value at a single unit price, or at each of a series of unit prices, shall be computed for every delivery within either the range of measurement of the device or the range of the computing elements, whichever is less. Value graduations shall be supplied and shall be accurately positioned. The total price shall be computed on the basis of the quantity indicated when the value of the smallest division indicated is equal to or less than the values specified in S.1.1.3. Value of Smallest Unit.

S.1.4.3. Money-Values, Mathematical Agreement. – Any digital money-value indication and any recorded money-value on a computing type device shall be in mathematical agreement with its associated quantity indication or representation to within 1 cent of money-value.

S.2. Design of Measuring Elements.

S.2.1. Air/Vapor Elimination. – A measuring system shall be equipped with an effective air/vapor eliminator or other automatic means to prevent the passage of air/vapor through the meter. Vent lines from the air/vapor eliminator shall be made of appropriate non-collapsible material. (Also see Section T. Tolerances.)

(Amended 2018)

S.2.2. Directional Flow Valves. – A valve or valves or other effective means, automatic in operation, to prevent the reversal of flow shall be installed in or adjacent to the measuring device.

(Amended 1978)

S.2.3. Maintenance of Liquid State. – A device shall be so designed that the product being measured will remain in a liquid state during passage through the device.

S.2.4. Automatic Temperature or Density Compensation. – A device shall be equipped with automatic means for adjusting the indication and/or recorded representation of the measured quantity of the product, to indicate and/or record in terms of: kilograms or pounds; or liters or gallons of liquid at the normal boiling point of the specific cryogenic product; or the equivalent cubic meters (cubic feet) of gas at a normal temperature of 21 °C (70 °F) and an absolute pressure of 101.325 kPa (14.696 lb/in² absolute). *When a compensator system malfunctions, the indicating and recording elements may indicate and*

*record in uncompensated volume if the mode of operation is clearly indicated, e.g., by a marked annunciator, recorded statement, or other obvious means.**

*[*Nonretroactive as of January 1, 1992]*

(Amended 1991 and 2002)

S.2.5. Provision for Sealing. – For devices or systems in which the configuration or calibration parameters can be changed by use of a removable digital storage device, security shall be provided for those parameters as specified in G-S.8.2. Devices and Systems Adjusted Using Removable Digital Storage Devices. For parameters adjusted using other means, the following applies.

Adequate provision shall be made for an approved means of security (e.g., data change audit trail) or for physically applying a security seal in such a manner that requires the security seal to be broken before an adjustment or interchange can be made of:

- (a) any measuring or indicating element;
- (b) any adjustable element for controlling delivery rate when such rate tends to affect the accuracy of deliveries;
- (c) any automatic temperature or density compensating system; and
- (d) any metrological parameter that will affect the metrological integrity of the device or system.

When applicable, any adjusting mechanism shall be readily accessible for purposes of affixing a security seal.

*Audit trails shall use the format set forth in Table S.2.5. Categories of Device and Methods of Sealing.**

*[*Nonretroactive as of January 1, 1995]*

(Amended 2006 and 2019)

Table S.2.5. Categories of Device and Methods of Sealing

Categories of Device	Methods of Sealing
<p>Category 1: No remote configuration capability.</p>	<p>Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.</p>
<p>Category 2: Remote configuration capability, but access is controlled by physical hardware.</p> <p>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.</p>	<p>The hardware enabling access for remote communication must be on-site. The hardware must be sealed using a physical seal or an event counter for calibration parameters and an event counter for configuration parameters. The event counters may be located either at the individual measuring device or at the system controller; however, an adequate number of counters must be provided to monitor the calibration and configuration parameters of the individual devices at a location. If the counters are located in the system controller rather than at the individual device, means must be provided to generate a hard copy of the information through an on-site device.</p>
<p>Category 3: Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password).</p> <p>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.</p>	<p>An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. A printed copy of the information must be available on demand through the device or through another on-site device. The information may also be available electronically. The event logger shall have a capacity to retain records equal to 10 times the number of sealable parameters in the device, but not more than 1000 records are required. (Note: Does not require 1000 changes to be stored for each parameter.)</p>

[Nonretroactive as of January 1, 1995]

(Table Added 2006) (Amended 2016)

S.3. Design of Discharge Lines and Discharge Line Valves.

S.3.1. Diversion of Measured Liquid. – No means shall be provided by which any measured liquid can be diverted from the measuring chamber of the device or the discharge line therefrom, except that a manually controlled outlet that may be opened for purging or draining the measuring system shall be permitted. Effective means shall be provided to prevent the passage of liquid through any such outlet during normal operation of the device and to indicate clearly and unmistakably when the valve controls are so set as to permit passage of liquid through such outlet.

S.3.2. Discharge Hose. – The discharge hose of a measuring system shall be of the completely draining dry-hose type.

S.4. Marking Requirements.

S.4.1. Limitation of Use. – If a measuring system is intended to measure accurately only liquids having particular properties, or to measure accurately only under specific installation or operating conditions, or to measure accurately only when used in conjunction with specific accessory equipment, these limitations shall be clearly and permanently marked on the device.

S.4.2. Discharge Rates. – A meter shall be marked to show its designed maximum and minimum discharge rates.

S.4.3. Temperature or Density Compensation. – Devices equipped with an automatic temperature or density compensator, shall be clearly and conspicuously marked on the primary indicating elements, recording elements, and recorded representations to show that the quantity delivered has been adjusted to the conditions specified in S.2.4. Automatic Temperature or Density Compensation.

N. Notes

N.1. Test Liquid. – A meter shall be tested with the liquid to be commercially measured except that, in a type evaluation examination, nitrogen may be used.

N.2. Vaporization and Volume Change. – Care shall be exercised to reduce to a minimum vaporization and volume changes. When testing by weight, the weigh tank and transfer systems shall be pre-cooled to liquid temperature prior to the start of the test to avoid the venting of vapor from the vessel being weighed.

N.3. Test Drafts.

N.3.1. Gravimetric Test. – Weight test drafts shall be equal to at least the amount delivered by the device in 2 minutes at its maximum discharge rate, and shall in no case be less than 907 kg (2000 lb).

N.3.2. Transfer Standard Test. – When comparing a meter with a calibrated transfer standard, the test draft shall be equal to at least the amount delivered by the device in

two minutes at its maximum discharge rate, and shall in no case be less than 180 L (50 gal) or equivalent thereof. When testing uncompensated volumetric meters in a continuous recycle mode, appropriate corrections shall be applied if product conditions are abnormally affected by this test mode.

(Amended 1976)

N.4. Density. – Temperature and pressure of the metered test liquid shall be measured during the test for the determination of density or volume correction factors when applicable. For Liquid Density and Volume Correction Factors (with respect to temperature and pressure) the publications shown in Table N.4. Density or Volume Correction Factors shall apply.

(Amended 1986 and 2004)

Table N.4. Density or Volume Correction Factors

Cryogenic Liquid	Publication
Argon	Tegeler, Ch., Span, R., Wagner, W. "A New Equation of State for Argon Covering the Fluid Region for Temperatures from the Melting Line to 700 K at Pressures up to 1000 Mpa." <i>J. Phys. Chem. Ref. Data</i> , 28(3):779-850, 1999.
Ethylene	Smukala, J., Span, R., Wagner, W. "New Equation of State for Ethylene Covering the Fluid Region for Temperatures from the Melting Line to 450 k at Pressures up to 300 Mpa." <i>J. Phys. Chem. Ref. Data</i> , 29(5):1053-1122, 2000.
Nitrogen	Span, R., Lemmon, E.W., Jacobsen, R.T, Wagner, W., and Yokozeki, A. "A Reference Thermodynamic Property Formulation for Nitrogen." <i>J. Phys. Chem. Ref. Data</i> , Volume 29, Number 6, pp. 1361-1433, 2000.
Oxygen	Schmidt, R., Wagner, W. "A New Form of the Equation of State for Pure Substances and its Application to Oxygen." <i>Fluid Phase Equilib.</i> , 19:175-200, 1985
Hydrogen	Leachman, J. W., Jacobsen, R. T., Lemmon, E.W., and Penoncello, S.G. "Fundamental Equations of State for Parahydrogen, Normal Hydrogen, and Orthohydrogen" <i>J. Phys. Chem. Ref. Data</i> , Volume 38, Number 3, pp. 565, 2009.

Note: A complete database program containing all of the most recent equations for calculating density for various cryogenic liquids is available in "NIST Reference Fluid Thermodynamic and Transport Properties Database (REFPROP)" at www.nist.gov/srd. There is a fee for download of this database.

(Added 2004)

N.5. Testing Procedures.

N.5.1. Normal Tests. – The “normal” tests of a device shall be made over a range of discharge rates that may be anticipated under the conditions of installation.

N.5.2. Special Tests. – Any test except as set forth in N.5.1. Normal Tests shall be considered a “special” test. Tests shall be conducted, if possible, to evaluate any special elements or accessories attached to or associated with the device. A device shall be tested at a minimum discharge rate of:

- (a) 50 % of the maximum discharge rate developed under the conditions of installation, or the minimum discharge rate marked on the device, whichever is less; or
- (b) the lowest discharge rate practicable under conditions of installation.

Special tests may be conducted to develop any characteristics of the device that are not normally anticipated under the conditions of installation.

N.5.3. Repeatability Tests. – Tests for repeatability should include a minimum of three consecutive test drafts of approximately the same size and be conducted under controlled conditions where variations in factors such as temperature, pressure, and flow rate are reduced to the extent that they will not affect the results obtained. When conducting the tests, the discharge rates shall be within the minimum and maximum discharge rates as marked by the manufacturer. For devices equipped with an automatic temperature or density compensator, results shall be based on either:

- (1) all runs conducted with the compensated (net) volume (e.g., with the temperature or density compensator activated); or
- (2) all runs conducted with the uncompensated (gross) volume (e.g., with the temperature or density compensator deactivated).

(Amended 2019)

N.6. Temperature Correction. – Corrections shall be made for any changes in volume resulting from the differences in liquid temperature between time of passage through the meter and time of volumetric determination of test draft.

N.7. Automatic Temperature or Density Compensation. – When a device is equipped with an automatic temperature or density compensator, the compensator shall be tested by comparing the quantity indicated or recorded by the device (with the compensator connected and operating) with the actual delivered quantity corrected to the normal boiling point of the cryogenic product being measured or to the normal temperature and pressure as applicable.

T. Tolerances

T.1. Application.

T.1.1. To Underregistration and to Overregistration. – The tolerances hereinafter prescribed shall be applied to errors of underregistration and errors of overregistration.

T.2. Tolerance Values. – The maintenance and acceptance tolerances for normal and special tests shall be as shown in Table T.2. Accuracy Classes and Tolerances for Cryogenic Liquid-Measuring Devices.

(Amended 2003)

Table T.2. Accuracy Classes and Tolerances for Cryogenic Liquid-Measuring Devices

Accuracy Class	Application	Acceptance Tolerance	Maintenance Tolerance	Special Test Tolerance
2.5	Cryogenic products; liquefied compressed gases other than liquid carbon dioxide	1.5 %	2.5 %	2.5 %

(Added 2003)

T.3. On Tests Using Transfer Standards. – To the basic tolerance values that would otherwise be applied, there shall be added an amount equal to two times the standard deviation of the applicable transfer standard when compared to a basic reference standard.

(Added 1976)

T.4. Repeatability. – When multiple tests are conducted at approximately the same flow rate and draft size, the range of the test results for the flow rate shall not exceed 40 % of the absolute value of the maintenance tolerance and the results of each test shall be within the applicable tolerance. Also see N.5.3. Repeatability Tests.

(Added 2001) (Amended 2019)

UR. User Requirements

UR.1. Installation Requirements.

UR.1.1. Discharge Rate. – A device shall be so installed that the actual maximum discharge rate will not exceed the rated maximum discharge rate. If necessary, means for flow regulation shall be incorporated in the installation.

UR.1.2. Length of Discharge Hose. – The discharge hose shall be of such a length and design as to keep vaporization of the liquid to a minimum.

UR.1.3. Maintenance of Liquid State. – A device shall be so installed and operated that the product being measured shall remain in the liquid state during passage through the meter.

UR.2. Use Requirements.

UR.2.1. Return of Indicating and Recording Elements to Zero. – The primary indicating elements (visual) and the primary recording elements shall be returned to zero immediately before each delivery.

UR.2.2. Condition of Discharge System. – The discharge system, up to the measuring element, shall be precooled to liquid temperatures before a “zero” condition is established prior to the start of a commercial delivery.

UR.2.3. Vapor Return Line. – A vapor return line shall not be used during a metered delivery.

(Amended 1976)

UR.2.4. Drainage of Discharge Line. – On a dry-hose system, upon completion of a delivery, the vendor shall leave the discharge line connected to the receiving container with the valve adjacent to the meter in the closed position and the valve at the discharge line outlet in the open position for a period of at least:

- (a) 1 minute for small delivery devices; and
- (b) 3 minutes for large delivery devices

to allow vaporization of some product in the discharge line to force the remainder of the product in the line to flow into the receiving container.

(Amended 1976)

UR.2.5. Conversion Factors. – Established conversion values (Also see references in Table N.4. Density or Volume Correction Factors.) shall be used whenever metered liquids are to be billed in terms of:

- (a) kilograms or pounds based on a meter indication of liters, gallons, cubic meters of gas, or cubic feet of gas;
- (b) cubic meters or cubic feet of gas based on a meter indication of liters or gallons, kilograms, or pounds; or
- (c) liters or gallons based on a meter indication of kilograms or pounds, cubic meters of gas or cubic feet of gas.

All sales of cryogenics shall be based on either kilograms or pounds, liters or gallons of liquid at NBP,¹ cubic meters of gas or cubic feet of gas at NTP¹.

(Amended 1986)

¹ See Appendix D, Definitions.

UR.2.6. Temperature or Density Compensation.

UR.2.6.1. Use of Automatic Temperature or Density Compensators. – If a device is equipped with an automatic temperature or density compensator, this shall be connected, operable, and in use at all times. Such automatic temperature or density compensator may not be removed, nor may a compensated device be replaced with an uncompensated device, without the written approval of the weights and measures authority having jurisdiction over the device.

UR.2.6.2. Tickets or Invoices. – Any written invoice or printed ticket based on a reading of a device that is equipped with an automatic temperature or density compensator shall have shown thereon that the quantity delivered has been adjusted to the quantity at the NBP of the specific cryogenic product or the equivalent volume of gas at NTP.

UR.2.6.3. Printed Ticket. – Any printed ticket issued by a device of the computing type on which there is printed the total computed price, the total quantity of the delivery, or the price per unit, shall also show the other two values (either printed or in clear hand script).

UR.2.6.4. Ticket in Printing Device. – A ticket shall not be inserted into a device equipped with a ticket printer until immediately before a delivery is begun, and in no case shall a ticket be in the device when the vehicle is in motion while on a public street, highway, or thoroughfare.

UR.2.7. Pressure of Tanks with Volumetric Metering Systems without Temperature Compensation. – When the saturation pressure of the product in the vendor's tank exceeds 240 kPa (35 psia), a correction shall be applied to the written invoice or printed ticket using the appropriate tables as listed in Table N.4. Density or Volume Correction Factors; or the saturation pressure shall be reduced to 207 kPa (30 psia) (if this can be safely accomplished) prior to making a delivery.

(Added 1976)

Table of Contents

	Page
Section 3.35. Milk Meters	3-95
A. Application	3-95
A.1. General.	3-95
A.2. Exceptions.....	3-95
A.3. Additional Code Requirements.....	3-95
S. Specifications	3-95
S.1. Design of Indicating and Recording Elements and of Recorded Representations.....	3-97
S.1.1. Primary Elements.	3-95
S.1.2. Graduations.	3-96
S.1.3. Indicators.	3-96
S.1.4. Computing-Type Devices.....	3-97
S.2. Design of Measuring Elements.....	3-98
S.2.1. Air/Vapor Elimination.	3-98
S.2.2. Maintaining Flooded Condition.	3-98
S.2.3. Provision for Sealing.....	3-98
S.2.4. Directional Flow Valves.....	3-99
S.3. Design of Intake Lines.....	3-99
S.3.1. Diversion of Liquid to be Measured.	3-99
S.3.2. Intake Hose.....	3-100
S.4. Marking Requirements.	3-100
S.4.1. Limitation of Use.	3-100
S.4.2. Discharge Rates.	3-100
S.4.3. Measuring Components.....	3-100
S.4.4. Flood Volume.....	3-100
S.4.5. Conversion Factor.	3-100
N. Notes	3-100
N.1. Test Liquid.....	3-100
N.2. Evaporation and Volume Change.....	3-101
N.2.1. Temperature Correction.....	3-101
N.3. Test Drafts.....	3-101
N.4. Testing Procedures.	3-101
N.4.1. Normal Tests.	3-101
N.4.2. Special Tests.	3-101
N.4.3. System Capacity.....	3-101
N.4.4. Repeatability Tests	3-101
T. Tolerances	3-101
T.1. Application.....	3-101
T.1.1. To Underregistration and to Overregistration.....	3-101
T.2. Tolerance Values.	3-102

T.3. Repeatability.....	3-102
UR. User Requirements.....	3-102
UR.1. Installation Requirements.	3-102
UR.1.1. Plumb and Level Condition.	3-102
UR.1.2. Discharge Rate.	3-102
UR.1.3. Unit Price.	3-102
UR.1.4. Intake Hose.....	3-102
UR.2. Use Requirements.	3-103
UR.2.1. Return of Indicating and Recording Elements to Zero.	3-103
UR.2.2. Printed Ticket.....	3-103
UR.2.3. Ticket in Printing Device.	3-103
UR.2.4. Credit for Flood Volume.....	3-103

Section 3.35. Milk Meters

A. Application

A.1. General. – This code applies to devices used for the measurement of milk; generally applicable to, but not limited to, meters used in dairies, milk processing plants, and cheese factories, to measure incoming bulk milk.

A.2. Exceptions. – This code does not apply to mass flow meters. (Also see Section 3.37. Code for Mass Flow Meters.)

(Added 1994)

A.3. Additional Code Requirements. – In addition to the requirements of this code, Milk Meters shall meet the requirements of Section 1.10. General Code.

S. Specifications

S.1. Design of Indicating and Recording Elements and of Recorded Representations.

S.1.1. Primary Elements.

S.1.1.1. General. – A meter shall be equipped with a primary indicating element and may also be equipped with a primary recording element.

S.1.1.2. Units.

- (a) A meter shall indicate, and record if the meter is equipped to record, its deliveries in terms of liters or gallons. Fractional parts of the liter shall be in terms of decimal subdivisions. Fractional parts of the gallon shall be in terms of either decimal or binary subdivisions.
- (b) When it is an industry practice to purchase and sell milk by weight based upon 1.03 kg/L (8.6 lb/gal), the primary indicating element may indicate in kilograms or pounds. The weight value division shall be a decimal multiple or submultiple of 1, 2, or 5. Fractional parts of the kilogram or pound shall be in decimal subdivisions. (Also see S.4.5. Conversion Factor.)

S.1.1.3. Value of Smallest Unit. – The value of the smallest unit of indicated quantity and recorded quantity, if the meter is equipped to record, shall not exceed the equivalent of:

- (a) 0.5 L or 0.5 kg (1 pt or 1 lb) when measuring quantities less than or equal to 4000 L or 4000 kg (1000 gal or 8600 lb); or
- (b) 5 L or 5 kg (1 gal or 10 lb) when measuring quantities in excess of 4000 L or 4000 kg (1000 gal or 8600 lb).

(Amended 1989)

S.1.1.4. Advancement of Indicating and Recording Elements. – Primary indicating and recording elements shall be susceptible to advancement only by the mechanical operation of the meter. However, a meter may be cleared by advancing its elements to zero, but only if:

- (a) the advancing movement, once started, cannot be stopped until zero is reached;
or
- (b) in the case of indicating elements only, such elements are automatically obscured until the elements reach the correct zero position.

S.1.1.5. Return to Zero. – Primary indicating elements and primary recording elements, if the device is equipped to record, shall be readily returnable to a definite zero indication. Means shall be provided to prevent the return of the primary indicating elements and the primary recording elements, if the device is so equipped, beyond their correct zero position.

S.1.1.6. Indication of Measurement. – A meter shall be constructed to show automatically its initial zero condition and the volume measured up to the nominal capacity of the device.

S.1.2. Graduations.

S.1.2.1. Length. – Graduations shall be so varied in length that they may be conveniently read.

S.1.2.2. Width. – In any series of graduations, the width of a graduation shall in no case be greater than the width of the minimum clear interval between graduations, and the width of main graduations shall be not more than 50 % greater than the width of subordinate graduations. Graduations shall in no case be less than 0.2 mm (0.008 in) in width.

S.1.2.3. Clear Interval between Graduations. – The clear interval shall be not less than 1.0 mm (0.04 in). If the graduations are not parallel, the measurement shall be made:

- (a) along the line of relative movement between the graduations at the end of the indicator; or
- (b) if the indicator is continuous, at the point of widest separation of the graduations.

S.1.3. Indicators.

S.1.3.1. Symmetry. – The index of an indicator shall be symmetrical with respect to the graduations, at least throughout that portion of its length associated with the graduations.

S.1.3.2. Length. – The index of an indicator shall reach to the finest graduations with which it is used, unless the indicator and the graduations are in the same plane, in which case the distance between the end of the indicator and the ends of the graduations, measured along the line of graduations, shall be not more than 1.0 mm (0.04 in).

S.1.3.3. Width. – The width of the index of an indicator in relation to the series of graduations with which it is used shall be not greater than:

(a) *the width of the narrowest graduation;* and*
[*Nonretroactive as of January 1, 2002]
(Amended 2001)

(b) the width of the minimum clear interval between graduations.

When the index of an indicator extends along the entire length of a graduation, that portion of the index of the indicator that may be brought into coincidence with the graduation shall be of the same width throughout the length of the index that coincides with the graduation.

S.1.3.4. Clearance. – The clearance between the index of an indicator and the graduations shall in no case be more than 1.5 mm (0.06 in).

S.1.3.5. Parallax. – Parallax effects shall be reduced to the practicable minimum.

S.1.3.6. Travel of Indicator. – If the most sensitive element of the primary indicating element utilizes an indicator and graduations, the relative movement of these parts corresponding to the smallest indicated value shall be not less than 5 mm (0.20 in).

S.1.4. Computing-Type Devices.

S.1.4.1. Display of Unit Price. – In a device of the computing type, means shall be provided for displaying on the outside of the device, and in close proximity to the display of the total computed price, the price per unit at which the device is set to compute.

S.1.4.2. Printed Ticket. – If a computing-type device issues a printed ticket which displays the total computed price, the ticket also shall have printed clearly thereon the total quantity of the delivery, the appropriate fraction of the quantity, and the price per unit of quantity.

(Amended 1989)

S.1.4.3. Money-Value Computations. – Money-value computations shall be of the full-computing type in which the money-value at a single unit price, or at each of a series of unit prices, shall be computed for every delivery within either the range of measurement of the device or the range of the computing elements, whichever is less. Value graduations shall be supplied and shall be accurately positioned. The value of each graduated interval shall be 1 cent.

S.1.4.4. Money-Values, Mathematical Agreement. – Any digital money-value indication and any recorded money-value on a computing-type device shall be in mathematical agreement with its associated quantity indicating or representation to within 1 cent of money-value.

S.2. Design of Measuring Elements.

S.2.1. Air/Vapor Elimination. – A measuring system shall be equipped with an effective air/vapor eliminator or other automatic means to prevent the passage of air/vapor through the meter. Vent lines from the air/vapor eliminator shall be made of appropriate non-collapsible material.

(Amended 2017)

S.2.2. Maintaining Flooded Condition. – The vent on the vapor eliminator shall be positioned or installed in such a manner that the vapor eliminator cannot easily be emptied between uses.

S.2.3. Provision for Sealing. – For devices and systems in which the configuration or calibration parameters can be changed by use of a removable digital storage device, security shall be provided for those parameters as specified in G-S.8.2. Devices and Systems Adjusted Using Removable Digital Storage Devices. For parameters adjusted using other means, the following applies.

Adequate provision shall be made for an approved means of security (e.g., data change audit trail) or for physically applying a security seal in such a manner that requires the security seal to be broken before an adjustment or interchange can be made of any:

- (a) measuring element or indicating element;
- (b) adjustable element for controlling delivery rate, when such rate tends to affect the accuracy of deliveries; and
- (c) metrological parameter that will affect the metrological integrity of the device or system.

When applicable, the adjusting mechanism shall be readily accessible for purposes of affixing a security seal.

*Audit trails shall use the format set forth in Table S.2.3. Categories of Device and Methods of Sealing.**

*[*Nonretroactive as of January 1, 1995]*

(Amended 2006 and 2019)

Table S.2.3. Categories of Device and Methods of Sealing

Categories of Device	Methods of Sealing
<p>Category 1: No remote configuration capability.</p>	<p><i>Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.</i></p>
<p>Category 2: Remote configuration capability, but access is controlled by physical hardware.</p> <p><i>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.</i></p>	<p><i>The hardware enabling access for remote communication must be on-site. The hardware must be sealed using a physical seal or an event counter for calibration parameters and an event counter for configuration parameters. The event counters may be located either at the individual measuring device or at the system controller; however, an adequate number of counters must be provided to monitor the calibration and configuration parameters of the individual devices at a location. If the counters are located in the system controller rather than at the individual device, means must be provided to generate a hard copy of the information through an on-site device.</i></p>
<p>Category 3: Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password).</p> <p><i>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.</i></p>	<p><i>An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. A printed copy of the information must be available on demand through the device or through another on-site device. The information may also be available electronically. The event logger shall have a capacity to retain records equal to 10 times the number of sealable parameters in the device, but not more than 1000 records are required. (Note: Does not require 1000 changes to be stored for each parameter.)</i></p>

[Nonretroactive as of January 1, 1995]

(Table Added 2006) (Amended 2016)

S.2.4. Directional Flow Valves. – Valves intended to prevent reversal of flow shall be automatic in operation.

S.3. Design of Intake Lines.

S.3.1. Diversion of Liquid to be Measured. – No means shall be provided by which any liquid can be diverted from the supply tank to the receiving tank without being measured by the device. A manually controlled outlet that may be opened for purging or draining the measuring system shall be permitted. Effective means shall be provided to prevent passage of liquid through any such outlet during normal operation of the measuring system. (Amended 1994)

S.3.2. Intake Hose. – The intake hose shall be:

- (a) of the dry-hose type;
- (b) adequately reinforced;
- (c) not more than 6 m (20 ft) in length unless it can be demonstrated that a longer hose is essential to permit transfer from a supply tank; and
- (d) connected to the pump at horizontal or above to permit complete drainage of the hose.

(Amended 1991)

S.4. Marking Requirements.

S.4.1. Limitation of Use. – If a meter is intended to measure accurately only liquids having particular properties, or to measure accurately only under specific installation or operating conditions, or to measure accurately only when used in conjunction with specific accessory equipment, these limitations shall be clearly and permanently stated on the meter.

S.4.2. Discharge Rates. – A meter shall be marked to show its designed maximum and minimum discharge rates. The marked minimum discharge rate shall not exceed 20 % of the marked maximum discharge rate.

Note: Also see example in Section 3.30. Liquid-Measuring Devices Code, paragraph S.4.4.1. Discharge Rates.
(Added 2003)

S.4.3. Measuring Components. – All components that affect the measurement of milk that are disassembled for cleaning purposes shall be clearly and permanently identified with a common serial number.

S.4.4. Flood Volume. – When applicable, the volume of product (to the nearest minimum division of the meter) necessary to flood the system when dry shall be clearly, conspicuously, and permanently marked on the air eliminator.

S.4.5. Conversion Factor. – When the conversion factor of 1.03 kg/L (8.6 lb/gal) is used to convert the volume of milk to weight, the conversion factor shall be clearly marked on the primary indicating element and recorded on the delivery ticket.

N. Notes

N.1. Test Liquid.

- (a) A meter shall be tested with the liquid to be commercially measured or with a liquid of the same general physical characteristics. Following a satisfactory examination, the weights and measures official should attach a seal or tag indicating the product used during the test.

(Amended 1989)

- (b) A milk measuring system shall be tested with the type of milk to be measured when the accuracy of the system is affected by the characteristics of milk (e.g., positive displacement meters).

(Added 1989)

N.2. Evaporation and Volume Change. – Care shall be exercised to reduce to a minimum, evaporation losses and volume changes resulting from changes in temperature of the test liquid.

N.2.1. Temperature Correction. – Corrections shall be made for any changes in volume resulting from the differences in liquid temperatures between time of passage through the meter and time of volumetric determination in the test measure. When adjustments are necessary, appropriate tables should be used.

N.3. Test Drafts. – Test drafts should be equal to at least the amount delivered by the device in one minute at its maximum discharge rate, and shall in no case be less than 400 L or 400 kg (100 gal or 1 000 lb).

(Amended 1989)

N.4. Testing Procedures.

N.4.1. Normal Tests. – The “normal” test of a meter shall be made at the maximum discharge rate that may be anticipated under the conditions of the installation. The “normal” test shall include a determination of the effectiveness of the air elimination system.

N.4.2. Special Tests. – “Special” tests shall be made to develop the operating characteristics of a device and any special elements and accessories attached to or associated with the device. Any test except as set forth in N.4.1. Normal Tests shall be considered a special test.

N.4.3. System Capacity. – The test of a milk-metering system shall include the verification of the volume of product necessary to flood the system as marked on the air eliminator.

N.4.4. Repeatability Tests. – Tests for repeatability should include a minimum of three consecutive test drafts of approximately the same size and be conducted under controlled conditions where variations in factors such as temperature, pressure, and flow rate are reduced to the extent that they will not affect the results obtained. When conducting the tests, the discharge rates shall be within the minimum and maximum discharge rates as marked by the manufacturer.

(Amended 2019)

T. Tolerances

T.1. Application.

T.1.1. To Underregistration and to Overregistration. – The tolerances hereinafter prescribed shall be applied to errors of underregistration and errors of overregistration.

T.2. Tolerance Values. – Maintenance and acceptance tolerances shall be as shown in Table 1. Tolerances for Milk Meters.

(Amended 1989)

Table 1. Tolerances for Milk Meters

Indication (gallons)	Maintenance (gallons)	Acceptance (gallons)
100	0.5	0.3
200	0.7	0.4
300	0.9	0.5
400	1.1	0.6
500	1.3	0.7
Over 500	Add 0.002 gallon per indicated gallon over 500	Add 0.001 gallon per indicated gallon over 500

(Added 1989)

T.3. Repeatability. – When multiple tests are conducted at approximately the same flow rate and draft size, the range of the test results for the flow rate shall not exceed 40 % of the absolute value of the maintenance tolerance and the results of each test shall be within the applicable tolerance. Also see N.4.4. Repeatability Tests.

(Added 2002) (Amended 2019)

UR. User Requirements

UR.1. Installation Requirements.

UR.1.1. Plumb and Level Condition. – A device installed in a fixed location shall be installed plumb and level, and the installation shall be sufficiently strong and rigid to maintain this condition.

UR.1.2. Discharge Rate. – A meter shall be so installed that the actual maximum discharge rate will not exceed the rated maximum discharge rate. If necessary, means for flow regulation shall be incorporated in the installation, in which case this shall be fully effective and automatic in operation.

UR.1.3. Unit Price. – There shall be displayed on the face of a device of the computing type the unit price at which the device is set to compute.

UR.1.4. Intake Hose. – The intake hose shall be so installed as to permit complete drainage and that all available product is measured following each transfer.

UR.2. Use Requirements.

UR.2.1. Return of Indicating and Recording Elements to Zero. – The primary indicating elements (visual), and the primary recording elements when these are returnable to zero, shall be returned to zero before each transfer.

UR.2.2. Printed Ticket. – Any printed ticket issued by a device of the computing type on which there is printed the total computed price, the total quantity, or the price per unit of quantity, shall also show the other two values (either printed or in clear script).

(Amended 1989)

UR.2.3. Ticket in Printing Device. – A ticket shall not be inserted into a device equipped with a ticket printer until immediately before a transfer is begun. If the meter is mounted on a vehicle, in no case shall a ticket be in the device when the vehicle is in motion while on a public street, highway, or thoroughfare.

UR.2.4. Credit for Flood Volume. – The volume of product necessary to flood the system as marked on the air eliminator shall be individually recorded on the ticket of each transfer affected.

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Table of Contents

	Page
Section 3.36. Water Meters	105
A. Application	105
A.1. General	105
A.2. Exceptions.....	105
A.3. Additional Code Requirements.....	105
S. Specifications	105
S.1. Design of Indicating and Recording Elements and of Recorded Representations. 105	
S.1.1. Primary Elements.	105
S.1.2. Graduations.	106
S.1.3. Indicators.	107
S.2. Design of Measuring Elements.....	107
S.2.1. Provision for Sealing.....	107
S.2.2. Batching Measuring Systems Only.	109
S.2.3. Multi-Jet Meter Identification.	109
S.3. Markings	109
S.3.1. <i>Location of Marking Information; Utility Type Meters.</i>	109
S.3.2. <i>Meter Size and Directional Flow Marking Information.</i>	109
N. Notes	109
N.1. Test Liquid.....	109
N.2. Evaporation and Volume Change.....	109
N.3. Test Drafts.....	109
N.4. Testing Procedures.	110
N.4.1. Normal Tests.	110
N.4.2. Special Tests.	110
N.4.3. Batching Meter Tests.....	111
N.4.4. Repeatability Tests	112
T. Tolerances	112
T.1. Tolerance Values.	112
T.1.1. Repeatability.....	113
UR. User Requirements	113
UR.1. Batching Meters Only.	113
UR.1.1. Strainer.	113
UR.1.2. Siphon Breaker.	113
UR.1.3. Provision for Testing.	113
UR.2. Accessibility of Customer Indication.	113

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Section 3.36. Water Meters

A. Application

A.1. General. – This code applies to devices used for the measurement of water; generally applicable to, but not limited to, utilities type meters installed in residences or business establishments and meters installed in batching systems.

(Amended 2002)

A.2. Exceptions. – This code does not apply to:

(a) water meters mounted on vehicle tanks (for which see Section 3.31. Vehicle-Tank Meters); or

(b) mass flow meters. (Also see Section 3.37. Mass Flow Meters.)

(Added 1994)

A.3. Additional Code Requirements. – In addition to the requirements of this code, Water Meters shall meet the requirements of Section 1.10. General Code.

S. Specifications

S.1. Design of Indicating and Recording Elements and of Recorded Representations.

S.1.1. Primary Elements.

S.1.1.1. General. – A water meter shall be equipped with a primary indicating element and may also be equipped with a primary recording element. Such elements shall be visible at the point of measurement or be stored in non-volatile and non-resettable memory. The display may be remotely located provided it is readily accessible to the customer.

(Amended 2002)

S.1.1.2. Units. – A water meter shall indicate and record, if the device is equipped to record, its deliveries in terms of liters, gallons or cubic feet or binary or decimal subdivisions thereof except batch plant meters, which shall indicate deliveries in terms of liters, gallons or decimal subdivisions of the liter or gallon only.

S.1.1.3. Value of Smallest Unit. – The value of the smallest unit of indicated delivery and recorded delivery, if the device is equipped to record, shall not exceed the equivalent of:

(a) 50 L (10 gal or 1 ft³) on utility type meters, sizes 1 in and smaller; or

(b) 500 L (100 gal or 10 ft³) on utility-type meters, sizes 1½ in and 2 in; or

(c) 0.2 L ($1/10$ gal or $1/100$ ft³) on batching meters delivering less than 375 L/min (100 gal/min or 13 ft³/min); or

(d) 5 L (1 gal or $1/10$ ft³) on batching meters delivering 375 L/min (100 gal/min or 13 ft³/min) or more.

(Amended 2009)

S.1.1.4. Advancement of Indicating and Recording Elements. – Primary indicating and recording elements shall advance only by the designed operation of the device, as intended by the manufacturer.

(Amended 2021)

S.1.1.5. Return to Zero. – If the meter is so designed that the primary indicating elements are readily returnable to a definite zero indication, means shall be provided to prevent the return of these elements beyond their correct zero position.

S.1.1.6. Proving Indicator. – Utility-type meters shall be equipped with a proving indicator. The individual graduations on a mechanical (analog) proving indicator shall indicate volumes no larger than $1/100$ of the value of the smallest unit of indicated delivery required in S.1.1.3. Value of Smallest Unit. For electronic (digital) proving indications, the smallest unit of volume displayed shall be no larger than $1/1000$ of the value of the smallest unit of indicated delivery required in S.1.1.3.

(Added 2009)

S.1.2. Graduations.

S.1.2.1. Length. – Graduations shall be so varied in length that they may be conveniently read.

S.1.2.2. Width. – In any series of graduations, the width of a graduation shall in no case be greater than the width of the minimum clear interval between graduations, and the width of main graduations shall be not more than 50 % greater than the width of subordinate graduations. Graduations shall in no case be less than 0.2 mm (0.008 in) in width.

S.1.2.3. Clear Interval Between Graduations. – The clear interval shall not be less than 1.0 mm (0.04 in). If the graduations are not parallel, the measurement shall be made:

(a) along the line of relative movement between the graduations at the end of the indicator; or

(b) if the indicator is continuous, at the point of widest separation of the graduations.

S.1.3. Indicators.

S.1.3.1. Symmetry. – The index of an indicator shall be symmetrical with respect to the graduations, at least throughout that portion of its length associated with the graduations.

S.1.3.2. Length. – The index of an indicator shall reach to the finest graduations with which it is used, the width of the minimum clear interval between graduations, and the width of main graduations shall be not more than 50 % greater than the width of subordinate graduations. Graduations shall in no case be less than 0.2 mm (0.008 in) in width.

S.1.3.3. Width. – The width of the index of an indicator in relation to the series of graduations with which it is used shall not be greater than:

(a) *the width of the narrowest graduation;* and*
*[*Nonretroactive as of January 1, 2002]*
(Amended 2001)

(b) the width of the minimum clear interval between graduations.

When the index of an indicator extends along the entire length of a graduation, that portion of the index of the indicator that may be brought into coincidence with the graduation shall be of the same width throughout the length of the index that coincides with the graduation.

S.1.3.4. Clearance. – The clearance between the index of an indicator and the graduations shall in no case be more than 1.5 mm (0.06 in).

S.1.3.5. Parallax. – Parallax effects shall be reduced to the practicable minimum.

S.2. Design of Measuring Elements.

S.2.1. Provision for Sealing. – For devices or systems in which the configuration or calibration parameters can be changed by use of a removable digital storage device, security shall be provided for those parameters as specified in G-S.8.2. Devices and Systems Adjusted Using Removable Digital Storage Devices. For parameters adjusted using other means, the following applies.

Adequate provision shall be made for an approved means of security (e.g., data change audit trail) or for physically applying a security seal in such a manner that requires the security seal to be broken before an adjustment or interchange can be made of:

- (a) any measuring or indicating element;
- (b) any adjustable element for controlling delivery rate when such rate tends to affect the accuracy of deliveries; and

(c) any metrological parameter that will affect the metrological integrity of the device or system.

When applicable, the adjusting mechanism shall be readily accessible for purposes of affixing a security seal.

*Audit trails shall use the format set forth in Table S.2.1. Categories of Device and Methods of Sealing.**

**[Nonretroactive as of January 1, 2019]*

(Amended 2018 and 2019)

Table S.2.1. Categories of Device and Methods of Sealing

Categories of Device	Method of Sealing
<i>Category 1: No remote configuration capability.</i>	<i>Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.</i>
<p><i>Category 2: Remote configuration capability, but access is controlled by physical hardware.</i></p> <p><i>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.</i></p>	<p><i>The hardware enabling access for remote communication must be on-site. The hardware must be sealed using a physical seal or an event counter for calibration parameters and an event counter for configuration parameters. The event counters may be located either at the individual measuring device or at the system controller; however, an adequate number of counters must be provided to monitor the calibration and configuration parameters of the individual devices at a location. If the counters are located in the system controller rather than at the individual device, means must be provided to generate a hard copy of the information through an on-site device.</i></p>
<p><i>Category 3: Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password).</i></p> <p><i>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.</i></p>	<p><i>An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. A printed copy of the information must be available on demand through the device or through another on-site device. The information may also be available electronically. The event logger shall have a capacity to retain records equal to 10 times the number of sealable parameters in the device, but not more than 1000 records are required. (Note: Does not require 1000 changes to be stored for each parameter.)</i></p>

[Nonretroactive as of January 1, 2019]

(Table Added 2018)

S.2.2. Batching Measuring Systems Only.

S.2.2.1. Air/Vapor Elimination, Batching Measuring Systems. – Batching measuring systems shall be equipped with an effective air/vapor eliminator or other automatic means to prevent the passage of air/vapor through the meter. Vent lines from the air/vapor eliminator shall be made of appropriate non-collapsible material.

(Amended 2017)

S.2.2.2. Directional Flow Valves. – Valves intended to prevent reversal of flow shall be automatic in operation.

S.2.3. Multi-Jet Meter Identification. – Multi-Jet water meters shall be clearly and permanently marked as such on the device or identified on the Certificate of Conformance.

(Added 2003)

S.3. Markings

S.3.1. Location of Marking Information; Utility Type Meters. – All required markings, including those required by G-S.1. Identification, shall be either on the meter body or primary indicator.

[Nonretroactive as of January 1, 2013]

(Added 2012)

S.3.2. Meter Size and Directional Flow Marking Information. – A water meter shall be clearly and indelibly marked with the following information:

(a) meter size on the indicator face plate; and

(b) water flow direction.

[Nonretroactive as of January 1, 2022]

(Added 2021)

N. Notes

N.1. Test Liquid. – A meter shall be tested with water.

N.2. Evaporation and Volume Change. – Care shall be exercised to reduce to a minimum, evaporation losses and volume changes resulting from changes to temperature of the test liquid.

N.3. Test Drafts. – Test drafts should be equal to at least the amount delivered by the device in two minutes and in no case less than the amount delivered by the device in one minute at the actual maximum flow rate developed by the installation. The test draft sizes shown in Table N.4.1. Flow Rate and Draft Size for Water Meters Normal Tests, shall be followed as closely as possible.

(Amended 2003)

N.4. Testing Procedures.

N.4.1. Normal Tests. – The normal test of a meter shall be made at the maximum discharge rate developed by the installation. Meters with maximum gallon per minute ratings higher than the values specified in Table N.4.1. Flow Rate and Draft Size for Water Meters Normal Tests may be tested up to the meter rating, with meter indications no less than those shown.

(Amended 1990, 2002, and 2003)

Table N.4.1. Flow Rate and Draft Size for Water Meters Normal Tests

Meter Size (inches)	Rate of Flow (gal/min)	Maximum Rate Meter Indication/Test Draft (gal)	Maximum Rate Meter Indication/Test Draft (ft³)
Less than 5/8	8	50	5
5/8	15	50	5
3/4	25	50	5
1	40	100	10
1½	80	300	40
2	120	500	40
3	250	500	50
4	350	1000	100
6	700	1000	100

(Table Added 2003)

N.4.2. Special Tests. – Special tests to develop the operating characteristics of meters may be made according to the rates and quantities shown in Table N.4.2.a. Flow Rate and Draft Size for Water Meters Special Tests and Table N.4.2.b. Flow Rate and Draft Size for Utility Type Water Meters Special Tests.

(Amended 2003 and 2010)

Table N.4.2.a. Flow Rate and Draft Size for Batching Water Meters Special Tests

Meter Size (inches)	Intermediate Rate of Flow (gal/min)	Intermediate Rate Meter Indication/Test Draft (gal)	Intermediate Rate Meter Indication/Test Draft (ft ³)	Minimum Rate of Flow (gal/min)	Minimum Rate Meter Indication/Test Draft (gal)	Minimum Rate Meter Indication/Test Draft (ft ³)
Less than or equal to $\frac{5}{8}$	2	10	1	$\frac{1}{4}$	5	1
$\frac{3}{4}$	3	10	1	$\frac{1}{2}$	5	1
1	4	10	1	$\frac{3}{4}$	5	1
$1\frac{1}{2}$	8	50	5	$1\frac{1}{2}$	10	1
2	15	50	5	2	10	1
3	20	50	5	4	10	1
4	40	100	10	7	50	5
6	60	100	10	12	50	5

(Table Added 2003) (Table Amended 2010)

Table N.4.2.b. Flow Rate and Draft Size for Utility Type Water Meters Special Tests

Meter Size (inches)	Intermediate Rate of Flow (gal/min)	Intermediate Rate Meter Indication/Test Draft (gal)	Intermediate Rate Meter Indication/Test Draft (ft ³)	Minimum Rate of Flow (gal/min)	Minimum Rate Meter Indication/Test Draft (gal)	Minimum Rate Meter Indication/Test Draft (ft ³)
Less than $\frac{5}{8}$	2	10	1	$\frac{1}{4}$	5	1
$\frac{5}{8}$	2	10	1	$\frac{1}{4}$	5	1
$\frac{5}{8} \times \frac{3}{4}$	2	10	1	$\frac{1}{4}$	5	1
$\frac{3}{4}$	3	10	1	$\frac{1}{2}$	5	1
1	4	10	1	$\frac{3}{4}$	5	1
$1\frac{1}{2}$	8	100	10	$1\frac{1}{2}$	100	10
2	15	100	10	2	100	10

(Table Added 2010)

N.4.3. Batching Meter Tests. – Tests on batching meters should be conducted at the maximum and intermediate rates only.

N.4.4. Repeatability Tests. – Tests for repeatability should include a minimum of three consecutive test drafts of approximately the same size and be conducted under controlled conditions where variations in factors such as temperature, pressure, and flow rate are reduced to the extent that they will not affect the results obtained. When conducting the tests, the minimum flow rate shall be at least the minimum rate specified in Table N.4.2.a., and the maximum discharge rates shall not exceed the maximum discharge rate developed under the conditions of the installation.

(Amended 2019)

T. Tolerances

T.1. Tolerance Values. – Maintenance and acceptance tolerances shall be as shown in Table T.1. Accuracy Classes and Tolerances for Water Meters.

Table T.1. Accuracy Classes and Tolerances for Water Meters

Accuracy Class	Application	Acceptance Tolerance	Maintenance Tolerance	Tolerance for Special Tests Conducted at the Minimum Flow Rate
1.5	Water, Other Than Multi-Jet Water Meters Overregistration	1.5 %	1.5 %	1.5 %
1.5	Water, Other Than Multi-Jet Water Meters Underregistration	1.5 %	1.5 %	5.0 %
1.5	Water, Multi-Jet Water Meters Overregistration	1.5 %	1.5 %	3.0 %
1.5	Water, Multi-Jet Water Meters Underregistration	1.5 %	1.5 %	3.0 %

(Table Added 2003)

(Amended 2003)

T.1.1. Repeatability. – When multiple tests are conducted at approximately the same flow rate, each test shall be within the applicable tolerances and the range of test results shall not exceed the values shown in Table T.1.1. Repeatability. Also see N.4.4. Repeatability Tests.

(Added 2002) (Amended 2010)

Table T.1.1. Repeatability

	Batching Meters	Utility-Type Meters
Normal Flow Rates	0.6 %	0.6 %
Intermediate Flow Rates	0.6 %	2.0 %
Minimum Flow Rate	1.3 %	4.0 %

(Table Added 2010)

UR. User Requirements

UR.1. Batching Meters Only.

UR.1.1. Strainer. – A filter or strainer shall be provided if it is determined that the water contains excessive amounts of foreign material.

UR.1.2. Siphon Breaker. – An automatic siphon breaker or other effective means shall be installed in the discharge piping at the highest point of outlet, in no case below the top of the meter, to prevent siphoning of the meter and permit rapid drainage of the pipe or hose.

UR.1.3. Provision for Testing. – Acceptable provisions for testing shall be incorporated into all meter systems. Such provisions shall include a two-way valve, or manifold valving, and a pipe or hose installed in the discharge line accessible to the proper positioning of the test measure.

UR.2. Accessibility of Customer Indication. – An unobstructed standing space of at least 76 cm (30 in) wide, 91 cm (36 in) deep, and 198 cm (78 in) high shall be maintained in front of an indication intended for use by the customer to allow for reading the indicator. The customer indication shall be readily observable to a person located within the standing space without necessity of a separate tool or device.

(Added 2008)

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Table of Contents

	Page
Section 3.37. Mass Flow Meters	115
A. Application.....	115
A.1. Liquids.....	115
A.2. Vapor (Gases).....	115
A.3. Additional Code Requirements.....	115
S. Specifications	115
S.1. Indicating and Recording Elements.....	115
S.1.1. Indicating Elements.	115
S.1.2. Compressed Natural Gas and Liquefied Natural Gas Dispensers.....	115
S.1.3. Units.	115
S.1.3.1.1. Compressed Natural Gas Used as an Engine Fuel. [NOT ADOPTED - CCR § 4001. Exceptions.].....	116
CCR § 4002.10. Mass Flow Meters. (3.37.), S.1.3.1.1. Compressed Natural Gas Used as an Engine Fuel.	116
S.1.3.1.2..... Liquefied Natural Gas Used as an Engine Fuel. [NOT ADOPTED - CCR § 4001. Exceptions.].....	116
CCR § 4002.10. Mass Flow Meters. (3.37.). S.1.3.1.2. Liquefied Natural Gas Used as an Engine Fuel.	116
S.2. Operating Requirements.....	117
S.2.1. Return to Zero.	117
S.2.2. Indicator Reset Mechanism.....	117
S.2.3. Non-resettable Indicator.	117
S.2.4. Provisions for Power Loss.....	117
S.2.5. Display of Unit Price and Product Identity.	117
S.2.6. Money-Value Computations.	118
S.2.7. Recorded Representations, Point-of-Sale Systems.....	119
S.2.8. Indication of Delivery.	119
S.2.9. Automatic Timeout – Pay-At-Retail Motor-Fuel Devices.....	119
S.3. Measuring Elements and Measuring Systems.....	119
S.3.1. Maximum and Minimum Flow-Rates.	119
S.3.2. Adjustment Means.....	119
S.3.3. Air/Vapor Elimination.	120
S.3.4. Maintenance of Liquid State.	120
S.3.5. Provision for Sealing.....	120
S.3.6. Automatic Density Correction.	122
S.3.7. Pressurizing the Discharge Hose.	122
S.3.8. Zero-Set-Back Interlock, Retail Motor-Fuel Devices.....	122
S.4. Discharge Lines and Valves.....	122
S.4.1. Diversion of Measured Product.	122
S.4.2. Pump-Discharge Unit.	123
S.4.3. Directional Flow Valves.	123

S.4.4. Discharge Valves.....	123
S.4.5. Antidrain Means.....	123
S.4.6. Other Valves.....	123
S.5. Markings.....	123
S.5.1. Location of Marking Information; Retail Motor-Fuel Dispensers.	124
S.5.2. Marking of Equivalent Conversion Factors for Compressed Natural Gas. [NOT ADOPTED - CCR § 4001. Exceptions.]	124
CCR § 4002.10. Mass Flow Meters. (3.37.). S.5.2. Marking of Gasoline Volume Equivalent Conversion Factors for Compressed Natural Gas.	124
S.5.3. Marking of Equivalent Conversion Factor for Liquefied Natural Gas. [NOT ADOPTED - CCR § 4001. Exceptions.]	125
CCR § 4002.10. Mass Flow Meters. (3.37.). S.5.3. Marking of Diesel Volume Equivalent Conversion Factors for Liquefied Natural Gas.	125
S.6. Printer.....	125
S.6.1. Printed Receipt.	125
S.7. Totalizers for Retail Motor-Fuel Devices.....	125
N. Notes	126
N.1. Minimum Measured Quantity.....	126
N.2. Test Medium.....	126
N.2.1. Liquid-Measuring Devices.	126
N.2.2. Vapor-Measuring Devices.	126
N.3. Test Drafts.....	126
N.4. Minimum Measured Quantity.....	126
N.5. Motor-Fuel Dispenser.....	126
N.6. Testing Procedures.....	126
N.6.1. Normal Tests.	126
N.6.2. Special Tests.	126
N.6.3. Repeatability Tests.....	126
T. Tolerances	127
T.1. Tolerances, General.....	127
T.2. Tolerances.....	127
T.3. Repeatability.....	131
T.4. Type Evaluation Examinations for Liquid-Measuring Devices.....	131
UR. User Requirements.....	131
UR.1. Selection Requirements.....	131
UR.1.1. Discharge Hose-Length.	131
UR.1.2. Minimum Measured Quantity.	131
UR.2. Installation Requirements.....	131
UR.2.1. Manufacturer’s Instructions.	131
UR.2.2. Discharge Rate.	132
UR.2.3. Low-Flow Cut-Off Valve.....	132
UR.3. Use of Device.....	132

UR.3.1. Unit Price and Product Identity for Retail Dispensers.....	132
UR.3.1.1. Marking of Equivalent Conversion Factors for Compressed Natural Gas. [NOT ADOPTED - CCR § 4001. Exceptions.]	132
§ 4002.10. Mass Flow Meters. (3.37.). UR.3.1.1. Marking of Equivalent Conversion Factor for Compressed Natural Gas.	132
U.R.3.1.2. Marking of Equivalent Conversion Factor for Liquefied Natural Gas. [NOT ADOPTED - CCR § 4001. Exceptions.]	133
§ 4002.10. Mass Flow Meters. (3.37.). U.R.3.1.2. Marking of Equivalent Conversion Factor for Liquefied Natural Gas.	133
UR.3.2. Vapor-Return Line.	133
UR.3.3. Ticket Printer; Customer Ticket.....	133
UR.3.4. Printed Ticket.....	133
UR.3.5. Ticket in Printing Device.	133
UR.3.6. Steps After Dispensing.	133
UR.3.7. Return of Indicating and Recording Elements to Zero.	134
UR.3.8. Return of Product to Storage, Retail Compressed and Liquefied Natural Gas Dispensers.....	134

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Section 3.37. Mass Flow Meters

A. Application

A.1. Liquids. – This code applies to devices that are designed to dynamically measure the mass, or the mass and density of liquids. It also specifies the relevant examinations and tests that are to be conducted.

(Amended 1997)

A.2. Vapor (Gases). – This code applies to devices that are designed to dynamically measure the mass of hydrocarbon gas in the vapor state. Examples of these products are propane, propylene, butanes, butylenes, ethane, methane, natural gas and any other hydrocarbon gas/air mix.

A.3. Additional Code Requirements. – In addition to the requirements of this code, Mass Flow Meters shall meet the requirements of Section 1.10. General Code.

S. Specifications

S.1. Indicating and Recording Elements.

S.1.1. Indicating Elements. – A measuring assembly shall include an indicating element. Indications shall be clear, definite, accurate, and easily read under normal conditions of operation of the instrument.

S.1.2. Compressed Natural Gas and Liquefied Natural Gas Dispensers. – Except for fleet sales and other price contract sales, a compressed or liquefied natural gas dispenser used to refuel vehicles shall be of the computing type and shall indicate the quantity, the unit price, and the total price of each delivery. The dispenser shall display the mass measured for each transaction either continuously on an external or internal display accessible during the inspection and test of the dispenser, or display the quantity in mass units by using controls on the device.

(Added 1994) (Amended 2016)

S.1.3. Units.

S.1.3.1. Units of Measurement. – Deliveries shall be indicated and recorded in grams, kilograms, metric tons, pounds, tons, and/or liters, gallons, quarts, pints and decimal subdivisions thereof. The indication of a delivery shall be on the basis of apparent mass versus a density of 8.0 g/cm^3 . The volume indication shall be based on the mass measurement and an automatic means to determine and correct for changes in product density.

(Amended 1993 and 1997)

S.1.3.1.1. Compressed Natural Gas Used as an Engine Fuel. [NOT ADOPTED - CCR § 4001. Exceptions.]

CCR § 4002.10. Mass Flow Meters. (3.37.), S.1.3.1.1. Compressed Natural Gas Used as an Engine Fuel.

When compressed natural gas is dispensed as an engine fuel, the delivered quantity shall be indicated in “gasoline gallon equivalent (GGE) units.” (Also see Appendix D definitions.)

(Adopted, 4 CCR 4002.10.)

S.1.3.1.2. Liquefied Natural Gas Used as an Engine Fuel. [NOT ADOPTED - CCR § 4001. Exceptions.]

CCR § 4002.10. Mass Flow Meters. (3.37.). S.1.3.1.2. Liquefied Natural Gas Used as an Engine Fuel.

When liquefied natural gas is dispensed as an engine fuel, the delivered quantity shall be indicated in “diesel gallon equivalent (DGE) units.” (Also, see Appendix D definitions.)

(Adopted, 4 CCR 4002.10.)

S.1.3.2. Numerical Value of Quantity-Value Divisions. – The value of a scale interval shall be equal to:

- (a) 1, 2, or 5; or
- (b) a decimal multiple or submultiple of 1, 2, or 5.

S.1.3.3. Maximum Value of Quantity-Value Divisions. - The maximum value of the quantity-value division shall not exceed the following:

- (a) For compressed natural gas dispensed as an engine fuel:
 - (1) 0.001 for gasoline gallon equivalent (GGE) units; or
 - (2) 0.001 diesel gallon equivalent (DGE) units; or
 - (3) 0.001 kg or 0.001 lb for mass units.
- (b) For liquefied natural gas dispensed as an engine fuel:
 - (1) 0.001 for diesel gallon equivalent (DGE) units; or
 - (2) 0.001 kg or 0.001 lb for mass units.
- (c) For all other gases or liquids, a maximum value not greater than 0.2 % of the minimum measured quantity.

(Amended 1994, 2019, and 2021)

S.1.3.4. Values Defined. – Indicated values shall be adequately defined by a sufficient number of figures, words, symbols, or combinations thereof. A display of “zero” shall be a zero digit for all displayed digits to the right of the decimal mark and at least one to the left.

S.2. Operating Requirements.

S.2.1. Return to Zero. – Except for measuring assemblies in a pipeline:

- (a) One indicator and the primary recording elements, if the device is equipped to record, shall be provided with a means for readily returning the indication to zero either automatically or manually.
- (b) It shall not be possible to return primary indicating elements, or primary recording elements, beyond the correct zero position.

(Amended 1993)

S.2.2. Indicator Reset Mechanism. – The reset mechanism for the indicating element shall not be operable during a delivery. Once the zeroing operation has begun, it shall not be possible to indicate a value other than the latest measurement, or “zeros” when the zeroing operation has been completed.

S.2.3. Non-resettable Indicator. – An instrument may also be equipped with a non-resettable indicator if the indicated values cannot be construed to be the indicated values of the resettable indicator for a delivered quantity.

S.2.4. Provisions for Power Loss.

S.2.4.1. Transaction Information. – In the event of a power loss, the information needed to complete any transaction in progress at the time of the power loss (such as the quantity and unit price, or sales price) shall be determinable for at least 15 minutes at the dispenser or at the console if the console is accessible to the customer.

(Added 1993)

S.2.4.2. User Information. – The device memory shall retain information on the quantity of fuel dispensed and the sales price totals during power loss.

(Added 1993)

S.2.5. Display of Unit Price and Product Identity.

S.2.5.1. Unit Price. – A computing or money-operated device shall be able to display on each face the unit price at which the device is set to compute or to dispense.

(Added 1993)

S.2.5.2. Product Identity. – A device shall be able to conspicuously display on each side the identity of the product being dispensed.

(Added 1993)

S.2.5.3. Selection of Unit Price. – *Except for dispensers used exclusively for fleet sales, other price contract sales, and truck refueling (e.g., truck stop dispensers used only to refuel trucks), when a product or grade is offered for sale at more than one unit price through a computing device, the selection of the unit price shall be made prior to delivery using controls on the device or other customer-activated controls. A system shall not permit a change to the unit price during delivery of a product.*

[Nonretroactive as of January 1, 1998]

(Added 1997)

S.2.5.4. Agreement Between Indications. – *When a quantity value indicated or recorded by an auxiliary element is a derived or computed value based on data received from a retail motor-fuel dispenser, the value may differ from the quantity value displayed on the dispenser, provided the following conditions are met:*

(a) all total money-values for an individual sale that are indicated or recorded by the system agree; and

(b) within each element the values indicated or recorded meet the formula (quantity \times unit price = total sales price) to the closest cent.

[Nonretroactive as of January 1, 1998]

(Added 1997)

S.2.6. Money-Value Computations. – A computing device shall compute the total sales price at any single-purchase unit price (i.e., excluding fleet sales, other price contract sales, and truck stop dispensers used only to refuel trucks) for which the product being measured is offered for sale at any delivery possible within either the measurement range of the device or the range of the computing elements, whichever is less.

(Added 1993)

S.2.6.1. Auxiliary Elements. – If a system is equipped with auxiliary indications, all indicated money-value and quantity divisions of the auxiliary element shall be identical with those of the primary element.

(Added 1993)

S.2.6.2. Display of Quantity and Total Price. – When a delivery is completed, the total price and quantity for that transaction shall be displayed on the face of the dispenser for at least 5 minutes or until the next transaction is initiated by using controls on the device or other user-activated controls.

(Added 1993)

S.2.7. Recorded Representations, Point-of-Sale Systems. – *The sales information recorded by cash registers when interfaced with a retail motor-fuel dispenser shall contain the following information for products delivered by the dispenser:*

- (a) the total volume of the delivery;*
- (b) the unit price;*
- (c) the total computed price; and*
- (d) the product identity by name, symbol, abbreviation, or code number.*

[Nonretroactive as of January 1, 1986]

(Added 1993)

S.2.8. Indication of Delivery. – *The device shall automatically show on its face the initial zero condition and the quantity delivered (up to the nominal capacity). However, the first 0.03 L (0.009 gal) of a delivery and its associated total sales price need not be indicated.*

[Nonretroactive as of January 1, 1998]

(Added 1997)

S.2.9. Automatic Timeout – Pay-At-Retail Motor-Fuel Devices. – *Once a retail motor-fuel device has been authorized, it must deauthorize within two minutes if not activated. Reauthorization of the retail motor-fuel device must be performed before product is delivered. If the time limit to deauthorize the retail motor-fuel device is programmable, it shall not accept an entry greater than two minutes.*

[Nonretroactive as of January 1, 2020]

(Added 2019)

S.3. Measuring Elements and Measuring Systems.

S.3.1. Maximum and Minimum Flow-Rates.

- (a) The ratio of the maximum to minimum flow-rates specified by the manufacturer for devices measuring liquefied gases shall be 5:1 or greater.
- (b) The ratio of the maximum to minimum flow-rates specified by the manufacturer for devices measuring other than liquefied gases shall be 10:1 or greater.

S.3.2. Adjustment Means. – An assembly shall be provided with the means to change the ratio between the indicated quantity and the quantity of liquid measured by the assembly. A bypass on the measuring assembly shall not be used for these means.

S.3.2.1. Discontinuous Adjusting Means. – When the adjusting means changes the ratio between the indicated quantity and the quantity of measured liquid in a discontinuous manner, the consecutive values of the ratio shall not differ by more than 0.1 %.

S.3.3. Air/Vapor Elimination. – A measuring system shall be equipped with an effective air/vapor eliminator or other automatic means to prevent the measurement of air/vapor. Vent lines from the air/vapor eliminator shall be made of appropriate non-collapsible material.

(Amended 1999 and 2017)

S.3.3.1. Air/Vapor Elimination on Loading Rack Liquid Measuring Systems.

(a) A loading rack measuring system shall be equipped with an effective air/vapor eliminator or other automatic means to prevent the passage of air/vapor through the meter unless the system is designed or operationally controlled by a means such that neither air nor vapor can enter the system.

(b) Vent lines from the air/vapor eliminator shall be made of appropriate non-collapsible material.

(Added 1995) (Amended 2017)

S.3.4. Maintenance of Liquid State. – A liquid-measuring device shall be installed so that the measured product remains in a liquid state during passage through the instrument.

S.3.5. Provision for Sealing. – For devices or systems in which the configuration or calibration parameters can be changed by use of a removable digital storage device, security shall be provided for those parameters as specified in G-S.8.2. Devices and Systems Adjusted Using Removable Digital Storage Devices. For parameters adjusted using other means, the following applies.

Adequate provision shall be made for an approved means of security (e.g., data change audit trail) or physically applying security seals in such a manner that no adjustment or interchange can be made of:

- (a) any measuring or indicating element;
- (b) any adjustable element for controlling delivery rate when such rate tends to affect the accuracy of deliveries;
- (c) the zero-adjustment mechanism; and
- (d) any metrological parameter that will affect the metrological integrity of the device or system.

When applicable, the adjusting mechanism shall be readily accessible for purposes of affixing a security seal.

*Audit trails shall use the format set forth in Table S.3.5. Categories of Device and Methods of Sealing.**

*[*Nonretroactive as of January 1, 1995]*

(Amended 1992, 1995, 2006, and 2019)

Table S.3.5. Categories of Device and Methods of Sealing

Categories of Device	Methods of Sealing
<p>Category 1: No remote configuration capability.</p>	<p>Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.</p>
<p>Category 2: Remote configuration capability, but access is controlled by physical hardware.</p> <p>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.</p>	<p>[The hardware enabling access for remote communication must be on-site. The hardware must be sealed using a physical seal or an event counter for calibration parameters and an event counter for configuration parameters. The event counters may be located either at the individual measuring device or at the system controller; however, an adequate number of counters must be provided to monitor the calibration and configuration parameters of the individual devices at a location. If the counters are located in the system controller rather than at the individual device, means must be provided to generate a hard copy of the information through an on-site device.]*</p> <p>[*Nonretroactive as of January 1, 1996]</p>
<p>Category 3: Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password).</p> <p>[Nonretroactive as of January 1, 1995]</p> <p>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.</p> <p>[Nonretroactive as of January 1, 2001]</p>	<p>An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. A printed copy of the information must be available on demand through the device or through another on-site device. The information may also be available electronically. The event logger shall have a capacity to retain records equal to 10 times the number of sealable parameters in the device, but not more than 1000 records are required. (Note: Does not require 1000 changes to be stored for each parameter.)</p>

[Nonretroactive as of January 1, 1995]

(Table Added 1995) (Amended 1995, 1998, 1999, 2006, and 2016)

S.3.6. Automatic Density Correction.

- (a) An automatic means to determine and correct for changes in product density shall be incorporated in any mass flow metering system that is affected by changes in the density of the product being measured.
- (b) Volume-measuring devices with automatic temperature compensation used to measure natural gas as a motor vehicle engine fuel shall be equipped with an automatic means to determine and correct for changes in product density due to changes in the temperature, pressure, and composition of the product.

(Amended 1994 and 1997)

S.3.7. Pressurizing the Discharge Hose. – The discharge hose for compressed natural gas shall automatically pressurize prior to the device beginning to register the delivery.

(Added 1993)

S.3.8. Zero-Set-Back Interlock, Retail Motor-Fuel Devices. – A device shall be constructed so that:

- (a) after a delivery cycle has been completed by moving the starting lever to any position that shuts off the device, an automatic interlock prevents a subsequent delivery until the indicating elements, and recording elements if the device is equipped and activated to record, have been returned to their zero positions;
- (b) the discharge nozzle cannot be returned to its designed hanging position (that is, any position where the tip of the nozzle is placed in its designed receptacle and the lock can be inserted) until the starting lever is in its designed shut-off position and the zero-set-back interlock has been engaged; and
- (c) in a system with more than one dispenser supplied by a single pump, an effective automatic control valve in each dispenser prevents product from being delivered until the indicating elements on that dispenser are in a correct zero position.

(Added 1993)

S.4. Discharge Lines and Valves.

S.4.1. Diversion of Measured Product. – No means shall be provided by which any measured product can be diverted from the measuring instrument. However, two or more delivery outlets may be permanently installed and operated simultaneously, provided that any diversion of flow to other than the intended receiving receptacle cannot be readily accomplished or is readily apparent. Such means include physical barriers, visible valves, or indications that make it clear which outlets are in operation, and explanatory signs if deemed necessary.

An outlet that may be opened for purging or draining the measuring system, or for recirculating product if recirculation is required in order to maintain the product in a deliverable state shall be permitted. Effective automatic means shall be provided to

prevent the passage of liquid through any such outlet during normal operation of the measuring system and to inhibit meter indications (or advancement of indications) and recorded representations while the outlet is in operation.

(Amended 2002 and 2006)

S.4.2. Pump-Discharge Unit. – A pump-discharge unit for liquids equipped with a flexible discharge hose shall be of the wet-hose type.

(Added 1993)

S.4.3. Directional Flow Valves. – If a reversal of flow could result in errors that exceed the tolerance for the minimum measured quantity, a valve or valves or other effective means, automatic in operation (and equipped with a pressure limiting device, if necessary) to prevent the reversal of flow shall be properly installed in the system. (Also see N.1. Minimum Measured Quantity.)

S.4.4. Discharge Valves. – A discharge valve may be installed on a discharge line only if the system is a wet-hose type. Any other shutoff valve on the discharge side of the instrument shall be of the automatic or semiautomatic predetermined-stop type or shall be operable only:

- (a) by means of a tool (but not a pin) entirely separate from the device; or
- (b) by means of a security seal with which the valve is sealed open.

S.4.5. Antidrain Means. – In a wet-hose type device, effective means shall be provided to prevent the drainage of the hose between transactions.

S.4.6. Other Valves. – Check valves and closing mechanisms that are not used to define the measured quantity shall have relief valves (if necessary) to dissipate any abnormally high pressure that may arise in the measuring assembly.

S.5. Markings. – A measuring system shall be legibly and indelibly marked with the following information:

- (a) pattern approval mark (i.e., type approval number);
- (b) name and address of the manufacturer or his trademark and, if required by the weights and measures authority, the manufacturer's identification mark in addition to the trademark;
- (c) model identifier or product name selected by the manufacturer;
- (d) nonrepetitive serial number;

(e) *the accuracy class of the meter as specified by the manufacturer consistent with Table T.2. Accuracy Classes for Mass Flow Meter Applications Covered in NIST Handbook 44, Section 3.37 Mass Flow Meters;**

*[*Nonretroactive as of January 1, 1995]*

(Added 1994)

(f) maximum and minimum flow rates in pounds per unit of time;

(g) maximum working pressure;

(h) applicable range of temperature if other than – 10 °C to + 50 °C;

(i) minimum measured quantity; and

(j) product limitations, if applicable.

S.5.1. Location of Marking Information; Retail Motor-Fuel Dispensers. – *The marking information required in General Code, paragraph G-S.1. Identification shall appear as follows:*

(a) within 60 cm (24 in) to 150 cm (60 in) from the base of the dispenser;

(b) either internally and/or externally provided the information is permanent and easily read; and

(c) on a portion of the device that cannot be readily removed or interchanged (i.e., not on a service access panel).

[Nonretroactive as of January 1, 2003]

The use of a dispenser key or tool to access internal marking information is permitted for retail liquid and compressed gas-measuring devices.

(Added 2006) (Amended 2019)

S.5.2. Marking of Equivalent Conversion Factors for Compressed Natural Gas. [NOT ADOPTED - CCR § 4001. Exceptions.]

CCR § 4002.10. Mass Flow Meters. (3.37.). S.5.2. Marking of Gasoline Volume Equivalent Conversion Factors for Compressed Natural Gas.

A device dispensing compressed natural gas shall have the statement “1 Gasoline Gallon Equivalent (GGE) equals 5.66 lb of Compressed Natural Gas” permanently and conspicuously marked on the face of the dispenser.

(Adopted, 4 CCR 4002.10.)

S.5.3. Marking of Equivalent Conversion Factor for Liquefied Natural Gas. [NOT ADOPTED - CCR § 4001. Exceptions.]

CCR § 4002.10. Mass Flow Meters. (3.37.). S.5.3. Marking of Diesel Volume Equivalent Conversion Factors for Liquefied Natural Gas.

A device dispensing liquefied natural gas shall have the statement “1 Diesel Gallon Equivalent (DGE) equals 6.06 lb of Liquefied Natural Gas” permanently and conspicuously marked on the face of the dispenser

(Adopted, 4 CCR 4002.10.)

S.6. Printer. – When an assembly is equipped with means for printing the measured quantity, the following conditions apply:

- (a) the scale interval shall be the same as that of the indicator;
- (b) the value of the printed quantity shall be the same value as the indicated quantity;
- (c) *the printed quantity shall also include the mass value if the mass is not the indicated quantity;*
[Nonretroactive as of January 1, 2021]
- (d) a quantity for a delivery (other than an initial reference value) cannot be recorded until the measurement and delivery has been completed;
- (e) the printer is returned to zero when the resettable indicator is returned to zero; and
- (f) the printed values shall meet the requirements applicable to the indicated values.

(Amended 2016)

S.6.1. Printed Receipt. – Any delivered, printed quantity shall include an identification number, the time and date, and the name of the seller. This information may be printed by the device or pre-printed on the ticket.

S.7. Totalizers for Retail Motor-Fuel Devices. – *Retail motor-fuel dispensers shall be equipped with a nonresettable totalizer for the quantity delivered through the metering device.*

[Nonretroactive as of January 1, 1998]

(Added 1997)

N. Notes

N.1. Minimum Measured Quantity. – The minimum measured quantity shall be specified by the manufacturer.

N.2. Test Medium.

N.2.1. Liquid-Measuring Devices. – The device shall be tested with the liquid that the device is intended to measure or another liquid with the same general physical characteristics.

N.2.2. Vapor-Measuring Devices. – The device shall be tested with air or the product to be measured.

N.3. Test Drafts. – The minimum test shall be one test draft at the maximum flow rate of the installation and one test draft at the minimum flow rate. More tests may be performed at these or other flow rates. (Also see T.3. Repeatability.)

N.4. Minimum Measured Quantity. – The device shall be tested for a delivery equal to the declared minimum measured quantity when the device is likely to be used to make deliveries on the order of the minimum measured quantity.

N.5. Motor-Fuel Dispenser. – When a device is intended for use as a liquid motor-fuel dispenser, the type evaluation test shall include a test for accuracy using five starts and stops during a delivery to simulate the operation of the automatic shut-off nozzle. This test may be conducted as part of the normal inspection and test of the meter.

N.6. Testing Procedures.

N.6.1. Normal Tests. – The normal test of a meter shall be made at the maximum discharge rate developed by the installation. Any additional tests conducted at flow rates down to and including the rated minimum discharge flow rate shall be considered normal tests.

(Added 1999)

N.6.2. Special Tests. – “Special” tests shall be made to develop the operating characteristics of a device and any special elements and accessories attached to or associated with the device. Any test except as set forth in N.6.1. Normal Tests shall be considered a special test. Special tests of a measuring system shall be made to develop operating characteristics of the measuring systems during a split compartment delivery. Also see Table T.2. Accuracy Classes and Tolerances for Mass Flow Meters.

(Added 1999)

N.6.3. Repeatability Tests. – Tests for repeatability should include a minimum of three consecutive test drafts of approximately the same size and be conducted under controlled conditions where variations in factors such as temperature, pressure, and flow rate are reduced to the extent that they will not affect the results obtained. When conducting the

tests, the discharge rates shall be within the minimum and maximum discharge rates as marked by the manufacturer.

(Amended 2019)

T. Tolerances

T.1. Tolerances, General.

- (a) The tolerances apply equally to errors of underregistration and errors of overregistration.
- (b) The tolerances apply to all products at all temperatures measured at any flow rate within the rated measuring range of the meter.

(Amended 1999)

T.2. Tolerances. – The tolerances for mass flow meters for specific liquids, gases, and applications are listed in Table T.2. Accuracy Classes and Tolerances for Mass Flow Meters.

(Amended 1994 and 1999)

Table T.2. Accuracy Classes and Tolerances for Mass Flow Meters

Accuracy Class	Application or Commodity Being Measured	Acceptance Tolerance	Maintenance Tolerance	Special Tolerance
0.3	<ul style="list-style-type: none"> - Large capacity motor-fuel dispensers (maximum discharge flow rates greater than 100 L/min or 25 gal/min) - Heated products (other than asphalt) at temperatures greater than 50 °C (122 °F) - Asphalt at temperatures equal to or below 50 °C (122 °F) - Loading rack meters - Vehicle-tank meters - Home heating oil - Milk and other food products - All other liquid applications not shown in the table where the minimum delivery is at least 700 kg (1500 lb) 	0.2 %	0.3 %	0.5 %
0.3A	<ul style="list-style-type: none"> - Asphalt at temperatures greater than 50 °C (122 °F) 	0.3 %	0.3 %	0.5 %
0.5	<ul style="list-style-type: none"> - Small capacity (retail) motor-fuel dispensers - Agri-chemical liquids - All other liquid applications not shown in the table where the minimum delivery is less than 700 kg or 1500 lb 	0.3 %	0.5 %	0.5 %
1.0	<ul style="list-style-type: none"> - Anhydrous ammonia - LP Gas (including vehicle-tank meters) 	0.6 %	1.0 %	1.0 %
2.0	<ul style="list-style-type: none"> - Compressed natural gas as a motor-fuel - All other hydrocarbon gases and any other hydrocarbon gas/air mix applications not shown in the table 	1.5 %	2.0 %	2.0 %
2.5	<ul style="list-style-type: none"> - Cryogenic liquid meters - Liquefied compressed gases other than LP Gas 	1.5 %	2.5 %	2.5 %

(Added 1994) (Amended 1999, 2001, 2013 and 2022)

T.3. Repeatability. – When multiple tests are conducted at approximately the same flow rate and draft size, the range of the test results for the flow rate shall not exceed 40 % of the absolute value of the maintenance tolerance and the results of each test shall be within the applicable tolerance. Also see N.6.3 Repeatability Tests.

(Amended 1992, 1994, 2001, and 2019)

T.4. Type Evaluation Examinations for Liquid-Measuring Devices. – For type evaluation examinations, the tolerance values shall apply under the following conditions:

- (a) with any one liquid within the range of liquids;
- (b) at any one liquid temperature and pressure within the operating range of the meter; and
- (c) at all flow rates within the range of flow rates.

(Added 1993) (Amended 1994)

UR. User Requirements

UR.1. Selection Requirements.

UR.1.1. Discharge Hose-Length. – *The length of the discharge hose on a retail motor-fuel device shall not exceed 4.6 m (15 ft) unless it can be demonstrated that a longer hose is essential to permit deliveries to be made to receiving vehicles or vessels.*

[Nonretroactive as of January 1, 1998]

(Added 1997)

UR.1.2. Minimum Measured Quantity.

- (a) The minimum measured quantity shall be specified by the manufacturer.
- (b) The minimum measured quantity appropriate for a transaction may be specified by the weights and measures authority. A device may have a minimum measured quantity smaller than that specified by the weights and measures authority; however, the device must perform within the performance requirements for the declared minimum measured quantity.

UR.2. Installation Requirements.

UR.2.1. Manufacturer's Instructions. – A device shall be installed in accordance with the manufacturer's instructions, and the installation shall be sufficiently secure and rigid to maintain this condition.

(Added 1997)

UR.2.2. Discharge Rate. – A device shall be installed so that the actual maximum discharge rate will not exceed the rated maximum discharge rate. Automatic means of flow regulation shall be incorporated in the installation if necessary.

(Added 1997)

UR.2.3. Low-Flow Cut-Off Valve. – If a metering system is equipped with a programmable or adjustable “low-flow cut-off” feature:

- (a) the low-flow cut-off value shall not be set at flow rates lower than the minimum operating flow rate specified by the manufacturer on the meter; and
- (b) the system shall be equipped with flow control valves which prevent the flow of product and stop the indicator from registering product flow whenever the product flow rate is less than the low-flow cut-off value.

(Added 1992)

UR.3. Use of Device.

UR.3.1. Unit Price and Product Identity for Retail Dispensers. – The following information shall be conspicuously displayed or posted on the face of a retail dispenser used in direct sale:

- (a) except for dispensers used exclusively for fleet sales, other price contract sales, and truck refueling (e.g., truck stop dispensers used only to refuel trucks), all of the unit prices at which the product is offered for sale; and
- (b) in the case of a computing type or money-operated type, the unit price at which the dispenser is set to compute.

(Added 1993)

UR.3.1.1. Marking of Equivalent Conversion Factors for Compressed Natural Gas. [NOT ADOPTED - CCR § 4001. Exceptions.]

§ 4002.10. Mass Flow Meters. (3.37.). UR.3.1.1. Marking of Equivalent Conversion Factor for Compressed Natural Gas.

A device dispensing compressed natural gas shall have the statement “1 Gasoline Gallon Equivalent (GGE) equals 5.66 lb of Compressed Natural Gas” permanently and conspicuously marked on the face of the dispenser.

(Adopted, 4 CCR 4002.10.)

U.R.3.1.2. Marking of Equivalent Conversion Factor for Liquefied Natural Gas. [NOT ADOPTED - CCR § 4001. Exceptions.]

§ 4002.10. Mass Flow Meters. (3.37.). U.R.3.1.2. Marking of Equivalent Conversion Factor for Liquefied Natural Gas.

A device dispensing liquefied natural gas shall have the statement “1 Diesel Gallon Equivalent (DGE) equals 6.06 lb of Liquefied Natural Gas” permanently and conspicuously marked on the face of the dispenser.

(Adopted, 4 CCR 4002.10.)

UR.3.2. Vapor-Return Line. – During any metered delivery of liquefied petroleum gas and other liquids from a supplier’s tank to a receiving container, there shall be no vapor-return line from the receiving container to the supplier’s tank:

(a) in the case of any receiving container to which normal deliveries can be made without the use of such vapor-return line; or

(b) in the case of any new receiving container when the ambient temperature is below 90 °F.

(Added 1993)

UR.3.3. Ticket Printer; Customer Ticket. – Vehicle-mounted metering systems shall be equipped with a ticket printer which shall be used for all sales where product is delivered through the meter. A copy of the ticket issued by the device shall be left with the customer at the time of delivery or as otherwise specified by the customer.

(Added 1994)

UR.3.4. Printed Ticket. – The total price, the total quantity of the delivery, and the price per unit shall be printed on any ticket issued by a device of the computing type and containing any one of these values.

(Added 1993)

UR.3.5. Ticket in Printing Device. – A ticket shall not be inserted into a device equipped with a ticket printer until immediately before a delivery is begun, and in no case shall a ticket be in the device when the vehicle is in motion while on a public street, highway, or thoroughfare.

(Added 1993)

UR.3.6. Steps After Dispensing. – After delivery to a customer from a retail motor-fuel device:

(a) the starting lever shall be returned to its shutoff position and the zero-set-back interlock engaged; and

- (b) the discharge nozzle shall be returned to its designed hanging position unless the primary indicating elements, and recording elements, if the device is equipped and activated to record, have been returned to a definite zero indication.

(Added 1993)

UR.3.7. Return of Indicating and Recording Elements to Zero. – The primary indicating elements (visual), and the primary recording elements when these are returnable to zero, shall be returned to zero immediately before each delivery. Exceptions to this requirement are totalizers on key-lock-operated or other self-operated dispensers and the primary recording element if the device is equipped to record.

(Added 1995) (Amended 1997)

UR.3.8. Return of Product to Storage, Retail Compressed and Liquefied Natural Gas Dispensers. – Provisions at the site shall be made for returning product to storage or disposing of the product in a safe and timely manner during or following testing operations. Such provisions may include return lines, or cylinders adequate in size and number to permit this procedure.

(Added 1998) (Amended 2016)

Table of Contents

	Page
Section 3.38. Carbon Dioxide Liquid-Measuring Devices	135
A. Application	135
A.1. General.	135
A.2. Exceptions.....	135
A.3. Additional Code Requirements.....	135
A.4. Type Evaluation.....	135
S. Specifications	135
S.1. Design of Indicating and Recording Elements and of Recorded Representations.	135
S.1.1. Primary Elements.	135
S.1.2. Graduations.....	136
S.1.3. Indicators.....	136
S.1.4. Computing-Type Devices.	137
S.2. Design of Measuring Elements.....	137
S.2.1. Air/Vapor Elimination. –	137
S.2.2. Reverse Flow Measurement.....	138
S.2.3. Maintenance of Liquid State.	138
S.2.4. Automatic Temperature or Density Compensation.....	138
S.2.5. Provision for Sealing.....	138
S.3. Design of Discharge Lines and Discharge Line Valves.	139
S.3.1. Diversion of Measured Liquid.	139
S.3.2. Discharge Hose.....	140
S.4. Marking Requirements.	140
S.4.1. Limitation of Use.....	140
S.4.2. Discharge Rates.....	140
N. Notes	140
N.1. Test Liquid.....	140
N.2. Vaporization and Volume Change.....	140
N.3. Test Drafts.....	140
N.3.1. Gravimetric Test.	140
N.3.2. Transfer Standard Test.....	140
N.3.3. Volumetric Prover Test Drafts.	140
N.4. Testing Procedures.	140
N.4.1. Normal Tests.....	140

- N.4.2. Special Tests.....141
- N.4.3. Density.141
- N.4.4. Automatic Temperature or Density Compensation.141
- N.4.5. Repeatability Tests150
- T. Tolerances 150**
 - T.1. Application.....150
 - T.1.1. To Underregistration and to Overregistration.150
 - T.2. Tolerance Values.150
 - T.2.1. Repeatability.....151
 - T.3. On Tests Using Transfer Standards.151
- UR. User Requirements..... 151**
 - UR.1. Installation Requirements.151
 - UR.1.1. Discharge Rate.....151
 - UR.1.2. Length of Discharge Hose.151
 - UR.1.3. Maintenance of Liquid State.151
 - UR.2. Use Requirements.151
 - UR.2.1. Return of Indicating and Recording Elements to Zero.151
 - UR.2.2. Condition of Discharge System.151
 - UR.2.3. Vapor Equalization Line.....151
 - UR.2.4. Temperature or Density Compensation.....152
 - UR.2.5. Ticket in Printing Device.152
 - UR.2.6. Sale by Weight.152

Section 3.38. Carbon Dioxide Liquid-Measuring Devices

A. Application

A.1. General. – This code applies to liquid-measuring devices used for the measurement of liquid carbon dioxide.

A.2. Exceptions. – This code does not apply to devices used solely for dispensing a product in connection with operations in which the amount dispensed does not affect customer charges.

A.3. Additional Code Requirements. – In addition to the requirements of this code, Carbon Dioxide Liquid-Measuring Devices shall meet the requirements of Section 1.10. General Code.

A.4. Type Evaluation. – The National Type Evaluation Program will accept for type evaluation only those devices that comply with all requirements of this code.

(Added 1998)

S. Specifications

S.1. Design of Indicating and Recording Elements and of Recorded Representations.

S.1.1. Primary Elements.

S.1.1.1. General. – A device shall be equipped with a primary indicating element and may also be equipped with a primary recording element.

S.1.1.2. Units. – A device shall indicate and record, if equipped to record, its deliveries in terms of pounds or kilograms or decimal subdivisions or multiples thereof.

S.1.1.3. Value of Smallest Unit. – The value of the smallest unit of indicated delivery, and recorded delivery, if the device is equipped to record, shall not exceed the equivalent of:

(a) for small delivery devices:

- (1) 1 kilogram; or
- (2) 1 pound

(b) for large delivery devices:

- (1) 10 kilograms; or
- (2) 10 pounds

S.1.1.4. Advancement of Indicating and Recording Elements. – Primary indicating and recording elements shall be susceptible to advancement only by the normal

operation of the device. However, a device may be cleared by advancing its elements to zero, but only if:

- (a) the advancing movement, once started, cannot be stopped until zero is reached;
or
- (b) in the case of indicating elements only, such elements are automatically obscured until the elements reach the correct zero position.

S.1.1.5. Return to Zero. – Primary indicating and recording elements shall be readily returnable to a definite zero indication. Means shall be provided to prevent the return of primary indicating elements and of primary recording elements beyond their correct zero position.

S.1.2. Graduations.

S.1.2.1. Length. – Graduations shall be so varied in length that they may be conveniently read.

S.1.2.2. Width. – In any series of graduations, the width of a graduation shall in no case be greater than the width of the minimum clear interval between graduations. The width of main graduations shall be not more than 50 % greater than the width of subordinate graduations. Graduations shall in no case be less than 0.2 mm (0.008 in) in width.

S.1.2.3. Clear Interval Between Graduations. – The clear interval shall be not less than 1.0 mm (0.04 in). If the graduations are not parallel, the measurement shall be made:

- (a) along the line of relative movement between the graduations at the end of the indicator; or
- (b) if the indicator is continuous, at the point of widest separation of the graduations.

(Also see S.1.3.6. Travel of Indicator.)

S.1.3. Indicators.

S.1.3.1. Symmetry. – The index of an indicator shall be of the same shape as the graduations at least throughout that portion of its length associated with the graduations.

S.1.3.2. Length. – The index of an indicator shall reach to the finest graduations with which it is used, unless the indicator and the graduations are in the same plane, in which case the distance between the end of the indicator and the ends of the graduations, measured along the line of the graduations, shall be not more than 1.0 mm (0.04 in).

S.1.3.3. Width. – The width of the index of the indicator in relation to the series of graduations with which it is used shall be not greater than:

(a) *the width of the narrowest graduation;* and*

*[*Nonretroactive as of January 1, 2002]*

(Amended 2001)

(b) the width of the minimum clear interval between graduations.

When the index of an indicator extends along the entire length of a graduation, that portion of the index of the indicator that may be brought into coincidence with the graduation shall be of the same width throughout the length of the index that coincides with the graduation.

S.1.3.4. Clearance. – The clearance between the index of an indicator and the graduations shall in no case be more than 1.5 mm (0.06 in).

S.1.3.5. Parallax. – Parallax effects shall be reduced to the practicable minimum.

S.1.3.6. Travel of Indicator. – If the most sensitive element of the primary indicating element utilizes an indicator and graduations, the relative movement of these parts corresponding to the smallest indicated value shall be no less than 5 mm (0.20 in).

S.1.4. Computing-Type Devices.

S.1.4.1. Printed Ticket. – Any printed ticket issued by a device of the computing type on which there is printed the total computed price shall have printed clearly thereon also the total quantity of the delivery and the price per unit.

S.1.4.2. Money-Value Computations. – Money-value computations shall be of the full-computing type in which the money-value at a single unit price, or at each of a series of unit prices, shall be computed for every delivery within either the range of measurement of the device or the range of the computing elements, whichever is less.

The total price shall be computed on the basis of the quantity indicated when the value of the smallest division indicated is equal to or less than the value specified in S.1.1.3. Value of Smallest Unit.

S.1.4.3. Money-Values, Mathematical Agreement. – Any digital money-value indication and any recorded money-value on a computing-type device shall be in mathematical agreement with its associated quantity indication or representation to within 1 cent of money-value.

S.2. Design of Measuring Elements.

S.2.1. Air/Vapor Elimination. – A measuring system shall be equipped with an effective air/vapor eliminator or other automatic means to prevent the passage of air/vapor through

the meter. Vent lines from the air/vapor eliminator shall be made of appropriate non-collapsible material. (Also see Section T. Tolerances.)

(Amended 2016 and 2018)

S.2.2. Reverse Flow Measurement. – Effective means, automatic in operation, shall be installed to prevent reverse flow measurement.

S.2.3. Maintenance of Liquid State. – A device shall be so designed that the product being measured will remain in a liquid state during passage through the device.

S.2.4. Automatic Temperature or Density Compensation. – A volumetric device shall be equipped with automatic means for adjusting the indication and recorded representation of the measured quantity of the product to indicate or record the quantity of the product measured in terms of pounds.

S.2.5. Provision for Sealing. – For devices and systems in which the configuration or calibration parameters can be changed by use of a removable digital storage device, security shall be provided for those parameters as specified in G-S.8.2. Devices and Systems Adjusted Using Removable Digital Storage Devices. For parameters adjusted using other means, the following applies.

Adequate provision shall be made for an approved means of security (e.g., data change audit trail) or for physically applying a security seal in such a manner that requires the security seal to be broken before an adjustment or interchange can be made of:

- (a) any measuring or indicating element;
- (b) any adjustable element for controlling delivery rate when such rate tends to affect the accuracy of deliveries;
- (c) any automatic temperature or density compensating system; and
- (d) any metrological parameter that will affect the metrological integrity of the device or system.

When applicable any adjusting mechanism shall be readily accessible for purposes of affixing a security seal.

*Audit trails shall use the format set forth in Table S.2.5. Provision for Sealing.**

*[*Nonretroactive as of January 1, 1995]*

(Amended 2006 and 2019)

Table S.2.5. - Categories of Device and Methods of Sealing

Categories of Device	Methods of Sealing
<p>Category 1: No remote configuration capability.</p>	<p>Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.</p>
<p>Category 2: Remote configuration capability, but access is controlled by physical hardware.</p> <p>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.</p>	<p>The hardware enabling access for remote communication must be on-site. The hardware must be sealed using a physical seal or an event counter for calibration parameters and an event counter for configuration parameters. The event counters may be located either at the individual measuring device or at the system controller; however, an adequate number of counters must be provided to monitor the calibration and configuration parameters of the individual devices at a location. If the counters are located in the system controller rather than at the individual device, means must be provided to generate a hard copy of the information through an on-site device.</p>
<p>Category 3: Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password).</p> <p>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.</p>	<p>An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. A printed copy of the information must be available on demand through the device or through another on-site device. The information may also be available electronically. The event logger shall have a capacity to retain records equal to 10 times the number of sealable parameters in the device, but not more than 1000 records are required. (Note: Does not require 1000 changes to be stored for each parameter.)</p>

[Nonretroactive as of January 1, 1995]

(Table Added 2006) (Amended 2016)

S.3. Design of Discharge Lines and Discharge Line Valves.

S.3.1. Diversion of Measured Liquid. – No means shall be provided by which any measured liquid can be diverted from the measuring chamber of the device or the discharge line therefrom, except that a manually controlled outlet that may be opened for purging or draining the measuring system shall be permitted. Effective means shall be provided to prevent the passage of liquid through any such outlet during normal operation of the device and to indicate clearly and unmistakably when the valve controls are so set as to permit passage of liquid through such outlet.

S.3.2. Discharge Hose. – The discharge hose of a measuring system shall be of a wet hose type with a shutoff valve at its outlet end.

S.4. Marking Requirements.

S.4.1. Limitation of Use. – If a measuring system is intended to measure accurately only liquids having particular properties, or to measure accurately only under specific installation or operating conditions, or to measure accurately only when used in conjunction with specific accessory equipment, these limitations shall be clearly and permanently marked on the device.

S.4.2. Discharge Rates. – A meter shall be marked to show its designed maximum and minimum discharge rates. The marked minimum discharge rate shall not exceed 20 % of the marked maximum discharge rate.

Note: Also see example in Section 3.30. Liquid-Measuring Devices Code, paragraph S.4.4.1. Discharge Rates.

(Note Added 2003)

N. Notes

N.1. Test Liquid. – The test liquid shall be carbon dioxide in a compressed liquid state.

N.2. Vaporization and Volume Change. – Care shall be exercised to reduce vaporization and volume changes to a minimum. When testing by weight, the weigh tank and transfer systems shall be pre-cooled to liquid temperature prior to the start of the test to avoid the venting of vapor from the vessel being weighed.

N.3. Test Drafts.

N.3.1. Gravimetric Test. – Weight test drafts shall be equal to at least the amount delivered by the device in 2 minutes at its maximum discharge rate.

N.3.2. Transfer Standard Test. – When comparing a meter with a calibrated transfer standard, the test draft shall be equal to at least the amount delivered by the device in two minutes at its maximum discharge rate.

N.3.3. Volumetric Prover Test Drafts. – Test drafts shall be equal to at least the amount delivered in one minute at its normal discharge rate.

N.4. Testing Procedures.

N.4.1. Normal Tests. – The “normal” test of a device shall be made at the maximum discharge flow rate developed under the conditions of installation. Any additional tests conducted at flow rates down to and including one-half of the sum of the maximum discharge flow rate and the rated minimum discharge flow rate shall be considered normal tests.

N.4.2. Special Tests. – Any test except as set forth in N.4.1. Normal Tests shall be considered a special test. Tests shall be conducted, if possible, to evaluate any special elements or accessories attached to or associated with the device. A device shall be tested at a minimum discharge rate of:

- (a) not less than the marked minimum discharge rate or 20 % of the maximum rated discharge rate of the device, whichever is less; or
- (b) the lowest discharge rate practicable under the conditions of installation.

“Special” tests may be conducted to develop any characteristics of the device anticipated under the conditions of installation.

N.4.3. Density. – Temperature and pressure of the metered test liquid shall be measured during the test for the determination of density or volume correction when applicable. The appropriate correction values shall apply as specified in Table N.4.4.

N.4.4. Automatic Temperature or Density Compensation. – If a device is equipped with an automatic temperature or density compensator, the compensator shall be tested by comparing the quantity indicated or recorded by the device (with the compensator connected and operating) with the actual delivered quantity. The appropriate correction values shall apply as specified in Table N.4.4. Automatic Temperature or Density Compensation.

Table N.4.4. Automatic Temperature or Density Compensation

Temp °F	Pressure PSIA	Pressure PSIG	Liquid Density lb/gal	Liquid Density (lb-oz)/gal	Vapor Density lb/cu ft	Vapor Density lb/gal	Vapor Displacement %
- 30.00	177.89	163.19	9.127	9 - 2.0	1.989	0.266	2.9
- 29.75	178.75	164.05	9.122	9 - 2.0	1.999	0.267	2.9
- 29.50	179.62	164.92	9.117	9 - 1.9	2.008	0.268	2.9
- 29.25	180.49	165.79	9.113	9 - 1.8	2.018	0.270	3.0
- 29.00	181.36	166.67	9.108	9 - 1.7	2.028	0.271	3.0
- 28.75	182.24	167.54	9.103	9 - 1.7	2.038	0.272	3.0
- 28.50	183.12	168.42	9.098	9 - 1.6	2.048	0.274	3.0
- 28.25	184.00	169.31	9.094	9 - 1.5	2.058	0.275	3.0
- 28.00	184.89	170.19	9.089	9 - 1.4	2.067	0.276	3.0

CCR Title 4, Div. 9, CCR § 4000.
2023 Edition of NIST HB 44 Section 3.38. Carbon Dioxide Liquid-Measuring Devices

Temp °F	Pressure PSIA	Pressure PSIG	Liquid Density lb/gal	Liquid Density (lb-oz)/gal	Vapor Density lb/cu ft	Vapor Density lb/gal	Vapor Displacement %
- 27.75	185.78	171.08	9.084	9 - 1.3	2.077	0.278	3.1
- 27.50	186.67	171.98	9.080	9 - 1.3	2.087	0.279	3.1
- 27.25	187.57	172.87	9.075	9 - 1.2	2.098	0.280	3.1
- 27.00	188.47	173.77	9.070	9 - 1.1	2.108	0.282	3.1
- 26.75	189.37	174.67	9.065	9 - 1.0	2.118	0.283	3.1
- 26.50	190.28	175.58	9.061	9 - 1.0	2.128	0.284	3.1
- 26.25	191.18	176.49	9.056	9 - 0.9	2.138	0.286	3.2
- 26.00	192.10	177.40	9.051	9 - 0.8	2.148	0.287	3.2
- 25.75	193.01	178.32	9.046	9 - 0.7	2.159	0.289	3.2
- 25.50	193.93	179.23	9.041	9 - 0.7	2.169	0.290	3.2
- 25.25	194.85	180.16	9.037	9 - 0.6	2.179	0.291	3.2
- 25.00	195.78	181.08	9.032	9 - 0.5	2.190	0.293	3.2
- 24.75	196.70	182.01	9.027	9 - 0.4	2.200	0.294	3.3
- 24.50	197.64	182.94	9.022	9 - 0.4	2.211	0.296	3.3
- 24.25	198.57	183.87	9.017	9 - 0.3	2.221	0.297	3.3
- 24.00	199.51	184.81	9.013	9 - 0.2	2.232	0.298	3.3
- 23.75	200.45	185.75	9.008	9 - 0.1	2.243	0.300	3.3
- 23.50	201.39	186.70	9.003	9 - 0.0	2.253	0.301	3.3
- 23.25	202.34	187.64	8.998	9 - 0.0	2.264	0.303	3.4
- 23.00	203.29	188.60	8.993	8 - 15.9	2.275	0.304	3.4
- 22.75	204.25	189.55	8.989	8 - 15.8	2.286	0.306	3.4
- 22.50	205.20	190.51	8.984	8 - 15.7	2.296	0.307	3.4
- 22.25	206.16	191.47	8.979	8 - 15.7	2.307	0.308	3.4

CCR Title 4, Div. 9, CCR § 4000.
2023 Edition of NIST HB 44 Section 3.38. Carbon Dioxide Liquid-Measuring Devices

Temp °F	Pressure PSIA	Pressure PSIG	Liquid Density lb/gal	Liquid Density (lb-oz)/gal	Vapor Density lb/cu ft	Vapor Density lb/gal	Vapor Displacement %
- 22.00	207.13	192.43	8.974	8 - 15.6	2.318	0.310	3.5
- 21.75	208.09	193.40	8.969	8 - 15.5	2.329	0.311	3.5
- 21.50	209.06	194.37	8.964	8 - 15.4	2.340	0.313	3.5
- 21.25	210.04	195.34	8.959	8 - 15.4	2.351	0.314	3.5
- 21.00	211.02	196.32	8.955	8 - 15.3	2.362	0.316	3.5
- 20.75	212.00	197.30	8.950	8 - 15.2	2.374	0.317	3.5
- 20.50	212.98	198.28	8.945	8 - 15.1	2.385	0.319	3.6
- 20.25	213.97	199.27	8.940	8 - 15.0	2.396	0.320	3.6
- 20.00	214.96	200.26	8.935	8 - 15.0	2.407	0.322	3.6
- 19.75	215.95	201.26	8.930	8 - 14.9	2.419	0.323	3.6
- 19.50	216.95	202.25	8.925	8 - 14.8	2.430	0.325	3.6
- 19.25	217.95	203.25	8.920	8 - 14.7	2.441	0.326	3.7
- 19.00	218.95	204.26	8.915	8 - 14.6	2.453	0.328	3.7
- 18.75	219.96	205.27	8.911	8 - 14.6	2.464	0.329	3.7
- 18.50	220.97	206.28	8.906	8 - 14.5	2.476	0.331	3.7
- 18.25	221.99	207.29	8.901	8 - 14.4	2.488	0.333	3.7
- 18.00	223.01	208.31	8.896	8 - 14.3	2.499	0.334	3.8
- 17.75	224.03	209.33	8.891	8 - 14.3	2.511	0.336	3.8
- 17.50	225.05	210.36	8.886	8 - 14.2	2.523	0.337	3.8
- 17.25	226.08	211.38	8.881	8 - 14.1	2.534	0.339	3.8
- 17.00	227.11	212.42	8.876	8 - 14.0	2.546	0.340	3.8
- 16.75	228.15	213.45	8.871	8 - 13.9	2.558	0.342	3.9
- 16.50	229.18	214.49	8.866	8 - 13.9	2.570	0.344	3.9

CCR Title 4, Div. 9, CCR § 4000.
2023 Edition of NIST HB 44 Section 3.38. Carbon Dioxide Liquid-Measuring Devices

Temp °F	Pressure PSIA	Pressure PSIG	Liquid Density lb/gal	Liquid Density (lb-oz)/gal	Vapor Density lb/cu ft	Vapor Density lb/gal	Vapor Displacement %
- 16.25	230.23	215.53	8.861	8 - 13.8	2.582	0.345	3.9
- 16.00	231.27	216.58	8.856	8 - 13.7	2.594	0.347	3.9
- 15.75	232.32	217.62	8.851	8 - 13.6	2.606	0.348	3.9
- 15.50	233.37	218.68	8.846	8 - 13.5	2.618	0.350	4.0
- 15.25	234.43	219.73	8.841	8 - 13.5	2.630	0.352	4.0
- 15.00	235.49	220.79	8.836	8 - 13.4	2.643	0.353	4.0
- 14.75	236.55	221.86	8.831	8 - 13.3	2.655	0.355	4.0
- 14.50	237.62	222.92	8.826	8 - 13.2	2.667	0.357	4.0
- 14.25	238.69	223.99	8.821	8 - 13.1	2.680	0.358	4.1
- 14.00	239.76	225.07	8.816	8 - 13.1	2.692	0.360	4.1
- 13.75	240.84	226.14	8.811	8 - 13.0	2.704	0.362	4.1
- 13.50	241.92	227.22	8.806	8 - 12.9	2.717	0.363	4.1
- 13.25	243.00	228.31	8.801	8 - 12.8	2.729	0.365	4.1
- 13.00	244.09	229.39	8.796	8 - 12.7	2.742	0.367	4.2
- 12.75	245.18	230.49	8.791	8 - 12.7	2.755	0.368	4.2
- 12.50	246.28	231.58	8.786	8 - 12.6	2.767	0.370	4.2
- 12.25	247.37	232.68	8.781	8 - 12.5	2.780	0.372	4.2
- 12.00	248.48	233.78	8.776	8 - 12.4	2.793	0.373	4.3
- 11.75	249.58	234.89	8.771	8 - 12.3	2.806	0.375	4.3
- 11.50	250.69	236.00	8.765	8 - 12.2	2.819	0.377	4.3
- 11.25	251.80	237.11	8.760	8 - 12.2	2.832	0.379	4.3
- 11.00	252.92	238.22	8.755	8 - 12.1	2.845	0.380	4.3
- 10.75	254.04	239.34	8.750	8 - 12.0	2.858	0.382	4.4

CCR Title 4, Div. 9, CCR § 4000.
2023 Edition of NIST HB 44 Section 3.38. Carbon Dioxide Liquid-Measuring Devices

Temp °F	Pressure PSIA	Pressure PSIG	Liquid Density lb/gal	Liquid Density (lb-oz)/gal	Vapor Density lb/cu ft	Vapor Density lb/gal	Vapor Displacement %
- 10.50	255.16	240.47	8.745	8 - 11.9	2.871	0.384	4.4
- 10.25	256.29	241.60	8.740	8 - 11.8	2.884	0.386	4.4
- 10.00	257.42	242.73	8.735	8 - 11.8	2.897	0.387	4.4
- 9.75	258.56	243.86	8.730	8 - 11.7	2.911	0.389	4.5
- 9.50	259.70	245.00	8.725	8 - 11.6	2.924	0.391	4.5
- 9.25	260.84	246.14	8.719	8 - 11.5	2.937	0.393	4.5
- 9.00	261.98	247.29	8.714	8 - 11.4	2.951	0.394	4.5
- 8.75	263.13	248.44	8.709	8 - 11.3	2.964	0.396	4.5
- 8.50	264.29	249.59	8.704	8 - 11.3	2.978	0.398	4.6
- 8.25	265.44	250.75	8.699	8 - 11.2	2.991	0.400	4.6
- 8.00	266.60	251.91	8.694	8 - 11.1	3.005	0.402	4.6
- 7.75	267.77	253.07	8.688	8 - 11.0	3.019	0.404	4.6
- 7.50	268.93	254.24	8.683	8 - 10.9	3.032	0.405	4.7
- 7.25	270.11	255.41	8.678	8 - 10.8	3.046	0.407	4.7
- 7.00	271.28	256.59	8.673	8 - 10.8	3.060	0.409	4.7
- 6.75	272.46	257.76	8.668	8 - 10.7	3.074	0.411	4.7
- 6.50	273.64	258.95	8.662	8 - 10.6	3.088	0.413	4.8
- 6.25	274.83	260.13	8.657	8 - 10.5	3.102	0.415	4.8
- 6.00	276.02	261.32	8.652	8 - 10.4	3.116	0.417	4.8
- 5.75	277.21	262.52	8.647	8 - 10.3	3.130	0.418	4.8
- 5.50	278.41	263.72	8.641	8 - 10.3	3.144	0.420	4.9
- 5.25	279.61	264.92	8.636	8 - 10.2	3.159	0.422	4.9
- 5.00	280.82	266.12	8.631	8 - 10.1	3.173	0.424	4.9

CCR Title 4, Div. 9, CCR § 4000.
 2023 Edition of NIST HB 44 Section 3.38. Carbon Dioxide Liquid-Measuring Devices

Temp °F	Pressure PSIA	Pressure PSIG	Liquid Density lb/gal	Liquid Density (lb-oz)/gal	Vapor Density lb/cu ft	Vapor Density lb/gal	Vapor Displacement %
- 4.75	282.03	267.33	8.626	8 - 10.0	3.187	0.426	4.9
- 4.50	283.24	268.55	8.620	8 - 9.9	3.202	0.428	5.0
- 4.25	284.46	269.76	8.615	8 - 9.8	3.216	0.430	5.0
- 4.00	285.68	270.98	8.610	8 - 9.8	3.231	0.432	5.0
- 3.75	286.90	272.21	8.604	8 - 9.7	3.245	0.434	5.0
- 3.50	288.13	273.44	8.599	8 - 9.6	3.260	0.436	5.1
- 3.25	289.37	274.67	8.594	8 - 9.5	3.275	0.438	5.1
- 3.00	290.60	275.91	8.589	8 - 9.4	3.289	0.440	5.1
- 2.75	291.84	277.15	8.583	8 - 9.3	3.304	0.442	5.1
- 2.50	293.09	278.39	8.578	8 - 9.2	3.319	0.444	5.2
- 2.25	294.33	279.64	8.573	8 - 9.2	3.334	0.446	5.2
- 2.00	295.58	280.89	8.567	8 - 9.1	3.349	0.448	5.2
- 1.75	296.84	282.14	8.562	8 - 9.0	3.364	0.450	5.3
- 1.50	298.10	283.40	8.556	8 - 8.9	3.379	0.452	5.3
- 1.25	299.36	284.67	8.551	8 - 8.8	3.395	0.454	5.3
- 1.00	300.63	285.93	8.546	8 - 8.7	3.410	0.456	5.3
- 0.75	301.90	287.21	8.540	8 - 8.6	3.425	0.458	5.4
- 0.50	303.18	288.48	8.535	8 - 8.6	3.440	0.460	5.4
- 0.25	304.46	289.76	8.530	8 - 8.5	3.456	0.462	5.4
0.00	305.74	291.74	8.524	8 - 8.4	3.471	0.464	5.4
0.25	307.03	292.33	8.519	8 - 8.3	3.487	0.466	5.5
0.50	308.32	293.62	8.513	8 - 8.2	3.503	0.468	5.5
0.75	309.61	294.92	8.508	8 - 8.1	3.518	0.470	5.5

CCR Title 4, Div. 9, CCR § 4000.
2023 Edition of NIST HB 44 Section 3.38. Carbon Dioxide Liquid-Measuring Devices

Temp °F	Pressure PSIA	Pressure PSIG	Liquid Density lb/gal	Liquid Density (lb-oz)/gal	Vapor Density lb/cu ft	Vapor Density lb/gal	Vapor Displacement %
1.00	310.91	296.21	8.502	8 - 8.0	3.534	0.472	5.6
1.25	312.21	297.52	8.497	8 - 8.0	3.550	0.475	5.6
1.50	313.52	298.82	8.491	8 - 7.9	3.566	0.477	5.6
1.75	314.83	300.13	8.486	8 - 7.8	3.582	0.479	5.6
2.00	316.15	301.45	8.480	8 - 7.7	3.598	0.481	5.7
2.25	317.46	302.77	8.475	8 - 7.6	3.614	0.483	5.7
2.50	318.79	304.09	8.469	8 - 7.5	3.630	0.485	5.7
2.75	320.11	305.42	8.464	8 - 7.4	3.646	0.487	5.8
3.00	321.45	306.75	8.458	8 - 7.3	3.662	0.490	5.8
3.25	322.78	308.08	8.453	8 - 7.2	3.679	0.492	5.8
3.50	324.12	309.42	8.447	8 - 7.2	3.695	0.494	5.8
3.75	325.46	310.77	8.442	8 - 7.1	3.712	0.496	5.9
4.00	326.81	312.11	8.436	8 - 7.0	3.728	0.498	5.9
4.25	328.16	313.46	8.431	8 - 6.9	3.745	0.501	5.9
4.50	329.52	314.82	8.425	8 - 6.8	3.761	0.503	6.0
4.75	330.88	316.18	8.420	8 - 6.7	3.778	0.505	6.0
5.00	332.24	317.54	8.414	8 - 6.6	3.795	0.507	6.0
5.25	333.61	318.91	8.408	8 - 6.5	3.812	0.510	6.1
5.50	334.98	320.28	8.403	8 - 6.4	3.829	0.512	6.1
5.75	336.35	321.66	8.397	8 - 6.4	3.846	0.514	6.1
6.00	337.73	323.04	8.392	8 - 6.3	3.863	0.516	6.2
6.25	339.12	324.42	8.386	8 - 6.2	3.880	0.519	6.2
6.50	340.51	325.81	8.380	8 - 6.1	3.897	0.521	6.2

CCR Title 4, Div. 9, CCR § 4000.
2023 Edition of NIST HB 44 Section 3.38. Carbon Dioxide Liquid-Measuring Devices

Temp °F	Pressure PSIA	Pressure PSIG	Liquid Density lb/gal	Liquid Density (lb-oz)/gal	Vapor Density lb/cu ft	Vapor Density lb/gal	Vapor Displacement %
6.75	341.90	327.20	8.375	8 - 6.0	3.915	0.523	6.3
7.00	343.30	328.60	8.369	8 - 5.9	3.932	0.526	6.3
7.25	344.70	330.00	8.363	8 - 5.8	3.949	0.528	6.3
7.50	346.10	331.41	8.358	8 - 5.7	3.967	0.530	6.3
7.75	347.51	332.82	8.352	8 - 5.6	3.984	0.533	6.4
8.00	348.92	334.23	8.346	8 - 5.5	4.002	0.535	6.4
8.25	350.34	335.65	8.341	8 - 5.4	4.020	0.537	6.4
8.50	351.76	337.07	8.335	8 - 5.4	4.038	0.540	6.5
8.75	353.19	338.49	8.335	8 - 5.4	4.038	0.540	6.5
9.00	354.62	339.92	8.323	8 - 5.2	4.073	0.545	6.5
9.25	356.06	341.36	8.318	8 - 5.1	4.091	0.547	6.6
9.50	357.49	342.80	8.312	8 - 5.0	4.110	0.549	6.6
9.75	358.94	344.24	8.306	8 - 4.9	4.128	0.552	6.6
10.00	360.38	345.69	8.300	8 - 4.8	4.146	0.554	6.7
10.25	361.84	347.14	8.295	8 - 4.7	4.164	0.557	6.7
10.50	363.29	348.60	8.289	8 - 4.6	4.183	0.559	6.7
10.75	364.75	350.06	8.283	8 - 4.5	4.201	0.562	6.8
11.00	366.22	351.52	8.277	8 - 4.4	4.220	0.564	6.8
11.25	367.68	352.99	8.271	8 - 4.3	4.238	0.567	6.8
11.50	369.16	354.46	8.266	8 - 4.2	4.257	0.569	6.9
11.75	370.64	355.94	8.260	8 - 4.2	4.276	0.572	6.9
12.00	372.12	357.42	8.254	8 - 4.1	4.295	0.574	7.0
12.25	373.60	358.91	8.248	8 - 4.0	4.314	0.577	7.0

CCR Title 4, Div. 9, CCR § 4000.
2023 Edition of NIST HB 44 Section 3.38. Carbon Dioxide Liquid-Measuring Devices

Temp °F	Pressure PSIA	Pressure PSIG	Liquid Density lb/gal	Liquid Density (lb-oz)/gal	Vapor Density lb/cu ft	Vapor Density lb/gal	Vapor Displacement %
12.50	375.09	360.40	8.242	8 - 3.9	4.333	0.579	7.0
12.75	376.59	361.89	8.236	8 - 3.8	4.352	0.582	7.1
13.00	378.09	363.39	8.230	8 - 3.7	4.371	0.584	7.1
13.25	379.59	364.89	8.224	8 - 3.6	4.390	0.587	7.1
13.50	381.10	366.40	8.219	8 - 3.5	4.410	0.589	7.2
13.75	382.61	367.91	8.213	8 - 3.4	4.429	0.592	7.2
14.00	384.13	369.43	8.207	8 - 3.3	4.449	0.595	7.2
14.25	385.65	370.95	8.201	8 - 3.2	4.468	0.597	7.3
14.50	387.17	372.48	8.195	8 - 3.1	4.488	0.600	7.3
14.75	388.70	374.01	8.189	8 - 3.0	4.508	0.603	7.4
15.00	390.24	375.54	8.183	8 - 2.9	4.527	0.605	7.4
15.25	391.78	377.08	8.177	8 - 2.8	4.547	0.608	7.4
15.50	393.32	378.62	8.171	8 - 2.7	4.567	0.611	7.5
15.75	394.87	380.17	8.165	8 - 2.6	4.587	0.613	7.5
16.00	396.42	381.72	8.159	8 - 2.5	4.608	0.616	7.5
16.25	397.98	383.28	8.153	8 - 2.4	4.628	0.619	7.6
16.50	399.54	384.84	8.147	8 - 2.3	4.648	0.621	7.6
16.75	401.10	386.41	8.141	8 - 2.2	4.669	0.624	7.7
17.00	402.67	387.98	8.134	8 - 2.2	4.689	0.627	7.7
17.25	404.25	389.55	8.128	8 - 2.1	4.710	0.630	7.7
17.50	405.82	391.13	8.122	8 - 2.0	4.731	0.632	7.8
17.75	407.41	392.71	8.116	8 - 1.9	4.751	0.635	7.8
18.00	409.00	394.30	8.110	8 - 1.8	4.772	0.638	7.9

Temp °F	Pressure PSIA	Pressure PSIG	Liquid Density lb/gal	Liquid Density (lb-oz)/gal	Vapor Density lb/cu ft	Vapor Density lb/gal	Vapor Displacement %
18.25	410.59	395.89	8.104	8 - 1.7	4.793	0.641	7.9
18.50	412.19	397.49	8.098	8 - 1.6	4.814	0.644	7.9
18.75	413.79	399.09	8.092	8 - 1.5	4.835	0.646	8.0
19.00	415.39	400.70	8.085	8 - 1.4	4.857	0.649	8.0
19.25	417.00	402.31	8.079	8 - 1.3	4.878	0.652	8.1
19.50	418.62	403.92	8.073	8 - 1.2	4.900	0.655	8.1
19.75	420.24	405.54	8.067	8 - 1.1	4.921	0.658	8.2
20.00	421.86	407.17	8.061	8 - 1.0	4.943	0.661	8.2

N.4.5. Repeatability Tests. – Tests for repeatability should include a minimum of three consecutive test drafts of approximately the same size and be conducted under controlled conditions where variations in factors such as temperature, pressure, and flow rate are reduced to the extent that they will not affect the results obtained. When conducting the tests, the discharge rates shall be within the minimum and maximum discharge rates as marked by the manufacturer. For devices equipped with an automatic temperature or density compensator, results shall be based on tests with either:

- (1) all runs conducted with the compensated (net) volume (e.g., with the temperature or density compensator activated); or
- (2) all runs conducted with the uncompensated (gross) volume (e.g., with the temperature or density compensator deactivated).

(Amended 2019)

T. Tolerances

T.1. Application.

T.1.1. To Underregistration and to Overregistration. – The tolerances hereinafter prescribed shall be applied to errors of underregistration and errors of overregistration.

T.2. Tolerance Values. – The maintenance and acceptance tolerances for normal and special tests shall be as shown in Table T.2. Accuracy Classes and Tolerances for Carbon Dioxide Liquid-Measuring Devices.

Table T.2. Accuracy Classes and Tolerances for Carbon Dioxide Liquid-Measuring Devices

Accuracy Class	Application	Acceptance Tolerance	Maintenance Tolerance	Special Test Tolerance
2.5	Liquid Carbon dioxide	1.5 %	2.5 %	2.5 %

(Table Added 2003) (Amended 2003)

T.2.1. Repeatability. – When multiple tests are conducted at approximately the same flow rate and draft size, the range of the test results for the flow rate shall not exceed 40 % of the absolute value of the maintenance tolerance and the results of each test shall be within the applicable tolerance. Also see N.4.5. Repeatability Tests.

(Added 2002) (Amended 2019)

T.3. On Tests Using Transfer Standards. – To the basic tolerance values that would otherwise be applied, there shall be added an amount equal to two times the standard deviation of the applicable transfer standard when compared to a basic reference standard.

UR. User Requirements

UR.1. Installation Requirements.

UR.1.1. Discharge Rate. – A device shall be so installed that the actual maximum discharge rate will not exceed the rated maximum discharge rate. If necessary, means for flow regulation shall be incorporated in the installation.

UR.1.2. Length of Discharge Hose. – The discharge hose shall be of such a length and design as to keep vaporization of the liquid to a minimum.

UR.1.3. Maintenance of Liquid State. – A device shall be so installed and operated that the product being measured shall remain in the liquid state during passage through the meter.

UR.2. Use Requirements.

UR.2.1. Return of Indicating and Recording Elements to Zero. – The primary indicating elements (visual) and the primary recording elements shall be returned to zero immediately before each delivery.

UR.2.2. Condition of Discharge System. – The discharge hose, up to the valve at the end of the discharge hose, shall be completely filled and pre-cooled to liquid temperatures before a “zero” condition is established and prior to the start of a commercial delivery. Means shall be provided to fill the discharge hose with liquid prior to the start of a delivery.

UR.2.3. Vapor Equalization Line. – A vapor equalization line shall not be used during a metered delivery unless the quantity of vapor displaced from the buyer’s tank to the seller’s

tank is deducted from the metered quantity. The appropriate correction values shall apply as specified in Table N.4.4.

UR.2.4. Temperature or Density Compensation.

UR.2.4.1. Use of Automatic Temperature or Density Compensators. – Devices equipped with an automatic temperature or density compensator shall have the compensator connected, operable, and in use at all times. Such automatic temperature or density compensator may not be removed.

UR.2.4.2. Tickets or Invoices. – Any written invoice or printed ticket based on a reading of a device that is equipped with an automatic temperature or density compensator shall have shown thereon that the quantity delivered has been temperature or density compensated.

UR.2.5. Ticket in Printing Device. – A ticket shall not be inserted into a device equipped with a ticket printer until immediately before a delivery is begun, and in no case shall a ticket be in the device when the vehicle is in motion while on a public street, highway, or thoroughfare.

UR.2.6. Sale by Weight. – All quantity determinations shall be made by means of an approved and sealed weighing or measuring device. All sales shall be stated in kilograms or pounds.

Table of Contents

	Page
Section 3.39. Hydrogen Gas-Measuring Devices	153
A. Application	153
A.1. General.	153
A.2. Exceptions.....	153
(c) [NOT ADOPTED - CCR § 4001. Exceptions.]	153
A.3. Additional Code Requirements.....	153
A.4. Type Evaluation. – [NOT ADOPTED - CCR § 4001. Exceptions.].....	153
§ 4002.9. Hydrogen Gas-Measuring Devices (3.39.). A.4.Type Evaluation.....	153
S. Specifications	153
S.1. Indicating and Recording Elements.....	153
S.1.1. Indicating Elements	153
S.1.2. Vehicle Fuel Dispensers	153
S.1.3. Units.....	153
S.1.4. Value of Smallest Unit.....	154
S.2. Operating Requirements.	154
S.2.1. Return to Zero.....	154
S.2.2. Indicator Reset Mechanism.	154
S.2.3. Provision for Power Loss.	154
S.2.4. Display of Unit Price and Product Identity.....	155
S.2.5. Money-Value Computations.....	155
S.2.6. Recorded Representations, Point of Sale Systems.	155
S.2.7. Indication of Delivery.....	155
S.2.8. Automatic Timeout – Pay-At-Vehicle Fuel Dispensers.....	156
S.3. Design of Measuring Elements and Measuring Systems.	156
S.3.1. Maximum and Minimum Flow-Rates.....	156
S.3.2. Adjustment Means.	156
S.3.3. Provision for Sealing.....	156
(Amended 2016).....	157
S.3.4. Automatic Density Correction.	157
S.3.5. Pressurizing the Discharge Hose.....	157
S.3.6. Zero-Set-Back Interlock, Retail Vehicle Fuel Devices.....	158
S.4. Discharge Lines and Valves.	158
S.4.1. Diversion of Measured Product.....	158
S.4.2. Directional Flow Valves.....	158
S.4.3. Other Valves.	158
S.5. Markings.....	158
S.5.1. Location of Marking Information; Hydrogen-Fuel Dispensers.	159
§ 4002.9. S.5.2. Location of Accuracy Class 2.0, 3.0, 5.0, 7.0, and 10.0 Information.	159

CCR Title 4, Div. 9, CCR §§ 4000., 4001., 4002.9
 2023 Edition of NIST HB 44 Section 3.39. Hydrogen Gas-Measuring Devices

S.6. Printer.....	160
S.6.1. Printed Receipt.....	160
S.7. Totalizers for Vehicle Fuel Dispensers.....	160
S.8. Minimum Measured Quantity.....	160
N. Notes	161
N.1. Minimum Measured Quantity.....	161
N.2. Test Medium.....	161
N.3. Test Drafts.....	161
N.4. Tests.....	161
N.4.1. Master Meter (Transfer) Standard Test.....	161
N.4.2. Gravimetric Tests.....	161
N.4.3. PVT Pressure Volume Temperature Test.....	161
N.5. Minimum Measured Quantity.....	162
N.6. Testing Procedures.....	162
N.6.1. General.....	162
N.6.2. Repeatability Tests.....	162
N.7. Density.....	162
T. Tolerances.....	162
T.1. Tolerances, General.....	162
T.2. Tolerances.....	163
§ 4002.9. Hydrogen Gas-Measuring Devices (3.39.) Table T.2.....	163
T.3. Repeatability.....	163
T.4. Tolerance Application on Test Using Transfer Standard Test Method.....	163
T.5. Tolerance Application in Type Evaluation Examinations for Devices.....	163
UR. User Requirements.....	164
UR.1. Selection Requirements.....	164
UR.1.1. Computing-Type Device; Retail Dispenser.....	164
UR.1.2. Discharge Hose-Length.....	164
UR.1.3. Minimum Measured Quantity.....	164
UR.2. Installation Requirements.....	165
UR.2.1. Manufacturer’s Instructions.....	165
UR.2.2. Discharge Rate.....	165
UR.2.3. Low-Flow Cut-Off Valve.....	165
UR.3. Use of Device.....	165
UR.3.1. Unit Price and Product Identity for Retail Dispensers.....	165
UR.3.2. Vehicle-mounted Measuring Systems Ticket Printer.....	165
UR.3.3. Printed Ticket.....	165
UR.3.4. Steps After Dispensing.....	165
UR.3.5. Return of Indicating and Recording Elements to Zero.....	166
UR.3.6. Return of Product to Storage, Retail Hydrogen Gas Dispensers.....	166
UR.3.7. Conversion Factors.....	166

Section 3.39. Hydrogen Gas-Measuring Devices

A. Application

A.1. General. – This code applies to devices that are used for the measurement of hydrogen gas in the vapor state used as a vehicle fuel.

A.2. Exceptions. – This code does not apply to:

- (a) Devices used solely for dispensing a product in connection with operations in which the amount dispensed does not affect customer charges.
- (b) The wholesale delivery of hydrogen gas.
- (c) **[NOT ADOPTED - CCR § 4001. Exceptions.]**
- (d) Systems that measure pressure, volume, and temperature with a calculating device to determine the mass of gas accumulated in or discharged from a tank of known volume.

A.3. Additional Code Requirements. – In addition to the requirements of this code, Hydrogen Gas-Measuring Devices shall meet the requirements of Section 1.10. General Code.

A.4. Type Evaluation. – **[NOT ADOPTED - CCR § 4001. Exceptions.]**

§ 4002.9. Hydrogen Gas-Measuring Devices (3.39.). A.4.Type Evaluation. The National Type Evaluation Program (NTEP) or California Type Evaluation Program (CTEP) will accept for type evaluation only those hydrogen gas-measuring devices that comply with all applicable requirements of this device article.

(Adopted, 4 CCR 4002.9.)

S. Specifications

S.1. Indicating and Recording Elements.

S.1.1. Indicating Elements. – A measuring assembly shall include an indicating element that continuously displays measurement results relative to quantity and total price. Indications shall be clear, definite, accurate, and easily read under normal conditions of operation of the device.

S.1.2. Vehicle Fuel Dispensers. – A hydrogen gas dispenser used to fuel vehicles shall be of the computing type and shall indicate the mass, the unit price, and the total price of each delivery.

S.1.3. Units.

S.1.3.1. Units of Measurement. – Deliveries shall be indicated and recorded in kilograms and decimal subdivisions thereof.

S.1.3.2. Numerical Value of Quantity-Value Divisions. – The value of an interval (i.e., increment or scale division) shall be equal to:

(a) 1, 2, or 5; or

(b) a decimal multiple or submultiple of 1, 2, or 5.

Examples: quantity-value divisions may be 10, 20, 50, 100; or 0.01, 0.02, 0.05; or 0.1, 0.2, or 0.5; etc.

S.1.3.3. Maximum Value of Quantity-Value Divisions. – The maximum value of the quantity-value division shall not be greater than 0.5% of the minimum measured quantity.

S.1.3.4. Values Defined. – Indicated values shall be adequately defined by a sufficient number of figures, words, symbols, or combinations thereof. A display of “zero” shall be a zero digit for all displayed digits to the right of the decimal mark and at least one to the left.

S.1.4. Value of Smallest Unit. – The value of the smallest unit of indicated delivery, and recorded delivery if the device is equipped to record, shall not exceed the equivalent of:

(a) 0.001 kg on devices with a marked maximum flow rate of 30 kg/min or less; or

(b) 0.01 kg on devices with a marked maximum flow rate of more than 30 kg/min.

S.2. Operating Requirements.

S.2.1. Return to Zero.

(a) The primary indicating and the primary recording elements, if the device is equipped to record, shall be provided with a means for readily returning the indication to zero either automatically or manually.

(b) It shall not be possible to return primary indicating elements, or primary recording elements, beyond the correct zero position.

S.2.2. Indicator Reset Mechanism. – The reset mechanism for the indicating element shall not be operable during a delivery. Once the zeroing operation has begun, it shall not be possible to indicate a value other than the latest measurement, or “zeros” when the zeroing operation has been completed.

S.2.3. Provision for Power Loss.

S.2.3.1. Transaction Information. – In the event of a power loss, the information needed to complete any transaction in progress at the time of the power loss (such as the quantity and unit price, or sales price) shall be determinable for at least 15 minutes at the dispenser or at the console if the console is accessible to the customer.

S.2.3.2. User Information. – The device memory shall retain information on the quantity of fuel dispensed and the sales price totals during power loss.

S.2.4. Display of Unit Price and Product Identity.

S.2.4.1. Unit Price. – A computing or money-operated device shall be able to display on each face the unit price at which the device is set to compute or to dispense.

S.2.4.2. Product Identity. – A device shall be able to conspicuously display on each side the identity of the product being dispensed.

S.2.4.3. Selection of Unit Price. – When a product is offered for sale at more than one unit price through a computing device, the selection of the unit price shall be made prior to delivery using controls on the device or other customer-activated controls. A system shall not permit a change to the unit price during delivery of a product.

S.2.4.4. Agreement Between Indications. – All quantity, unit price, and total price indications within a measuring system shall agree for each transaction.

S.2.5. Money-Value Computations. – A computing device shall compute the total sales price at any single-purchase unit price for which the product being measured is offered for sale at any delivery possible within either the measurement range of the device or the range of the computing elements, whichever is less.

S.2.5.1. Auxiliary Elements. – If a system is equipped with auxiliary indications, all indicated money value and quantity divisions of the auxiliary element shall be identical with those of the primary element.

S.2.5.2. Display of Quantity and Total Price. – When a delivery is completed, the total price and quantity for that transaction shall be displayed on the face of the dispenser for at least 5 minutes or until the next transaction is initiated by using controls on the device or other user-activated controls.

S.2.6. Recorded Representations, Point of Sale Systems. – A printed receipt shall be available through a built-in or separate recording element for transactions conducted with point-of-sale systems or devices activated by debit cards, credit cards, and/or cash. The printed receipt shall contain the following information for products delivered by the dispenser:

- (a) the total mass of the delivery;
- (b) the unit price;
- (c) the total computed price; and
- (d) the product identity by name, symbol, abbreviation, or code number.

S.2.7. Indication of Delivery. – The device shall automatically show on its face the initial zero condition and the quantity delivered (up to the nominal capacity).

S.2.8. Automatic Timeout – Pay-At-Vehicle Fuel Dispensers. – *Once a vehicle fuel dispenser has been authorized, it must deauthorize within two minutes if not activated. Reauthorization of the vehicle fuel dispenser must be performed before any product is delivered. If the time limit to deauthorize the vehicle fuel dispenser is programmable, it shall not accept an entry greater than two minutes.*

[Nonretroactive as of January 1, 2020]

(Added 2019)

S.3. Design of Measuring Elements and Measuring Systems.

S.3.1. Maximum and Minimum Flow-Rates. – The ratio of the maximum to minimum flow-rates specified by the manufacturer for devices measuring gases shall be 10:1 or greater.

S.3.2. Adjustment Means. – An assembly shall be provided with means to change the ratio between the indicated quantity and the quantity of gas measured by the assembly. A bypass on the measuring assembly shall not be used for these means.

S.3.2.1. Discontinuous Adjusting Means. – When the adjusting means changes ratio between the indicated quantity and the quantity of measured gas in a discontinuous manner, the consecutive values of the ratio shall not differ by more than 0.1 %.

S.3.3. Provision for Sealing. – For devices and systems in which the configuration or calibration parameters can be changed by use of a removable digital storage device, security shall be provided for those parameters as specified in G-S.8.2. Devices and Systems Adjusted Using Removable Digital Storage Devices. For parameters adjusted using other means, the following applies.

Adequate provision shall be made for an approved means of security (e.g., data change audit trail) or physically applying security seals in such a manner that no adjustment can be made of:

- (a) each individual measurement element;
- (b) any adjustable element for controlling delivery rate when such rate tends to affect the accuracy of deliveries;
- (c) the zero-adjustment mechanism; and
- (d) any metrological parameter that detrimentally affects the metrological integrity of the device or system.

When applicable, the adjusting mechanism shall be readily accessible for purposes of affixing a security seal. Audit trails shall use the format set forth in Table S.3.3. Categories of Device and Methods of Sealing.

(Amended 2019)

Table S.3.3. Categories of Device and Methods of Sealing

Categories of Device	Method of Sealing
<p>Category 1: No remote configuration capability.</p>	<p>Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.</p>
<p>Category 2: Remote configuration capability, but access is controlled by physical hardware.</p> <p>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.</p>	<p>The hardware enabling access for remote communication must be on-site. The hardware must be sealed using a physical seal or an event counter for calibration parameters and an event counter for configuration parameters. The event counters may be located either at the individual measuring device or at the system controller; however, an adequate number of counters must be provided to monitor the calibration and configuration parameters of the individual devices at a location. If the counters are located in the system controller rather than at the individual device, means must be provided to generate a hard copy of the information through an on-site device.</p>
<p>Category 3: Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password).</p> <p>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.</p>	<p>An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. A printed copy of the information must be available on demand through the device or through another on-site device. The information may also be available electronically. The event logger shall have a capacity to retain records equal to 10 times the number of sealable parameters in the device, but not more than 1000 records are required. (Note: Does not require 1000 changes to be stored for each parameter.)</p>

(Amended 2016)

S.3.4. Automatic Density Correction.

- (a) An automatic means to determine and correct for changes in product density shall be incorporated in any hydrogen gas-measuring system where measurements are affected by changes in the density of the product being measured.
- (b) Volume-measuring devices with automatic temperature compensation used to measure hydrogen gas as a vehicle fuel shall be equipped with an automatic means to determine and correct for changes in product density due to changes in the temperature, pressure, and composition of the product.

S.3.5. Pressurizing the Discharge Hose. – The discharge hose for hydrogen gas shall automatically pressurize to a pressure equal to or greater than the receiving vessel prior to

the device beginning to register the delivery. The indications shall not advance as a result of the initial pressurization or the purging/bleeding of the discharge hose.

S.3.6. Zero-Set-Back Interlock, Retail Vehicle Fuel Devices.

(a) A device shall be constructed so that:

- (1) when the device is shut-off at the end of a delivery an automatic interlock prevents a subsequent delivery until the indicating element and recording elements, if the device is equipped and activated to record, have been returned to their zero positions; and
- (2) it shall not be possible to return the discharge nozzle to its start position unless the zero set back interlock is engaged or becomes engaged.

(b) For systems with more than one:

- (1) dispenser supplied by a single measuring element, an effective automatic control valve in each dispenser prevents product from being delivered until the indicating elements on that dispenser are in a correct zero position; or
- (2) hose supplied by a single measuring element, effective automatic means must be provided to prevent product from being delivered until the indicating element(s) corresponding to each hose are in a correct zero position.

S.4. Discharge Lines and Valves.

S.4.1. Diversion of Measured Product. – No means shall be provided by which any measured product can be diverted from the measuring device.

S.4.2. Directional Flow Valves. – If a reversal of flow could result in errors that exceed the tolerance for the minimum measured quantity, a valve or valves or other effective means, automatic in operation (and equipped with a pressure limiting device, if necessary) to prevent the reversal of flow shall be properly installed in the system. (Also see N.1. Minimum Measured Quantity.)

S.4.3. Other Valves. – Check valves and closing mechanisms that are not used to define the measured quantity shall have relief valves (if necessary) to dissipate any abnormally high pressure that may arise in the measuring assembly.

S.5. Markings. – A measuring system shall be conspicuously, legibly, and indelibly marked with the following information:

- (a) pattern approval mark (i.e., type approval number);
- (b) name and address of the manufacturer or his trademark and, if required by the weights and measures authority, the manufacturer's identification mark in addition to the trademark;

- (c) model designation or product name selected by the manufacturer;
- (d) nonrepetitive serial number;
- (e) the accuracy class of the device as specified by the manufacturer consistent with Table T.2. Accuracy Classes and Tolerances for Hydrogen-Gas Measuring Devices;
- (f) maximum and minimum flow rates in kilograms per unit of time;
- (g) maximum working pressure;
- (h) applicable range of ambient temperature if other than - 10 °C to + 50 °C;
- (i) minimum measured quantity; and
- (j) product limitations (such as fuel quality), if applicable.

S.5.1. Location of Marking Information; Hydrogen-Fuel Dispensers. – The marking information required in General Code, paragraph G S.1. Identification shall appear as follows:

- (a) within 60 cm (24 in) to 150 cm (60 in) from the base of the dispenser;
- (b) either internally and/or externally provided the information is permanent and easily read; and accessible for inspection; and
- (c) on a portion of the device that cannot be readily removed or interchanged (i.e., not on a service access panel).

The use of a dispenser key or tool to access internal marking information is permitted for retail hydrogen-measuring devices.

§ 4002.9. S.5.2. Location of Accuracy Class 2.0, 3.0, 5.0, 7.0, and 10.0 Information. - An additional Accuracy Class statement shall be placed adjacent to the quantity display on the face for the dispenser and shall be conspicuously, legibly, and indelibly marked with a statement such as “The Accuracy Class of this dispenser is XX.0 and represents the accuracy of the delivery expressed as a plus or minus percentage of the delivered quantity”. The lettering shall be in Helvetica or Arial Bold font type, in all capitals, and no less than 3/16 inch (0.48 cm) in height.

Note: The XX.0 is the Accuracy Class as stated on the NTEP Certificate of Conformance or CTEP Certificate of Approval and is part of the identification information required in paragraph S.5. The rating represents the allowable limits of error expressed as a plus and minus value.

EXAMPLE:

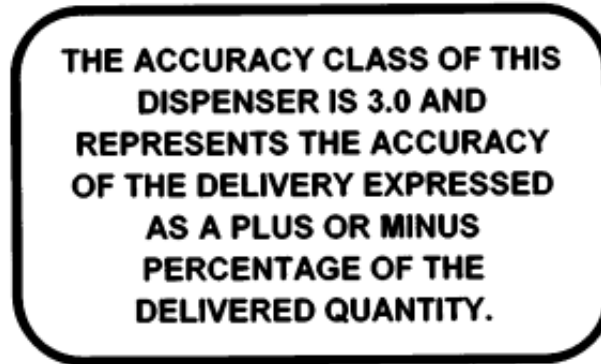


Figure 1 - "THE ACCURACY CLASS OF THIS DISPENSER IS 3.0 AND REPRESENTS THE ACCURACY OF THE DELIVERY EXPRESSED AS A PLUS OR MINUS PRECENTAGE OF THE DELIVERED QUANTITY."

(Adopted, 4 CCR 4002.10.)

S.6. Printer. – When an assembly is equipped with means for printing the measured quantity, the printed information must agree with the indications on the dispenser for the transaction and the printed values shall be clearly defined.

S.6.1. Printed Receipt. – Any delivered, printed quantity shall include an identification number, the time and date, and the name of the seller. This information may be printed by the device or pre-printed on the ticket.

S.7. Totalizers for Vehicle Fuel Dispensers. – Vehicle fuel dispensers shall be equipped with a nonresettable totalizer for the quantity delivered through each separate measuring device.

S.8. Minimum Measured Quantity. – The minimum measured quantity shall satisfy the conditions of use of the measuring system as follows:

- (a) Measuring systems having a maximum flow rate less than or equal to 4 kg/min shall have a minimum measured quantity not exceeding 0.5 kg.
- (b) Measuring systems having a maximum flow rate greater than 4 kg/min but not greater than 12 kg/min shall have a minimum measured quantity not exceeding 1.0 kg.

N. Notes

N.1. Minimum Measured Quantity. – The minimum measured quantity shall be specified by the manufacturer.

N.2. Test Medium. – The device shall be tested with the product commercially measured except that, in a type evaluation examination, hydrogen gas as specified in NIST Handbook 130 shall be used.

N.3. Test Drafts. – The minimum test shall be one test draft at twice the declared minimum measured quantity and one test draft at approximately five times the minimum measured quantity or 4 kg, whichever is greater. More tests may be performed over the range of normal quantities dispensed. (Also see T.3. Repeatability.)

The test draft shall be made at flows representative of that during normal delivery. The pressure drop between the dispenser and the proving system shall not be greater than that for normal deliveries. The control of the flow (e.g., pipework or valve(s) size, etc.) shall be such that the flow of the measuring system is maintained within the range specified by the manufacturer.

N.4. Tests.

N.4.1. Master Meter (Transfer) Standard Test. – When comparing a measuring system with a calibrated transfer standard, the minimum test shall be one test draft at the declared minimum measured quantity and one test draft at approximately ten times the minimum measured quantity or 1 kg, whichever is greater. More tests may be performed over the range of normal quantities dispensed.

N.4.1.1. Verification of Master Metering Systems. – A master metering system used to verify a hydrogen gas-measuring device shall be verified before and after the verification process. A master metering system used to calibrate a hydrogen gas-measuring device shall be verified before starting the calibration and after the calibration process.

N.4.2. Gravimetric Tests. – The weight of the test drafts shall be equal to at least twice the amount delivered by the device at the declared minimum measured quantity and one test draft at approximately five times the minimum measured quantity or 4 kg, whichever is greater. More tests may be performed over the range of normal quantities dispensed.

N.4.3. PVT Pressure Volume Temperature Test. – The minimum test with a calibrated volumetric standard shall be one test draft at twice the declared minimum measured quantity and one test draft at approximately five times the minimum measured quantity or 4 kg, whichever is greater. More tests may be performed over the range of normal quantities dispensed.

N.5. Minimum Measured Quantity. – The device shall be tested for a delivery equal to the declared minimum measured quantity when the device is likely to be used to make deliveries on the order of the declared minimum measured quantity.

N.6. Testing Procedures.

N.6.1. General. – The device or system shall be tested under normal operating conditions of the dispenser.

The test draft shall be made at flows representative of that during normal delivery. The pressure drop between the dispenser and the proving system shall not be greater than that for normal deliveries. The control of the flow (e.g., pipework or valve(s) size, etc.) shall be such that the flow of the measuring system is maintained within the range specified by the manufacturer.

N.6.2. Repeatability Tests. – Tests for repeatability should include a minimum of three consecutive test drafts of approximately the same size and be conducted under controlled conditions where variations in factors are reduced to minimize the effect on the results obtained. When conducting the tests, the discharge rates shall be within the minimum and maximum discharge rates as marked by the manufacturer.

(Amended 2019)

N.7. Density. – Temperature and pressure of hydrogen gas shall be measured during the test for the determination of density or volume correction factors when applicable. For the thermophysical properties of hydrogen the following publications shall apply: for density calculations at temperatures above 255 K and pressures up to 120 MPa, a simple relationship may be used that is given in the publication of Lemmon et al., J. Res. NIST, 2008.

Calculations for a wider range of conditions and additional thermophysical properties of hydrogen are available free of charge online at the “NIST Chemistry WebBook, NIST Standard Reference Database Number 69” webbook.nist.gov/chemistry, or available for purchase from NIST as the computer program NIST Standard Reference Database 23 “NIST Reference Fluid Thermodynamic and Transport Properties Database (REFPROP): Version 10.0”

www.nist.gov/srd/refprop. These calculations are based on the reference Leachman, J.W., Jacobsen, R.T, Lemmon, E.W., and Penoncello, S.G. “Fundamental Equations of State for Parahydrogen, Normal Hydrogen, and Orthohydrogen” published in the Journal of Physical and Chemical Reference Data (www.nist.gov/publications/fundamental-equations-state-parahydrogen-normal-hydrogen-and-ortho-hydrogen?pub_id=832374).

T. Tolerances

T.1. Tolerances, General.

- (a) The tolerances apply equally to errors of underregistration and errors of overregistration.
- (b) The tolerances apply to all products at all temperatures measured at any flow rate within the rated measuring range of the device.

T.2. Tolerances. – The tolerances for hydrogen gas measuring devices are listed in Table T.2. Accuracy Classes and Tolerances for Hydrogen Gas-Measuring Devices. (Proposed tolerance values are based on previous work with compressed gas products and will be confirmed based on performance data evaluated by the U.S. National Work Group.)

**(NIST HB 44) Table T.2. [NOT ADOPTED - CCR § 4001. Exceptions.]
 Accuracy Classes and Tolerances for Hydrogen Gas-Measuring Devices**

§ 4002.9. Hydrogen Gas-Measuring Devices (3.39.) Table T.2.

Table T.2. Accuracy Classes and Tolerances for Hydrogen Gas-Measuring Devices

Accuracy Class	Application or Commodity Being Measured	Acceptance Tolerance	Maintenance Tolerance
2.0	Hydrogen Gas as a Vehicle Fuel	1.5%	2.0%
3.0	Hydrogen Gas as a Vehicle Fuel	2.0%	3.0%
5.0	Hydrogen Gas as a Vehicle Fuel	4.0%	5.0%
7.0	Hydrogen Gas as a Vehicle Fuel	5.0%	7.0%
10.0	Hydrogen Gas as a Vehicle Fuel	5.0%	10.0%

In Table T.2., above, the tolerance values for Accuracy Class 10.0 hydrogen gas-measuring devices are applicable to devices installed prior to January 1, 2018.

T.3. Repeatability. – When multiple tests are conducted at approximately the same flow rate and draft size, the range of the test results for the flow rate shall not exceed 40 % of the absolute value of the maintenance tolerance and the results of each test shall be within the applicable tolerance. Also see N.6.2. Repeatability Tests.

(Amended 2019)

T.4. Tolerance Application on Test Using Transfer Standard Test Method. – To the basic tolerance values that would otherwise be applied, there shall be added an amount equal to two times the standard deviation of the applicable transfer standard when compared to a basic reference standard.

T.5. Tolerance Application in Type Evaluation Examinations for Devices. – For type evaluation examinations, the tolerance values shall apply under the following conditions:

- (a) at any temperature and pressure within the operating range of the device, and
- (b) for all quantities greater than the minimum measured quantity.

UR. User Requirements

UR.1. Selection Requirements.

UR.1.1. Computing-Type Device; Retail Dispenser. – A hydrogen gas dispenser used to refuel vehicles shall be of the computing type and shall indicate the mass, the unit price, and the total price of each delivery.

UR.1.2. Discharge Hose-Length. – The length of the discharge hose on a retail fuel dispenser:

- (a) shall not exceed 4.6 m (15 ft) unless it can be demonstrated that a longer hose is essential to permit deliveries to be made to receiving vehicles or vessels;
- (b) shall be measured from its housing or outlet of the discharge line to the inlet of the discharge nozzle; and
- (c) shall be measured with the hose fully extended if it is coiled or otherwise retained or connected inside a housing.

An unnecessarily remote location of a device shall not be accepted as justification for an abnormally long hose.

UR.1.3. Minimum Measured Quantity.

- (a) The minimum measured quantity shall be specified by the manufacturer.
- (b) The minimum measured quantity appropriate for a transaction may be specified by the weights and measures authority. A device may have a declared minimum measured quantity smaller than that specified by the weights and measures authority; however, the device must perform within the performance requirements for the declared or specified minimum measured quantity up to deliveries at the maximum measurement range.
- (c) The minimum measured quantity shall satisfy the conditions of use of the measuring system as follows:
 - (1) measuring systems having a maximum flow rate less than or equal to 4 kg/min shall have a minimum measured quantity not exceeding 0.5 kg; and
 - (2) measuring systems having a maximum flow rate greater than 4 kg/min but not greater than 12 kg/min shall have a minimum measured quantity not exceeding 1.0 kg.

UR.2. Installation Requirements.

UR.2.1. Manufacturer's Instructions. – A device shall be installed in accordance with the manufacturer's instructions, and the installation shall be sufficiently secure and rigid to maintain this condition.

UR.2.2. Discharge Rate. – A device shall be installed so that after initial equalization the actual maximum discharge rate will not exceed the rated maximum discharge rate. Automatic means of flow regulation shall be incorporated in the installation if necessary.

UR.2.3. Low-Flow Cut-Off Valve. – If a measuring system is equipped with a programmable or adjustable "low-flow cut-off" feature:

- (a) the low-flow cut-off value shall not be set at flow rates lower than the minimum operating flow rate specified by the manufacturer on the measuring device; and
- (b) the system shall be equipped with flow control valves which prevent the flow of product and stop the indicator from registering product flow whenever the product flow rate is less than the low-flow cut-off value.

UR.3. Use of Device.

UR.3.1. Unit Price and Product Identity for Retail Dispensers. – The unit price at which the dispenser is set to compute shall be conspicuously displayed or posted on the face of a retail dispenser used in direct sale.

UR.3.2. Vehicle-mounted Measuring Systems Ticket Printer.

UR.3.2.1. Customer Ticket. – Vehicle-mounted measuring systems shall be equipped with a ticket printer which shall be used for all sales where product is delivered through the device. A copy of the ticket issued by the device shall be left with the customer at the time of delivery or as otherwise specified by the customer.

UR.3.2.2. Ticket in Printing Device. – A ticket shall not be inserted into a device equipped with a ticket printer until immediately before a delivery is begun, and in no case shall a ticket be in the device when the vehicle is in motion while on a public street, highway, or thoroughfare.

UR.3.3. Printed Ticket. – The total price, the total quantity of the delivery, and the price per unit shall be printed on any ticket issued by a device of the computing type and containing any one of these values.

UR.3.4. Steps After Dispensing. – After delivery to a customer from a retail dispenser:

- (a) the device shall be shut-off at the end of a delivery, through an automatic interlock that prevents a subsequent delivery until the indicating elements and recording elements, if the device is equipped and activated to record, have been returned to their zero positions; and

- (b) the discharge nozzle shall not be returned to its start position unless the zero set-back interlock is engaged or becomes engaged by the act of disconnecting the nozzle or the act of returning the discharge nozzle.

UR.3.5. Return of Indicating and Recording Elements to Zero. – The primary indicating elements (visual), and the primary recording elements shall be returned to zero immediately before each delivery.

UR.3.6. Return of Product to Storage, Retail Hydrogen Gas Dispensers. – Provisions at the site shall be made for returning product to storage or disposing of the product in a safe and timely manner during or following testing operations. Such provisions may include return lines, or cylinders adequate in size and number to permit this procedure.

UR.3.7. Conversion Factors. – Established correction values. (Also see references in N.7. Density.) shall be used whenever measured hydrogen gas is billed. All sales shall be based on kilograms.

Table of Contents

Section 3.40. Electric Vehicle Fueling Systems. (3.40)	167
A. Application	167
A.1. General	167
CCR §4002.11. Electrical Vehicle Fueling Systems. (3.40.) A.1.1. Effective Date for AC EVSE	167
CCR §4002.11. Electrical Vehicle Fueling Systems. (3.40.) A.1.2. Effective Date for DC EVSE	167
A.2. Exceptions	167
A.3. Additional Code Requirements	168
A.3.1. Electric Vehicle Supply Equipment (EVSE) with Integral Time-Measuring Devices	168
A.4.Type Evaluation. [NOT ADOPTED - CCR § 4001. Exceptions.]	168
CCR §4002.11. Electrical Vehicle Fueling Systems. (3.40.), A.4. Type Evaluation	168
S. Specifications	168
S.1. Primary Indicating and Recording Elements	168
S.2. EVSE Operating Requirements	169
CCR §4002.11. Electrical Vehicle Fueling Systems. (3.40.), S.2.4.1. Unit Price	170
CCR § 4002.11. Electrical Vehicle Fueling Systems. (3.40), S.2.4.2. Equipment Capacity and Type of Voltage	171
CCR §4002.11. Electrical Vehicle Fueling Systems. (3.40.), S.2.7. Indication of Delivery	172
S.3. Design of Measuring Elements and Measuring Systems	173
CCR §4002.11. Electrical Vehicle Fueling Systems. (3.40.), S.3.5. Temperature Range for System Components	175
S.4. Connections	175
S.5. Markings	175
CCR §4002.11. Electrical Vehicle Fueling Systems. (3.40.), S.5.2. EVSE Identification and Marking Requirements	175
S.6. Printer	176
S.7. Totalizers for EVSE Systems	176
S.8. Minimum Measured Quantity (MMQ)	176
N. Notes	176
N.1. No Load Test	176

N.2. Starting Load Test. - [NOT ADOPTED - CCR § 4001. Exceptions.].....	176
CCR §4002.11. Electrical Vehicle Fueling Systems. (3.40.), N.2. Starting Load Test.	177
N.3. Minimum Test Draft (Size).....	177
N.4. EVSE System Test Loads.	177
N.5. Test of an EVSE System.....	177
N.6. Repeatability Tests.....	178
T. Tolerances	178
T.1. Tolerances, General.....	178
T.2. Load Test Tolerances. [NOT ADOPTED - CCR § 4001. Exceptions.].....	178
CCR §4002.11. Electrical Vehicle Fueling Systems. (3.40.), T.2. Load Test Tolerances.	178
T.3. Repeatability.....	179
T.4. Tolerance Application in Type Evaluation Examinations for EVSEs.....	179
T.5. No Load Test.....	179
T.6. Starting Load.....	179
UR. User Requirements.....	179
UR.1. Selection Requirements.....	179
UR.2. Installation Requirements.	179
UR.3. Use of EVSE.....	180
Appendix D. Definitions	181
alternating current (AC).	182
ampere.	182
audit trail.....	182
calibration parameter.....	182
configuration parameter.....	182
creep.....	182
current.	182
direct current (DC).	182
electric vehicle, plug-in.	183
electric vehicle supply equipment (EVSE).	183
electricity as vehicle fuel - [NOT ADOPTED - CCR § 4001. Exceptions.].....	183
CCR §4002.11. Electrical Vehicle Fueling Systems. (3.40.), Appendix D –Definitions. Electricity as vehicle fuel.	183
energy.	183

energy flow.....	183
equipment, commercial.....	183
event counter.....	183
event logger.....	184
EVSE field reference standard.....	184
face.....	184
hertz (Hz).....	184
megajoule (MJ).....	184
kilowatt (kW).....	184
kilowatt-hour (kWh).....	184
load, full.....	184
load, light.....	184
master meter, electric.....	185
meter, electricity.....	185
metrological components.....	185
minimum measured quantity (MMQ).....	185
nationally recognized testing laboratory (NRTL).....	185
nonresettable totalizer.....	185
ohm (Ω).....	185
percent registration.....	185
power factor (PF).....	186
primary indicating or recording elements.....	186
recorded representation.....	186
recording element.....	186
remote configuration capability.....	186
retail device.....	186
serving utility.....	186
starting load.....	186
submeter.....	186
test accuracy – in-service.....	187
test amperes (TA).....	187
thermal overload protector.....	187
unit price.....	187
vehicle connector.....	187

CCR Title 4, Div. 9, CCR §§ 4000, 4001, 4002.11
2023 Edition of NIST HB 44 Section 3.40. EVSE

vehicle coupler.	187
vehicle inlet.....	187
volt.....	187
watt.....	187
watthour (Wh).....	187

Section 3.40. Electric Vehicle Fueling Systems.

A. Application

A.1. General. – This code applies to devices, accessories, and systems used for the measurement of electricity dispensed in vehicle fuel applications wherein a quantity determination or statement of measure is used wholly or partially as a basis for sale or upon which a charge for service is based.

CCR §4002.11. Electrical Vehicle Fueling Systems. (3.40.) A.1.1. Effective Date for AC EVSE. All AC EVSE used for commercial purposes shall comply with all requirements of this article in accordance with the following:

- (a) All AC EVSE installed prior to January 1, 2021, shall comply with the requirements of this article by January 1, 2031.
- (b) All AC EVSE installed on or after January 1, 2021, shall comply with the requirements of this article upon installation.

(Adopted, 4 CCR 4002.11.)

CCR §4002.11. Electrical Vehicle Fueling Systems. (3.40.) A.1.2. Effective Date for DC EVSE. Effective Dates for DC EVSE. – All DC EVSE used for commercial purposes shall comply with all requirements of this article in accordance with the following:

- (a) All DC EVSE installed prior to January 1, 2023, shall comply with the requirements of this article by January 1, 2033.
- (b) All DC EVSE installed on or after January 1, 2023, shall comply with the requirements of this article upon installation.

(Adopted, 4 CCR 4002.11.)

A.2. Exceptions. – This code does not apply to:

- (a) The use of any measure or measuring device owned, maintained, and used by a public utility or municipality only in connection with measuring electricity subject to the authority having jurisdiction such as the Public Utilities Commission.
- (b) Electric Vehicle Supply Equipment (EVSEs) used solely for dispensing electrical energy in connection with operations in which the amount dispensed does not affect customer charges or compensation.
- (c) The wholesale delivery of electricity.

A.3. Additional Code Requirements. – In addition to the requirements of this code, Electric Fueling Systems shall meet the requirements of Section 1.10. General Code.

A.3.1. Electric Vehicle Supply Equipment (EVSE) with Integral Time-Measuring Devices. – An EVSE that is used for both the sale of electricity as vehicle fuel and used to measure time during which services (e.g., vehicle parking) are received. These devices shall also meet the requirements of Section 5.55. Timing Devices.

A.4. Type Evaluation. [NOT ADOPTED - CCR § 4001. Exceptions.]

CCR §4002.11. Electrical Vehicle Fueling Systems. (3.40.), A.4. Type Evaluation. The National Type Evaluation Program (NTEP) or California Type Evaluation Program (CTEP) will accept for type evaluation only those EVSEs that comply with all requirements of this article and have received safety certification by a nationally recognized testing laboratory (NRTL).

(Adopted, 4 CCR 4002.11.)

S. Specifications

S.1. Primary Indicating and Recording Elements.

S.1.1. Electric Vehicle Supply Equipment (EVSE). – An EVSE used to charge electric vehicles shall be of the computing type and shall indicate the electrical energy, the unit price, and the total price of each transaction.

- (a) EVSEs capable of applying multiple unit prices over the course of a single transaction shall also be capable of indicating the start and stop time, the total quantity of energy delivered, the unit price, and the total price for the quantity of energy delivered during each discrete phase corresponding to one of the multiple unit prices.
- (b) EVSEs capable of applying additional fees for time-based and other services shall also be capable of indicating the total time measured; the unit price(s) for the additional time-based service(s); the total computed price(s) for the time measured; and the total transaction price, including the total price for the energy and all additional fees.

S.1.2. EVSE Indicating Elements. – An EVSE used to charge electric vehicles shall include an indicating element that accumulates continuously and displays, for a minimum of 15 seconds at the activation by the user and at the start and end of the transaction, the correct measurement results relative to quantity and total price. Indications shall be clear, definite, accurate, and easily read under normal conditions of operation of the device. All indications and representations of electricity sold shall be clearly identified and separate from other time-based fees indicated by an EVSE that is used for both the sale of electricity as vehicle fuel and the sale of other separate time-based services (e.g., vehicle parking).

S.1.2.1. Multiple EVSEs Associated with a Single Indicating Element. – A system with a single indicating element for two or more EVSEs shall be provided with means to

display information from the individual EVSE(s) selected or displayed, and shall be provided with an automatic means to indicate clearly and definitely which EVSE is associated with the displayed information.

S.1.3. EVSE Units.

S.1.3.1. EVSE Units of Measurement. – EVSE units used to charge electric vehicles shall be indicated and recorded in kilowatt-hours (kWh) and decimal subdivisions thereof.

(Amended 2022)

S.1.3.2. EVSE Value of Smallest Unit. - [NOT ADOPTED - CCR § 4001. Exceptions.]

CCR §4002.11. Electrical Vehicle Fueling Systems. (3.40.), S.1.3.2. EVSE Value of Smallest Unit. The value of the smallest unit of indicated delivery by an EVSE, and recorded delivery if the EVSE is equipped to record, shall be no greater than 0.0005 MJ or 0.0001 kWh.

(Adopted, 4 CCR 4002.11.)

S.1.3.3. Values Defined. – Indicated values shall be adequately defined by a sufficient number of figures, words, symbols, or combinations thereof. An indication of “zero” shall be a zero digit for all displayed digits to the right of the decimal mark and at least one to the left.

S.2. EVSE Operating Requirements.

S.2.1. EVSE Return to Zero.

- (a) The primary indicating and the primary recording elements of an EVSE used to charge electric vehicles, if the EVSE is equipped to record, shall be provided with a means for readily returning the indication to zero either automatically or manually.
- (b) It shall not be possible to return primary indicating elements, or primary recording elements, beyond the correct zero position.

S.2.2. EVSE Indicator Zero Reset Mechanism. – The reset mechanism for the indicating element of an EVSE used to charge electric vehicles shall not be operable during a transaction. Once the zeroing operation has begun, it shall not be possible to indicate a value other than: the latest measurement; “all zeros;” blank the indication; or provide other indications that cannot be interpreted as a measurement during the zeroing operation.

S.2.3. EVSE Provision for Power Loss.

S.2.3.1. Transaction Information. – In the event of a power loss, the information needed to complete any transaction (i.e., delivery is complete and payment is settled) in

progress at the time of the power loss (such as the quantity and unit price, or sales price) shall be determinable through one of the means listed below or the transaction shall be terminated without any charge for the electrical energy transfer to the vehicle:

- (a) at the EVSE;
- (b) at the console, if the console is accessible to the customer;
- (c) via on site internet access; or
- (d) through toll-free phone access.

For EVSEs in parking areas where vehicles are commonly left for extended periods, the information needed to complete any transaction in progress at the time of the power loss shall be determinable through one of the above means for at least eight hours.

S.2.3.2. Transaction Termination. – In the event of a power loss, either:

- (a) the transaction shall terminate at the time of the power loss; or
- (b) the EVSE may continue charging without additional authorization if the EVSE is able to determine it is connected to the same vehicle before and after the supply power outage.

In either case, there must be a clear indication on the receipt provided to the customer of the interruption, including the date and time of the interruption along with other information required under S.2.6. EVSE Recorded Representations.

S.2.3.3. User Information. – The EVSE memory, or equipment on the network supporting the EVSE, shall retain information on the quantity of fuel dispensed and the sales price totals during power loss.

S.2.4. EVSE Indication of Unit Price and Equipment Capacity and Type of Voltage.

S.2.4.1. Unit Price. - [NOT ADOPTED - CCR § 4001. Exceptions.]

CCR §4002.11. Electrical Vehicle Fueling Systems. (3.40.), S.2.4.1. Unit Price. An EVSE shall be able to indicate on each face the unit price at which the EVSE is set to compute or to dispense at any point in time during a transaction. A computing EVSE shall display the unit price in whole cents (e.g., \$0.12) or tenths of one cent (e.g., \$0.119) on the basis of price per megajoule (MJ) or kilowatt-hour (kWh). In cases where the electrical energy is unlimited or free of charge, this fact shall be clearly indicated in place of the unit price.

S.2.4.2. Equipment Capacity and Type of Voltage. [NOT ADOPTED - CCR § 4001. Exceptions.]

CCR § 4002.11. Electrical Vehicle Fueling Systems. (3.40), S.2.4.2. Equipment Capacity and Type of Voltage. – An EVSE shall be able to conspicuously display on each face the maximum rate of energy transfer (i.e., maximum power) and the type of current associated with each unit price offered (e.g., 7 kW AC, 25 kW DC, etc.).

S.2.4.3. Selection of Unit Price. – When electrical energy is offered for sale at more than one unit price through an EVSE, the selection of the unit price shall be made prior to delivery through a deliberate action of the purchaser to select the unit price for the fuel delivery. Except when the conditions for variable price structure have been approved by the customer prior to the sale, a system shall not permit a change to the unit price during delivery of electrical energy.

Note: When electrical energy is offered at more than one unit price, selection of the unit price may be through the deliberate action of the purchaser: 1) using controls on the EVSE; 2) through the purchaser's use of personal or vehicle-mounted electronic equipment communicating with the system; or 3) verbal instructions by the customer.

S.2.4.4. Agreement Between Indications. – All quantity, unit price, and total price indications within a measuring system shall agree for each transaction.

S.2.5. EVSE Money-Value Computations. – An EVSE shall compute the total sales price at any single-purchase unit price for which the electrical energy being measured is offered for sale at any delivery possible within either the measurement range of the EVSE or the range of the computing elements, whichever is less.

S.2.5.1. Money-Value Divisions Digital. – An EVSE with digital indications shall comply with the requirements of paragraph G-S.5.5. Money-Values, Mathematical Agreement, and the total price computation shall be based on quantities not exceeding 0.5 MJ or 0.1 kWh.

S.2.5.2. Auxiliary Elements. – If a system is equipped with auxiliary indications, all indicated money value and quantity divisions of the auxiliary element shall be identical to those of the primary element.

S.2.6. EVSE Recorded Representations. – A receipt, either printed or electronic, providing the following information shall be available at the completion of all transactions:

- (a) the total quantity of the energy delivered with unit of measure;
- (b) the total computed price of the energy sale;

- (c) the unit price of the energy, and for systems capable of applying multiple unit prices for energy during a single transaction, the following additional information is required:
 - (1) the start and stop time of each phase during which one of the multiple unit prices was applied;
 - (2) the unit price applied during each phase;
 - (3) the total quantity of energy delivered during each phase;
 - (4) the total purchase price for the quantity of energy delivered during each phase;
- (d) the maximum rate of energy transfer (i.e., maximum power) and type of current (e.g., 7 kW AC, 25 kW DC, etc.);
- (e) any additional separate charges included in the transaction (e.g., charges for parking time) including:
 - (1) the time and date when the service begins and the time and date when the service ends; or the total time interval purchased, and the time and date that the service either begins or ends;
 - (2) the unit price applied for the time-based service;
 - (3) the total purchase price for the quantity of time measured during the complete transaction;
- (f) the final total price of the complete transaction including all items;
- (g) the unique EVSE identification number;
- (h) the business name; and
- (i) the business location.

S.2.7. Indication of Delivery. - [NOT ADOPTED - CCR § 4001. Exceptions.]

CCR §4002.11. Electrical Vehicle Fueling Systems. (3.40.), S.2.7. Indication of Delivery. The EVSE shall automatically display on its face the initial zero condition and the quantity delivered (up to the capacity of the indicating elements).

(Adopted, 4 CCR 4002.11.)

S.2.8. Automatic Timeout – Pay-At-EVSE. – *Once an EVSE has been authorized, it must deauthorize within two minutes if not activated. Reauthorization of the EVSE must be performed before any electrical energy is delivered and/or timing charges assessed. If the*

time limit to deauthorize the EVSE is programmable, it shall not accept an entry greater than two minutes.

[Nonretroactive as of January 1, 2020]

(Added 2019)

S.3. Design of Measuring Elements and Measuring Systems.

S.3.1. Metrological Components. – An EVSE measuring system shall be designed and constructed so that metrological components are adequately protected from environmental conditions likely to be detrimental to accuracy. The system shall be designed to prevent undetected access to adjustment mechanisms and terminal blocks by providing for application of a physical security seal or an audit trail.

S.3.2. Terminals. – The terminals of the EVSE system shall be arranged so that the possibility of short circuits while removing or replacing the cover, making connections, or adjusting the system, is minimized.

S.3.3. Provision for Sealing. – For devices and systems in which the configuration or calibration parameters can be changed by use of a removable digital storage device, security shall be provided for those parameters as specified in G-S.8.2. Devices and Systems Adjusted Using Removable Digital Storage Devices. For parameters adjusted using other means, the following applies.

Adequate provision shall be made for an approved means of security (e.g., data change audit trail) or physically applying security seals in such a manner that no adjustment can be made of:

- (a) each individual measurement element;
- (b) any adjustable element for controlling voltage or current when such control tends to affect the accuracy of deliveries;
- (c) any adjustment mechanism that corrects or compensates for energy loss between the system and vehicle connection; and
- (d) any metrological parameter that detrimentally affects the metrological integrity of the EVSE or system.

When applicable, the adjusting mechanism shall be readily accessible for purposes of affixing a security seal. Audit trails shall use the format set forth in Table S.3.3. Categories of Device and Methods of Sealing.

(Amended 2019)

Table S.3.3. Categories of Device and Methods of Sealing

Categories of Device	Method of Sealing
<p>Category 1: No remote configuration capability.</p>	<p>Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.</p>
<p>Category 2: Remote configuration capability, but access is controlled by physical hardware.</p> <p>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.</p>	<p>The hardware enabling access for remote communication must be on-site. The hardware must be sealed using a physical seal or an event counter for calibration parameters and an event counter for configuration parameters. The event counters may be located either at the individual measuring EVSE or at the system controller; however, an adequate number of counters must be provided to monitor the calibration and configuration parameters of the individual EVSEs at a location. If the counters are located in the system controller rather than at the individual EVSE, means must be provided to generate a copy of the information through an on-site device; this information may be provided electronically in lieu of or in addition to a hard copy at the time of inspection.</p>
<p>Category 3: Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password).</p> <p>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.</p>	<p>An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. The event logger information may be provided electronically in lieu of or in addition to a hard copy at the time of inspection, provided the event logger information is retained in the system for future reference. The event logger shall have a capacity to retain records equal to 10 times the number of sealable parameters in the EVSE, but not more than 1000 records are required. (Note: Does not require 1000 changes to be stored for each parameter.)</p>

(Amended 2021)

S.3.4. Data Storage and Retrieval.

- (a) EVSE data accumulated and indicated shall be unalterable and accessible.
- (b) Values indicated or stored in memory shall not be affected by electrical, mechanical, or temperature variations, radio-frequency interference, power failure, or any other environmental influences to the extent that accuracy is impaired.

- (c) Memory and/or display shall be recallable for a minimum of three years. A replaceable battery shall not be used for this purpose.

S.3.5. Temperature Range for System Components. - [NOT ADOPTED - CCR § 4001. Exceptions.]

CCR §4002.11. Electrical Vehicle Fueling Systems. (3.40.), S.3.5. Temperature Range for System Components. EVSEs shall be accurate and correct over the temperature range of -40 °C to + 85 °C (-40 °F to 185 °F). If the system or any measuring system components are not capable of meeting these requirements, the temperature range over which the system is capable shall be stated on the National Type Evaluation Program (NTEP) Certificate of Conformance (CC) or California Type Evaluation Program (CTEP) Certificate of Approval (COA), conspicuously, legibly, and indelibly marked on the EVSE, and installations shall be limited to the narrower temperature limits.

(Adopted, 4 CCR 4002.11.)

S.4. Connections.

S.4.1. Diversion of Measured Electricity. – No means shall be provided by which any measured electricity can be diverted from the measuring device.

S.4.1.1. Unauthorized Disconnection. – Means shall be provided to automatically terminate the transaction in the event that there is an unauthorized break in the connection with the vehicle.

S.4.2. Directional Control. – If a reversal of energy flow could result in errors that exceed the tolerance for the minimum measured quantity, effective means, automatic in operation to prevent or account for the reversal of flow shall be properly installed in the system. (See N.3. Minimum Test Draft [Size])

S.5. Markings. – The following identification and marking requirements are in addition to the requirements of Section 1.10. General Code, paragraph G-S.1. Identification.

S.5.1. Location of Marking Information; EVSE. – The marking information required in General Code, paragraph G-S.1. Identification shall appear as follows:

- (a) within 60 cm (24 in) to 150 cm (60 in) from ground level; and
- (b) on a portion of the EVSE that cannot be readily removed or interchanged (e.g., not on a service access panel).

S.5.2. EVSE Identification and Marking Requirements. - [NOT ADOPTED - CCR § 4001. Exceptions.]

CCR §4002.11. Electrical Vehicle Fueling Systems. (3.40.), S.5.2. EVSE Identification and Marking Requirements. In addition to all the marking requirements of Section 1.10.

General Code, paragraph G-S.1. Identification, each EVSE shall have the following information conspicuously, legibly, and indelibly marked:

- (a) voltage rating;
- (b) maximum current deliverable;
- (c) type of current (AC or DC or, if capable of both, both shall be listed);
- (d) minimum measured quantity (MMQ); and
- (e) temperature limits, if narrower than and within $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$ ($-40\text{ }^{\circ}\text{F}$ to $185\text{ }^{\circ}\text{F}$).

S.5.3. Abbreviations and Symbols. – The following abbreviations or symbols may appear on an EVSE system.

- (a) VAC = volts alternating current;
- (b) VDC = volts direct current;
- (c) MDA = maximum deliverable amperes;
- (d) J = joule.

S.6. Printer. – When a system is equipped with means for printing the measured quantity, the printed information must agree with the indications on the EVSE for the transaction and the printed values shall be clearly defined.

S.6.1. Printed Receipt. – Any delivered, printed quantity shall include an EVSE identification number that uniquely identifies the EVSE from all other EVSEs within the seller's facility, the time and date, and the name of the seller. This information may be printed by the EVSE system or pre-printed on the ticket.

S.7. Totalizers for EVSE Systems. – EVSE systems shall be designed with a nonresettable totalizer for the quantity delivered through each separate measuring device. Totalizer information shall be adequately protected and unalterable. Totalizer information shall be provided by the system and readily available on site or via on site internet access.

S.8. Minimum Measured Quantity (MMQ). – The minimum measured quantity shall satisfy the conditions of use of the measuring system as follows:

- (a) Measuring systems shall have a minimum measured quantity not exceeding 2.5 MJ or 0.5 kWh.

N. Notes

N.1. No Load Test. – A no load test may be conducted on an EVSE measuring system by applying rated voltage to the system under test and no load applied.

N.2. Starting Load Test. - [NOT ADOPTED - CCR § 4001. Exceptions.]

CCR §4002.11. Electrical Vehicle Fueling Systems. (3.40.), N.2. Starting Load Test. A system starting load test may be conducted by applying rated voltage and 0.5-ampere load.

(Adopted, 4 CCR 4002.11.)

N.3. Minimum Test Draft (Size). – Full and light load tests shall require test of the EVSE System for a delivery of the minimum measured quantity as declared by the manufacturer.

N.4. EVSE System Test Loads. – EVSE measuring system testing shall be accomplished by connecting the test load and test standard at the point where the fixed cord is connected to the vehicle. Losses in the cord between the EVSE under test and the test standard should be automatically corrected for in the EVSE quantity indication for direct comparison to the test standard and also while the EVSE is in normal operation. For EVSEs that require a customer-supplied cord, system testing shall be accomplished by connecting the test load and test standard at the point where the customer's cord is connected to the EVSE.

N.5. Test of an EVSE System.

N.5.1. Performance Verification in the Field. – Testing in the field is intended to validate the transactional accuracy of the EVSE system. The following testing is deemed sufficient for a field validation.

N.5.2. Accuracy Testing. – The testing methodology compares the total energy delivered in a transaction and the total cost charged as displayed/reported by the EVSE with that measured by the measurement standard.

(a) For AC systems:

- (1) Accuracy test of the EVSE system at a load of not less than 85 % of the maximum deliverable amperes (expressed as MDA) as determined from the pilot signal for a total energy delivered of at least twice the minimum measured quantity (MMQ). If the MDA would result in maximum deliverable power of greater than 7.2 kW, then the test may be performed at 7.2 kW.
- (2) Accuracy test of the EVSE system at a load of not greater than 10 % of the maximum deliverable amperes (expressed as MDA) as determined from the pilot signal for a total energy delivered of at least the minimum measured quantity (MMQ).

(b) For DC systems (see note):

- (1) Accuracy test of the EVSE system at a load of not less than 85 % of the maximum deliverable amperes current (expressed as MDA) as determined from the digital communication message from the DC EVSE to the test standard for a total energy delivered of at least twice the minimum measured quantity (MMQ).
- (2) Accuracy test of the EVSE system at a load of not more than 10 % of the maximum deliverable amperes (expressed as MDA) as determined from the

digital communication message from the DC EVSE to the test standard for a total energy delivered of at least the minimum measured quantity (MMQ).

All DC EVSE are Exempt from this requirement until January 1, 2028.
 (Amended 2022)

Note: For DC systems it is anticipated that an electric vehicle may be used as the test load. Under that circumstance, testing at the load presented by the vehicle shall be sufficient.

N.6. Repeatability Tests. – Tests for repeatability shall include a minimum of three consecutive tests at the same load, similar time period, etc., and be conducted under conditions where variations in factors are reduced to minimize the effect on the results obtained.

T. Tolerances

T.1. Tolerances, General.

- (a) The tolerances apply equally to errors of underregistration and errors of overregistration.
- (b) The tolerances apply to all deliveries measured at any load within the rated measuring range of the EVSE.
- (c) Where instrument transformers or other components are used, the provisions of this section shall apply to all system components.

T.2. Load Test Tolerances. [NOT ADOPTED - CCR § 4001. Exceptions.]

CCR §4002.11. Electrical Vehicle Fueling Systems. (3.40.), T.2. Load Test Tolerances. The tolerances for EVSE load tests shall be as shown in Table T.2. Accuracy Classes and Tolerances for EVSE.

4002.11. Electrical Vehicle Fueling Systems. (3.40.), Table T.2.

(Adopted, 4 CCR 4002.11.)

Table T.2. Accuracy Classes and Tolerances for EVSE

Accuracy Class	Application or Commodity Being Measured	Acceptance Tolerance	Maintenance Tolerance
2.0	AC electricity as a vehicle fuel	1.0 %	2.0 %
5.0*	DC electricity as a vehicle fuel	2.5 %	5.0 %
2.0**	DC electricity as a vehicle fuel	1.0 %	2.0 %

Accuracy Class	Application or Commodity Being Measured	Acceptance Tolerance	Maintenance Tolerance
<p>*The tolerance values for Accuracy Class 5.0 DC EVSE are applicable to devices installed prior to January 1, 2033.</p> <p>**The tolerance values for Accuracy Class 2.0 DC EVSE are applicable to devices installed on or after January 1, 2033.</p>			

(Adopted, 4 CCR 4002.11.)

T.2.1. EVSE Load Test Tolerances. - [NOT ADOPTED - CCR § 4001. Exceptions.]

T.3. Repeatability. – When multiple load tests are conducted at the same load condition, the range of the load test results shall not exceed 25 % of the absolute value of the maintenance tolerance and the results of each test shall be within the applicable tolerance.

T.4. Tolerance Application in Type Evaluation Examinations for EVSEs. – For type evaluation examinations, the acceptance tolerance values shall apply under the following conditions:

- (a) at any temperature, voltage, load, and power factor within the operating range of the EVSE, and
- (b) regardless of the influence factors in effect at the time of the conduct of the examination, and
- (c) for all quantities greater than the minimum measured quantity.

T.5. No Load Test. – An EVSE measuring system shall not register when no load is applied.

T.6. Starting Load. – An EVSE measuring system shall register a starting load test at a 0.5 ampere (A) load.

UR. User Requirements

UR.1. Selection Requirements.

UR.1.1. Computing-Type Device; Retail EVSE. – An EVSE used to charge electric vehicles shall be of the computing type and shall indicate the electrical energy, the unit price, and the total price of each delivery.

UR.1.2. Connection Cord-Length. – An adequate means for cord management shall be in use when the cord exceeds 25 ft in length.

UR.2. Installation Requirements.

UR.2.1. Maximum Deliverable Current. – The marked maximum deliverable current shall not exceed the total capacity in amperes of the EVSE or the thermal overload protectors of the installation site.

UR.2.2. Manufacturer’s Instructions. – An EVSE shall be installed in accordance with the manufacturer’s instructions, and the installation shall be sufficiently secure and rigid to maintain this condition.

UR.2.3. Load Range. – An EVSE shall be installed so that the current and voltage will not exceed the rated maximum values over which the EVSE is designed to operate continuously within the specified accuracy. Means to limit current and/or voltage shall be incorporated in the installation if necessary.

UR.2.4. Regulation Conflicts and Permit Compliance. – If any provision of Section UR.2. Installation Requirements is less stringent than that required of a similar installation by the serving utility, the installation shall be in accordance with those requirements of the serving utility.

The installer of any EVSE shall obtain all necessary permits.

UR.2.5. Responsibility, Unattended EVSE. – An unattended EVSE shall have clearly and conspicuously displayed thereon, or immediately adjacent thereto, adequate information detailing the name, address, and phone number of the local responsible party for the device.

UR.3. Use of EVSE.

UR.3.1. Unit Price for Retail EVSE Devices. – The unit price at which the EVSE is set to compute shall be conspicuously displayed or posted on the face of the retail EVSE used in direct sale.

UR.3.2. Return of Indicating and Recording Elements to Zero. – The primary indicating elements (visual) and the primary recording elements shall be returned to zero immediately before each transaction.

UR.3.3. EVSE Recorded Representations. – A receipt, either printed or electronic, providing the following information shall be available at the completion of all transactions:

- (a) the total quantity of the energy delivered with unit of measure;
- (b) the total computed price of the energy sale;
- (c) the unit price of the energy; and for systems capable of applying multiple unit prices for energy during a single transaction, the following additional information is required:
 - (1) the start and stop time of each phase during which one of the multiple unit prices was applied;

- (2) the unit price applied during each phase;
- (3) the total quantity of energy delivered during each phase;
- (4) the total purchase price for the quantity of energy delivered during each phase;
- (d) the maximum rate of energy transfer (i.e., maximum power) and type of current (e.g., 7 kW AC, 25 kW DC, etc.);
- (e) any additional separate charges included in the transaction (e.g., charges for parking time) including:
 - (1) the time and date when the service begins and the time and date when the service ends; or the total time interval purchased, and the time and date that the service either begins or ends;
 - (2) the unit price applied for the time-based service;
 - (3) the total purchase price for the quantity of time measured during the complete transaction;
- (f) the final total price of the complete transaction including all items;
- (g) the unique EVSE identification number;
- (h) the business name; and
- (i) the business location.

UR.3.4. EVSE in Operation. – The EVSE shall be permanently, plainly, and visibly identified so that it is clear which EVSE and connector is in operation.

UR.3.5. Steps After Charging. – After delivery to a customer from a retail EVSE:

- (a) the EVSE shall be shut-off at the end of a charge, through an automatic interlock that prevents subsequent charging until the indicating elements and recording elements, if the EVSE is equipped and activated to record, have been returned to their zero positions; and
- (b) the vehicle connector shall not be returned to its starting position unless the zero set-back interlock is engaged or becomes engaged by the act of disconnecting from the vehicle or the act of returning the connector to the starting position.

Appendix D. Definitions

The following includes new definitions to address Electric Vehicle Fueling Systems. Also included are those definitions currently found in Appendix D that are intended to apply to these

systems. The specific code(s) to which each definition applies is shown in [brackets] at the end of the definition. Definitions for the General Code [1.10] apply to all codes in Handbook 44.

A

alternating current (AC). – An electric current that reverses direction in a circuit at regular intervals. [3.40]

ampere. – The practical unit of electric current. It is the quantity of current caused to flow by a potential difference of one volt through a resistance of one ohm. One ampere (A) is equal to the flow of one coulomb of charge per second. One coulomb (C) is the unit of electric charge equal in magnitude to the charge of 6.24×10^{18} electrons. [3.40]

audit trail. – An electronic count and/or information record of the changes to the values of the calibration or configuration parameters of a device. [1.10, 2.20, 2.21, 2.24, 3.30, 3.37, 3.39, 3.40, 5.56(a)]
(Added 1993)

C

calibration parameter. – Any adjustable parameter that can affect measurement or performance accuracy and, due to its nature, needs to be updated on an ongoing basis to maintain device accuracy (e.g., span adjustments, linearization factors, and coarse zero adjustments). [2.20, 2.21, 2.24, 3.30, 3.37, 3.39, 3.40, 5.56(a)]
(Added 1993)

configuration parameter. – Any adjustable or selectable parameter for a device feature that can affect the accuracy of a transaction or can significantly increase the potential for fraudulent use of the device and, due to its nature, needs to be updated only during device installation or upon replacement of a component (e.g., division value [increment], sensor range, and units of measurement). [2.20, 2.21, 2.24, 3.30, 3.37, 3.40, 5.56(a)]
(Added 1993)

creep. – A continuous apparent measurement of energy indicated by a system with operating voltage applied and no power consumed (load terminals open circuited). [3.40]

current. – The rate of the flow of electrical charge past any one point in a circuit. The unit of measurement is amperes (A) or coulombs (C) per second. [3.40]

D

direct current (DC). – An electric current that flows in one direction. [3.40]

E

electric vehicle, plug-in. – A vehicle that employs electrical energy as a primary or secondary mode of propulsion. Plug-in electric vehicles may be all-electric vehicles (EV's) or plug-in hybrid electric vehicles (PHEV's). All-electric vehicles are powered by an electric motor and battery at all times. All-electric vehicles may also be called battery-electric vehicles (BEV's). Plug-in hybrid electric vehicles employ both an electric motor and an internal combustion engine that consumes either conventional or alternative fuel or a fuel cell. In a parallel type hybrid-electric vehicle, either the electric motor or the engine may propel the vehicle. In a series type hybrid-electric vehicle, the engine or fuel cell generates electricity that is then used by the electric motor to propel the vehicle. EV's, BEV's, and PHEV's are capable of receiving and storing electricity via connection to an external electrical supply. Not all hybrid-electric vehicles are of the plug-in type. Hybrid-electric vehicles that do not have the capability to receive electrical energy from an external supply (HEV's) generate electrical energy onboard with the internal combustion engine, regenerative braking, or both. [3.40]

electric vehicle supply equipment (EVSE). – A device or system designed and used specifically to transfer electrical energy to an electric vehicle, either as charge transferred via physical or wireless connection, by loading a fully charged battery, or by other means. [3.40]

electricity as vehicle fuel - [NOT ADOPTED - CCR § 4001. Exceptions].

CCR §4002.11. Electrical Vehicle Fueling Systems. (3.40.), Appendix D –Definitions. Electricity as vehicle fuel. Electrical energy transferred to or stored onboard an electric vehicle primarily for the purpose of propulsion. [3.40]

(Adopted, 4 CCR 4002.11.)

energy. – The integral of active power with respect to time. [3.40]

energy flow. – The flow of energy between line and load terminals (conductors) of an electricity system. Flow from the line to the load terminals is considered energy delivered. Energy flowing in the opposite direction (i.e., from the load to line terminals) is considered as energy received. [3.40]

equipment, commercial. – Weights, measures, and weighing and measuring devices, instruments, elements, and systems or portion thereof, used or employed in establishing the measurement or in computing any basic charge or payment for services rendered on the basis of weight or measure. As used in this definition, measurement includes the determination of size, quantity, value, extent, area, composition (limited to meat and poultry), constituent value (for grain), or measurement of quantities, things, produce, or articles for distribution or consumption, purchased, offered, or submitted for sale, hire, or award. [1.10, 2.20, 2.21, 2.22, 2.24, 3.30, 3.31, 3.32, 3.33, 3.34, 3.35, 3.38, 3.40, 4.40, 5.51, 5.56.(a), 5.56.(b), 5.57, 5.58, 5.59]

(Added 2008)

event counter. – A nonresettable counter that increments once each time the mode that permits changes to sealable parameters is entered and one or more changes are made to

sealable calibration or configuration parameters of a device. [2.20, 2.21, 3.30, 3.37, 3.39, 3.40, 5.54, 5.56(a), 5.56(b), 5.57]

(Added 1993)

event logger. – A form of audit trail containing a series of records where each record contains the number from the event counter corresponding to the change to a sealable parameter, the identification of the parameter that was changed, the time and date when the parameter was changed, and the new value of the parameter. [2.20, 2.21, 3.30, 3.37, 3.39, 3.40, 5.54, 5.56(a), 5.56(b), 5.57]

(Added 1993)

EVSE field reference standard. – A portable apparatus that is traceable to NIST and is used as a standard to test EVSEs in commercial applications. This instrument is also known as a portable standard or working standard. [3.40]

F

face. – That portion of a computing-type pump or dispenser which displays the actual computation of price per unit, delivered quantity, and total sale price. In the case of some electronic displays, this may not be an integral part of the pump or dispenser. [3.30, 3.40]

(Added 1987)

H

hertz (Hz). – Frequency or cycles per second. One cycle of an alternating current or voltage is one complete set of positive and negative values of the current or voltage. [3.40]

J

megajoule (MJ). – An SI unit of energy equal to 1 000 000 joules (J). [3.40]

K

kilowatt (kW). – A unit of power equal to 1000 watts (W). [3.40]

kilowatt-hour (kWh). – A unit of energy equal to 1000 watthours (W h). [3.40]

L

load, full. – A test condition with rated voltage, current at 100 % of test amps level, and power factor of 1.0. [3.40]

load, light. – A test condition with rated voltage, current at 10 % of test amps level, and power factor of 1.0. [3.40]

M

master meter, electric. – An electric watthour meter owned, maintained, and used for commercial billing purposes by the serving utility. All the electric energy served to a submetered service system is recorded by the master meter. [3.40]

meter, electricity. – An electric watthour meter. [3.40]

metrological components. – Elements or features of a measurement device or system that perform the measurement process or that may affect the final quantity determination or resulting price determinations. This includes accessories that can affect the validity of transactions based upon the measurement process. The measurement process includes determination of quantities; the transmission, processing, storage, or other corrections or adjustments of measurement data or values; and the indication or recording of measurement values or other derived values such as price or worth or charges. [3.40]

minimum measured quantity (MMQ). – The smallest quantity delivered for which the measurement is to within the applicable tolerances for that system. [3.37, 3.39, 3.40]

N

nationally recognized testing laboratory (NRTL). – A laboratory that conducts testing and certification that is recognized by the Occupational Safety and Health Administration (OSHA). [3.40]

nonresettable totalizer. – An element interfaced with the measuring or weighing element that indicates the cumulative registration of the measured quantity with no means to return to zero. [3.30, 3.37, 3.39, 3.40]

O

ohm (Ω). – The practical unit of electric resistance that allows one ampere of current to flow when the impressed potential is one volt. [3.40]

P

percent registration. – Percent registration is calculated as follows:

The percent registration equals the Wh measured by the EVSE divided by the WH measured by the standard multiplied by 100.

$$\text{Percent Registration} = \frac{\text{Wh measured by EVSE}}{\text{WH measured by standard}} \times 100$$

Figure 1 - Equation for the Calculation of Percentage Registration.

[3.40]

power factor (PF). – The ratio of “active power” to “apparent power” in an AC circuit. It describes the efficient use of available power. [3.40] (Amended 2019)

primary indicating or recording elements. – The term “primary” is applied to those principal indicating (visual) elements and recording elements that are designed to, or may, be used by the operator in the normal commercial use of a device. The term “primary” is applied to any element or elements that may be the determining factor in arriving at the sale representation when the device is used commercially. (Examples of primary elements are the visual indicators for meters or scales not equipped with ticket printers or other recording elements and both the visual indicators and the ticket printers or other recording elements for meters or scales so equipped.) The term “primary” is not applied to such auxiliary elements as, for example, the totalizing register, or predetermined-stop mechanism on a meter or the means for producing a running record of successive weighing operations, these elements being supplementary to those that are the determining factors in sales representations of individual deliveries or weights. (See “indicating element” and “recording element.”). [1.10, 3.40]

R

recorded representation. – The printed, electronically recorded, or other representation that retains a copy of the quantity and any other required information generated by a weighing or measuring device. [1.10, 3.40]

recording element. – An element incorporated, connected to, or associated with a weighing or measuring device by means of which its performance relative to quantity or money value is permanently recorded in a printed or electronic form. [1.10, 3.40]

remote configuration capability. – The ability to adjust a weighing or measuring device or change its sealable parameters from or through some other device that is not itself necessary to the operation of the weighing or measuring device or is not a permanent part of that device. [2.20, 2.21, 2.24, 3.30, 3.37, 3.39, 3.40, 5.56(a)]
(Added 1993)

retail device. – A measuring device primarily used to measure electrical energy for the purpose of sale to the end user. [3.40]

S

serving utility. – The utility distribution company that owns the master meter and sells electric energy to the owner of a submeter system. [3.40]

starting load. – The minimum load above which the device will indicate energy flow continuously. [3.40]

submeter. – A system furnished, owned, installed, and maintained by the customer who is served through a utility owned master meter. [3.40]

T

test accuracy – in-service. – The device accuracy determined by a test made during the period that the system is in service. It may be made on the customer’s premises without removing the system from its mounting or by removing the EVSE for testing either on the premises or in a laboratory or shop. [3.40]

test amperes (TA). – The full load current (amperage) specified by the EVSE manufacturer for testing and calibration adjustment. (Example: TA 30). [3.40]

thermal overload protector. – A circuit breaker or fuse that automatically limits the maximum current in a circuit. [3.40]

U

unit price. – The price at which the electrical energy is being sold and expressed in whole units of measurement. [1.10, 3.30, 3.40]

(Added 1992)

V

vehicle connector. – A device that by insertion into a vehicle inlet, establishes an electrical connection to the electric vehicle for the purpose of providing power and information exchange, with means for attachment of an electric vehicle cable. This device is a part of the vehicle coupler. [3.40]

vehicle coupler. – A means enabling the connection, at will, of an electric vehicle cable to the equipment. It consists of a vehicle connector and a vehicle inlet. [3.40]

vehicle inlet. – The part incorporated in, or fixed to the vehicle, which receives power from a vehicle connector. [3.40]

volt. – The practical unit of electromotive force. One volt will cause one ampere to flow when impressed across a resistance of one ohm. [3.40]

W

watt. – The practical unit of electric power. In an alternating-current (AC) circuit, the power in watts is volts times amperes multiplied by the circuit power factor. [3.40]

watthour (Wh). – The practical unit of electric energy that is expended in one hour when the average power consumed during the hour is one watt. [3.40]

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Extracts from the
CALIFORNIA CODE OF REGULATIONS
TITLE 4, DIVISION 9

WEIGHTS AND MEASURES FIELD REFERENCE MANUAL (2023)
Chapter 1, Tolerances and Specifications for Commercial Weighing and
Measuring Devices

Part 4: NIST Handbook 44

Sections:

- 4.40. Vehicle Tanks Used as Measures**
- 4.41. Liquid Measures**
- 4.42. Farm Milk Tanks**
- 4.43. Measure-Containers**
- 4.44. Graduates**
- 4.45. Dry Measures**
- 4.46. Berry Baskets**



CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE
DIVISION OF MEASUREMENT STANDARDS

**California Department of Food and Agriculture
Division of Measurement Standards**

DISCLAIMER

This document combines the 2023 Edition of National Institute of Standards and Technology, Handbook 44, Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices (NIST Handbook 44).

Paragraphs not adopted from the 2023 Edition of NIST Handbook 44. are annotated in the text with the statement **[NOT ADOPTED]**.

Additional language in CCR Section 4002.X. The additional text can be identified in **gray shaded font**.

Sources: [NIST Handbook 44](#) and [4 CCR 4000, 4001 and 4002](#).

CCR Article 1, National Uniformity, Exceptions and Additions

§ 4000. Application. Commercial weighing and measuring devices shall, except where noted below, conform to the latest requirements set forth in the National Institute of Standards and Technology Handbook 44 “Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices”, which is herein incorporated by reference, and to the Additional Requirements listed herein. Copies of Handbook 44 may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. [Added 1994, 4 CCR 4000]

§ 4001. Exceptions. The following regulations in Handbook 44 are not adopted or incorporated by reference (click on § 4001. Exceptions).

§ 4002. Additional Requirements. The following sections apply to devices in addition to the Handbook 44 requirements that are incorporated by reference. The number in parenthesis following the section number and section title refers to the related section in Handbook 44; i.e., 4002.1. General Code (1.10.) refers to Section 1.10. General Code in Handbook 44.

§ 4002. Additional Language.

Note: Authority cited: Sections 12027 and 12107, Business and Professions Code. Reference: Section 12107, Business and Professions Code.

Table of Contents

	Page
Section 4.40. Vehicle Tanks Used as Measures	4-1
A. Application.....	4-1
A.1. General.	4-1
A.2. Exceptions.....	4-1
A.3. Additional Code Requirements.....	4-1
S. Specifications	4-1
S.1. Design of Compartments.....	4-1
S.1.1. Compartment Distortion.	4-1
S.1.2. Venting.....	4-1
S.1.3. Completeness of Delivery.....	4-1
S.1.4. Fill or Inspection Opening.	4-1
S.1.5. Dome Flange and Baffle Plates.	4-2
S.1.6. Compartment and Piping Capacities and Emergency Valve.....	4-2
S.1.7. Expansion Space.....	4-2
S.2. Design of Compartment Indicators.	4-2
S.2.1. General.	4-2
S.2.2. Number of Indicators.....	4-2
S.2.3. Identification of Multiple Indicators.....	4-2
S.2.4. Location.	4-2
S.2.5. Permanence.	4-3
S.2.6. Adjustable Indicators.....	4-3
S.2.7. Sensitiveness.....	4-3
S.3. Design of Compartment Discharge Manifold.....	4-3
S.4. Marking of Compartments.	4-4
S.4.1. Compartment Identification.....	4-4
S.4.2. Compartment Capacity, Single Indicator.....	4-4
S.4.3. Compartment Capacity, Multiple Indicators.	4-4
N. Notes	4-4
N.1. Test Liquid.....	4-4
N.2. Evaporation and Volume Change.....	4-4
N.3. To Deliver.	4-4
N.4. Gauging of Compartments.	4-4
N.5. Adjustment and Remarkings.	4-4
T. Tolerances	4-5
T.1. Application.....	4-5
T.1.1. To Excess and to Deficiency.....	4-5
T.2. Tolerance Values.	4-5

UR. User Requirements	4-5
UR.1. Conditions of Use.	4-5
UR.1.1. Filling.	4-5
UR.1.2. Delivering.....	4-5

Section 4.40. Vehicle Tanks Used as Measures

A. Application

A.1. General. – This code applies to vehicle tanks when these are used as commercial measures.

A.2. Exceptions. – This code does not apply to the following devices:

- (a) Devices used solely for dispensing a product in connection with operations in which the amount dispensed does not affect customer charges.
- (b) Meters mounted on vehicle tanks (for which see Section 3.31. Code for Vehicle-Tank Meters).

A.3. Additional Code Requirements. – In addition to the requirements of this code, Vehicle Tanks Used as Measures shall meet the requirements of Section 1.10. General Code.

S. Specifications

S.1. Design of Compartments.

S.1.1. Compartment Distortion. – The shell and bulkheads of a vehicle tank shall be so constructed that under any condition of liquid lading they will not become distorted sufficiently to cause a change in the capacity of any compartment (as determined by volumetric test) equal to more than 0.25 L per 750 L (0.5 pt per 200 gal), or fraction thereof, of the nominal compartment capacity, or to more than 0.5 L (1 pt), whichever is greater. (This specification prescribes a limit on permissible distortion only, and is not to be construed as setting up a secondary tolerance on compartment capacities to be added to the values given in tolerance paragraph T.2. Tolerance Values.)

S.1.2. Venting. – During filling operations, effective venting of a compartment shall be provided to permit air to escape from all spaces designed to be filled with liquid and to permit the influx of air to the compartment during the discharge of liquid therefrom. Venting shall prevent any formation of air pockets.

S.1.3. Completeness of Delivery. – A tank shall be so constructed that, when it is standing on a level surface, complete delivery can be made from any compartment through its delivery faucet or valve whether other compartments are full or empty, and whether or not the delivery is through a manifold.

S.1.4. Fill or Inspection Opening. – The fill or inspection opening of a compartment shall be of such size and location that it can readily be determined by visual inspection that the compartment has been properly filled or completely emptied and shall be so positioned with respect to the ends of the compartment that the indicator may be positioned as required. In

no case shall the opening, if circular, have a diameter of less than 20 cm ($7\frac{5}{8}$ in), or, if other than circular, have an effective area of less than 290 cm² (45 in²).

S.1.5. Dome Flange and Baffle Plates. – Any dome flange extending into a compartment shall be provided with sufficient perforations or openings flush with the compartment shell to prevent any trapping of air. All baffle plates in a compartment shall be so cut away at top and bottom, and elsewhere as necessary, as to facilitate loading and unloading.

S.1.6. Compartment and Piping Capacities and Emergency Valve. – If a compartment is equipped with an emergency (or safety) valve, this shall be positioned at the lowest point of outlet from the compartment, and the compartment capacity or capacities shall be construed as excluding the capacity of the piping leading therefrom. However, the capacity of the piping leading from such a compartment shall be separately determined and reported and may be separately marked as specified in S.4. Marking of Compartments.

S.1.6.1. On Vehicle Tanks Equipped for Bottom Loading. – On equipment designed for bottom loading, the compartment capacity shall include the piping of a compartment to the valve located on the upstream side of the manifold and immediately adjacent thereto or, if not manifolded, to the outlet valve, provided that on or immediately adjacent to the marking as specified in S.4. Marking of Compartments the following words or a statement of similar meaning shall be affixed: “Warning: Emergency valves must be opened before checking measurement.”

S.1.7. Expansion Space. – When a compartment is filled to the level of the highest indicator in the compartment, there shall remain an expansion space of at least 0.75 % of the nominal compartment capacity as defined by that indicator.

S.2. Design of Compartment Indicators.

S.2.1. General. – An indicator shall be so designed that it will distinctly and unmistakably define a capacity point of its compartment when liquid is in contact with the lowest portion of the indicator.

S.2.2. Number of Indicators. – In no case shall a compartment be provided with more than five indicators.

(Amended 1972)

S.2.3. Identification of Multiple Indicators. – If a compartment is provided with multiple indicators, each such indicator shall be conspicuously marked with an identifying letter or number.

S.2.4. Location. – An indicator shall be located:

- (a) midway between the sides of its compartment;

- (b) as nearly as practicable midway between the ends of its compartment, and in no case offset by more than 10 % of the compartment space or 15 cm (6 in), whichever is less;
(Amended 1972)
- (c) so that it does not extend into, nor more than 15 cm (6 in) from that section of the compartment defined by a vertical projection of the fill opening;
(Amended 1974)
- (d) at a depth, measuring from the top of the dome opening, not lower than 46 cm (18 in) for fill openings of less than 38 cm (15 in) in diameter, or, if other than circular, an effective area of less than 1130 cm² (175 in²), and not lower than 61 cm (24 in) for larger fill openings; and
- (e) to provide a clearance of not less than 5 cm (2 in) between indicators.

S.2.5. Permanence. – Any indicator that is not intended to remain adjustable and all brackets or supports shall be securely welded in position.

S.2.6. Adjustable Indicators. – Adequate provision shall be made for conveniently affixing a security seal or seals:

- (a) to any indicator intended to remain adjustable, so that no adjustment of the indicator can be made without mutilating or destroying the seal; and
- (b) to any removable part to which an indicator may be attached, so that the part cannot be removed without mutilating or destroying the seal.

S.2.7. Sensitiveness. – The position of any indicator in its compartment shall be such that at the level of the indicator a change of 1.0 mm (0.04 in) in the height of the liquid surface will represent a volume change of not more than the value of the tolerance for the nominal compartment capacity as defined by that indicator.

S.3. Design of Compartment Discharge Manifold. – When two or more compartments discharge through a common manifold or other single outlet, effective means shall be provided to ensure that:

- (a) liquid can flow through the delivery line leading from only one compartment at one time and that flow of liquid from one compartment to any other is automatically prevented; or
- (b) all compartments will discharge simultaneously.

If the discharge valves from two or more compartments are automatically controlled so that they can only be operated together, thus effectively connecting these compartments to one another, such compartments shall, for purposes of this paragraph, be construed to be one compartment.

S.4. Marking of Compartments.

S.4.1. Compartment Identification. – Each compartment of a multiple-compartment tank shall be conspicuously identified by a letter or number marked on the dome or immediately below the fill opening. Such letters or numbers shall be in regular sequence from front to rear, and the delivery faucets or valves shall be marked to correspond with their respective compartments.

S.4.2. Compartment Capacity, Single Indicator. – A compartment provided with a single indicator shall be clearly, permanently, and conspicuously marked with a statement of its capacity as defined by its indicator.

S.4.3. Compartment Capacity, Multiple Indicators. – A compartment provided with two or more indicators shall be clearly, permanently, and conspicuously marked with a statement identifying:

- (a) each indicator by a letter or number; and
- (b) immediately adjacent to each letter or number, the capacity of the compartment as defined by the particular indicator.

N. Notes

N.1. Test Liquid. – Water or light fuel oil shall be used as the test liquid for a vehicle-tank compartment.

N.2. Evaporation and Volume Change. – Care shall be exercised to reduce to a minimum, evaporation losses and volume changes resulting from changes in temperature of the test liquid.

N.3. To Deliver. – A vehicle-tank compartment shall be gauged “to deliver.” If the compartment is gauged by measuring the test liquid into the tank, the inside tank walls shall first be thoroughly wetted.

N.4. Gauging of Compartments. – When a compartment is gauged to determine the proper position for an indicator or to determine what a capacity marking should be, whether on a new vehicle tank or following repairs or modifications that might affect compartment capacities, tolerances are not applicable, and the indicator shall be set and the compartment capacity shall be marked as accurately as practicable.

N.5. Adjustment and Remarkings. – When a compartment is found upon test to have an error in excess of the applicable tolerance, the capacity of the compartment shall be adjusted to agree with its marked capacity, or its marked capacity shall be changed to agree with its capacity as determined by the test.

T. Tolerances

T.1. Application.

T.1.1. To Excess and to Deficiency. – The tolerances hereinafter prescribed shall be applied to errors in excess and in deficiency.

T.2. Tolerance Values. – Maintenance and acceptance tolerances shall be as shown in Table 1. Maintenance and Acceptance Tolerances on Vehicle-Tank Compartments.

Table 1. Maintenance and Acceptance Tolerances on Vehicle-Tank Compartments

Nominal Capacity of Compartment (Gallons)	Maintenance and Acceptance Tolerances (Expressed in Quarts)	Maintenance and Acceptance Tolerances (Expressed in Gallons)
200 or less	2	0.5
201 to 400, inclusive	3	0.75
401 to 600, inclusive	4	1.0
601 to 800, inclusive	5	1.25
801 to 1000, inclusive	6	1.50
over 1000	Add 1 quart per 200 gallons or fraction thereof	Add 0.25 gallon per 200 gallons or fraction thereof

UR. User Requirements

UR.1. Conditions of Use.

UR.1.1. Filling. – A vehicle shall stand upon a level surface during the filling of a compartment.

UR.1.2. Delivering. – During a delivery, a vehicle shall be so positioned as to assure complete emptying of a compartment. Each compartment shall be used for an individual delivery only; that is, an individual delivery shall consist of the entire contents of a compartment or compartments.

(Amended 1976)

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Table of Contents

	Page
Section 4.41. Liquid Measures	4-7
A. Application	4-7
A.1. General.....	4-7
A.2. Exceptions.....	4-7
A.3. Additional Code Requirements.....	4-7
S. Specifications	4-7
S.1. Units.....	4-7
S.2. Material.....	4-7
S.3. Capacity Point.....	4-7
S.4. Reinforcing Rings.....	4-7
S.5. Discharge.....	4-8
S.6. Marking Requirements.....	4-8
T. Tolerances	4-8
T.1. Tolerance Values.....	4-8

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Section 4.41. Liquid Measures

A. Application

A.1. General. – This code applies to liquid measures; that is, to rigid measures of capacity designed for general and repeated use in the measurement of liquids.

A.2. Exceptions. – The code does not apply to test measures or other volumetric standards.

A.3. Additional Code Requirements. – In addition to the requirements of this code, Liquid Measures shall meet the requirements of Section 1.10. General Code.

S. Specifications

S.1. Units.

- (a) The capacity of a liquid measure marked in SI units shall be 0.1 L, 0.2 L, 0.5 L, 1 L, 2 L, 5 L, or a multiple of 5 L, and the measure shall not be subdivided.
- (b) The capacity of a liquid measure marked in U.S. customary units shall be 1 gill, ½ liq pt, 1 liq pt, 1 liq qt, ½ gal, ¼ gal, 1½ gal, or a multiple of 1 gal, and the measure shall not be subdivided. However, 3 pt and 5 pt brick molds and 2½ gal (10 qt) cans shall be permitted when used exclusively for ice cream.

S.2. Material. – Measures shall be made of metal, glass, earthenware, enameled ware, composition, or similar and suitable material. If made of metal, the thickness of the metal shall not be less than the appropriate value given in Table 1. Minimum Thickness of Metal for Liquid Measures.

Table 1. Minimum Thickness of Metal for Liquid Measures

Nominal Capacity	Minimum Thickness For Iron or Steel, Plated, or Unplated (inch)	Minimum Thickness For Copper or Aluminum (inch)
1 pint or less	0.010	0.020
1 quart, ½ gallon, 1 gallon	0.014	0.028
Over 1 gallon	0.016	0.032

S.3. Capacity Point. – The capacity of a measure shall be determined to a definite edge, or to the lowest portion of a plate, bar, or wire, at or near the top of the measure, and shall not include the capacity of any lip or rim that may be provided.

S.4. Reinforcing Rings. – Reinforcing rings, if used, shall be attached to the outside of the measure and shall show no divisions or lines on the inside surface of the measure.

S.5. Discharge. – A measure equipped with a discharge faucet or valve shall be susceptible to complete discharge through the faucet or valve when the measure is standing on a level surface.

S.6. Marking Requirements. – A measure shall be marked on its side with a statement of its capacity. If the capacity is stated in terms of the pint or quart, the word “Liquid” or the abbreviation “Liq” shall be included.

T. Tolerances

T.1. Tolerance Values. – Maintenance tolerances in excess and in deficiency shall be as shown in Table 2. Maintenance Tolerances, in Excess and in Deficiency, for Liquid Measures. Acceptance tolerances shall be one-half the maintenance tolerances.

Table 2. Maintenance Tolerances, in Excess and in Deficiency, for Liquid Measures

Nominal Capacity	Tolerance In Excess	Tolerance In Excess	Tolerance In Deficiency	Tolerance In Deficiency
½ pt or less	2.0 fluid drams	0.4 cubic inches	1.0 fluid drams	0.2 cubic inches
1 pt	3.0 fluid drams	0.7 cubic inches	1.5 fluid drams	0.3 cubic inches
1 qt	4.0 fluid drams	0.9 cubic inches	2.0 fluid drams	0.5 cubic inches
½ gal	6.0 fluid drams	1.4 cubic inches	3.0 fluid drams	0.7 cubic inches
1 and 1¼ gal	1.0 fluid ounces	1.8 cubic inches	4.0 fluid drams	0.9 cubic inches
1½ gal	1.5 fluid ounces	2.7 cubic inches	6.0 fluid drams	1.4 cubic inches
2 gal	2.0 fluid ounces	3.5 cubic inches	1.0 fluid ounces	1.8 cubic inches
3 and 4 gal	4.0 fluid ounces	7.0 cubic inches	2.0 fluid ounces	3.6 cubic inches
5 gal	6.0 fluid ounces	11.0 cubic inches	3.0 fluid ounces	5.4 cubic inches
10 gal	10.0 fluid ounces	18.0 cubic inches	5.0 fluid ounces	9.0 cubic inches

Table of Contents

	Page
Section 4.42. Farm Milk Tanks	9
A. Application.....	9
A.1. General.....	9
A.2. Exceptions.....	9
A.3. Additional Code Requirements	9
S. Specifications.....	9
S.1. Components.....	9
S.2. Design of Tank.....	9
S.2.1. Level.....	9
S.2.2. Level-Indicating Means.....	9
S.2.3. Portable Tank.....	10
S.2.4. <i>Capacity</i>	10
S.3. Design of Indicating Means.....	10
S.3.1. <i>General</i>	10
S.3.2. Gauge-Rod Bracket or Supports.....	10
S.3.3. Gauge Rod.....	10
S.3.4. Surface-Gauge Bracket or Supports.....	11
S.3.5. Surface Gauge.....	11
S.3.6. External Gauge Assemblies.....	11
S.3.7. Graduations.....	11
S.3.8. <i>Design of Indicating Means on Tanks with a Capacity Greater than 8000 Liters or 2000 Gallons</i>	12
S.4. Design of Volume Chart.....	12
S.4.1. General.....	12
S.4.2. For a Tank of 1 000 Liters, or 250 Gallons, or Less.....	13
S.4.3. For a Tank of 1 001 Liters to 2000 Liters, or 251 to 500 Gallons.....	13
S.4.4. For a Tank of Greater than 2000 Liters, or 500 Gallons.....	13
S.5. Gauging.....	13
S.5.1. Level.....	13
S.5.2. To Deliver.....	13

CCR Title 4, Div. 9, CCR §§ 4000, 4002.7
2023 Edition of NIST HB 44 Section 4.42. Farm Milk Tanks

S.5.3. Preparation of Volume Chart.	13
S.6. Identification.....	13
N. Notes	13
CCR § 4002.7. Farm Milk Tanks. (4.42.)(a) Calibration at Installation.	13
N.1. Test Liquid.	14
N.2. Evaporation and Volume Change.	14
N.3. To Deliver.....	14
N.4. Level.	14
N.5. Test Methods.	14
N.5.1. Verification of Master Metering Systems.	14
N.5.2. Temperature Changes in Water Supply.	14
N.6. Reading the Meniscus.	14
T. Tolerances	15
T.1. Application.	15
T.2. Minimum Tolerance Values.....	15
T.3. Basic Tolerance Values.	15
T.4. Basic Tolerance Values, Master Meter Method.	15
UR. User Requirements	15
UR.1. Installation.	15
UR.2. Level Condition.....	15
UR.2.1. Stationary Tank.....	15
UR.2.2. Portable Tank.	15
UR.3. Weight Chart.	16
UR.4. Use.....	16

Section 4.42. Farm Milk Tanks

A. Application

A.1. General. – This code applies to farm milk tanks on the premises of producers when these are used, or are to be used, for the commercial measurement of milk.

A.2. Exceptions. – This code does not apply to tanks mounted on highway vehicles.

A.3. Additional Code Requirements. – In addition to the requirements of this code, Farm Milk Tanks shall meet the requirements of Section 1.10. General Code.

S. Specifications

S.1. Components. – A farm milk tank, whether stationary or portable, shall be considered suitable for commercial use only when it comprises:

- (a) a vessel, whether or not it is equipped with means for cooling its contents;
- (b) a means for reading the level of liquid in the tank, such as a removable gauge rod or surface gauge; and
- (c) a chart for converting level-of-liquid readings to volume.

Each compartment of a subdivided tank shall, for the purposes of this code, be construed to be a farm milk tank.

S.2. Design of Tank.

S.2.1. Level. – A farm milk tank shall be designed to be in normal operating position when it is in level. The tank shall be so constructed that it will maintain its condition of level under all normal conditions of lading.

S.2.2. Level-Indicating Means. – A tank shall be permanently equipped with sensitive means by which the level of the tank can be determined.

S.2.2.1. On a Stationary Tank. – A stationary tank shall be provided with such level-indicating means as a two-way or circular level, a plumb bob, two-way leveling lugs, or the like; or the top edge or edges of the tank shall be so constructed throughout as to provide an accurate reference for level determinations; provided, that when leveling lugs or the top edge or edges of the tank are used as the reference for level determinations, there shall be supplied with the tank a sensitive spirit level of appropriate dimensions, and the positions where such level is intended to be used shall be permanently marked on the reference surface of the tank; and provided further, that when leveling lugs are used they shall be so designed, constructed, and installed at the factory that any alteration of the original position or condition, such as by hammering or filing,

would be difficult and would become obvious. A stationary tank with a nominal capacity of 2 000 L or 500 gal, or greater shall be provided with at least two similar level-indicating means, and these shall be located in opposite and distant positions from each other to facilitate an accurate level determination in both directions of the tank's horizontal plane.

(Amended 1980)

S.2.2.2. On a Portable Tank. – A portable tank shall be provided with either a two-way or a circular level.

S.2.3. Portable Tank. – A portable tank shall be of the center-reading type; that is, it shall be so designed that the gauge rod or surface gauge, when properly positioned for use, will be approximately in the vertical axis of the tank, centrally positioned with respect to the tank walls.

S.2.4. Capacity. – *A farm milk tank shall be clearly and permanently marked on a surface visible after installation with its capacity as determined by the manufacturer. The capacity shall not exceed an amount that can be agitated without overflowing and that can be measured accurately with the liquid at rest.*

[Nonretroactive as of January 1, 1979]

S.3. Design of Indicating Means.

S.3.1. General. – *A tank shall include indicating means and shall be calibrated over the entire range of the volume of the tank from 5 % of capacity or 2 m³ (500 gal) whichever is less, to its maximum capacity.*

[Nonretroactive as of January 1, 1986]

(Added 1985)

S.3.2. Gauge-Rod Bracket or Supports. – If a tank is designed for use with a gauge rod, a substantial and rigid gauge-rod bracket or other suitable supporting elements for positioning the gauge rod shall be provided. A gauge rod and its brackets or other supporting elements shall be so constructed that, whenever the rod is placed in engagement with the bracket or supports and released, the rod will automatically seat itself at a fixed height and in a vertical position. When a gauge rod is properly seated on its brackets or supports, there shall be a clearance of at least 7.5 cm (3 in) between the graduated face of the rod and any tank wall or other surface that it faces.

S.3.3. Gauge Rod. – When properly seated in position, a rod shall not touch the bottom of the tank unless this is required by the design of the supporting elements. The rod shall be graduated throughout an interval corresponding to the volume range within which readings of liquid level are to be made.

S.3.4. Surface-Gauge Bracket or Supports. – If a tank is designed for use with a surface gauge, a substantial and rigid surface-gauge bracket or other suitable supporting elements for positioning the surface gauge shall be provided. A surface gauge and its brackets or other supporting elements shall be so constructed that, whenever the gauge assembly is placed in engagement with the bracket or supports, the indicator, if not permanently mounted on the tank, will automatically seat itself in correct operating position, and the graduated element will be vertically positioned and will be securely held at any height to which it may be manually set.

S.3.5. Surface Gauge. – When properly engaged with its bracket and set to its lowest position, a surface gauge shall not touch the bottom of the tank. The gauge shall be graduated throughout an interval corresponding to the volume range within which readings of liquid level are to be made.

S.3.6. External Gauge Assemblies.

S.3.6.1. Design and Installation. – The gauge assembly shall be designed to meet sanitary requirements and shall be readily accessible for cleaning purposes. The gauge assembly shall be mounted in a vertical position and equipped with a sliding mechanism to assist in determining the liquid level.

S.3.6.2. Gauge Tube. – The gauge tube shall be borosilicate glass or approved rigid plastic or rigidly supported flexible tubing with a uniform internal diameter not less than 2 cm ($\frac{3}{4}$ in). It shall be designed and constructed so that all product in the gauge can be discarded in such a manner that no product in the gauge tube will enter the discharge line or tank.

(Amended 1983)

S.3.6.3. Scale Plate. – The scale plate shall be mounted adjacent to and parallel with the gauge tube and be no more than 7 mm ($\frac{1}{4}$ in) from the tube.

S.3.6.4. Scale Graduations. – The graduation lines shall be clear and easily readable and shall comply with the requirements of paragraphs included under S.3.7. Graduations.

S.3.6.5. Venting. – An external gauge tube shall be adequately vented at the top, open to the atmosphere. Any attachment to the gauge tube shall not adversely affect the operation of this vent.

(Added 1984)

(Added 1977)

S.3.7. Graduations.

S.3.7.1. Spacing and Width of Graduations. – On a gauge rod or surface gauge, the spacing of the graduations, center to center, shall be not more than 1.6 mm (0.0625 in or $\frac{1}{16}$ in) and shall not be less than 0.8 mm (0.03125 in or

$\frac{1}{32}$ in). The graduations shall not be less than 0.12 mm (0.005 in) in width, and the clear interval between adjacent edges of successive graduations shall be not less than 0.4 mm (0.015625 in or $\frac{1}{64}$ in).

S.3.7.2. Values of Graduations. – On a gauge rod or surface gauge, the graduations may be designated in inches or in centimeters and fractions thereof, or may be identified in a numerical series without reference to inches or centimeters or fractions thereof. In either case, a volume chart shall be provided for each such rod or gauge and each tank with which it is associated, showing values in terms of the graduation on the rod or gauge. If a rod or gauge is associated with but one tank, in lieu of linear or numerical series graduations and volume chart, values in terms of volume of liquid in the tank may be shown directly on the rod or gauge.

S.3.7.3. Value of Graduated Interval. – The value of a graduated interval on a gauge rod or surface gauge (exclusive on the interval from the bottom of the tank to the lowest graduation) shall not exceed:

- (a) 2 L for a tank of a nominal capacity of 1000 L or less; $\frac{1}{2}$ gal for a tank of a nominal capacity of 250 gal or less;
- (b) 4 L for a tank of a nominal capacity of 1001 L to 2000 L, inclusive; 1 gal for a tank of a nominal capacity of 251 gal to 500 gal, inclusive;
- (c) 6 L for a tank of a nominal capacity of 2001 L to 6000 L, inclusive; $1\frac{1}{2}$ gal for a tank of a nominal capacity of 501 gal to 1500 gal, inclusive;
- (d) 8 L for a tank of a nominal capacity of 6001 L to 10 000 L, inclusive; 2 gal for a tank of a nominal capacity of 1501 gal to 2500 gal, inclusive; or
- (e) 8 L plus 4 L for each additional 10 000 L or fraction thereof, for tanks of nominal capacity above 10 000 L or 2 gal plus 1 gal for each additional 2500 gal or fraction thereof, for tanks with nominal capacity above 2500 gal.

(Amended 1980)

S.3.8. Design of Indicating Means on Tanks with a Capacity Greater than 8000 Liters or 2000 Gallons. – *Any farm milk tank with a capacity greater than 8000 L, or 2000 gal, shall be equipped with an external gauge assembly.*

[Nonretroactive and applicable only to tanks manufactured after January 1, 1981]

(Added 1980)

S.4. Design of Volume Chart.

S.4.1. General. – A volume chart shall show volume values only, *over the entire range of the volume of the tank from 5 % of capacity or 2 m³ (500 gal) whichever is*

less, to its maximum capacity. * All letters and figures on the chart shall be distinct and easily readable. The chart shall be substantially constructed, and the face of the chart shall be so protected that its lettering and figures will not tend easily to become obliterated or illegible.

[*Nonretroactive as of January 1, 1986]

(Amended 1985)

S.4.2. For a Tank of 1 000 Liters, or 250 Gallons, or Less. – The volume chart for a tank of nominal capacity of 1000 L, or 250 gal, or less shall show values at least to the nearest 1 L, or ¼ gal.

S.4.3. For a Tank of 1 001 Liters to 2000 Liters, or 251 to 500 Gallons. – The volume chart for a tank of nominal capacity of 1001 L to 2000 L, or 251 gal to 500 gal, inclusive, shall show values at least to the nearest 2 L, or ½ gal.

S.4.4. For a Tank of Greater than 2000 Liters, or 500 Gallons. – The volume chart for a tank of nominal capacity of greater than 2000 L, or 500 gal, shall show values at least to the nearest gallon, or 4 L.

(Amended 1980)

S.5. Gauging.

S.5.1. Level. – A farm milk tank shall be level, as shown by the level-indicating means, during the original gauging operation.

S.5.2. To Deliver. – A farm milk tank shall be originally gauged “to deliver.” If the tank is gauged by measuring the test liquid into the tank, the inside tank walls shall first be thoroughly wetted and the tank shall then be drained for 30 seconds after the main drainage flow has ceased.

S.5.3. Preparation of Volume Chart. – When a tank is gauged for the purposes of preparing a volume chart, tolerances are not applicable, and the chart shall be prepared as accurately as practicable.

S.6. Identification. – A tank and any gauge rod, surface gauge, spirit level, and volume chart intended to be used therewith shall be mutually identified, as by a common serial number, in a prominent and permanent manner.

N. Notes

CCR § 4002.7. Farm Milk Tanks. (4.42.)(a) Calibration at Installation. Any farm milk tank exceeding 1,000 gallons capacity installed or relocated after January 1, 1982 shall be calibrated at the farm and a volume chart prepared before the acceptance test is performed.

(Adopted, 4 CCR 4002.)

N.1. Test Liquid. – Water shall be used as the test liquid for a farm milk tank.

N.2. Evaporation and Volume Change. – Care shall be exercised to reduce to a minimum, evaporation losses and volume changes resulting from changes in temperature of the test liquid.

N.3. To Deliver. – A farm milk tank shall be tested “to deliver.” If the tank is gauged by measuring the test liquid delivered into the tank, the inside tank walls shall first be thoroughly wetted and the tank then shall be drained for 30 seconds after the main drainage flow has ceased.

N.4. Level. – A farm milk tank shall be level, as shown by the level-indicating means, during gauging and testing.

N.5. Test Methods. – Acceptance tests of milk tanks may be of either the prover method or the master meter method provided that the master metering system is capable of operating within 25 % of the applicable tolerance found in T.3. Basic Tolerance Values. Subsequent tests may be of either the prover method or the master meter method provided that the master metering system is capable of operating within 25 % of the applicable tolerance found in T.4. Basic Tolerance Values, Master Meter Method.

N.5.1. Verification of Master Metering Systems. – A master metering system used to gauge a milk tank shall be verified before and after the gauging process. A master metering system used to calibrate a milk tank shall be verified before starting the calibration and re-verified at least every quarter of the tank capacity, or every 2000 L (500 gal), whichever is greater. The above process of re-verifying the master metering system may be waived if the system is verified using a NIST traceable prover with a minimum of two tests immediately before and one test immediately after the gauging process and that each test result is within 25 % of T.3. Basic Tolerance Values.

(Added 2001) (Amended 2012)

N.5.2. Temperature Changes in Water Supply. – When using a master metering system to gauge or calibrate a milk tank, the official shall monitor the temperature of the water before and after changing sources of supply. If the water temperature of the new source changes by more than 2.8 °C (5 °F) from the previous supply, the official shall re-verify the accuracy of the master metering system as soon as possible after the system reaches temperature equilibrium with the new supply source.

(Added 2001)

N.6. Reading the Meniscus. – When a reading or setting is to be obtained from a meniscus formed by milk or other opaque liquid, the index or reading line is the position

of the highest point of the center of the meniscus. When calibrating a device with water and the device is to be used with an opaque liquid, the reading should be obtained accordingly; that is, the position of the highest point of the center of the meniscus.

(Added 1984)

T. Tolerances

T.1. Application. – The tolerances hereinafter prescribed shall be applied equally to errors in excess and errors in deficiency.

T.2. Minimum Tolerance Values. – On a particular tank, the maintenance and acceptance tolerance applied shall be not smaller than the volume corresponding to the graduated interval at the point of test draft on the indicating means or 2 L (½ gal), whichever is greater.

(Amended 1980)

T.3. Basic Tolerance Values. – The basic maintenance and acceptance tolerance shall be 0.2 % of the volume of test liquid in the tank at each test draft.

(Amended 1975)

T.4. Basic Tolerance Values, Master Meter Method. – The basic maintenance and acceptance tolerance for tanks tested by the master meter method shall be 0.4 % of the volume of test liquid in the tank at each test draft.

(Added 1975)

UR. User Requirements

UR.1. Installation. – A stationary tank shall be rigidly installed in level without the use of removable blocks or shims under the legs. If such tank is not mounted permanently in position, the correct position on the floor for each leg shall be clearly and permanently defined.

UR.2. Level Condition.

UR.2.1. Stationary Tank. – A stationary farm milk tank shall be maintained in level.

UR.2.1.1. Leveling Lugs. – If leveling lugs are provided on a stationary tank, such lugs shall not be hammered or filed to establish or change a level condition of the tank.

UR.2.2. Portable Tank. – On a portable tank, measurement readings shall be made only when the tank is approximately level; that is, when it is not out of level by more than 5 % or approximately three degrees in any direction.

UR.3. Weight Chart. – An auxiliary weight chart may be provided, on which shall be prominently displayed the weight per unit volume value used to derive the weight values from the official volume chart.

UR.4. Use. – A farm milk tank shall not be used to measure quantities greater than an amount that can be agitated without overflowing.

Table of Contents

	Page
Section 4.43. Measure-Containers	4-17
A. Application	4-17
A.1. General.	4-17
A.2. Exceptions.....	4-17
A.3. Additional Code Requirements.....	4-17
S. Specifications	4-17
S.1. Units.	4-17
S.2. Capacity Point.	4-17
S.3. Shape.....	4-17
S.4. Marking.	4-18
S.4.1. Capacity Point.....	4-18
S.4.2. Capacity Statement.	4-18
N. Notes	4-18
N.1. Test Liquid.....	4-18
N.2. Preparation of Container for Test.	4-18
N.2.1. General.....	4-18
N.2.2. Restraining Form for Test.	4-18
T. Tolerances	4-18
T.1. Tolerances on an Individual Measure.....	4-18
T.2. Tolerance on Average Capacity.	4-19
UR. User Requirements	4-19
UR.1. Limitation of Use.....	4-19

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Section 4.43. Measure-Containers

A. Application

A.1. General. – This code applies to measure-containers, including lids or closures if such are necessary to provide total enclosure of the measured commodity, as follows:

- (a) Retail measure-containers intended to be used only once to determine at the time of retail sale, and from bulk supply, the quantity of commodity on the basis of liquid measure. The retail measure-container serves as the container for the delivery of the commodity.
- (b) Prepackaged measure-containers intended to be used only once to determine in advance of sale the quantity of a commodity (such as ice cream, ice milk, or sherbet) on the basis of liquid measure. The prepackaged measure-container serves as the container for the delivery of the commodity, in either a wholesale or a retail marketing unit.

A.2. Exceptions. – This code does not apply to rigid containers used for milk, cream, or other fluid dairy products, which are covered by packaging requirements.

A.3. Additional Code Requirements. – In addition to the requirements of this code, Measure-Containers shall meet the requirements of Section 1.10. General Code.

S. Specifications

S.1. Units. – The capacity of a measure-container shall be a multiple of or a binary submultiple of a quart or a liter, and the measure shall not be subdivided. However, for prepackaged measure-containers, any capacity less than $\frac{1}{4}$ L or $\frac{1}{2}$ liq pt shall be permitted.

(Amended 1979)

S.2. Capacity Point. – The capacity of a measure-container shall be sharply defined by:

- (a) the top edge;
- (b) a line near the top edge; or
- (c) the horizontal cross-sectional plane established by the bottom surface of the removable lid or cap when seated in the container.

S.3. Shape. – A measure-container shall be designed as some suitable geometrical shape, and its capacity shall be determined without distortion from its normal assembled shape.

S.4. Marking.

S.4.1. Capacity Point. – If the capacity point of a measure-container is defined by a line, the container shall be marked conspicuously on its side with a suitable statement clearly identifying this line as the capacity point.

S.4.2. Capacity Statement. – A measure-container shall be clearly and conspicuously marked with a statement of its capacity in terms of one of the units prescribed in Section S.1. Units.

N. Notes

N.1. Test Liquid. – Water shall be used as the test liquid for a measure-container.

N.2. Preparation of Container for Test.

N.2.1. General. – Before an actual test is begun, a measure-container shall, if necessary, be so restrained that it will maintain its normal assembled shape and that its sides will not bulge when it is filled with water.

N.2.2. Restraining Form for Test.

N.2.2.1. For Rectangular Containers of One Liter, One Quarter Less. – Bulging of the sides of a rectangular measure-container of 1 L (1 qt) capacity or less may be controlled by holding against each side of the container, with a cord, rubber bands, or tape, a metal plate or a piece of heavy cardboard slightly smaller than the side of the container.

(Amended 1979)

N.2.2.2. For Rectangular Prepackaged Measure-container of Two Quarts or Two Liters or Greater. – A rectangular prepackaged measure-container of 2 L (2 qt) capacity or greater shall be supported during a test by a rigid restraining form. This form shall restrain not less than the entire area of the central two-thirds of each side of the container, measured from bottom to top. The inside width dimension of any side panel of the restraining form shall be 1.6 mm ($1/16$ in) greater than the corresponding outside dimension of the container. (The outside width dimension of any side panel of the container shall be established by adding to the inner side center-of-score to center-of-score dimension two thicknesses of the board used, and the sum thus obtained shall be rounded off to the nearest 0.4 mm ($1/64$ in).)

(Amended 1979)

T. Tolerances

T.1. Tolerances on an Individual Measure. – The acceptance tolerances in excess and in deficiency on an individual measure shall be as shown in Table 1. Acceptance Tolerances, in Excess and in Deficiency, for Measure-Containers.

T.2. Tolerance on Average Capacity. – The average capacity on a random sample of 10 measures selected from a lot of 25 or more shall be equal to or greater than the nominal capacity.

(Amended 1979)

UR. User Requirements

UR.1. Limitation of Use. – The use of a measure-container with a rectangular cross section of a capacity of 2 L (2 qt) or greater shall be limited to the packaging, in advance of sale, of ice cream, sherbet, or other similar frozen desserts.

(Amended 1979)

Table 1. Acceptance Tolerances, in Excess and in Deficiency, for Measure-Containers

Nominal Capacity	Tolerance In Excess milliliters	Tolerance In Deficiency milliliters
¼ liter or less	10	5.0
½ liter	15	7.5
1 liter	20	10.0
Over 1 liter	Add per liter 10 milliliters	Add per liter 5.0 milliliters

Nominal Capacity	Tolerance In Excess milliliters fluid drams	Tolerance In Excess milliliters cubic inches	Tolerance In Deficiency milliliters fluid drams	Tolerance In Deficiency milliliters cubic inches
½ pint or less	3	0.6	1.5	0.3
1 pint	4	1.0	2.0	0.5
1 quart	6	1.4	3.0	0.7
2 quarts	9	2.0	4.5	1.0
3 quarts	10	2.4	5.0	1.2
4 quarts	12	2.8	6.0	1.2
Over 4 quarts	Add per quart 3 fluid drams	Add per quart 0.7 cubic inch	Add per quart 1.5 fluid drams	Add per quart 0.35 cubic inch

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Table of Contents

	Page
Section 4.44. Graduates	4-21
A. Application	4-21
A.1. General.	4-21
A.2. Additional Code Requirements.....	4-21
S. Specifications	4-21
S.1. Units.	4-21
S.2. Initial Interval.	4-22
S.3. Shape.....	4-22
S.4. Material.	4-22
S.5. Dimensional Proportions.	4-22
S.5.1. On a Circular Conical Graduate.....	4-22
S.5.2. On a Cylindrical Graduate.....	4-22
S.6. Base.	4-22
S.7. Design of Graduations.....	4-22
S.7.1. General.....	4-22
S.7.2. On a Single-Scale Graduate.....	4-22
S.7.3. On a Double-Scale or a Duplex Graduate.	4-22
S.8. Basis of Graduation.....	4-23
S.9. Marking Requirements.	4-23
N. Notes	4-23
N.1. Test Liquid.....	4-23
N.2. Temperature Control.	4-23
T. Tolerances	4-23
T.1. Tolerance Values	4-23

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Section 4.44. Graduates

A. Application

A.1. General. – This code applies to subdivided glass measures of capacity, either cylindrical or conical in shape.

A.2. Additional Code Requirements. – In addition to the requirements of this code, Graduates shall meet the requirements of Section 1.10. General Code.

S. Specifications

S.1. Units. – Nominal capacities, graduation ranges, values of graduated intervals, and numbered graduations applicable to single-scale graduates and to the appropriate portions of double scale graduates shall be as shown in Table 1. Design Details for Graduates.

Table 1. Design Details for Graduates

Nominal Capacity	To be Graduated Between	Value of Graduated Intervals	Number at Each Graduation Divisible by
5 mL 10 mL 25 mL 50 mL 100 mL 500 mL 1000 mL	1 and 5 mL 2 and 10 mL 5 and 25 mL 10 and 50 mL 20 and 100 mL 100 and 500 mL 200 and 1000 mL	½ mL 1 mL 5 mL 5 mL 10 mL 25 mL 50 mL	1 mL 2 mL 5 mL 10 mL 20 mL 50 mL 100 mL
60 <u>minims</u> 120 <u>minims</u>	15 and 60 <u>minims</u> 30 and 120 <u>minims</u>	5 <u>minims</u> 10 <u>minims</u>	10 ^a <u>minims</u> 20 ^b <u>minims</u>
4 <u>fluid drams</u> 8 <u>fluid drams</u>	1 and 4 <u>fluid drams</u> 2 and 8 <u>fluid drams</u>	½ <u>fluid drams</u> 1 <u>fluid drams</u>	1 <u>fluid drams</u> 2 <u>fluid drams</u>
2 <u>fluid ounces</u> 4 <u>fluid ounces</u> 8 <u>fluid ounces</u> 16 <u>fluid ounces</u> 32 <u>fluid ounces</u>	½ and 2 <u>fluid ounces</u> 1 and 4 <u>fluid ounces</u> 2 and 8 <u>fluid ounces</u> 4 and 16 <u>fluid ounces</u> 8 and 32 <u>fluid ounces</u>	¼ <u>fluid ounces</u> ½ <u>fluid ounces</u> ½ <u>fluid ounces</u> 1 <u>fluid ounces</u> 2 <u>fluid ounces</u>	½ <u>fluid ounces</u> 1 <u>fluid ounces</u> 1 <u>fluid ounces</u> 2 <u>fluid ounces</u> 4 <u>fluid ounces</u>

^a And, in addition, at the first (15-minim) graduation.

^b And, in addition, at the first (30-minim) graduation.

S.2. Initial Interval. – A graduate shall have an initial interval that is not subdivided, equal to not less than one-fifth and not more than one-fourth of the capacity of the graduate.

S.3. Shape. – A graduate of a capacity of more than 15 mL (4 fl dr) may be of either the cylindrical or circular conical type. A graduate of a capacity of 15 mL (4 fl dr) or less shall be of the single-scale cylindrical type.

S.4. Material. – A graduate shall be made of good-quality, thoroughly annealed, clear, transparent glass, free from bubbles and streaks that might affect the accuracy of measurement. The glass shall be uniform in thickness and shall not be excessively thick.

S.5. Dimensional Proportions.

S.5.1. On a Circular Conical Graduate. – The inside measurement from the bottom of a circular conical graduate to the capacity graduation shall be not less than two times the inside diameter at the capacity graduation. The inside measurement from the bottom of the graduate to the point representing one-fourth of the capacity shall be not less than the inside diameter at that point.

S.5.2. On a Cylindrical Graduate. – The inside measurement from the bottom of a cylindrical graduate to the capacity graduation shall be not less than five times the inside diameter at the capacity graduation.

S.6. Base. – The base of the graduate shall be perpendicular to the vertical axis of the graduate. The diameter of the base shall be of such size that the empty graduate will remain standing on an inclined surface of 25 %, or approximately 15 degrees, from the horizontal.

S.7. Design of Graduations.

S.7.1. General. – Graduations shall be perpendicular to the vertical axis of the graduate and parallel to each other. Graduations shall be continuous, of uniform thickness not greater than 0.4 mm (0.015 in), clearly visible, permanent, and indelible under normal conditions of use.

(Amended 1977)

S.7.2. On a Single-Scale Graduate. – On a single-scale graduate, the main graduations shall completely encircle the graduate and subordinate graduations shall extend at least one-half the distance around the graduate.

S.7.3. On a Double-Scale or a Duplex Graduate. – On a double-scale or duplex graduate, there shall be a clear space between the ends of the main graduations on the two scales, and this space shall be approximately 90 degrees from the lip of the graduate and shall conform to the requirements of Table 2. Clear Space Between Ends of Main Graduations on Double Scale Graduates.

Table 2. Clear Space Between Ends of Main Graduations on Double Scale Graduates

Inside Diameter of Graduate at the Graduations (inches)	Clear Space Between Ends of Main Graduations (inch)
Less than 1.5	$\frac{1}{8}$ to $\frac{1}{4}$
1.5 to 3, inclusive	$\frac{1}{4}$ to $\frac{1}{2}$
Over 3	$\frac{3}{8}$ to $\frac{5}{8}$

S.8. Basis of Graduation. – A graduate shall be graduated “to deliver” when the temperature of the graduate is 20 °C (68 °F), and shall be marked accordingly in a permanent and conspicuous manner.

S.9. Marking Requirements. – Each main graduation shall be marked to show its value. Intermediate graduations shall not be marked. Value figures shall be uniformly positioned either directly upon or immediately above the graduations to which they refer. Figures placed upon graduations shall be set in from the ends of the graduations a sufficient distance to allow the ends of the graduations to be used in making a setting.

N. Notes

N.1. Test Liquid. – Water shall be used as the test liquid for graduates.

N.2. Temperature Control. – During the test of a graduate, appropriate precautions shall be exercised to reduce any detrimental temperature effects to the practicable minimum.

T. Tolerances

T.1. Tolerance Values. – Maintenance and acceptance tolerances in excess and in deficiency shall be as shown in Table 3. Maintenance and Acceptance Tolerances, in Excess and Deficiency, for Graduates for graduates that are graduated “to contain” or “to deliver.” (The tolerance to be applied at any graduation is determined by the inside diameter of the graduate at the graduation in question.)

Table 3. Maintenance and Acceptance Tolerances, in Excess and in Deficiency, for Graduates

Inside Diameter of Graduate From	Inside Diameter of Graduate To but Not Including	Tolerance	Inside Diameter of Graduate From	Inside Diameter of Graduate To but Not Including	Tolerance
0 mL	16 mL	0.1 mL	0 inches	9/16 inches	2 minims
16 mL	21 mL	0.2 mL	9/16 inches	13/16 inches	3 minims
21 mL	26 mL	0.4 mL	13/16 inches	1 1/16 inches	6 minims
26 mL	31 mL	0.6 mL	1 1/16 inches	1 5/16 inches	10 minims
31 mL	36 mL	0.8 mL	1 5/16 inches	1 9/16 inches	15 minims
36 mL	41 mL	1.1 mL	1 9/16 inches	1 13/16 inches	20 minims
41 mL	46 mL	1.4 mL	1 13/16 inches	2 1/16 inches	30 minims
46 mL	51 mL	1.8 mL	2 1/16 inches	2 5/16 inches	40 minims
51 mL	56 mL	2.2 mL	2 5/16 inches	2 9/16 inches	50 minims
56 mL	61 mL	2.8 mL	2 9/16 inches	2 13/16 inches	65 minims
61 mL	66 mL	3.4 mL	2 13/16 inches	3 1/16 inches	80 minims
66 mL	71 mL	4.1 mL	3 1/16 inches	3 5/16 inches	95 minims
71 mL	76 mL	4.8 mL	3 5/16 inches	3 9/16 inches	110 minims
76 mL	81 mL	5.6 mL	3 9/16 inches	3 13/16 inches	130 minims
81 mL	86 mL	6.4 mL	3 13/16 inches	4 1/16 inches	150 minims
86 mL	91 mL	7.2 mL			
91 mL	96 mL	8.1 mL			
96 mL	101 mL	9.0 mL			

(Amended 1974)

Table of Contents

	Page
Section 4.45. Dry Measures	25
A. Application	25
A.1. General.	25
A.2. Exceptions.	25
A.3. Additional Code Requirements.	25
S. Specifications	25
S.1. Units.....	25
S.2. Material.	25
S.3. Shape.	25
S.3.1. Conical Dry Measure.	26
S.4. Capacity Point.....	26
S.5. Top Reinforcement.	26
S.6. Marking Requirements.	26
N. Notes	26
N.1. Testing Medium.	26
N.1.1. Watertight Dry Measures.	26
N.1.2. Non-Watertight Dry Measures.	27
T. Tolerances	27
T.1. Tolerance Values	27

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Section 4.45. Dry Measures

A. Application

A.1. General. – This code applies to rigid measures of capacity designed for general and repeated use in the measurement of solids, including the capacities of $\frac{1}{2}$ bu or more.

A.2. Exceptions.

- (a) This code does not apply to “standard containers” used for the measurement of fruits and vegetables and as shipping containers thereof.
- (b) This code does not apply to berry baskets and boxes. (Also see Section 4.46. Code for Berry Baskets and Boxes.)
(Added 1976)

A.3. Additional Code Requirements. – In addition to the requirements of this code, Dry Measures shall meet the requirements of Section 1.10. General Code.

S. Specifications

S.1. Units. – The capacity of a measure shall be 1 bu, a multiple of the bushel, or a binary submultiple of the bushel, and the measure shall not be subdivided or double-ended.

S.2. Material. – A dry measure shall be made of any suitable material that will retain its shape during normal usage.

S.3. Shape. – A measure, other than a basket, of a capacity of $\frac{1}{2}$ bu or less, shall be cylindrical or conical in shape. The top diameter shall in no case be less than the appropriate minimum diameter shown in Table 1. Minimum Top Diameters for Dry Measure other than Baskets. The bottom of a measure, other than a basket, shall be perpendicular to the vertical axis of the measure and shall be flat, except that a metal bottom may be slightly corrugated. The bottom of a measure shall not be adjustable or movable

Table 1. Minimum Top Diameters for Dry Measures other than Baskets

Nominal Capacity	Minimum Top Diameter Inches
1 pint	4
1 quart	5 and $\frac{3}{8}$
2 quarts	6 and $\frac{5}{8}$
$\frac{1}{2}$ peck	8 and $\frac{1}{2}$
1 peck	10 and $\frac{7}{8}$
$\frac{1}{2}$ bushel	13 and $\frac{3}{4}$

S.3.1. Conical Dry Measure. – If conical, the top diameter shall exceed the bottom diameter by not more than 10 % of the bottom diameter.

S.4. Capacity Point. – The capacity of a measure shall be determined by the top edge of the measure.

S.5. Top Reinforcement. – The top edge of a measure shall be reinforced. On a wooden measure other than a basket, of a capacity of 1 qt or more, this reinforcement shall be in the form of a firmly attached metal band.

S.6. Marking Requirements. – A measure shall be conspicuously marked on its side with a statement of its capacity. If the capacity is stated in terms of the pint or quart, the word “Dry” shall be included. The capacity statement shall be in letters of the following dimensions:

- (a) At least $\frac{1}{2}$ in high and $\frac{1}{4}$ in wide on a measure of any capacity between $\frac{1}{2}$ pt and 1 pk.
- (b) At least 1 in high and $\frac{1}{2}$ in wide on a measure of a capacity of $\frac{1}{2}$ bu or more.
- (c) On a measure of a capacity of $\frac{1}{4}$ pt or less, the statement shall be as prominent as practicable, considering the size and design of such measure.

N. Notes

N.1. Testing Medium.

N.1.1. Watertight Dry Measures. – Water shall be used as the testing medium for watertight dry measures.

N.1.2. Non-Watertight Dry Measures. – A dry measure shall be tested either volumetrically using rapeseed as a testing medium or geometrically through inside measurement and calculation.

(Amended 1988)

T. Tolerances

T.1. Tolerance Values. – Maintenance tolerances in excess and in deficiency shall be as shown in Table 2. Maintenance Tolerances, in Excess and in Deficiency, for Dry Measure. Acceptance tolerances shall be one-half the maintenance tolerances.

Table 2. Maintenance Tolerances, in Excess and in Deficiency, for Dry Measures

Nominal Capacity	Tolerance In Excess Cubic Inches	Tolerance In Deficiency Cubic Inches
1/32 pint or less	0.1	0.05
1/16 pint	0.15	0.1
1/8 pint	0.25	0.15
1/4 pint	0.5	0.3
1/2 pint	1.0	0.5
1 pint	2.0	1.0
1 quart	3.0	1.5
2 quarts	5.0	2.5
1/2 peck	10.0	5.0
1 peck	16.0	8.0
1/2 bushel	30.0	15.0
1 bushel	50.0	25.0

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Table of Contents

	Page
Section 4.46. Berry Baskets and Boxes	4-29
A. Application	4-29
A.1. General.	4-29
A.2. Additional Code Requirements.....	4-29
S. Specifications	4-29
S.1. Units.	4-29
S.2. Materials.....	4-29
S.3. Capacity Point.	4-29
N. Notes	4-29
N.1. Method of Test.	4-29
T. Tolerances	4-29
T.1. Tolerances on Individual Measures.....	4-29
T.2. Tolerances on Average Capacity.	4-29

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Section 4.46. Berry Baskets and Boxes

A. Application

A.1. General. – This code applies to baskets and boxes for berries and small fruits in capacities of 1 dry quart and less.

A.2. Additional Code Requirements. – In addition to the requirements of this code, berry baskets and boxes shall meet the requirements of Section 1.10. General Code.

S. Specifications

S.1. Units. – The capacity of a berry basket or box shall be ½ dry pint, 1 dry pint, or 1 dry quart.

S.2. Materials. – A berry basket or box shall be made of any suitable materials that will retain its shape during normal filling, storage, and handling.

S.3. Capacity Point. – The capacity of a berry basket or box shall be determined by its top edges.

N. Notes

N.1. Method of Test. – A berry basket or box may be tested either volumetrically, using rape seed as the testing medium, or geometrically through accurate inside dimension measurement and calculation.

T. Tolerances

T.1. Tolerances on Individual Measures. – Maintenance and acceptance tolerances in excess and deficiency on an individual measure shall be as shown in Table 1. Maintenance and Acceptance Tolerances in Excess and in Deficiency.

T.2. Tolerances on Average Capacity. – The average capacity on a random sample of 10 measures selected from a lot of 25 or more shall be equal to or greater than the nominal capacity.

(Amended 1979)

Table 1. Maintenance and Acceptance Tolerances in Excess and in Deficiency

Nominal Capacity	Tolerance In Excess Cubic Inches	Tolerance In Deficiency Cubic Inches
½ pint	1	0.5
1 pint	2	1.0
1 quart	3	1.5

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CALIFORNIA DEPARTMENT OF
FOOD & AGRICULTURE

Extracts from the

CALIFORNIA CODE OF REGULATIONS TITLE 4, DIVISION 9

WEIGHTS AND MEASURES FIELD REFERENCE MANUAL (2023)

Chapter 1, Tolerances and Specifications for Commercial Weighing and Measuring Devices

Part 5: NIST Handbook 44

Sections:

- 5.50. Fabric-Measuring Devices**
- 5.51. Wire- and Cordage-Measuring Devices**
- 5.52. Linear Measures**
- 5.53. Odometers**
- 5.54. Taximeters**
- 5.55. Timing Devices**
- 5.56. (a) & (b) Grain Moisture Meters – NOT PUBLISHED**
- 5.57. Near-Infrared Grain Analyzers – NOT PUBLISHED**
- 5.58. Multiple Dimension Measuring Devices**
- 5.59. Electronic Livestock, Meat, and Poultry Evaluation Systems and/or
Devices – NOT PUBLISHED**
- 5.60. Transportation Network Measurement Systems -Tentative Code**



**CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE
DIVISION OF MEASUREMENT STANDARDS**

**California Department of Food and Agriculture
Division of Measurement Standards**

DISCLAIMER

This document combines the 2023 Edition of National Institute of Standards and Technology, Handbook 44, Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices (NIST Handbook 44).

Paragraphs not adopted from the 2023 Edition of NIST Handbook 44. are annotated in the text with the statement **[NOT ADOPTED]**.

Additional language in CCR Section 4002.X. The additional text can be identified in **gray shaded font**.

Sources: [NIST Handbook 44](#) and [4 CCR 4000, 4001 and 4002](#).

CCR Article 1, National Uniformity, Exceptions and Additions

§ 4000. Application. Commercial weighing and measuring devices shall, except where noted below, conform to the latest requirements set forth in the National Institute of Standards and Technology Handbook 44 “Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices”, which is herein incorporated by reference, and to the Additional Requirements listed herein. Copies of Handbook 44 may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. [Added 1994, 4 CCR 4000]

§ 4001. Exceptions. The following regulations in Handbook 44 are not adopted or incorporated by reference (click on § 4001. Exceptions).

§ 4002. Additional Requirements. The following sections apply to devices in addition to the Handbook 44 requirements that are incorporated by reference. The number in parenthesis following the section number and section title refers to the related section in Handbook 44; i.e., 4002.1. General Code (1.10.) refers to Section 1.10. General Code in Handbook 44.

§ 4002. Additional Language.

Note: Authority cited: Sections 12027 and 12107, Business and Professions Code.
Reference: Section 12107, Business and Professions Code.

Table of Contents

	Page
Section 5.50. Fabric-Measuring Devices	5-1
A. Application.....	5-1
A.1. General.....	5-1
A.2. Devices Used to Measure Other Similar Material in Sheet, Roll, or Bolt Form.	5-1
A.3. Additional Code Requirements.	5-1
S. Specifications.....	5-1
S.1. Units.....	5-1
S.2. Design of Indicating Elements.....	5-1
S.2.1. Graduations.....	5-1
S.2.2. Indicator.....	5-2
S.2.3. Money-Value Computations.	5-2
S.2.4. Return to Zero.	5-3
S.3. Marking Requirements.....	5-3
S.4. Design Accuracy.....	5-3
N. Notes	5-3
N.1. Testing Medium.	5-3
T. Tolerances	5-3
T.1. Tolerance Values.....	5-3
UR. User Requirements	5-4
UR.1. Installation Requirements.....	5-4
UR.1.1. Installation.....	5-4
UR.2. Use Requirements.....	5-4
UR.2.1. Limitation of Use.....	5-4
UR.2.2. Return of Indicating Elements to Zero.....	5-4

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Section 5.50. Fabric-Measuring Devices

A. Application

A.1. General. – This code applies only to mechanisms and machines designed to indicate automatically (with or without value-computing capabilities) the length of fabric passed through the measuring elements.

A.2. Devices Used to Measure Other Similar Material in Sheet, Roll, or Bolt Form. – Insofar as they are clearly appropriate, the requirements and provisions of this code apply also to devices designed for the commercial measurement of other material similar to fabrics, in sheet, roll, or bolt form.

A.3. Additional Code Requirements. – In addition to the requirements of this code, Fabric-Measuring Devices shall meet the requirements of Section 1.10. General Code.

S. Specifications

S.1. Units. – A fabric-measuring device shall indicate lengths as follows:

- (a) For devices indicating in metric units, lengths shall be indicated in terms of 5 cm; 10 cm; 25 cm; or 50 cm and meters.

In addition, lengths may be indicated in terms of any or all of the following subdivisions: millimeters and centimeters.

- (b) For devices indicating in U.S. customary units, lengths shall be indicated in terms of $\frac{1}{8}$ yd; $\frac{1}{4}$ yd; or $\frac{1}{2}$ yd; and yards.

In addition, lengths may be indicated in terms of any or all of the following subdivisions: $\frac{1}{8}$ yd; $\frac{1}{16}$ yd; inches and feet.

Digital indicators may indicate values in decimal fractions.

(Amended 1977)

S.2. Design of Indicating Elements.

S.2.1. Graduations.

S.2.1.1. Length. – Graduations shall be so varied in length that they may be conveniently read.

S.2.1.2. Width. – In any series of graduations, the width of a graduation shall in no case be greater than the width of the minimum clear interval between graduations, and the width of main graduations shall be not more than 50 % greater than the width of

subordinate graduations. Graduations shall in no case be less than 0.2 mm (0.008 in) in width.

S.2.1.3. Clear Interval between Graduations. – The clear interval between graduations shall be at least 6 mm for cm graduations ($\frac{1}{4}$ in for $\frac{1}{8}$ yd graduations), and 3 mm for 20 cm graduations ($\frac{1}{8}$ in for 1 in graduations).

S.2.2. Indicator.

S.2.2.1. Symmetry. – The index of an indicator shall be symmetrical with respect to the graduations, at least throughout that portion of its length associated with the graduations.

S.2.2.2. Length. – The index of an indicator shall reach to the finest graduations with which it is used, unless the indicator and the graduations are in the same plane, in which case the distance between the end of the indicator and the ends of the graduations, measured along the line of the graduations, shall be not more than 1.0 mm (0.04 in).

S.2.2.3. Width. – The index of an indicator shall not be wider than the narrowest graduations with which it is used, and shall in no case exceed 0.4 mm (0.015 in).

S.2.2.4. Clearance. – The clearance between the index of an indicator and the graduations shall in no case be more than 1.5 mm (0.06 in).

S.2.2.5. Parallax. – Parallax effects shall be reduced to the practicable minimum.

S.2.3. Money-Value Computations.

S.2.3.1. Full-Computing Type. – In this type, the money value at each of a series of unit prices shall be computed automatically for every length within the range of measurement of the fabric-measuring device. Value graduations shall be provided and shall be accurately positioned. The value of each graduated interval shall be 1 cent at all prices per yard of 30 cents and less, and shall not exceed 2 cents at higher prices per yard. Five-cent intervals may be represented in the two-cent range by special graduations, but these shall not be positioned in the clear intervals between graduations of the regular series.

S.2.3.2. Limited-Computing Type. – In this type, the money value at each of a series of unit prices shall be computed automatically only for lengths corresponding to a definite series of length graduations. There shall be no value graduations. At no position that the chart can assume shall two value figures at the same price per yard be completely and clearly exposed to view at one time. Money values shown shall be mathematically accurate, except that a fraction of less than $\frac{1}{2}$ cent shall be dropped and

the next higher cent shall be shown in the case of a fraction of $\frac{1}{2}$ cent or more. One of the following requirements shall be met:

- (a) There shall be a money-value computation for each length graduation within the range of measurement of the device.
- (b) No money-value computation shall be exposed to view except at such times as the device shows a length indication for which a corresponding series of value indications is computed.
- (c) Each column or row of money-value computations shall be marked to show the length to which the computations correspond, the device shall be marked to show the character and limitations of the computations, and there shall be computations corresponding to at least 10 cm ($\frac{1}{8}$ yd) throughout the range of measurement of the device.

S.2.4. Return to Zero. – Primary indicating elements shall be readily returnable to a definite zero indication. Means shall be provided to prevent the return of the indicating elements beyond their correct zero positions.

S.3. Marking Requirements. – If a device will not accurately measure all fabrics, it shall be marked to indicate clearly its limitations.

S.4. Design Accuracy. – Indications of length and money value shall be accurate whether the values of the indications are being increased or decreased.

N. Notes

N.1. Testing Medium. – A fabric-measuring device shall be tested with a suitable testing tape approximately 7.62 cm (3 in) wide and with a graduated length of at least 11 m (12 yd), made from such material and having such surface finish as to provide dimensional stability and reduce slippage to the practicable minimum.

T. Tolerances

T.1. Tolerance Values. – Maintenance and acceptance tolerances shall be as shown in Table 1. Maintenance and Acceptance Tolerances for Fabric-Measuring Devices.

Table 1. Maintenance and Acceptance Tolerances for Fabric-Measuring Devices

Indication of Device (yards)	Maintenance Tolerance On Under-registration (inches)	Maintenance Tolerance On Over-registration (inches)	Acceptance Tolerance On Under-registration (inches)	Acceptance Tolerance On Over-registration (inches)
2 or less	$\frac{3}{8}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{8}$
3	$\frac{3}{8}$	$\frac{5}{16}$	$\frac{1}{4}$	$\frac{5}{32}$
4	$\frac{1}{2}$	$\frac{5}{16}$	$\frac{1}{4}$	$\frac{5}{32}$
5	$\frac{5}{8}$	$\frac{3}{8}$	$\frac{5}{16}$	$\frac{3}{16}$
6	$\frac{3}{4}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{3}{16}$
7 and 8	1	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{4}$
9	$1\frac{1}{4}$	$\frac{5}{8}$	$\frac{5}{8}$	$\frac{5}{16}$
10 and 11	$1\frac{1}{2}$	$\frac{3}{4}$	$\frac{3}{4}$	$\frac{3}{8}$
12 and 13	$1\frac{3}{4}$	$\frac{7}{8}$	$\frac{7}{8}$	$\frac{7}{16}$
14 and 15	2	1	1	$\frac{1}{2}$
Over 15	Add $\frac{1}{8}$ inch per indicated yard	Add $\frac{1}{16}$ inch per indicated yard	Add $\frac{1}{16}$ inch per indicated yard	Add $\frac{1}{32}$ inch per indicated yard

UR. User Requirements

UR.1. Installation Requirements.

UR.1.1. Installation. – A fabric-measuring device shall be securely supported and firmly fixed in position.

UR.2. Use Requirements.

UR.2.1. Limitation of Use. – A fabric-measuring device shall be used to measure only those fabrics that it was designed to measure, and in no case shall it be used to measure a fabric that a marking on the device indicates should not be measured.

UR.2.2. Return of Indicating Elements to Zero. – The primary indicating elements shall be returned to zero before each measurement.

Table of Contents

	Page
Section 5.51. Wire- and Cordage-Measuring Devices	5
A. Application	5
A.1. General.	5
A.2. Additional Code Requirements.....	5
S. Specifications	5
S.1. Units.	5
S.2. Design of Indicating Elements.	5
S.2.1. Graduations.	5
S.2.2. Indicator.	5
S.2.3. Zero Indication.	6
S.3. Design of Measuring Elements.....	6
S.3.1. Sensitiveness.....	6
S.3.2. Slippage.....	6
S.3.3. Accessibility.	6
S.4. Marking Requirements.	6
S.4.1. Limitation of Use.	6
S.4.2. Operating Instructions.....	6
S.4.3. Indications.....	6
S.5. Design Accuracy.	6
N. Notes	6
N.1. Testing Medium.	6
N.2. Minimum Test.	7
T. Tolerances	7
T.1. Tolerance Values.	7
UR. User Requirements.....	7
UR.1. Installation Requirements.....	7
UR.1.1. Installation.....	7
UR.2. Use Requirements.	7
UR.2.1. Limitation of Use.	7
UR.2.2. Return to Zero.....	7
UR.2.3. Operation of Device.	8
UR.2.4. Cleanliness.....	8

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Section 5.51. Wire- and Cordage-Measuring Devices

A. Application

A.1. General. – This code applies to mechanisms and machines designed to indicate automatically the length of cordage, rope, wire, cable, or similar flexible material passed through the measuring elements.

A.2. Additional Code Requirements. – In addition to the requirements of this code, Wire- and Cordage-Measuring Devices shall meet the requirements of Section 1.10. General Code.

S. Specifications

S.1. Units. – A wire- or cordage-measuring device shall indicate lengths in terms of feet, yards, or meters, or combinations of units of the same measurement system, and shall have minimum increments with values that do not exceed the equivalent of 0.1 meter or 0.1 yard.

(Amended 1989)

S.2. Design of Indicating Elements.

S.2.1. Graduations.

S.2.1.1. Length. – Graduations shall be so varied in length that they may be conveniently read.

S.2.1.2. Width. – In any series of graduations, the width of a graduation shall in no case be greater than the width of the minimum clear interval between graduations, and the width of main graduations shall be not more than 50 % greater than the width of subordinate graduations. Graduations shall in no case be less than 0.2 mm (0.008 in), nor more than 1.0 mm (0.04 in), in width.

S.2.1.3. Clear Interval between Graduations. – The clear interval between graduations shall be at least as wide as the widest graduation, and in no case less than 0.8 mm (0.03 in).

S.2.2. Indicator.

S.2.2.1. Symmetry. – The index of an indicator shall be symmetrical with respect to the graduations, at least throughout that portion of its length associated with the graduations.

S.2.2.2. Length. – The index of an indicator shall reach to the finest graduations with which it is used, unless the indicator and the graduations are in the same plane, in which case the distance between the end of the indicator and the ends of the graduations, measured along the line of the graduations, shall be not more than 1.0 mm (0.04 in).

S.2.2.3. Width. – The index of an indicator shall not be wider than the narrowest graduations with which it is used, and shall in no case exceed 0.4 mm (0.015 in).

S.2.2.4. Clearance. – The clearance between the index of an indicator and the graduations shall in no case be more than 1.5 mm (0.06 in).

S.2.2.5. Parallax. – Parallax effects shall be reduced to the practicable minimum.

S.2.3. Zero Indication. – Primary indicating elements shall be readily returnable to a definite zero indication.

S.3. Design of Measuring Elements.

S.3.1. Sensitiveness. – If the most sensitive element of the indicating system utilizes an indicator and graduations, the relative movement of these parts corresponding to a measurement of 30 cm (1 ft) shall be not less than 6 mm ($\frac{1}{4}$ in).

S.3.2. Slippage. – The measuring elements of a wire- or cordage-measuring device shall be so designed and constructed as to reduce to the practicable minimum any slippage of material being measured and any lost motion in the measuring mechanism.

S.3.3. Accessibility. – A wire- or cordage-measuring device shall be so constructed that the measuring elements are readily visible and accessible, without disassembly of any supporting frame or section of the main body, for purposes of cleaning or removing any foreign matter carried into the mechanism by the material being measured.

S.4. Marking Requirements.

S.4.1. Limitation of Use. – If a device will measure accurately only certain configurations, diameters, types, or varieties of materials, or with certain accessory equipment, all limitations shall be clearly and permanently stated on the device.

S.4.2. Operating Instructions. – Any necessary operating instructions shall be clearly stated on the device.

S.4.3. Indications. – Indicating elements shall be identified by suitable words or legends so that the values of the indications will be unmistakable.

S.5. Design Accuracy. – Indications of length shall be accurate whether the values of the indications are being increased or decreased.

N. Notes

N.1. Testing Medium. – Wherever feasible, a wire- or cordage-measuring device shall be tested with a steel tape not less than 10 mm ($\frac{3}{8}$ in) in width and at least 15 m (50 ft) in length. When a device cannot be tested in this manner because of the design of the device, it shall be tested with a dimensionally stable material appropriately marked and compared at frequent

periodic intervals with a steel tape in order to assure that any marked interval is not in error by more than $\frac{1}{3}$ of the tolerance of the device at that particular interval.

(Amended 1981)

N.2. Minimum Test. – Tests shall be conducted at a minimum initial increment of 5 m (20 ft) and appropriate increments up to at least 15 m (50 ft).

T. Tolerances

T.1. Tolerance Values. – Maintenance and acceptance tolerances shall be as shown in Table 1. Maintenance and Acceptance Tolerances for Wire- and Cordage-Measuring Devices.

Table 1. Maintenance and Acceptance Tolerances for Wire- and Cordage-Measuring Devices

Indication of Device (feet)	Acceptance and Maintenance Tolerances On Underregistration (inches)	Acceptance and Maintenance Tolerances On Overregistration (inches)
20	6	3
Over 20 to 30	8	4
Over 30 to 40	10	5
Over 40 to 50	12	6
Over 50	Add 2 inches per indicated 10 feet	Add 1 inch per indicated 10 feet

UR. User Requirements

UR.1. Installation Requirements.

UR.1.1. Installation. – A wire- or cordage-measuring device shall be securely supported and firmly fixed in position.

UR.2. Use Requirements.

UR.2.1. Limitation of Use. – A wire- or cordage-measuring device shall be used to measure only those materials that it was designed to measure, and in no case shall it be used to measure a material that a marking on the device indicates should not be measured.

UR.2.2. Return to Zero. – The primary indicating elements of a wire- or cordage-measuring device shall be returned to zero before each measurement.

UR.2.3. Operation of Device. – A wire- or cordage-measuring device shall not be operated in such a manner as to cause slippage or inaccurate measurement.

UR.2.4. Cleanliness. – The measuring elements of a wire- or cordage-measuring device shall be kept clean to prevent buildup of dirt and foreign material that would adversely affect the measuring capability of the device.

Table of Contents

	Page
Section 5.52. Linear Measures	9
A. Application	9
A.1. General.	9
A.2. Additional Code Requirements.....	9
S. Specifications	9
S.1.M. Units.	9
S.1. Units.	9
S.2. Material.	9
S.2.1. Flexible Tape.	9
S.2.2. End Measure.	9
S.3. Finish.....	9
S.4. Design.....	10
S.4.1. Rigid Measure.....	10
S.4.2. Folding Measure.	10
S.5. Graduations.....	10
S.5.1. General.....	10
S.5.2. Width.....	10
T. Tolerances	10
T.1. For Measures Except Metal Tapes.....	10
T.2. For Metal Tapes.	10

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Section 5.52. Linear Measures

A. Application

A.1. General. – This code applies to any linear measure or measure of length, whether flexible or inflexible, permanently installed or portable.

A.2. Additional Code Requirements. – In addition to the requirements of this code, Linear Measures shall meet the requirements of Section 1.10. General Code.

S. Specifications

S.1.M. Units. – A linear measure may be in total length, and the total length may be subdivided in any or all of the following:

- (a) centimeters and tenths of the centimeter;
- (b) meters; and
- (c) multiples of meters.

A one-meter measure may be graduated, in addition, to show 0.1 m and multiples of 0.1 m subdivisions.

S.1. Units. – A linear measure may be in total length, and the total length may be subdivided in any or all of the following:

- (a) inches and binary submultiples of the inch;
- (b) feet;
- (c) yards and multiples of yards.

A 1-yard measure may be graduated, in addition, to show $\frac{1}{3}$ yd and $\frac{2}{3}$ yd subdivisions. A flexible tape may be graduated in tenths or hundredths of a foot, or both tenths and hundredths of a foot. (Any other subdivisions are allowable only on measures of special purposes and when required for such purposes.)

S.2. Material.

S.2.1. Flexible Tape. – A flexible tape shall be made of metal.

S.2.2. End Measure. – If an end measure is made of material softer than brass, the ends of the measure shall be protected by brass (or other metal at least equally hard) securely attached.

S.3. Finish. – Measures shall be smoothly finished.

S.4. Design.

S.4.1. Rigid Measure. – A rigid measure shall be straight.

S.4.2. Folding Measure. – A folding measure shall open to a definite stop, and when so opened shall be straight.

S.5. Graduations.

S.5.1. General. – Graduations shall be perpendicular to the edge of the measure.

S.5.2. Width. – The width of the graduations on any measure shall not exceed one-half the width of the smallest graduated interval on the measure, and in no case shall be wider than 0.75 mm (0.03 in).

(Amended 1982)

T. Tolerances

T.1. For Measures Except Metal Tapes. – Maintenance tolerances in excess and in deficiency for measures except metal tapes shall be as shown in Table 1. Maintenance Tolerances, in Excess and in Deficiency, for Linear Measures Except Metal Tapes. Acceptance tolerances shall be one-half the maintenance tolerances.

Table 1. Maintenance Tolerances, in Excess and in Deficiency, for Linear Measures Except Metal Tapes

Nominal Interval from Zero in Feet	Tolerance in Inches
½ or less	1/64
1	1/32
2	1/16
3	3/32
4	1/8
5	5/32
6	3/16

T.2. For Metal Tapes. – Maintenance and acceptance tolerances in excess and in deficiency for metal tapes shall be as shown in Table 2. Maintenance and Acceptance Tolerances, in Excess and in Deficiency, for Metal Tapes. Tapes of 10 m (25 ft) or over shall be tested at a tension resulting from a load of 5 kg (10 lb). Tapes less than 10 m (25 ft) shall be tested at a tension resulting from a load of 2.5 kg (5 lb). However, flexible metal tapes of 10 m (25 ft) or less that are not normally used under tension shall be tested with no tension applied. All tapes shall be supported throughout on a horizontal flat surface whenever tested.

(Amended 1972)

Table 2. Maintenance and Acceptance Tolerances, in Excess and in Deficiency, for Metal Tapes

Nominal Interval from Zero in Feet	Tolerance in Inch
6 or less	1/32
7 to 30, inclusive	1/16
31 to 55, inclusive	1/8
56 to 80, inclusive	3/16
81 to 100, inclusive	1/4

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Table of Contents

	Page
Section 5.53. Odometers	13
A. Application	13
A.1. General.	13
A.2. Exceptions.....	13
A.3. Additional Code Requirements.....	13
S. Specifications	13
S.1. Design of Indicating Elements.	13
S.1.1. General.	13
S.1.2. Units.....	13
S.1.3. Minimum Indicated Value.....	13
S.1.4. Advancement of Indicating Elements.....	14
S.1.5. Readability.	14
S.1.6. Digital Indications and Representation.....	14
N. Notes	14
N.1. Testing Procedures.	14
N.1.1. Test Methods.	14
N.1.2. Test Runs.	15
N.1.3. Test Conditions.....	15
T. Tolerances	16
T.1. To Underregistration and to Overregistration.	16
T.2. Tolerance Values.	16
T.2.1. Tolerances for Unloaded Trucks.....	16
UR. User Requirements	16
UR.1. Inflation of Vehicle Tires.	16

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Section 5.53. Odometers

A. Application

A.1. General. – This code applies to odometers that are used or are to be used to determine the charges for rent or hire of passenger vehicles and trucks and buses. (When official examinations are undertaken on odometers that form the basis for the payment of fees or taxes to, or the preparation of reports for, governmental agencies, and in similar cases, the requirements of this code shall be applied insofar as they are applicable and appropriate to the conditions of such special uses.)

(Amended 1977)

A.2. Exceptions. – This code does not apply to taximeters (for which see Section 5.54. Code for Taximeters).

(Amended 1977)

A.3. Additional Code Requirements. – In addition to the requirements of this code, Odometers shall meet the requirements of Section 1.10. General Code.

S. Specifications

S.1. Design of Indicating Elements.

S.1.1. General. – The primary indicating element of an odometer may be:

- (a) the distance-traveled portion of the “speedometer” assembly of a motor vehicle;
- (b) a special cable-driven distance-indicating device; or
- (c) a hub odometer attached to the hub of a wheel on a motor vehicle.

(Amended 1977)

S.1.2. Units. – An odometer shall indicate in terms of miles or kilometers.

(Amended 1977)

S.1.3. Minimum Indicated Value. – The value of the interval of indicated distance shall be:

- (a) for odometers indicating in kilometers, 0.1 km; or
- (b) for odometers indicating in miles, 0.1 mi.

(Amended 1977)

S.1.4. Advancement of Indicating Elements. – The most sensitive indicating elements of an odometer may advance continuously or intermittently; all other elements shall advance intermittently. Except when the indications are being returned to zero, the indications of an installed odometer shall be susceptible to advancement only by the rotation of the vehicle wheel or wheels.

(Amended 1977)

S.1.5. Readability. – Distance figures and their background shall be of sharply contrasting colors. Figures indicating tenth units shall be differentiated from other figures with different colors, or with a decimal point, or by other equally effective means. Except during the period of advance of any decade to the next higher indication, only one figure in each decade shall be exposed to view. Any protective covering intended to be transparent shall be in such condition that it can be made transparent by ordinary cleaning of its exposed surface.

(Amended 1977)

S.1.6. Digital Indications and Representation. – Digital indicating odometers (discontinuous registration) shall “round off” indications to the nearest minimum division or truncate indications to the lower minimum division.

(Added 1990)

N. Notes

N.1. Testing Procedures.

N.1.1. Test Methods. – To determine compliance with distance tolerances, a distance test of an odometer shall be conducted using one or more of the following test methods:

- (a) **Road Test.** – A road test consists of driving the vehicle over a precisely measured road course.
- (b) **Fifth-Wheel Test.** – A fifth-wheel test consists of driving the vehicle over any reasonable road course and determining the distance actually traveled through the use of a mechanism known as a “fifth wheel” that is attached to the vehicle and that independently measures and indicates the distance.
- (c) **Simulated-Road Test.** – A simulated-road test consists of determining the distance traveled by use of a roller device, or by computation from rolling circumference and wheel-turn data.

(Amended 1977)

N.1.2. Test Runs. – Not less than two test runs shall be conducted. Acceleration and deceleration shall be carefully controlled to avoid spinning or skidding the wheels.

(Amended 1977)

N.1.2.1. For Devices Indicating in Miles. – The test runs shall be 2 mi in length, shall start from, and finish at, a dead stop with a minimum of 80 % of the run between 30 mi/h and 45 mi/h.

(Added 1977)

N.1.2.2. For Devices Indicating in Kilometers. – The test runs shall be 3 km in length, shall start from, and finish at, a dead stop with a minimum of 80 % of the run between 50 km/h and 75 km/h.

(Added 1977)

N.1.3. Test Conditions.

N.1.3.1. Tire Stabilization. – Road tests or fifth-wheel tests shall be preceded by a run of at least 8 km or 5 mi, for the purpose of stabilizing tire pressures. Simulated road tests on a roller device shall be made at stable tire pressures.

(Amended 1977)

N.1.3.2. Tire Pressure. – At the completion of the test run or runs, the tires of the vehicle under test shall be checked to determine that the tire pressure is that operating tire pressure posted in the vehicle. If not, the tire pressure should be adjusted to the posted tire pressure and further tests may be conducted to determine the operating characteristics of the odometer.

(Amended 1977)

N.1.3.3. Vehicle Loading.

(a) **Passenger Load.** – During the distance test of an odometer, the vehicle may carry two persons.

(b) **Truck Cargo Load.** – Truck odometers shall be tested by one of the following methods:

(1) the truck is loaded with one-half of the maximum cargo load; or

(2) unloaded if unloaded test tolerances are applied.

(Amended 1977 and 1987)

T. Tolerances

T.1. To Underregistration and to Overregistration. – The tolerances hereinafter prescribed shall be applied to errors of underregistration and errors of overregistration.

T.2. Tolerance Values. – Except for unloaded trucks, maintenance and acceptance tolerances on odometers shall be 4 % of the interval under test.

(Amended 1977 and 1987)

T.2.1. Tolerances for Unloaded Trucks. – Maintenance and acceptance tolerances on truck odometers shall be 5 % for underregistration and 3 % for overregistration of the interval under test.

(Added 1987)

UR. User Requirements

UR.1. Inflation of Vehicle Tires. – The operational tire pressure of passenger vehicle and truck tires shall be posted in the vehicle and tires shall be maintained at the posted pressure.

(Amended 1977)

Table of Contents

	Page
Section 5.54. Taximeters	5-17
A. Application	5-17
A.1. General.	5-17
A.2. Exceptions.....	5-17
A.3. Additional Code Requirements.....	5-17
S. Specifications	5-17
S.1. Design of Indicating and Recording Elements.....	5-17
S.1.1. General.....	5-17
S.1.2. Advancement of Indicating Elements.....	5-17
S.1.3. Visibility of Indications.....	5-18
S.1.4. Actuation of Fare-Indicating Mechanism.....	5-19
S.1.5. Operating Condition.	5-19
S.1.6. Fare Identification.	5-20
S.1.7. Extras.....	5-20
S.1.8. Protection of Indications.....	5-20
S.1.9. <i>Recorded Representation</i>	5-20
S.1.10. <i>Non-fare Information</i>	5-21
S.2. Basis of Fare Calculations.....	5-21
S.2.1. Initial Time and Distance Intervals.....	5-22
S.3. Design of Operating Control.....	5-22
S.3.1. Positions of Control.....	5-22
S.3.2. Control for Extras Mechanism.....	5-22
S.4. Interference.....	5-22
S.5. Provision for Security Seals.	5-22
S.5.1. Taximeter Connected to Networked Systems.....	5-24
S.5.2. Taximeters Calibrated to Specific Vehicles.....	5-24
S.6. Power Interruption, Electronic Taximeters.....	5-25
S.7. Measurement Signal Loss.....	5-25
S.7.1. Intermittent Trip Data Loss.....	5-25

CCR Title 4, Div. 9, CCR §§ 4000
2023 Edition of NIST HB 44 Section 5.54. Taximeters

S.7.2. Significant Trip Data Loss	5-25
S.8. Anti-Fraud Provisions, Electronic Taximeters.....	5-25
N. Notes	5-26
N.1. Distance Tests.....	5-26
N.1.1. Test Methods.	5-26
N.1.2. Test Procedures.	5-26
N.1.3. Test Conditions.....	5-27
N.2. Time Test.	5-28
N.3. Interference Test.	5-28
T. Tolerances	5-28
T.1. Tolerance Values.	5-28
T.1.1. On Distance Tests.	5-28
T.1.2. On Time Tests.	5-29
T.1.3. On Interference Tests.	5-29
T.2. Tests Using Transfer Standards.....	5-29
UR. User Requirements.....	5-29
UR.1. Inflation of Vehicle Tires.	5-29
UR.2. Position and Illumination of Taximeter.	5-29
UR.3. Statement of Rates.	5-30

Section 5.54. Taximeters

A. Application

A.1. General. – This code applies to taximeters; that is, to devices that automatically calculate at a predetermined rate or rates and indicate the charge for hire of a vehicle.

A.2. Exceptions. – This code does not apply to the following:

(a) odometers on vehicles that are rented on a distance basis. (Also see Section 5.53. Code for Odometers.)

(b) devices that only display a flat rate or negotiated rate; or

(c) Transportation Network Measurement Systems. (Also see Section 5.60. Transportation Network Measurement Systems.)

(Amended 1977, 2016, and 2017)

A.3. Additional Code Requirements. – In addition to the requirements of this code, Taximeters shall meet the requirements of Section 1.10. General Code.

S. Specifications

S.1. Design of Indicating and Recording Elements.

S.1.1. General. – A taximeter shall be equipped with a primary indicating element.

(Amended 1988 and 2015)

S.1.1.1. Recording Elements. – *A receipt providing information as required in S.1.9. Recorded Representations shall be available from a taximeter or taximeter system through an integral or separate recording element for all transactions conducted.*

[Nonretroactive January 1, 2016]

(Added 2015)

S.1.2. Advancement of Indicating Elements. – Except when a taximeter is being cleared, the primary indicating and recording elements shall be susceptible of advancement only by the movement of the vehicle or by the time mechanism.

At the conclusion of a transaction (e.g., following the totalizing of all accrued charges and having a customer receipt made available), no other advancement of fare, extras, or other charges shall occur until the taximeter has been cleared.

[Nonretroactive as of January 1, 2017]

Where permitted, a flat rate or negotiated rate shall be displayed in the “fare” indicating mechanism, provided that once a flat rate or negotiated rate is entered the fare may no longer be advanced by movement of the vehicle or the time mechanism.

(Amended 1988 and 2016)

S.1.2.1. Time Mechanism. – Means shall be provided on all taximeters designed to calculate fares based on a combination of time elapsed and distance traveled, to enable the vehicle operator to render the time mechanism either operative or inoperative with respect to the fare-indicating mechanism.

(Added 2017)

S.1.2.2. Distance Mechanism. – Means shall be provided on all taximeters designed to calculate fare based on a combination of time elapsed and/or distance traveled to enable the vehicle operator to render the distance mechanism either operative or inoperative with respect to the fare-indicating mechanism.

[Nonretroactive as of January 1, 2020]

(Added 2017) (Amended 2018)

S.1.3. Visibility of Indications.

S.1.3.1. Taximeter Indications. – The indications of fare, including extras, and the mode of operation, such as “time” or “hired,” shall be constantly displayed whenever the meter is in operation. All indications of passenger interest shall be easily read from a distance of 1.2 m (4 ft) under any condition of normal operation. This includes any necessary lighting, shading, or other means necessary to make displayed indications clearly visible to operator and passenger.

(Amended 1977, 1986, 1988, and 2017)

S.1.3.2. Minimum Height of Figures, Words, and Symbols. – The minimum height of the figures used to indicate the fare shall be 10 mm and for extras, 8 mm. The minimum height of the figures, words, or symbols used for other indications, including those used to identify or define, shall be 3.5 mm.

(Added 1986)

S.1.3.3. Passenger’s Indications. – A supplementary indicating element installed in a taxi to provide information regarding the taxi service to the passenger (*i.e.*, Passenger Information Monitor or PIM), shall clearly display the current total of all charges incurred for the transaction. The accruing total of all charges must remain clearly visible on the passenger’s display (unless disabled by the passenger) at all times during the transaction.

[Nonretroactive as of January 1, 2016]

(Added 2015) (Amended 2017)

S.1.3.3.1. Additional Information. – Additional information shall be displayed or made available through a passenger’s indicating element (as described in S.1.3.3.

Passenger's Indications) and shall be current and reflect any charges that have accrued. This additional information shall include:

(a) an itemized account of all charges incurred including fare, extras, and other additional charges; and

(b) the rate(s) in use at which any fare is calculated.

Any additional information made available must not obscure the accruing total of charges for the taxi service. This additional information may be made accessible through clearly identified operational controls (e.g., keypad, button, menu, touch-screen).

[Nonretroactive as of January 1, 2016]

(Added 2015)

S.1.3.3.2. Fare and Extras Charges. – *The indication of fare and extras charges on a passenger's indicating element shall agree with similar indications displayed on all other indicating elements in the system.*

[Nonretroactive as of January 1, 2016]

(Added 2015)

S.1.4. Actuation of Fare-Indicating Mechanism. – When a taximeter designed to calculate fares upon the basis of a combination of distance traveled and time elapsed, but not both time and distance used concurrently to calculate fare, is operative with respect to fare indication, the fare-indicating mechanism shall be actuated by the distance mechanism whenever the vehicle is in motion at such a speed that the rate of distance revenue equals or exceeds the time rate, and may be actuated by the time mechanism whenever the vehicle speed is less than this and when the vehicle is not in motion.

(Amended 1977 and 2017)

S.1.5. Operating Condition.

S.1.5.1. General. – When a taximeter is cleared, the indication “Not Registering,” “Vacant,” or an equivalent expression shall be shown. Whenever a taximeter is set to register charges, it shall indicate “Registering,” “Hired,” or an equivalent expression and the rate at which it is set shall be automatically indicated (Rate 1 or Rate A, for example).

(Amended 1988)

S.1.5.2. Time not Recording. – When a taximeter is set for fare registration with the time mechanism inoperative, it shall indicate “Time Not Recording” or an equivalent expression.

(Amended 1988)

S.1.5.3. Distance Not Recording. – *When a taximeter is set for fare registration with the distance mechanism inoperative, it shall indicate “Distance Not Recording” or an equivalent expression.*

[Nonretroactive as of January 1, 2020]

(Added 2017) (Amended 2018)

S.1.6. Fare Identification. – Fare indications shall be identified by the word “Fare” or by an equivalent expression. Values shall be defined by suitable words or monetary signs.

S.1.7. Extras. – Extras shall be indicated as a separate item and shall not be included in the fare indication. They shall be identified by the word “Extras” or by an equivalent expression. Values shall be defined by suitable words or monetary signs. Means may be provided to totalize the fare and extras if the totalized amount returns to separate indications of fare and extras within 5 seconds or less.

(Amended 1988)

S.1.7.1. Nonuse of Extras. – If and when taximeter extras are prohibited by legal authority or are discontinued by a vehicle operator, the extras mechanisms shall be rendered inoperative or the extras indications shall be effectively obscured by permanent means.

S.1.8. Protection of Indications. – All indications of fare and extras shall be protected from unauthorized alteration or manipulation.

(Amended 2015)

S.1.9. Recorded Representation. – *A printed or electronic receipt issued from a taximeter, whether through an integral or separate recording element, shall include as a minimum, the following information when processed through the taximeter system:*

(a) date;

*(b) unique vehicle identification number, such as the medallion number, taxi number, vehicle identification number (VIN), permit number, or other identifying information as specified by the statutory authority;**

*(c) start and end time of the trip;**

*(d) distance traveled, maximum increment of 0.1 km (0.1 mi);**

(e) fare in \$;

*(f) each rate at which the fare was computed and the associated fare at that rate;**

*(g) additional charges (in \$) where permitted such as extras, any surcharges, telecommunication charges, and taxes shall be identified and itemized;**

*(h) total charge for service in \$ (inclusive of fare, extras, and all additional charges);**

CCR Title 4, Div. 9, CCR §§ 4000
2023 Edition of NIST HB 44 Section 5.54. Taximeters

- (i) *trip number, if available;***
- (j) *telephone number (or other contract information) for customer assistance;***and
- (k) *a statement of chargeable time and chargeable distance for taximeters that calculate fare using time and distance concurrently.****

Note: When processed through the taximeter or taximeter system, any adjustments (in \$) to the total charge for service including discounts, credits, and tips shall also be included on the receipt.**

[Nonretroactive as of January 1, 1989]

*[Nonretroactive as of January 1, 2000]

**[Nonretroactive as of January 1, 2016]

***[Nonretroactive as of January 1, 2018]

(Added 1988) (Amended 1999, 2015, and 2017)

S.1.9.1. Multiple Recorded Representations - Duplicate Receipts. – *A recording element may produce a duplicate receipt for the previous transaction provided the information printed is identical to the original with the exception of time issued. The duplicate receipt shall include the words “duplicate” or “copy.” The feature to print a duplicate receipt shall be deactivated at the time the meter is hired for the next fare.*

[Nonretroactive as of January 1, 2000]

(Added 1999)

S.1.10. Non-fare Information. – *The fare and extras displays may be used to display auxiliary information provided the meter is in the vacant condition and such information is only displayed for 10 seconds, or less. If the information consists of a list of information, the list may be displayed one item after another, provided that each item is displayed for 10 seconds, or less.*

[Nonretroactive as of January 1, 2002]

(Added 2000)

S.2. Basis of Fare Calculations. – A taximeter shall calculate fares only upon the basis of:

- (a) distance traveled;
- (b) time elapsed; or
- (c) a combination of distance traveled and time elapsed.

A taximeter may utilize more than one rate to calculate the fare during a trip. Any change in the applied rate must occur at the completion of the current interval.

(Amended 1977 and 2016)

S.2.1. Initial Time and Distance Intervals. – The time and distance intervals of a taximeter that does not calculate fares based on distance traveled and time elapsed used concurrently shall be directly proportional as expressed in the following formula:

(NOTE: The seconds of initial time interval divided by the seconds per non-initial interval equals the distance of initial milage interval divided by the distance per non initial milage interval.)

$$\frac{\text{Seconds of Initial Time Interval}}{\text{Seconds per Non-Initial Interval}} = \frac{\text{Distance of Initial Milage Interval}}{\text{Distance per Non Initial Milage Interval}}$$

Figure 1 - Initial Time and Distance Intervals Equation

(Added 1990) (Amended 2017)

S.3. Design of Operating Control.

S.3.1. Positions of Control. – The several positions of the operating controls shall be clearly defined and shall be so constructed that accidental or inadvertent changing of the operating condition of the taximeter is improbable. Movement of the operating controls to an operating position immediately following movement to the cleared position shall be delayed enough to permit the taximeter to come to a complete rest in the cleared position. (Amended 1988)

S.3.2. Control for Extras Mechanism. – The knob, handle, or other means provided to actuate the extras mechanism shall be inoperable whenever the taximeter is cleared.

S.4. Interference. – The design of a taximeter shall be such that when a fare is calculated by using time and/or by using distance (but not used concurrently) there will be no interference between the time and the distance portions of the mechanism device at any speed of operation.

(Amended 1977, 1988, and 2017)

S.5. Provision for Security Seals. – Adequate provision shall be made for an approved means of security (e.g., data change audit trail) or physically applying security seals in such a manner that requires the security seal to be broken before an adjustment or interchange can be made of:

- (a) any metrological parameter affecting the metrological integrity of the taximeter and associated equipment; or
- (b) any metrological parameter controlled by software residing in the taximeter or an associated external computer network.

When applicable, the adjusting mechanism shall be readily accessible for purposes of affixing a security seal. (Audit trails shall use the format set forth in Table S.5. Categories of Device and Methods of Sealing)

(Amended 1988, 2000, and 2017)

Table S.5. Categories of Device and Methods of Sealing

Categories of Device	Methods of Sealing
<p>Category 1: No remote configuration capability.</p>	<p>Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.</p>
<p>Category 2: Remote configuration capability, but access is controlled by physical hardware.</p> <p>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode. The device shall not operate as normal when in the remote configuration mode.</p>	<p>The hardware enabling access for remote access to calibration functions must be at the device and sealed using a physical seal and the device shall include an event logger.</p> <p>An event logger must be used to record changes to configuration parameters made through remote access.</p> <p>The event logger must include event counters (000 to 999 with a minimum count of 1000 events), the parameter ID, the date and time of the change, and the new value of the parameter. A printed or electronic copy of the information must be available through the device. The event logger shall have a capacity to retain records equal to 10 times the number of sealable parameters in the device, but not more than 1000 records are required.</p> <p>(Note: Does not require 1000 changes to be stored for each parameter.)</p>

Categories of Device	Methods of Sealing
<p>Category 3: Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password).</p> <p>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode. The device shall not operate as normal when in the remote configuration mode.</p>	<p>An event logger must be used to record changes to adjustable parameters that are made through remote access and which is accessible only by authorized persons (using an Internet web browser or other such secure software).</p> <p>The event logger shall include event counters, the date and time of the change, the parameter ID, and the new value of the parameter. A printed or electronic copy of the information must be available through the device. The event loggers shall have a capacity to retain records equal to 10 times the number of sealable parameters in the device, but not more than 1000 records are required.</p> <p>(Note: Does not require 1000 change to be stored for each parameter.)</p> <p>The device shall become inoperable when access to the system’s metrological parameters is made through unapproved or unauthorized means. The device shall remain inoperable until cleared by the official having statutory authority.</p>

[Nonretroactive as of January 1, 2018]

(Table Added 2017) (Amended 2022)

S.5.1. Taximeter Connected to Networked Systems. – Metrological features that are not located on the taximeter device installed in the vehicle (i.e., accessed through a computer network, server, or “cloud”) shall be secured by means that will:

- (a) protect the integrity of metrological data and algorithms used to compute fares from such data against unauthorized modifications; and
- (b) use software-based access controls or equivalent technological protections that limit access to metrological data and algorithms used to compute fares from such data only to authorized persons.

(Added 2017)

S.5.2. Taximeters Calibrated to Specific Vehicles. – In the case of taximeters where the proper performance and calibration of the device has been verified when used in a specific vehicle and which may be removed from the vehicle (e.g., slide mounting the taximeter), means shall be provided through a physical seal or electronic link between components

affecting accuracy or indications of the device to ensure that its performance is not affected and operation is permitted only with those components having the same unique properties.
(Added 2017)

S.6. Power Interruption, Electronic Taximeters.

- (a) After a power interruption of three seconds or less, the fare and extras indications shall return to the previously displayed indications and may be susceptible to advancement without the taximeter being cleared.
- (b) After a power interruption exceeding three seconds, the fare and extras indications shall return to the previously displayed indications and shall not be susceptible to advancement until the taximeter is cleared.

*After restoration of power following an interruption exceeding three seconds, the previously displayed fare shall be displayed for a maximum of one minute at which time the fare shall automatically clear and the taximeter shall return to the vacant condition.**

*[*Nonretroactive as of January 1, 2002]*

(Added 1988) (Amended 1989, 1990, and 2000)

S.7. Measurement Signal Loss. – If the measurement signal is interrupted, the taximeter shall be capable of determining any information needed to complete a transaction in progress at the time of signal loss/interruption.

Note: If the meter ceases to increment fare based on distance, the taximeter may continue to increment fare based on elapsed time provided the time mechanism is not affected by signal loss.

(Added 2017)

S.7.1. Intermittent Trip Data Loss. – When the measurement signal is lost intermittently during a trip (e.g., traveling through a tunnel), but recovered prior to the end of the trip, the taximeter shall be capable of calculating an accurate fare in accordance with T.1.

Tolerance Values.

(Added 2017)

S.7.2. Significant Trip Data Loss. – When the signal is lost for a significant portion of the trip, the taximeter shall calculate the total charge utilizing recorded time and distance measurements and other charges (e.g., tolls and airport fees), and may also include other means in accordance with the terms of service (or other agreement) the passenger has agreed to.

Note: Significant trip data loss refers to instances when the measurement signal is lost to the extent that the taximeter cannot perform an accurate measurement or when the signal is not regained by the end of the trip.

(Added 2017)

S.8. Anti-Fraud Provisions, Electronic Taximeters. – An electronic taximeter may have provisions to detect and eliminate distance input that is inconsistent with the taximeter's

source(s) of distance measurement data. When a taximeter equipped with this feature detects input inconsistent with the distance measurement data source(s):

- (a) the meter shall either filter out the inconsistent distance input signals or cease to increment fare based on distance until the distance input signal is restored to normal operation. If the meter ceases to increment fare based on distance, the taximeter may continue to increment fare based on elapsed time when (1) permitted by the statutory authority; and (2) the time mechanism is not affected by inconsistent signals;
- (b) the taximeter shall provide a visible or audible signal that inconsistent input signals are being detected; and
- (c) the taximeter shall record the occurrence in an event logger. The event logger shall include an event counter, the date, and the time of at least the last 1000 occurrences.

(Added 2001) (Amended 2017)

N. Notes

N.1. Distance Tests.

N.1.1. Test Methods. – To determine compliance with distance tolerances, a distance test of a taximeter shall be conducted utilizing one or more of the following test methods:

- (a) **Road Test.** – A road test consists of driving the vehicle over a precisely measured road course.
- (b) **Fifth-Wheel Test.** – A fifth-wheel test consists of driving the vehicle over any reasonable road course and determining the distance actually traveled through the use of a mechanism known as a “fifth wheel” that is attached to the vehicle and independently measures and indicates the distance.
- (c) **Simulated-Road Test.*** – A simulated road test consists of determining the distance traveled by use of a roller device, or by computation from rolling circumference and wheel-turn data.

*Simulated-road testing is not appropriate for taximeters using measurement data from sources other than signal(s) generated by rotation of the wheels of the vehicle.

(Amended 1977 and 2017)

N.1.2. Test Procedures. – The distance test of a taximeter, whether a road test, a simulated-road test, or a fifth-wheel test, shall include at least duplicate runs of sufficient length to cover at least the third money drop or 1 mi, whichever is greater, and shall be at a speed approximating the average speed traveled by the vehicle in normal service. In the case of metric-calibrated taximeters, the test should cover at least the third money drop or 2 km, whichever is greater.

(Amended 1977)

N.1.2.1. Taximeters Using Measurement Data Sources from Other Than Rotation of the Wheels.

N.1.2.1.1. Testing, General. – Testing of taximeters with metrologically significant parameters that do not completely reside within the taximeter device shall include tests performed under variable conditions to verify that any non-compliant issue is generated from a network system rather than a single taximeter device. The variability tests shall include a minimum of three consecutive tests of varying lengths, locations, and/or environment conditions.

(Added 2017)

N.1.2.1.2. Repeatability Testing, Taximeters Using Measurement Data Sources From Other Than Rotation of the Wheels. – Repeatability testing shall be conducted if, during testing, a taximeter registers a distance measurement that does not comply with the tolerance values in T.1.1. Distance Tests. A minimum of three additional tests shall be conducted at the same location and where all test variables are reduced to the greatest extent practicable to verify the system’s ability to repeat transaction indications. Repeatability testing performed in excess of these three additional tests is done at the discretion of the official with statutory authority.

(Added 2017)

N.1.3. Test Conditions.

N.1.3.1. Measurement Data Based on the Rotation of the Vehicle’s Wheels. – For taximeters that receive input of measurement data generated (directly or indirectly) from rotation of the vehicle’s wheels, the test of the taximeter shall be performed under the following conditions.

(Added 2017)

N.1.3.1.1. Vehicle Lading. – During the distance test of a taximeter, the vehicle shall carry two persons, or in the case of a simulated-road test, 70 kg or 150 lb of test weights may be substituted in lieu of the second person.

N.1.3.1.2. Tire Pressure. – At the completion of test run or runs, the tires of the vehicle under test shall be checked to determine that the tire pressure is that operating tire pressure posted in the vehicle. If not, the tire pressure should be adjusted to the posted tire pressure and further tests may be conducted to determine the operating characteristics of the taximeter.

(Amended 1977)

N.1.3.2. Taximeters Using Other Measurement Data Sources. – Except during type evaluation, all tests shall be performed under conditions that are considered usual and customary for the location(s) where the system is normally operated and as deemed necessary by the statutory authority.

(Added 2017)

N.1.3.2.1. Testing for Environmental Influences. – During type evaluation, the distance test may be performed on a route traveled by the vehicle that exposes the system to conditions possibly contributing to the loss of, or interference with, the signal(s) providing measurement data. This may include:

- (a) objects that may obstruct or reflect signals such as tall buildings/structures, forestation, tunnels, etc.;
- (b) routes that do not follow a straight-line path;
- (c) significant changes in altitude; and
- (d) any other relevant environmental conditions.

(Added 2017)

N.2. Time Test. – If a taximeter is equipped with a timing device through which charges are made for time intervals, the timer shall be tested at the initial interval, four separate subsequent intervals, and an average time test of at least four consecutive subsequent time intervals.

(Amended 1988)

N.3. Interference Test. – For taximeters that calculate fares based on time and/or distance but not simultaneously, a test shall be conducted to determine whether there is interference between the time and distance elements. During the interference test, the vehicle's operating speed shall be 3 km/h or 4 km/h (2 mi/h or 3 mi/h) faster, and then 3 km/h or 4 km/h (2 mi/h or 3 mi/h) slower than the speed at which the basic distance rate equals the basic time rate. The basic rate per hour divided by the basic rate per mile is the speed (km/h or mi/h) at which the basic time rate and basic distance rate are equal.

Note: Performance of the interference test may not be considered appropriate as a field test while travelling in a vehicle equipped with a taximeter. This test may be performed during type evaluation under controlled conditions for practicality and for safety concerns.

(Amended 1988 and 2017)

T. Tolerances

T.1. Tolerance Values.

T.1.1. On Distance Tests. – Maintenance and acceptance tolerances for taximeters shall be as follows:

- (a) On Overregistration: 1 % of the interval under test.
- (b) On Underregistration: 4 % of the interval under test, with an added tolerance of 30 m or 100 ft whenever the initial interval is included in the interval under test.

T.1.2. On Time Tests.

T.1.2.1. On Individual Time Intervals. – Maintenance and acceptance tolerances on individual time intervals shall be as follows:

- (a) On Overregistration: 3 seconds per minute (5 %).
- (b) On Underregistration: 9 seconds per minute (15 %) on the initial interval, and 6 seconds per minute (10 %) on subsequent intervals.

T.1.2.2. On Average Time Interval Computed After the Initial Interval. – Except for the initial interval, maintenance and acceptance tolerances on the average time interval shall be as follows:

- (a) On Overregistration: 0.2 second per minute (0.33 %).
 - (b) On Underregistration: 3 seconds per minute (5 %).
- (Amended 1991)

T.1.3. On Interference Tests. – For taximeters designed to calculate fares upon the basis of a combination of distance traveled and time elapsed (but not using both simultaneously), the distance registration of a taximeter in the “time on” position shall agree within 1 % of its distance registration in the “time off” position.

(Added 1988) (Amended 2017)

T.2. Tests Using Transfer Standards. – To the basic tolerance values that would otherwise be applied, there shall be added an amount equal to two times the standard deviation of the applicable transfer standard (i.e., fifth-wheel) when compared to the basic reference standard.

(Added 2017)

UR. User Requirements

UR.1. Inflation of Vehicle Tires. – For taximeters that receive input of measurement data generated (directly or indirectly) from rotation of the vehicle’s wheels, the operational tire pressure of passenger vehicles and truck tires shall be posted in the vehicle and shall be maintained at the posted pressure.

(Amended 1977 and 2017)

UR.2. Position and Illumination of Taximeter. – A taximeter shall be so positioned and illuminated that its indications, operational markings, and controls of passenger interest can be conveniently read by a passenger seated in a position of up to 1.2 m (4 ft) away from the taximeter under any condition of normal operation.

(Amended 1985, 1986, and 2017)

UR.3. Statement of Rates. – The distance and time rates for which a taximeter is set, including the initial distance interval and the initial time interval, the local tax rate, and the schedule of extras when an extras indication is provided shall be conspicuously displayed inside the front and rear passenger compartments. The words “Rate,” “Rates,” or “Rates of Fare” shall precede the rate statement. The rate statement shall be fully informative, self-explanatory, and readily understandable by the ordinary passenger, and shall either be of a permanent character or be protected by glass or other suitable transparent material.
(Amended 1977, 1988, 1990, and 1999)

Table of Contents

	Page
Section 5.55. Timing Devices	31
A. Application	31
A.1. General.	31
A.2. Additional Code Requirements.....	31
S. Specifications	31
S.1. Design of Indicating and Recording Elements and of Recorded Representations. ..	31
S.1.1. Primary Elements.	31
S.1.2. Graduations.	32
S.1.3. Indicators.	32
S.1.4. Recorded Representations.	33
S.2. Marking Requirements, Operating Instructions.	33
S.3. Interference.	34
S.4. Provisions for Sealing.....	34
S.5. Power Interruption.	34
S.5.1. Transaction Termination.	34
S.5.2. User Information.	34
N. Notes	35
N.1. Test Method.	35
N.2. Broadcast Times and Frequencies.....	35
N.3. Interference Tests, EVSE.....	35
T. Tolerances	35
T.1. Tolerance Values.	36
T.1.1. For Timing Devices Other Than Those Specified in T.1.2. For Time Clocks and Time Recorders and T.1.3. On Parking Meters.	36
T.1.2. For Time Clocks and Time Recorders.	36
T.1.3. On Parking Meters and Other Timing Devices Used to Assess Charges for Parking.....	36
T.2. Tests Involving Digital Indications or Representations.	36
UR. User Requirements	36
UR.1. Statement of Rates.	36
UR.2. Time Representations.....	37

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Section 5.55. Timing Devices

A. Application

A.1. General. – This code applies to devices used to measure time during which services are being dispensed (such as vehicle parking, laundry drying, and car washing). This code also applies to Electric Vehicle Supply Equipment (EVSE) when used to assess charges for time-based services in addition to those charged for electrical energy.

(Amended 2015)

A.2. Additional Code Requirements. – In addition to the requirements of this code, Timing Devices shall meet the requirements of Section 1.10. General Code.

S. Specifications

S.1. Design of Indicating and Recording Elements and of Recorded Representations.

S.1.1. Primary Elements.

S.1.1.1. General. – A timing device shall be equipped with a primary indicating element, and may also be equipped with a primary recording element. A timing device incorporated into an Electric Vehicle Supply Equipment system for use in assessing charges for timing separate from charges for electrical energy shall be equipped with the capability to provide a recorded representation of the transaction through a built-in or separate recording element. A readily observable in-service light or other equally effective means that automatically indicates when laundry driers, vacuum cleaners, and car washes are in operation shall be deemed an appropriate primary indicating element.
(Amended 1979 and 2015)

S.1.1.2. Units. – A timing device shall indicate and record, if the device is equipped to record, the time in terms of minutes for time intervals of 60 minutes or less and in hours and minutes for time intervals greater than 60 minutes.

S.1.1.3. Value of Smallest Unit. – The value of the smallest unit of indicated time and recorded time, if the device is equipped to record, shall not exceed the following.

(a) For parking meters:

(1) one-half hour on parking meters indicating time in excess of two hours; or

(2) six minutes on parking meters indicating time in excess of one but not greater than two hours.

(b) For an EVSE equipped with an integral time-based feature:

- (1) one minute on an EVSE indicating time not greater than or equal to 60 minutes; or
- (2) hours and minutes on an EVSE indicating time intervals in excess of 60 minutes.

(c) For all other devices five minutes, except those equipped with an in-service light.
(Amended 1975 and 2021)

S.1.1.4. Advancement of Indicating and Recording Elements. – Primary indicating and recording elements shall be susceptible to advancement only during the mechanical operation of the device, except that clocks may be equipped to manually reset the time.

S.1.1.5. Operation of In-Service Indicator Light. – For devices equipped with an in-service indicator light, the indicator shall be operative only during the time the device is in operation.

(Amended 2015)

S.1.1.6. Discontinuous Indicating Parking Meters. – An indication of the time purchased shall be provided at the time the meter is activated in units of no more than one minute for times less than one hour and not more than two minutes for times of one hour or more. Convenient means shall be provided to indicate to the purchaser the unexpired time.

(Added 1975) (Amended 1976)

S.1.2. Graduations.

S.1.2.1. Length. – Graduations shall be so varied in length that they may be conveniently read.

S.1.2.2. Width. – In any series of graduations, the width of a graduation shall in no case be greater than the width of the minimum clear interval between graduations and the width of main graduations shall be not more than 50 % greater than the width of subordinate graduations. Graduations shall in no case be less than 0.2 mm (0.008 in) in width.

S.1.2.3. Clear Interval Between Graduations. – The clear interval shall be not less than 0.75 mm (0.03 in). If the graduations are not parallel, the measurement shall be made:

- (a) along the line of relative movement between the graduations at the end of the indicator; or
- (b) if the indicator is continuous, at the point of widest separation of the graduations.

S.1.3. Indicators.

S.1.3.1. Symmetry. – The index of an indicator shall be symmetrical with respect to the graduations, at least throughout that portion of its length associated with the graduations.

S.1.3.2. Length. – The index of an indicator shall reach to the finest graduations with which it is used, unless the indicator and the graduations are in the same plane, in which case the distance between the end of the indicator and the ends of the graduations, measured along the line of the graduations, shall be not more than 1.0 mm (0.04 in).

S.1.3.3. Width. – The width of the index of an indicator in relation to the series of graduations with which it is used shall be not greater than:

- (a) the width of the widest graduation; and
- (b) the width of the minimum clear interval between the graduations.

S.1.3.4. Parallax. – Parallax effect shall be reduced to a practicable minimum.

S.1.4. Recorded Representations.

S.1.4.1. Recorded Representations, Electric Vehicle Supply Equipment (EVSE) Timing Devices. – A timing device incorporated into an EVSE for use in assessing charges for timing separate from charges for electrical energy shall issue a recorded representation itemizing the charges for these services as defined in Section 3.40. Electric Vehicle Fueling Systems.

(Added 2015)

S.1.4.1.1. Duplicate Receipts. – Duplicate receipts are permissible, provided the word “duplicate” or “copy” is included on the receipt.

(Added 2015)

S.1.4.2. Recorded Representations, All Other Timing Devices. – A printed ticket issued or stamped by a timing device shall have printed clearly thereon:

- (a) the time and day when the service ends and the time and day when the service begins, except that a self-service money-operated device that clearly displays the time of day need not record the time and day when the service begins; or
- (b) the time interval purchased, and the time and day that the service either begins or ends.

(Added 2015)

(Amended 1983 and 2015)

S.2. Marking Requirements, Operating Instructions. – Operating instructions shall be clearly stated on the device.

S.3. Interference. – The design of the EVSE shall be such that there will be no interference between the time and electrical energy measurement elements of the system.

(Added 2015)

S.4. Provisions for Sealing. – For devices and systems in which the configuration or calibration parameters can be changed by use of a removable digital storage device, security shall be provided for those parameters as specified in G-S.8.2. Devices and Systems Adjusted Using Removable Digital Storage Devices. For parameters adjusted using other means adequate provisions shall be made to provide security for the timing element.

(Added 2015) (Amended 2019)

S.5. Power Interruption. – In the event of a power loss, the information needed to complete any transaction (i.e., delivery is complete and payment is settled) in progress at the time of the power loss (such as the quantity and unit price, or sales price) shall be determinable through one of the means listed below or the transaction shall be terminated without any charge for the electrical energy transfer to the vehicle:

- (a) at the EVSE;
- (b) at the console, if the console is accessible to the customer;
- (c) via on site Internet access; or
- (d) through toll-free phone access.

For EVSEs in parking areas where vehicles are commonly left for extended periods, the information needed to complete any transaction in progress at the time of the power loss shall be determinable through one of the above means for at least eight hours.

(Added 2015)

S.5.1. Transaction Termination. – In the event of a power loss, either:

- (a) the transaction shall terminate at the time of the power loss; or
- (b) the EVSE may continue charging without additional authorization if the EVSE is able to determine it is connected to the same vehicle before and after the supply power outage.

In either case, there must be a clear indication on the receipt provided to the customer of the interruption, including the date and time of the interruption along with other information required under S.1.4.2. Recorded Representations, All Other Timing Devices.

(Added 2015)

S.5.2. User Information. – The EVSE memory, or equipment on the network supporting the EVSE, shall retain information on the quantity of time and the sales price totals during a power loss.

(Added 2015)

N. Notes

N.1. Test Method. – A timing device shall be tested with a timepiece with an error of not greater than plus or minus 15 seconds per 24-hour period. In the test of timing devices with a nominal capacity of 1 hour or less, stopwatches with a minimum division of not greater than one-fifth second shall be used. In the test of timing devices with a nominal capacity of more than one hour, the value of the minimum division on the timepiece shall be not greater than one second. Time pieces and stopwatches shall be calibrated with standard time signals as described in National Institute of Standards and Technology Special Publication 432, NIST Time and Frequency Dissemination Services, or any superseding publication.

(Amended 1978)

N.2. Broadcast Times and Frequencies. – Time and frequency standards are broadcast by the stations listed in Table N.2. Broadcast Times and Frequencies.

Table N.2.* Broadcast Times and Frequencies

Station	Location, Latitude, Longitude	Frequency (MHz)	Times of Transmission (UTC)
WWV	Fort Collins, Colorado 40E 41' N 105E 02' W	2.5 5.0 10.0 15.0 20.0	Continuous
WWVH	Kauai, Hawaii 21E 59' N 159E 46' W	2.5 5.0 10.0 15.0	Continuous
CHU	Ottawa, Canada 45E 18' N 75E 45' W	3.330 7.335 14.670 14.670	Continuous

*From NIST Special Publication 559, "Time and Frequency Users' Manual," 1990.

(Added 1988)

N.3. Interference Tests, EVSE. – On an EVSE equipped with a timing device used to calculate time-based charges in addition to any charges assessed for electrical energy, a test shall be conducted to ensure that there is no interference between time and electrical energy measuring elements.

(Added 2015)

T. Tolerances

T.1. Tolerance Values. – Maintenance and acceptance tolerances for timing devices shall be as follows:

T.1.1. For Timing Devices Other Than Those Specified in T.1.2. For Time Clocks and Time Recorders and T.1.3. On Parking Meters. – The maintenance and acceptance tolerances shall be:

(a) On Overregistration: five seconds for any time interval of one minute or more; and
(Amended 1986)

(b) On Underregistration: six seconds per indicated minute.
(Amended 1975 and 1986)

T.1.2. For Time Clocks and Time Recorders. – The maintenance and acceptance tolerances on overregistration and underregistration shall be three seconds per hour, but not to exceed one minute per day.

(Amended 1975)

T.1.3. On Parking Meters and Other Timing Devices Used to Assess Charges for Parking. – The maintenance and acceptance tolerances are shown in Table T.1.3. Maintenance and Acceptance Tolerances for Parking Meters and Other Timing Devices Used to Assess Charges For Parking.

(Amended 2015)

(Amended 2015)

Table T.1.3. Maintenance and Acceptance Tolerances for Parking Meters and Other Timing Devices Used to Assess Charges for Parking

Nominal Time Capacity	On Overregistration	On Underregistration
30 minutes or less	No tolerance	10 seconds per minute, but not less than 2 minutes
Over 30 minutes to and including 1 hour	No tolerance	5 minutes plus 4 seconds per minute over 30 minutes
Over 1 hour	No tolerance	7 minutes plus 2 minutes per hour over 1 hour

T.2. Tests Involving Digital Indications or Representations. – To the tolerances that would otherwise be applied, there shall be added an amount equal to one-half the minimum value that can be indicated or recorded.

UR. User Requirements

UR.1. Statement of Rates. – The following information shall be clearly, prominently, and conspicuously displayed:

(a) the price in terms of money per unit or units of time for the service dispensed; and

(b) for a timing device other than an EVSE, the number of coins the device will accept and be activated by at one time.

(Amended 1976 and 2015)

UR.2. Time Representations. – Any time representation shall be within plus or minus two minutes of the correct time in effect in the area, except on an individual clock used only for “time out”; in addition, the time indication of the “time-out” clock shall be the same as or less than that of the “time-in” clock.

(Amended 1975)

The following Handbook 44 Sections are not published in this Field Reference Manual and are not currently enforced by the Division of Measurement Standards.

5.56. (a) and (b), Grain Moisture Meters,

5.57. Near-Infrared Grain Analyzers, and

5.59. Electronic Livestock, Meat, Poultry Evaluation Systems and/or Devices.

Table of Contents

	Page
Section 5.58. Multiple Dimension Measuring Devices	38
A. Application	38
A.1. General.	38
A.2. Other Devices Designed to Make Multiple Measurement Automatically to Determine a Volume.	38
A.3. Additional Code Requirements.....	38
A.4. Exceptions.....	38
A.5. Type Evaluation.....	38
S. Specifications	39
S.1. Design of Indicating and Recording Elements and of Recorded Representations. ..	39
S.1.1. Zero or Ready Indication.....	39
S.1.2. Digital Indications.....	39
S.1.3. Negative Values.....	39
S.1.4. Dimensions Indication.....	39
S.1.5. Value of Dimension/Volume Division Units.	39
S.1.6. Customer Indications and Recorded Representations.....	40
S.1.7. Minimum Measurement.	41
S.1.8. Indications Below Minimum and Above Maximum.....	41
S.1.9. Operating Temperature.....	41
S.1.10. Adjustable Components.....	42
S.1.11. Provision for Sealing	42
S.2. Design of Zero and Dimensional Offset.....	43
S.2.1. Zero or Ready Adjustment.....	43
S.2.2. Dimensional Offset.	43
S.3. Systems with Two or More Measuring Elements.....	44
S.4. Marking Requirements.	44
S.4.1. Multiple Dimension Measuring Devices, Main Elements, and Components of Measuring Devices.	44
S.4.2. Location of Marking Information.....	46
N. Notes	46
N.1. Test Procedures.....	46
N.1.1. General.....	46
N.1.2. Position Test.....	47
N.1.3. Disturbance Tests, Field Evaluation.	47
N.1.4. Test Object Size.	47
N.1.5. Digital Zero Stability.....	47
T. Tolerances	47
T.1. Design.....	47
T.2. Tolerance Application.....	48

CCR Title 4, Div. 9, CCR §§ 4000
2023 Edition of NIST HB 44 Section 5.58. Multiple Dimension Measuring Devices

T.2.1. Type Evaluation.	48
T.2.2. Subsequent Verification.	48
T.2.3. Multi-interval (Variable Division-Value) Devices.	48
T.2.4. Mixed-Interval Devices.....	48
T.3. Tolerance Values.	48
T.4. Position Tests.....	48
T.5. Influence Factors.....	48
T.5.1. Temperature.	48
T.5.2. Power Supply Voltage.....	49
T.6. Disturbances, Field Evaluation.	49
UR. User Requirements.....	49
UR.1. Selection Requirements.....	49
UR.1.1. Value of the Indicated and Recorded Division.....	49
UR.2. Installation Requirements.	49
UR.2.1. Supports.....	49
UR.2.2. Foundation, Supports, and Clearance.....	49
UR.2.3. Protection from Environmental Factors.	50
UR.3. Use Requirements.	50
UR.3.1. Minimum and Maximum Measuring Ranges.	50
UR.3.2. Special Designs.	50
UR.3.3. Object Placement.....	50
UR.4. Maintenance Requirements.....	50
UR.4.1. Zero or Ready Condition.	50
UR.4.2. Level Condition.	50
UR.4.3. Device Modification.....	50
UR.5. Customer Information Provided.	50

Section 5.58. Multiple Dimension Measuring Devices

A. Application

A.1. General. – This code applies to dimension and volume measuring devices used for determining the dimensions and/or volume of objects for the purpose of calculating freight, storage, or postal charges based on the dimensions and/or volume occupied by the object. A multiple dimension measuring device:

(a) is generally used to measure hexahedron-shaped objects; and

(Added 2008)

(b) may be used to measure irregularly-shaped objects.

(Added 2008)

(Amended 2008)

A.2. Other Devices Designed to Make Multiple Measurement Automatically to Determine a Volume. – Insofar as they are clearly applicable, the provisions of this code apply also to devices designed to make multiple measurements automatically to determine a volume for other applications as defined by Section 1.10. General Code Paragraph G-A.1. Commercial and Law-Enforcement Equipment.

A.3. Additional Code Requirements. – In addition to the requirements of this code, Multiple Dimension Measuring Devices shall meet the requirements of Section 1.10. General Code.

A.4. Exceptions. – This code does not apply to:

(a) devices designed to indicate automatically (with or without value-computing capabilities) the length of fabric passed through the measuring elements (also see Section 5.50. for Fabric-Measuring Devices);

(b) devices designed to indicate automatically the length of cordage, rope, wire, cable, or similar flexible material passed through the measuring elements (also see Section 5.51. for Wire- and Cordage-Measuring Devices); or

(c) any linear measure, measure of length, or devices used to measure individual dimensions for the purpose of assessing a charge per unit of measurement of the individual dimension (also see Section 5.52. for Linear Measures).

A.5. Type Evaluation. – The National Type Evaluation Program (NTEP) will accept for type evaluation only those devices that comply with all requirements of this code.

S. Specifications

S.1. Design of Indicating and Recording Elements and of Recorded Representations.

S.1.1. Zero or Ready Indication.

- (a) Provision shall be made to indicate or record either a zero or ready condition.
- (b) A zero or ready condition may be indicated by other than a continuous digital zero indication, provided that an effective automatic means is provided to inhibit a measuring operation when the device is in an out-of-zero or non-ready condition.

S.1.2. Digital Indications. – Indicated and recorded values shall be presented digitally.

S.1.3. Negative Values. – Negative values shall not be indicated or recorded.

(Amended 2021)

S.1.4. Dimensions Indication. – If in normal operation the device indicates or records only volume, a testing mode shall be provided to indicate dimensions for all objects measured.

S.1.5. Value of Dimension/Volume Division Units. – The value of a device division “d” expressed in a unit of dimension shall be presented in a decimal format. The value of “d” for each measurement axis shall be in the same unit of measure and expressed as:

- (a) 1, 2, or 5;
- (b) a decimal multiple or submultiple of 1, 2, or 5; or
- (c) a binary submultiple of a specific U.S. customary unit of measure.

Examples: device divisions may be 0.01, 0.02, 0.05; 0.1, 0.2, or 0.5; 1, 2, or 5; 10, 20, 50, or 100; 0.5, 0.25, 0.125, 0.0625, etc.

(Amended 2016)

S.1.5.1. For Indirect Sales. – In addition to the values specified in S.1.5. Value of Dimension/Volume Division Units, the value of the division may be 0.3 inch and 0.4 inch.

S.1.5.2. Devices Capable of Measuring Irregularly-Shaped Objects. – For devices capable of measuring irregularly shaped objects, the value of the division size (d) shall be the same for the length axis (x) and the width axis (y) and may be different for the height axis (z), provided that electronic rotation of the object to determine the smallest hexahedron is calculated in only a two-dimension horizontal plane, retaining the stable side plane as the bottom of the hexahedron.

(Added 2008)

S.1.6. Customer Indications and Recorded Representations. – Multiple dimension measuring devices or systems must provide information as specified in Table S.1.6. Required Information to be Provided by Multiple Dimension Measuring Systems. As a minimum, all devices or systems must be able to meet either column I or column II in Table S.1.6. Required Information to be Provided by Multiple Dimension Measuring Systems.

(Amended 2004)

Table S.1.6. Required Information to be Provided by Multiple Dimension Measuring Systems

Information	Column I ¹ Provided by device	Column II ¹ Provided by invoice or other means - Customer Present	Column II ¹ Provided by invoice or other means - Customer NOT present	Column III Provided by invoice or other means as specified in contractual agreement
1. Device identification ²	D or P	P	P	P or A
2. Error message (when applicable)	D or P	P	N/A	N/A
3. Hexahedron dimensions ³	D or P	P	P	P or A
4. Hexahedron volume (if used) ³	D or P	P	P	P or A
5. Actual weight (if used) ³	D or P	P	P	P or A
6. Dimensional Offset (if used) ³	D or P	N/A	N/A	N/A
7. Hexahedron measurement statement ⁴	D or P or M	P	P	P or G

Table S.1.6. Required Information to be Provided by Multiple Dimension Measuring Systems - Continued

A = AVAILABLE UPON REQUEST BY CUSTOMER⁵
D = DISPLAYED
G = PUBLISHED GUIDELINES OR CONTRACTS
M = MARKED
N/A = NOT APPLICABLE
P = PRINTED or RECORDED IN A MEMORY DEVICE and AVAILABLE UPON REQUEST BY CUSTOMER⁵

Notes:

¹ As a minimum all devices or systems must be able to meet either column I or column II.

² This is only required in systems where more than one device or measuring element is being used.

³ Some devices or systems may not utilize all of these values; however, as a minimum either hexahedron dimensions or hexahedron volume must be displayed or printed.

⁴ This is an explanation that the dimensions and/or volume shown are those of the smallest hexahedron in which the object that was measured may be enclosed rather than those of the object itself.

⁵ The information “available upon request by customer” shall be retained by the party having issued the invoice for at least 30 calendar days after the date of invoicing.

(Amended 2004 and 2021)

S.1.7. Minimum Measurement. – Except for entries of dimensional offset, the minimum measurement by a device is 12 d. The manufacturer may specify a longer minimum measurement. For multi-interval devices, this applies only to the first measuring range (or segment) of each measurement axis (length, width, and height).

(Amended 2017 and 2021)

S.1.8. Indications Below Minimum and Above Maximum. – When objects are smaller than the minimum dimensions identified in paragraph S.1.7. Minimum Measurement or larger than any of the maximum dimensions plus 9 d, and/or maximum volume marked on the device plus 9 d, or when a combination of dimensions, including dimensional offset, for the object being measured exceeds the measurement capability of the device, the indicating or recording element shall either:

(a) not indicate or record any usable values; or

(b) identify the indicated or recorded representation with an error indication.

(Amended 2004, 2017, and 2021)

S.1.9. Operating Temperature. – An indicating or recording element shall not indicate nor record any usable values until the operating temperature necessary for accurate measuring and a stable zero reference or ready condition has been attained.

S.1.10. Adjustable Components. – Adjustable components shall be held securely in adjustment and, except for a zeroing mechanism (when applicable), shall be located within the housing of the element.

S.1.11. Provision for Sealing. - For devices and systems in which the configuration or calibration parameters can be changed by use of a removable digital storage device, security shall be provided for those parameters as specified in G-S.8.2. Devices and Systems Adjusted Using Removable Digital Storage Devices. For parameters adjusted using other means, the following applies.

- (a) The device or system shall be designed with provision(s) for applying a security seal that must be broken, or for using other approved means of providing security (e.g., data change audit trail available at the time of inspection), before any change that detrimentally affects the metrological integrity can be made to any measuring element.
- (b) Audit trails shall use the format set forth in Table S.1.11. Categories of Devices and Methods of Sealing for Multiple Dimension Measuring Systems.
(Amended 2019)

Table S.1.11. Categories of Devices and Methods of Sealing for Multiple Dimension Measuring Systems

Categories of Devices	Methods of Sealing
<p>Category 1: No remote configuration.</p>	<p>Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.</p>
<p>Category 2: Remote configuration capability, but access is controlled by physical hardware.</p> <p>Device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode.</p>	<p>The hardware enabling access for remote communication must be at the device and sealed using a physical seal or two event counters: one for calibration parameters and one for configuration parameters.</p>
<p>Category 3: Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password).</p>	<p>An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. A printed copy of the information must be available through the device or through another on-site device. The event logger shall have a capacity to retain records equal to 10 times the number of sealable parameters in the device, but not more than 1000 records are required. (Note: Does not require 1000 changes to be stored for each parameter.)</p>

S.2. Design of Zero and Dimensional Offset.

S.2.1. Zero or Ready Adjustment. – A device shall be equipped with means by which the zero reference or ready condition can be adjusted, or the zero reference or ready condition shall be automatically maintained. The zero reference or ready control circuits shall be interlocked so that their use is prohibited during measurement operations.

S.2.2. Dimensional Offset. – The dimensional offset shall eliminate the effect of the conveyance method resulting in the measurement of only the object intended to be measured.

(Amended 2021)

S.2.2.1. Maximum Value of Dimensional Offset for Multi-Interval (Variable Division-Value Devices). – A multi- interval device shall not accept any dimensional offset value greater than the maximum capacity of the lowest range of the height axis.
(Added 2016) (Amended 2021)

(Added 2016)

S.3. Systems with Two or More Measuring Elements. – A multiple dimension measuring system with a single indicating or recording element, or a combination indicating-recording element, that is coupled to two or more measuring elements with independent measuring systems, shall be provided with means to prohibit the activation of any measuring element (or elements) not in use, and shall be provided with automatic means to indicate clearly and definitely which measuring element is in use.

Note: This requirement does not apply to individual devices that use multiple emitters/sensors within a device in combination to measure objects in the same measurement field.

(Amended 2004)

S.4. Marking Requirements. – (Also see G-S.1. Identification, G-S.4. Interchange or Reversal of Parts, G-S.5.2.5. Permanence, G-S.6. Marking Operational Controls, Indications, and Features, G-S.7. Lettering, G-UR.2.1.1. Visibility of Identification, and G-UR.3.1. Method of Operation.)

S.4.1. Multiple Dimension Measuring Devices, Main Elements, and Components of Measuring Devices. – Multiple dimension measuring devices, main elements of multiple dimension measuring devices when not contained in a single enclosure for the entire dimension/volume measuring device, and other components shall be marked as specified in Table S.4.1.a. and explained in the accompanying notes, Table S.4.1.b. Multiple Dimension Measuring Systems Notes for Table S.4.1.a.

Table S.4.1.a. - Marking Requirements for Multiple Dimension Measuring Systems

To Be Marked With ↓	Multiple Dimension Measuring Device and Indicating Element in Same Housing	Indicating Element not Permanently Attached to Multiple Dimension Measuring Element	Multiple Dimension Measuring Element Not Permanently Attached to the Indicating Element	Other Equipment (1)
Manufacturer's ID	x	x	x	x
Model Designation	x	x	x	x
Serial Number and Prefix	x	x	x	x (2)
Certificate of Conformance Number (8)	x	x	x	x (8)
Minimum and Maximum Dimensions for Each Axis for Each Range in Each Axis (3)(9)	x	x	x	
Value of Measuring Division, d (for each axis and range) (9)	x	x	x	
Temperature Limits (4)(9)	x	x	x	
Minimum and Maximum speed (5)(9)	x	x	x	
Special Application (6)(9)	x	x	x	
Limitation of Use (7)(9)	x	x	x	

(Amended 2016)

Table S.4.1.b. Multiple Dimension Measuring Systems Notes for Table S.4.1.a.

1. Necessary to the dimension and/or volume measuring system, but having no effect on the measuring value, e.g., auxiliary remote display, keyboard, etc.
2. Modules without “intelligence” on a modular system (e.g., printer, keyboard module, etc.) are not required to have serial numbers.
3. The minimum and maximum dimensions (using upper or lower case type) shall be marked. For example:
Length: min _____ max _____
Width: min _____ max _____
Height: min _____ max _____
4. Required if the range is other than – 10 °C to 40 °C (14 °F to 104 °F).
5. Multiple dimension measuring devices, which require that the object or device be moved relative to one another, shall be marked with the minimum and maximum speeds at which the device is capable of making measurements that are within the applicable tolerances.
6. A device designed for a special application rather than general use shall be conspicuously marked with suitable words visible to the operator and the customer restricting its use to that application.
7. Materials, shapes, structures, combination of object dimensions, speed, spacing, minimum protrusion size, or object orientations that are inappropriate for the device or those that are appropriate.
8. Required only if a Certificate of Conformance has been issued for the equipment.
9. This marking information may be readily accessible via the display. Instructions for displaying the information shall be described in the NTEP CC.

(Amended 2004, 2008, and 2016)

S.4.2. Location of Marking Information. – The required marking information shall be so located that it is readily observable without the necessity of the disassembly of a part requiring the use of any means separate from the device.

N. Notes

N.1. Test Procedures.

N.1.1. General. – The device shall be tested using test standards and objects of known and stable dimensions.

N.1.2. Position Test. – Measurements are made using different positions of the test object and consistent with the manufacturer’s specified use for the device.

N.1.2.1. Irregularly-Shaped Test Object Placement. – Irregularly-shaped test objects must be measured while placed on a stable side. The rotation of the object to determine the smallest hexahedron should be calculated in a two-dimensional plane, retaining the stable side plane as the bottom of the hexahedron.
(Added 2008)

N.1.3. Disturbance Tests, Field Evaluation. – A disturbance test shall be conducted at a given installation when the presence of disturbances specified in T.6. has been verified and characterized if those conditions are considered “usual and customary.”

N.1.4. Test Object Size. – Test objects may vary in size from the smallest dimension to the largest dimension marked on the device, and for field verification examinations, shall be an integer multiple of “d.”

N.1.4.1. Test Objects. – Verification of devices may be conducted using appropriate test objects of various sizes and of stable dimensions. Test object dimensions must be known to an expanded uncertainty (coverage factor $k = 2$) of not more than one-third of the applicable device tolerance. The dimensions shall also be checked to the same uncertainty when used at the extreme values of the influence factors.

The dimension of all test objects shall be verified using a reference standard that is traceable to NIST (or equivalent national laboratory) and meet the tolerances expressed in NIST Handbook 44 Fundamental Considerations, paragraph 3.2. (i.e., one-third of the smallest tolerance applied to the device).
(Added 2004)

N.1.4.2. Irregularly-Shaped Test Objects. – For irregularly-shaped test objects, at least one angle shall be obtuse and the smallest dimension for an axis shall be equal to or greater than the minimum dimension for that axis.
(Added 2008)

(Amended 2008 and 2012)

N.1.5. Digital Zero Stability. – A zero indication change test shall be conducted on all devices which show a digital zero. After the removal of any test object, the zero indication shall not change. (Also see G-UR.4.2. Abnormal Performance.)

T. Tolerances

T.1. Design. – The tolerance for a multiple dimension measuring device is a performance requirement independent of the design principle used.

T.2. Tolerance Application.

T.2.1. Type Evaluation. – For type evaluations, the tolerance values apply to tests within the influence factor limits of temperature and power supply voltage specified in T.5.1. Temperature and T.5.2. Power Supply Voltage.

T.2.2. Subsequent Verification. – For subsequent verifications, the tolerance values apply regardless of the influence factors in effect at the time of the verification. (Also see G-N.2. Testing with Nonassociated Equipment.)

T.2.3. Multi-interval (Variable Division-Value) Devices. – When there exist two or more partial measuring ranges (or segments) specified for any of the “dimensioning” axes (length (x), width (y), or height (z)) and the division values corresponding to those partial measuring ranges (or segments) within the same “dimensioning” axis differ, the tolerance values shall be based on the value of the division of the range in use.

(Amended 2016)

T.2.4. Mixed-Interval Devices. – For devices that measure to a different division value in at least one dimensioning axes and all axes are single range, the tolerance values shall be based on the value of the division of the axis in use.

(Added 2016)

T.3. Tolerance Values. – The maintenance and acceptance tolerance values shall be ± 1 division.

(Amended 2004)

T.4. Position Tests. – For a test standard measured several times in different positions by the device all indications shall be within applicable tolerances.

T.5. Influence Factors. – The following factors are applicable to tests conducted under controlled conditions only.

T.5.1. Temperature. – Devices shall satisfy the tolerance requirements under the following temperature conditions.

T.5.1.1. Temperature Limits. – If not marked on the device, the temperature limits shall be $-10\text{ }^{\circ}\text{C}$ to $40\text{ }^{\circ}\text{C}$ ($14\text{ }^{\circ}\text{F}$ to $104\text{ }^{\circ}\text{F}$).

T.5.1.2. Minimum Temperature Range. – If temperature limits are specified for the device, the range shall be at least $30\text{ }^{\circ}\text{C}$ or $54\text{ }^{\circ}\text{F}$.

T.5.1.3. Temperature Effect on Zero Indication. – The zero indication shall not vary by more than one division per $5\text{ }^{\circ}\text{C}$ ($9\text{ }^{\circ}\text{F}$) change in temperature.

T.5.2. Power Supply Voltage.

T.5.2.1. Alternating Current Power Supply. – Devices that operate using alternating current must perform within the conditions defined in paragraphs T.3. through T.6., inclusive, from – 15 % to + 10 % of the marked nominal line voltage(s) at 60 Hz, or the voltage range marked by the manufacturer, at 60 Hz.

(Added 2004)

T.5.2.2. Direct Current Power Supply. – Devices that operate using direct current shall operate and perform within the applicable tolerance at any voltage level at which the device is capable of displaying metrological registrations.

(Added 2004)

(Amended 2004)

T.6. Disturbances, Field Evaluation. – The following requirements apply to devices when subjected to disturbances which may normally exist in the surrounding environment. These disturbances include radio frequency interference (RFI), electromagnetic interference (EMI), acoustic changes, ambient light emissions, etc. The difference between the measurement indication with the disturbance and the measurement indication without the disturbance shall not exceed one division “d” or the equipment shall:

- (a) blank the indication;
- (b) provide an error message; or
- (c) the indication shall be so completely unstable that it could not be interpreted, or transmitted into memory or to a recording element, as a correct measurement value.

UR. User Requirements

UR.1. Selection Requirements. – Equipment shall be suitable for the service in which it is used with respect to elements of its design, including but not limited to, its maximum capacity, value of the division, minimum capacity, and computing capability.

UR.1.1. Value of the Indicated and Recorded Division. – The value of the division recorded shall be the same as the division value indicated.

UR.2. Installation Requirements.

UR.2.1. Supports. – A device that is portable and is being used on a counter, table, or the floor shall be so positioned that it is firmly and securely supported.

UR.2.2. Foundation, Supports, and Clearance. – The foundations and support of a device installed in a fixed location shall be such as to provide strength, rigidity, and permanence of all components, and clearance shall be provided around all live parts to the extent that no contacts may result when the measuring element is empty, nor throughout

the performance range of the device such that the operation or performance of the device is adversely affected.

UR.2.3. Protection from Environmental Factors. – The indicating and measuring elements of a device shall be adequately protected from environmental factors such as wind, weather, and RFI that may adversely affect the operation or performance of the device.

UR.3. Use Requirements.

UR.3.1. Minimum and Maximum Measuring Ranges. – A device shall not be used to measure objects smaller than the minimum or larger than the maximum dimensions marked on the device.

UR.3.2. Special Designs. – A multiple dimension measuring device designed and marked for a special application shall not be used for other than its intended purpose.

UR.3.3. Object Placement. – If the object being measured must be transported (e.g., shipped) on a stable side, that irregularly-shaped object must be measured while placed on that stable side. The electronic rotation of the object to determine the smallest hexahedron shall be calculated in a two-dimensional horizontal plane, retaining the stable side plane as the bottom of the hexahedron.

(Added 2008)

(Amended 2008)

UR.4. Maintenance Requirements.

UR.4.1. Zero or Ready Condition. – The zero-setting adjustment of a multiple dimension measuring device shall be maintained so that, with no object in or on the measuring element, the device shall indicate or record a zero or ready condition.

UR.4.2. Level Condition. – If a multiple dimension measuring device is equipped with a level-condition indicator, the device shall be maintained in a level condition.

UR.4.3. Device Modification. – The measuring capabilities of a device shall not be changed from the manufacturer's design unless the modification has been approved by the manufacturer and the weights and measures authority having jurisdiction over the device.

UR.5. Customer Information Provided. – The user of a multiple dimension measuring device or system shall provide transaction information to the customer as specified in Table UR.5. Customer Information Provided.

(Added 2004)

Table UR.5. Customer Information Provided

Information	No Contractual Agreement / Customer Present	No Contractual Agreement / Customer not Present	Contractual Agreement
1. Object identification	N/A	P	P or A
2. Billing method (scale or dimensional weight if used)	D or P	P	P or A
3. Billing rate or rate chart	D or P or A	P or G or A	P or A
4. Dimensional weight (if used)	P	P	P or A
5. Conversion factor (if dimensional weight is used)	D or P or A	P	P or G
6. Dimensional weight statement ¹ (if dimensional weight is used)	D or P	P	P or G
7. Total price	P	P	P or A

(Added 2004)

Table UR.5. Customer Information Provided - Continued

<p>A = Available upon Request by Customer² D = Displayed G = Published Guidelines or Contracts M = Marked N/A = Not Applicable P = Printed</p> <p>Notes: ¹ This is an explanation that the dimensional weight is not a true weight but is a calculated value obtained by applying a conversion factor to the hexahedron dimensions or volume of the object. ² The information “available upon request by customer” shall be retained by the party having issued the invoice for at least 30 calendar days after the date of invoicing.</p>

(Added 2004)

The following Handbook 44 Sections are not published in this Field Reference Manual and are not currently enforced by the Division of Measurement Standards.

5.56. (a) and (b), Grain Moisture Meters,

5.57. Near-Infrared Grain Analyzers, and

5.59. Electronic Livestock, Meat, Poultry Evaluation Systems and/or Devices.

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Table of Contents

	Page
Section 5.60. Transportation Network Measurement Systems – Tentative Code	55
A. Application	55
A.1. General	55
A.2. Exceptions	55
A.3. Additional Code Requirements	55
S. Specifications	55
S.1. Design of Indicating and Recording Elements	55
S.1.1. General Indicating Elements.....	56
S.1.2. General Recording Elements.....	56
S.1.3. Identification.....	56
S.1.4. Location of Identification Information.	56
S.1.5. Display of Rates and Additional Charges.....	57
S.1.6. Fare Estimates.....	57
S.1.7. Actuation of Measurement System.	57
S.1.8. <i>Fare Adjustment</i>	57
S.1.9. Fare Identification and Other Charges.	57
S.1.10. Receipt.....	57
S.1.11. Driver’s Summary.	58
S.2. Provision for Sealing.	58
S.2.1. System Security.....	58
S.2.2. System Audit.....	59
S.2.3. Change Tracking.	59
S.3. Provision for Trip Data Loss.....	59
S.3.1. Intermittent Trip Data Loss.....	59
S.3.2. Significant Trip Data Loss.....	59
S.3.3. Alternative Fare Structures	59
N. Notes	60
N.1. Distance Tests.	60
N.1.1. Test Methods.....	60
N.1.2. Test Procedures.	60
N.1.3. Test Conditions.....	60
N.2. Time Test.	61
T. Tolerances	61
T.1. Tolerance Values.....	61
T.1.1. Distance Tests.....	61
T.1.2. Time Tests.....	61
T.2. Tests Using Transfer Standards	61

UR. User Requirements	61
UR.1. System Indications.....	61
UR.1.1. Statement of Rates	62
UR.2. Change Tracking.....	62
UR.3. System Installation and Operation.	62
UR.4. Fare Estimates.....	62
UR.5. Determination of Total Charges When Location Service Data Is Lost	62
Appendix D. Definitions	63
digital network.....	63
network-arranged ride	63
transportation network company	63
transportation network company driver	63
transportation network company rider.....	63
transportation network measurement system.	63

Section 5.60. Transportation Network Measurement Systems – Tentative Code

This tentative code has a trial or experimental status and is not intended to be enforced. The requirements are designed for study prior to the development and adoption of a final code. Officials wanting to conduct an official examination of a device or system are advised to see paragraph G-A.3. Special and Unclassified Equipment.

(Tentative Code Added 2017)

A. Application

A.1. General. – This code applies to a transportation network measurement system used in connection with a digital network that determines the actual time elapsed and/or distance travelled during a network-arranged ride to calculate a fare for transportation services.

Note: The fare is calculated by software services residing on the transportation network company servers using data transmitted by the indicating elements present in the vehicle, which are running software applications or services supplied by the transportation network company. The measurement data is generated from sources not physically connected to the vehicle (e.g., a navigation satellite system such as GPS and/or other location services).

A.2. Exceptions. – This code does not apply to the following:

- (a) Any system that charges a flat rate or fixed charge, and/or does not use a measurement of actual time elapsed or distance travelled to calculate a fare for transportation services.
- (b) Odometers on vehicles that are rented or hired on a distance basis. (Also see Section 5.53. Odometers.)
- (c) Taximeters. (Also see Section 5.54. Taximeters.)
- (d) Any system where the fare is calculated by equipment located in the vehicle.

A.3. Additional Code Requirements. – In addition to the requirements of this code, transportation network measurement systems shall meet the requirements of Section 1.10. General Code.

S. Specifications

S.1. Design of Indicating and Recording Elements. – Indicating and recording elements shall provide indications and recorded representations that are clear, definite, accurate, and easily read under any conditions of normal operation of the device(s).

All indicating and recording elements used in a transportation network measurement system shall operate correctly while using the online-enabled technology application service provided by the transportation network company.

S.1.1. General Indicating Elements. – A transportation network measurement system shall include, as a minimum:

- (a) an indicating element used by a transportation network company driver that displays information and facilitates the measurements during a network-arranged ride to calculate a fare for transportation services; and
- (b) an indicating element used by a transportation network company rider that displays information that allows the rider to review the current rate(s) for the transportation service and to request a ride.

S.1.2. General Recording Elements. – A transportation network measurement system shall be capable of:

- (a) recording all information necessary to generate a receipt specified in S.1.10. Receipt;
- (b) providing information to transportation network company drivers, including, but not limited to, a summary of rides given as specified in S.1.11. Driver's Summary; and
- (c) providing a copy of all metrological data required by law to a weights and measures jurisdiction with statutory authority.

S.1.3. Identification. – All transportation network measurement system indicating elements shall display for the purposes of identification the following information:

- (a) the name, initials, or trademark of the transportation network measurement system manufacturer, distributor, or developer; and
- (b) the current version or revision identifier of the software application service provided by the transportation network company running on the indicating elements identified in S.1.1. General Indicating Elements.
- (c) The version or revision identifier shall be prefaced by words or an abbreviation that clearly identifies the number as the required version or revision.
- (d) Abbreviations for the word "Version" shall, as a minimum, begin with the letter "V" and may be followed by the word "Number." Abbreviations for the word "Revision" shall, as a minimum, begin with the letter "R" and may be followed by the word "Number." The abbreviation for the word "Number" shall, as a minimum, begin with the letter "N" (e.g., No or No.).

S.1.4. Location of Identification Information. – The information required by S.1.3. Identification shall be accessible through an easily recognized menu and, if necessary, a submenu or other appropriate means. Examples of menu and submenu identification include, but are not limited to, "Help," "About," "System Identification," "Weights and Measures Identification," or "Identification."

S.1.5. Display of Rates and Additional Charges. – The transportation network measurement system shall be designed to make available to transportation network company riders the rate(s) for transportation services before the beginning of a network-arranged ride. The system shall be capable of providing an explanation of the basis for calculating a fare including, if applicable, the base fare, rates for time and distance, and the amount of a booking fee, platform fee, or other similar service fee, before a rider submits the request for a network-arranged ride.

S.1.6. Fare Estimates. – The transportation network measurement system shall be capable of displaying a fare estimate to the transportation network company rider before a request for a network-arranged ride is made.

S.1.7. Actuation of Measurement System. – Following the initiation of a network-arranged ride by the transportation network company driver, and prior to the conclusion of that network-arranged ride, the transportation network measurement system shall only indicate and/or record measurements resulting from the movement of the vehicle or by the time mechanism.

S.1.8. Fare Adjustment. – *A transportation network measurement system shall be designed with:*

(a) a “time off” mechanism and a “distance off” mechanism provided for the transportation network system driver to render the measurement of time and distance either operative or inoperative during the ride; or

(b) the capability to make post-transaction fare adjustments to reduce the amount of the fare, provided the system creates a record of all location and time data from the time the ride request was accepted by the transportation network company driver.

[Nonretroactive as of January 1, 2018]

S.1.9. Fare Identification and Other Charges.

S.1.9.1. Fare Identification. – Fare indications shall be identified by the word “Fare” or by an equivalent expression when displayed on the transportation network company system receipt required by S.1.10 Receipt. Values shall be defined by suitable words or monetary signs.

S.1.9.2. Other Charges. – Other charges shall be indicated as separate line items when displayed on the receipt required by S.1.10. Receipt. Other charges shall be identified using an appropriate descriptive term, including but not limited to “Booking Fee,” “Tolls,” “Airport Pickup/Drop-off Surcharge” or an equivalent expression. Values shall be defined by suitable words or monetary signs.

S.1.10. Receipt. – A transportation network measurement system shall issue a printed or electronic receipt to a transportation network company rider. This receipt shall include as a minimum the following:

- (a) date of the start of the trip;
- (b) unique identifying information sufficient for the transportation network company to identify the transaction, or other identifying information as specified by the statutory authority;
- (c) start and end time of trip, total time of trip (maximum increment of one second), and if applicable, the total elapsed time during any time-off period;
- (d) distance traveled, maximum increment of 0.01 km or 0.01 mi;
- (e) the associated fare in \$;
- (f) other charges where permitted shall be identified and itemized;
- (g) total charge in \$;
- (h) the start and end addresses or locations of the trip;
- (i) a map showing the route taken; and
- (j) a means to obtain transportation network company rider assistance.

S.1.11. Driver's Summary. – A transportation network measurement system shall be capable of providing a summary of the driver's activity regarding network-arranged rides. The summary shall include, but not be limited to, the following information about each ride:

- (a) date and time for start of trip;
- (b) unique identifying information sufficient for the transportation network company to identify the transaction, or other identifying information as specified by the statutory authority;
- (c) total time of trip, maximum increment of one second;
- (d) distance traveled, maximum increment of 0.01 km or 0.01 mi;
- (e) the total fare received;
- (f) other charges where permitted; and
- (g) a means to obtain transportation network company driver assistance.

S.2. Provision for Sealing.

S.2.1. System Security. – Adequate provision shall be made to provide security for a transportation network measurement system. The system shall be designed to:

- (a) protect the integrity of metrological data and algorithms used to compute fares from such data against unauthorized modification using industry-standard technological protection mechanisms such as data encryption; and
- (b) use software-based access controls or equivalent technological protections that limit access to metrological data and algorithms used to compute fares from such data only to authorized persons.

S.2.2. System Audit. – The transportation network measurement system shall be designed in a manner that permits officials having statutory authority to verify compliance with this transportation network measurement system code.

S.2.3. Change Tracking. – Changes made by the manufacturer, distributor, or developer of a transportation network measurement system to any algorithms or code, which have a metrological effect, shall be logged and recorded. The period covered by this change record is not required to exceed one year.

S.3. Provision for Trip Data Loss. – If a portion of the trip data is lost due to power or signal interruption by the transportation network company driver's indicating element, the transportation network measurement system shall be capable of determining the information needed to complete any transaction in progress at the time of the power or signal loss.

S.3.1. Intermittent Trip Data Loss. – When the location services signal is lost intermittently during a prearranged ride (e.g., traveling through a tunnel), but recovered prior to the end of the ride, the transportation network measurement system shall be capable of calculating an accurate fare in accordance with T.1. Tolerance Values.

S.3.2. Significant Trip Data Loss. – When the location services signal is lost for a significant portion of the network-arranged ride, the transportation network measurement system shall provide for alternative fare structures.

Note: Significant trip data loss refers to instances when the location services signal is lost to the extent the transportation network measurement system is not capable of calculating an accurate fare in accordance with T.1. Tolerance Values using actual time and actual distance, or when the signal is not regained by the end of the ride.

S.3.3. Alternative Fare Structures. – If the transportation network measuring system is not using actual time and actual distance for a particular trip (e.g., zone-based fares, signal loss), that portion of the fare not based on actual time and actual distance is not subject to this code. Charges not based on actual time and actual distance measurements may be based on the terms of service.

N. Notes

N.1. Distance Tests.

N.1.1. Test Methods. – To determine compliance with distance tolerances, distance test(s) of a transportation network measurement system shall be conducted. The distance test(s) shall consist of a road test unless safety or other practical concerns prohibit road testing. A transfer standard test may be performed in the absence of a road test. At least one test shall be of a length sufficient to exceed the minimum fare.

N.1.1.1. Road Test. – The test consists of operating the conveyance over a precisely measured course calibrated to a traceable linear measure of at least one mile in length

N.1.1.2. Transfer Standard Test. – The test consists of operating the conveyance over an unmeasured course while using a calibrated transfer standard, such as a fifth-wheel, to measure the distance travelled.

Note: Field examinations of transportation network measurement systems need not include testing of all individual devices used as driver/passenger indicating elements in connection with the service provided. It is considered sufficient that a representative sample of various indicating elements be incorporated in testing to verify proper operation of the system.

N.1.2. Test Procedures.

N.1.2.1. Test Length. – All tests must be at least one mile in length. If a measured course or testing equipment is not readily available that will enable a test of a length sufficient to exceed the minimum fare, after completing the testing specified in N.1.1. Test Methods, an additional unmeasured test may be conducted. The purpose of this additional unmeasured test is to verify compliance with S.1.10. Receipt.

N.1.2.2. Additional Tests. – If during testing a transportation network measurement system produces a measurement that does not comply with the tolerance values in T.1.1. Distance Tests, a minimum of three additional tests shall be conducted at the same location where all test variables are reduced to the greatest extent practicable to verify the system's ability to repeat transaction indications. Repeatability testing performed in excess of these three additional tests is done at the discretion of the official with statutory authority.

To verify system-wide noncompliance, tests for variability shall be conducted, including a minimum of three consecutive tests of varying lengths, locations, and/or environmental conditions.

N.1.3. Test Conditions.

N.1.3.1. General. – Except during type evaluation, all tests shall be performed under the conditions that are considered usual and customary within the location(s) where the system is normally operated as deemed necessary by the statutory authority.

N.1.3.2. Roads. – All tests shall be conducted on public roads.

N.1.3.3. Testing for Environmental Influences. – During type evaluation, the distance test may include a route traveled by the vehicle that will expose the system to conditions that could contribute to the loss of, or interference with, the location service's signal. This may include:

- (a) objects that may obstruct or reflect signals such as tall buildings/structures, forestation, tunnels, etc.;
- (b) routes that do not follow a straight-line path;
- (c) significant changes in altitude; and
- (d) any other relevant environmental conditions.

N.2. Time Test. – A transportation network measurement system, which determines time elapsed, shall be tested for compliance with the tolerances values specified in T.1.2. Time Tests, using a certified, traceable standard.

T. Tolerances

T.1. Tolerance Values. – The tolerances will be as specified in T.1.1. Distance Tests and T.1.2. Time Tests. (The following proposed tolerance values will be confirmed based on performance data evaluated by the NIST U.S. National Work Group on Taximeters before the transportation network measurement systems code becomes a permanent code.)

T.1.1. Distance Tests. – Maintenance and acceptance tolerances shall be as follows:

- (a) On Overregistration: 2.5 %
- (b) On Underregistration: 2.5 %

T.1.2. Time Tests. – Maintenance and acceptance tolerances shall be as follows:

- (a) On Overregistration: 5 seconds or 0.5 %, whichever is greater
- (b) On Underregistration: 5 seconds or 0.5 %, whichever is greater

T.2. Tests Using Transfer Standards. – To the basic tolerance values that would otherwise be applied, there shall be added an amount equal to two times the standard deviation of the applicable transfer standard when compared to a basic reference standard.

UR. User Requirements

UR.1. System Indications. – The indicating elements identified in S.1.1. General Indicating Elements shall display indications and information in a manner such that they can be

conveniently read by the user of the device, computer, website, or online-enabled technology application service.

UR.1.1. Statement of Rates. – The transportation network company rider shall be able to view the basis for calculating the fare including, if applicable, the base fare, rates for time and distance, and the amount of a booking fee, platform fee, or other similar service fees.

UR.2. Change Tracking. – Upon request by an official having statutory authority, the transportation network company shall provide an explanation of changes that are logged pursuant to S.2.3. Change Tracking requirement during the time period covered by the request. Any such request shall be answered within two business days, unless extended by the official having statutory authority. Records provided pursuant to S.2.3. Change Tracking shall be treated as confidential and proprietary to the extent permitted by any applicable law.

UR.3. System Installation and Operation. – The transportation network company driver shall use the indicating elements identified in S.1.1.(a) General Indicating Elements in accordance with the requirements of the manufacturer, distributor, or developer.

UR.4. Fare Estimates. – Estimates for fare charges shall be provided by the transportation network measurement system when requested by the transportation network company rider and following the input of a final destination for the trip being requested. The recipient of the fare estimate shall be able to access information about the fare estimate, including key variables that may lead to discrepancies between actual fare charged and the fare estimate provided as required by law.

UR.5. Determination of Total Charges When Location Service Data Is Lost. – At the conclusion of the trip, the transportation network company shall disclose to the transportation network measurement service rider and driver the manner in which total charges are determined when there is significant data loss from location services.

Appendix D. Definitions

D

digital network. – An online-enabled technology application service, website, or system offered or used by a transportation network company that enables a transportation network company rider to arrange a network-arranged ride with a transportation network company driver. [5.60]

N

network-arranged ride. – The provision of transportation by a transportation network company driver to a transportation network company rider, or other persons selected by the transportation network company rider, arranged through a digital network. [5.60]

T

transportation network company. – An entity that uses a digital network to connect transportation network company riders with transportation network company drivers who provide network-arranged rides, and offers or provides a transportation network measurement system, subject to an agreement or terms of service between the transportation network company and transportation network company rider or driver. [5.60]

transportation network company driver. – An individual authorized by the transportation network company to access the digital network and receive connections to transportation network company riders for the purpose of providing network-arranged rides. [5.60]

transportation network company rider. – An individual who has obtained an account with a transportation network company and uses the transportation network company's digital network to connect with a transportation network company driver who can offer or provide a network-arranged ride to the transportation network company rider or other persons selected by the transportation network company rider. [5.60]

transportation network measurement system. – The information technology infrastructure and services offered or used by a transportation network company that receives data collected through a digital network and calculates a fare for a network-arranged ride. [5.60]

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CALIFORNIA DEPARTMENT OF
FOOD & AGRICULTURE

Extracts from the
CALIFORNIA CODE OF REGULATIONS
TITLE 4, DIVISION 9

WEIGHTS AND MEASURES FIELD REFERENCE MANUAL (2023)

Chapter 1
Tolerances and Specifications for
Commercial Weighing and Measuring Devices

Part 6:

- Article 2. Weighing and Measuring Devices Not Included in NIST Handbook 44**
- Article 2.1. Liquefied Petroleum Gas Tanks**
- Article 2.2. Electric Watthour Meters**
- Article 2.3. Carbon Dioxide Liquid-Measuring Devices**



CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE
DIVISION OF MEASUREMENT STANDARDS

DISCLAIMER

This document represents the Division of Measurement Standards' field manual for enforcing regulations pertaining to weights and measures in California. This field manual is not to be considered as the official Code of Regulations, as published by Barclays Law Publishers.

To find the latest online version of the California Code of Regulations (CCR) Title 4, Division 9, visit the California Office of Administration Law (OAL) at:

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The CCR may also be accessed at <http://oal.ca.gov/> by clicking the "Publications" tab at the top of the OAL home page.

For information concerning the contents of this document, please contact the Division of Measurement Standards by e-mail at dms@cdfa.ca.gov.

CCR Title 4, Div. 9, WEIGHING AND MEASURING DEVICES
Part 6 - Devices Not Included in NIST Handbook 44 (2023)

ARTICLE 2. Specifications and Tolerances and Other Technical Requirements for Commercial Weighing and Measuring Devices Not Included in NIST Handbook 44..... 1

§ 4010. Application. 1

ARTICLE 2.1. Liquefied Petroleum Gas Tanks when Mounted on Highway Vehicles and Used as Measures..... 1

§ 4012. A. Application..... 1

§ 4012.1. S. Specifications. 1

 S.1. Design of Liquefied Petroleum Gas Tanks..... 1

 S.2. Design and Location of Liquefied Petroleum Gas Tank Gaging Devices..... 1

 S.3. Marking of Capacity. 2

§ 4012.2. N. Notes..... 3

 N.1. Test Liquid. 3

 N.2. Evaporation and Volume Change..... 3

 N.3. Gaging. 3

 N.4. Adjustment and Remarking. 3

 N.5. Inspection. 3

§ 4012.4. T. Tolerances..... 4

 T.1. Application. 4

 T.2. Tolerance Values. 4

§ 4012.5. UR. User Requirements..... 4

 UR.1. Filling..... 4

 UR.2. Delivering..... 5

ARTICLE 2.2. Electric Watthour Meters 5

§ 4027. A. Application..... 5

§ 4027.1. D. Definitions. 5

§ 4027.2. S. Specifications. 9

 S.1. Metrological Components. 9

 S.2. Terminals..... 9

 S.3. Provision for Sealing..... 9

 S.4. *Meter Identification and Marking Requirements*..... 10

 S.5. Abbreviations and Symbols. 11

 S.6. Instrument Transformer. 12

 S.7. (MM) Meter Register..... 12

 S.8. (EM) Meter Watthour Display..... 12

 S.9. Multiple Meter Indicating Elements..... 13

 S.10. (EM) Meter-Control Program. 13

 S.11. (EM) Data Storage and Retrieval..... 13

 S.12. *Temperature Range for Metering Components*. 13

CCR Title 4, Div. 9, WEIGHING AND MEASURING DEVICES
Part 6 - Devices Not Included in NIST Handbook 44 (2023)

§ 4027.3. N. Notes.....	14
N.1. Meter Creep Test.....	14
N.2. Meter Starting Load.....	14
N.3. (MM) Test Revolutions.....	14
N.4. (EM) Meter Test Constant Output Indications.....	14
N.5. Meter and System Test Loads.....	14
N.6. Test of a Meter System.....	14
§ 4027.4. T. Tolerances.....	15
T.1. Meters with Separate Components.....	15
T.2. Meter Creep Test.....	15
T.3. Meter Starting Load Test.....	15
T.4. Application to Underregistration and to Overregistration.....	15
§ 4027.5. UR. User Requirements.....	16
UR.1. Selection Requirements.....	16
UR.2. Installation Requirements.....	16
U.R.3. Use Requirement.....	18
ARTICLE 2.3. Carbon Dioxide Liquid-Measuring Devices (See the current edition of NIST Handbook 44 Section 3.38.).....	18

ARTICLE 2. Specifications and Tolerances and Other Technical Requirements for Commercial Weighing and Measuring Devices Not Included in NIST Handbook 44

§ 4010. Application.

This article and Articles 2.1, 2.2 and 2.3 apply to tolerances, specifications and other technical requirements for commercial weighing and measuring devices that are not incorporated as part of National Institute of Standards and Technology's Handbook 44.

Note: Authority cited: Sections 12027 and 12107, Business and Professions Code. Reference: Section 12107, Business and Professions Code.

ARTICLE 2.1. Liquefied Petroleum Gas Tanks when Mounted on Highway Vehicles and Used as Measures

§ 4012. A. Application.

A.1. This code applies to liquefied petroleum gas tanks when mounted on highway vehicles and used as commercial measures. The code does not apply to the following devices:

- (a) Devices used solely for dispensing a product in connection with operations in which the amount dispensed does not affect customer charges.
- (b) Meters mounted on liquefied petroleum gas tanks (for which see code for Liquefied Petroleum Gas Meters).

A.2. See also General Code requirements.

Note: Authority cited: Sections 12027 and 12107, Business and Professions Code. Reference: Section 12107, Business and Professions Code.

§ 4012.1. S. Specifications.

S.1. Design of Liquefied Petroleum Gas Tanks.

S.1.1. Tank Requirements. Liquefied petroleum gas tanks when used as measures shall be so constructed and marked to fully comply with all requirements of the California State Department of Industrial Relations whenever such Department has jurisdiction pertaining to liquefied petroleum gas tanks.

S.1.2. Completeness of Delivery. A tank shall be so constructed that, when it is standing on a level surface, complete delivery can be made.

S.2. Design and Location of Liquefied Petroleum Gas Tank Gaging Devices.

S.2.1. General. A dip pipe shall be so designed that it will distinctly and unmistakably define a capacity point when liquid is in contact with the lowest portion of the dip pipe.

CCR Title 4, Div. 9, WEIGHING AND MEASURING DEVICES
Part 6 - Devices Not Included in NIST Handbook 44

S.2.2. Number of Dip Pipes. When any tank is used as a measure, it shall be provided with one or more dip pipes, one of which shall indicate between 86 percent and 87 percent of the actual total capacity of the tank.

S.2.3. Permanently Installed. Except as provided in S.2.5. and S.2.6., dip pipes shall be permanently installed as an integral part of the tank.

S.2.3.1. Cylindrical Tanks. Dip pipes on a cylindrical tank shall be installed with the location of the internal opening of the dip pipe or dip pipes on a line with the longitudinal axis of the tank midway between the ends. For the purpose of this article, "midway" means that the internal opening of the dip pipe or dip pipes shall not be more than 6 inches from the actual midway distance between the ends of the tank.

S.2.3.2. Spherical Tanks. The dip pipe or dip pipes on a spherical tank shall be installed with the location of the internal opening or openings of the dip pipe or dip pipes in line with the vertical axis of the tank.

S.2.4. Openings. The internal opening of a dip pipe shall be not less than one-quarter inch standard iron pipe size, for at least the first two inches above the liquid, and the internal opening of the dip pipe shall be parallel to the surface of the liquid and shall approach the liquid through the vapor space when the tank is plumb and level. The maximum opening of the bleeder valve shall be a number fifty-four drill size.

S.2.5. Dip Pipes on Valves. Dip pipes which are fastened to a valve or valves and are so installed as to be removable from the container and which are less than one-quarter inch standard iron pipe size shall be permitted only on containers of five hundred pounds water capacity or less.

S.2.6. Removable Dip Pipes. Removable dip pipes may be used on containers having a capacity in excess of five hundred pounds if the opening and at least the first two inches of the dip pipe above the liquid is not less than one-quarter inch standard iron pipe size. Provision shall be made so the dip pipe or dip pipes may be sealed in place by a weights and measures official in such a manner their position cannot be changed or the dip pipe or dip pipes be removed without destroying or mutilating the seal or seals.

S.3. Marking of Capacity.

Each liquefied petroleum gas tank used as a measure shall be plainly and conspicuously marked with its capacity. This marking shall appear on the rear or side of the tank, adjacent to the outage indicator valve, in letters, figures, or numerals not less than 3/4 inch in height and not less than 1/2 inch in width. On tanks having one calibrated capacity, the marking shall indicate the tank capacity to the nearest gallon and shall also indicate without qualification that the capacity is measured to the dip pipe. In the case of a liquefied petroleum gas tank having

CCR Title 4, Div. 9, WEIGHING AND MEASURING DEVICES
Part 6 - Devices Not Included in NIST Handbook 44

more than one calibrated capacity, the marking required by this section shall indicate the capacity applicable to the respective dip pipe.

A marking statement may be expressed in terms of percentage of fill (i.e., 86 1/2 %), if followed by the required marking which states the calibrated capacity in terms of gallons to the dip pipe.

Each and all letters, figures or numerals required by this section shall be of like color or tint and shall contrast with the background of such sign or designation. The required markings shall be the responsibility of the owner of the liquefied petroleum gas tank.

Note: Authority cited: Sections 12027 and 12107, Business and Professions Code. Reference: Section 12107, Business and Professions Code.

§ 4012.2. N. Notes.

N.1. Test Liquid.

Water or light fuel oil shall be used as the test liquid for a liquefied petroleum gas tank.

N.2. Evaporation and Volume Change.

Care shall be exercised to reduce to a minimum, evaporation losses and volume changes resulting from changes in temperature of the test liquid.

N.3. Gaging.

When a liquefied petroleum gas tank is gaged to determine the proper position for an indicator or to determine what a capacity marking should be, tolerances are not applicable. The indicator shall be set and the tank capacity shall be marked as accurately as practicable.

This requirement applies to new liquefied petroleum gas tanks or following repairs or modifications that might affect tank capacities.

N.4. Adjustment and Remarkng.

When a liquefied petroleum gas tank is found upon test to have an error in excess of the applicable tolerance, the capacity of the liquefied petroleum gas tank shall be adjusted to agree with its marked capacity, or its marked capacity shall be changed to agree with its capacity as determined by the test.

N.5. Inspection.

Weights and measures officials shall not inspect or certify liquefied petroleum gas liquid measuring devices until:

- (a) A certificate of inspection covering such equipment has been issued by the Division of Industrial Safety, Department of Industrial Relations of the State of California; or

CCR Title 4, Div. 9, WEIGHING AND MEASURING DEVICES
Part 6 - Devices Not Included in NIST Handbook 44

- (b) In the case of equipment requiring inspection by the United States Department of Transportation, a certificate has been issued by that agency applicable to such equipment; or until
- (c) Bonafide evidence has been presented that such inspection has been requested of the proper agency by the owner or operator of the equipment, and written permission from the proper agency has been received by him to operate the equipment until the requested inspection has been made. The provisions of this section shall not apply to marine terminals, natural gasoline plants, oil refineries or oil tank farms.

Note: Authority cited: Sections 12027 and 12107, Business and Professions Code. Reference: Section 12107, Business and Professions Code.

§ 4012.4. T. Tolerances.

T.1. Application.

The tolerances hereinafter prescribed shall be applied to errors in excess and in deficiency.

T.2. Tolerance Values.

Maintenance and acceptance tolerances shall be as shown in Table 1.

TABLE 1. MAINTENANCE AND ACCEPTANCE TOLERANCES ON LIQUEFIED PETROLEUM GAS TANKS

Nominal Capacity (Gallons)	Maintenance and Acceptance Tolerances (Gallons)
200 or less	1/2
201 to 400, inclusive	3/4
401 to 600, inclusive	1
601 to 800, inclusive	1-1/4
801 to 1,000, inclusive	1-1/2
Over 1,000	Add 1 quart per 200 gallons

Note: Authority cited: Sections 12027 and 12107, Business and Professions Code. Reference: Section 12107, Business and Professions Code.

§ 4012.5. UR. User Requirements.

UR.1. Filling.

A liquefied petroleum gas tank shall stand upon a level surface during the filling.

UR.2. Delivering.

During a delivery, a liquefied petroleum gas tank shall be so positioned as to assure complete emptying of tank.

Note: Authority cited: Sections 12027 and 12107, Business and Professions Code. Reference: Section 12107, Business and Professions Code.

ARTICLE 2.2. Electric Watthour Meters

§ 4027. A. Application.

A.1. This code applies to electronic and mechanical electric energy submeters used for "commercial purposes".

A.2. See also National Institute of Standards and Technology (NIST) Handbook 44, Section 1.10, General Code requirements adopted in Article 1, Chapter 1, Sections 4000, 4001, 4002.

A.3. This code does not apply to the use of any weight or measure or weighing or measuring instrument used by a public utility in connection with measuring gas, electricity, water, steam, or communication service subject to the jurisdiction of the Public Utilities Commission.

A.4. Code sections and subsections with an (EM) notation apply to electronic meters only. Code sections and subsections with a (MM) notation apply to mechanical meters only. Code sections and subsections without (EM) or (MM) notation apply to both meter types.

NOTE: Authority cited: Sections 12027 and 12107, Business and Professions Code. Reference: Sections 12107, 12500 and 12510, Business and Professions Code.

§ 4027.1. D. Definitions.

Accuracy Class. A performance specification for instrument transformers which expresses the maximum deviation from the true value of a measured quantity. (Instrument Transformer Accuracy Class) example: a 0.2 accuracy class transformer would be more accurate than a 0.3 accuracy class transformer.

The component of electric power that performs work, typically measured in kilowatts (kW) or megawatts (MW). Also known as "real power." The terms "active" or "real" power are used to modify the base term "power" to differentiate it from Reactive Power. The active power (P_{ac}) or real power measured by a meter, is the product of voltage (E) times current (I) times the cosine of the angle by which the current lags the voltage ($\cos \Phi$) or power factor (pf). $P_{ac} = (E) (I) (\cos \Phi)$ or $P_{ac} = (E) (I) (pf)$ where Φ is the phase angle of the lag.

Alternating Current (AC). An electric current that reverses direction in a circuit at regular intervals.

Ampere. The practical unit of electric current. It is the quantity of current caused to flow by a potential difference of one volt through a resistance of one ohm. One ampere is one coulomb of charge per second.

CCR Title 4, Div. 9, WEIGHING AND MEASURING DEVICES
Part 6 - Devices Not Included in NIST Handbook 44

Apparent Power: The product of the current and the voltage in a circuit.

Audit Trail. An electronic count and/or information record of the changes to the values of the calibration or configuration parameters of a device.

Balanced Load. Balanced load is used to indicate equal currents in all phases and relatively equal voltages between phases and between each phase and neutral (if one exists), with approximately equal watts in each phase of the load.

Basic Lightning Impulse Insulation Level (BIL). A specific insulation level expressed in kilovolts of the crest value of a standard lightning impulse. (Example: BIL = 10 Kv)

Burden (B). The impedance of the circuit connected to the instrument transformer's secondary winding. (Example: B = 21 Ohms Max.)

Commercial Purposes.

- a) A quantity determination or statement of weight, measure, or count of any commodity or thing, used wholly or partially, as a basis for sale, or,
- b) a quantity determination or statement of weight, measure, or count of any commodity or thing upon which, wholly or partially, a charge for service is based.

Coulomb. The meter-kilogram-second unit of electric charge equal in magnitude to the charge of 6.24×10^{18} electrons; charge transported through a conductor by a current of one ampere flowing for one second.

Creep. A continuous apparent measurement of energy in a meter with operating voltage applied and no power consumed.

Current. The rate of the electron flow past any one point in the circuit. The unit of measurement is coulombs per second or amperes.

Electronic Meter (EM). An electric watt-hour meter that does not have a rotor.

Element. A combination of a voltage-sensing unit and a current-sensing unit, which provides an output proportional to the quantities measured.

Form Designation (FM). (MM) An alphanumeric designation denoting the circuit arrangement for which the meter is applicable and its specific terminal arrangement. The same designation is applicable to equivalent meters for all manufacturers. (Example: FM 2S)

Hertz (Hz). Frequency or cycles per second. One cycle of an alternating current or voltage is one complete set of positive and negative values of the current or voltage.

Instrument Transformer. A transformer that reproduces in its secondary circuit, in a definite and known proportion, the voltage, or current of its primary circuit, with the phase relation preserved. Sometimes these devices may be referred to as VTs (Voltage Transformers) or CTs (Current Transformers).

Instrument Transformer-Rated Meter. A metering system with terminals arranged for connection to the secondary windings of external instrument transformers.

Instrument Transformer Ratio. The stated ratio of the primary circuit current or voltage compared to the secondary circuit current or voltage. (Example: CTR = 200 : 0.1)

Kilowatt (kW). A unit of power equal to 1,000 watts.

CCR Title 4, Div. 9, WEIGHING AND MEASURING DEVICES
Part 6 - Devices Not Included in NIST Handbook 44

Kilowatthour (kWh). 1,000 watthours.

Line Service. The service conductors connecting the master meter to the submeter.

Load Service. The service conductors connecting the submeter to the tenant's electrical load.

Master Meter. An electric watthour meter owned, maintained, and used for commercial billing purposes by the serving utility. All the electric energy served to a submetered service system is recorded by the master meter.

Mechanical Meter (MM). A watthour meter with a rotor.

Meter Class (CL). The manufacturer's designated maximum amperes a meter can measure continuously without damage or exceeding limits of accuracy. (Example: CL 200)

Meter. An electric watthour meter.

Metrological Components. Elements or features of a measurement instrument or system that perform the measurement process or that may affect the final quantity determination or resulting price determinations. This includes accessories that can affect the validity of transactions based upon the measurement process. The measurement process includes determination of quantities; the transmission, processing, storage, or other corrections or adjustments of measurement data or values; and the display or recording of measurement values or other derived values such as price or worth or charges.

Ohm. Practical unit of electric resistance, which allows one ampere to flow when the impressed potential is one volt.

Percent Registration. Percent registration is calculated as follows:

$$\text{Percent Registration} = \frac{\text{Wh measured by meter}}{\text{WH measured by STANDARD}} \times 100$$

Figure 1 - Image of Formula to Determine Percentage Error.

(Percentage error equals the watthour measured by the meter divided by the watthour measured by the standard multiplied by 100.)

Percent Error. Percent Error = Percent Registration – 100

Power Factor. The ratio of the active power to the apparent power.

Primary Watthour Constant (PKh) (MM). The meter Kh multiplied by the product of the current and/or voltage transformer ratio(s):

PKh = Kh (Current Transformer Ratio X Voltage Transformer Ratio)

Register Ratio (Rr) (MM). The number of revolutions of the gear meshing with the worm or pinion on the rotor shaft per complete rotation of the fastest (most sensitive) wheel or dial pointer.

Remote Configuration Capability. The ability to adjust a measuring device or change its sealable parameters from or through some other device that is not itself necessary to its operation and is not a permanent part of the adjustable device.

CCR Title 4, Div. 9, WEIGHING AND MEASURING DEVICES
Part 6 - Devices Not Included in NIST Handbook 44

Revolution Equivalent. The number of wathours represented by one increment (pulse period) of serial data.

Serving Utility. The utility distribution company that owns the master meter and sells electric energy to the owner of the submeter system.

Stator (MM). The unit which provides the driving torque in a wathour meter. It contains a voltage coil, one or more current coils, and the necessary steel to provide the required magnetic paths.

Submeter. A meter furnished, owned, installed, and maintained, by the customer who is served through a utility owned master meter.

Tenant. The person or persons served electric energy from a submetered service system.

Test Amperes (TA). The manufacturer's specified full load test amperage. (Example: TA 30)

Test Block. Device that facilitates safe meter testing by disconnecting the meter from the circuit without interrupting the service to the tenant.

Thermal Overload Protector. A circuit breaker or fuse that automatically limits the maximum current in a circuit.

Volt. The practical unit of electromotive force. One volt will cause one ampere to flow when impressed across a resistance of one ohm.

Voltage Transformer. A device which provides a secondary voltage which is a precise fraction of the primary voltage.

Watt. The practical unit of electric power. In an alternating-current circuit (AC), the power in watts is volts times amperes multiplied by the circuit power factor.

Wathour (Wh). The practical unit of electric energy, which is expended in one hour when the average load during the hour is one watt.

Wathour Constant (Kh). The expression of the relationship between the energy applied to the meter and one rotor revolution, or output indication, expressed as wathours per revolution or, wathours per output indication.

Wathour Meter. An electricity metering system comprised of components functioning together that measures and registers the integral, with respect to time, of the active power of the circuit in which it is connected. This power integral is the energy delivered to the circuit during the interval over which the integration extends. The unit in which this integral is measured is usually the kilowatthour.

Wathour Test Constant (Kt) (EM). The expression of the relationship between the energy applied to the meter system and corresponding occurrence of one test output indication expressed as wathours per test output indication.

NOTE: Authority cited: Sections 12027 and 12107, Business and Professions Code.

Reference: Sections 12107, 12500, Business and Professions Code.

§ 4027.2. S. Specifications.

S.1. Metrological Components.

A meter system shall be designed and constructed so that metrological components are adequately protected from environmental conditions likely to be detrimental to accuracy. Components shall be designed to prevent undetected access to adjustment mechanisms and terminal blocks by providing for application of a physical security seal or an audit trail.

S.2. Terminals.

The terminals of the meter shall be arranged so that the possibility of short circuits while removing or replacing the cover, making connections, or adjusting the meter, is minimized.

S.3. Provision for Sealing.

S.3.1. Sealing. Provisions shall be made for applying a security seal in a manner that requires the seal to be broken, or for other approved means of providing security (e.g. audit trail available at the time of inspection), before an adjustment can be made that affects the metrological integrity of the meter. The audit trail shall use the format set forth in Table S.3.1.

Table S.3.1. Categories of Device and Methods of Sealing

Category of Device	Method of Sealing
<p>Category 1: No remote configuration capability.</p>	<p>Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.</p>
<p>Category 2: Remote configuration capability, but access is controlled by physical hardware.</p> <p>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.</p>	<p>The hardware enabling access for remote communication must be on-site. The hardware must be sealed using a physical seal or an event counter for calibration parameters and an event counter for configuration parameters. The event counters may be located either at the individual measuring device or at the system controller; however, an adequate number of counters must be provided to monitor the calibration and configuration parameters of the individual devices at a location. If the counters are located in the system controller rather than at the individual device, means must be provided to generate a hard copy of the information through an on-site device.</p>
<p>Category 3: Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password).</p> <p>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.</p>	<p>An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. A printed copy of the information must be available through the device or through another on-site device. The event logger shall have a capacity to retain records equal to ten times the number of sealable parameters in the device, but not more than 1000 records are required. (Note: Does not require 1000 changes to be stored for each parameter.)</p>

S.4. Meter Identification and Marking Requirements.

The following identification and marking requirements are in addition to the requirements of National Institute of Standards and Technology (NIST) Handbook 44, Section 1.10, General Code, G-S.1.

Each meter shall have the following information legibly marked on the nameplate or register, if applicable.

CCR Title 4, Div. 9, WEIGHING AND MEASURING DEVICES
Part 6 - Devices Not Included in NIST Handbook 44

- (a) *Manufacturer's name or trademark, type designation, and non-repetitive serial number.*
- (b) *AC voltage rating.*
- (c) *Test amperes (TA).*
- (d) *Meter class (CL).*
- (e) *Watt-hour or rotor constant (K_h).*
- (f) *(MM) Register ratio (R_r) and multiplier (if greater than one).*
- (g) *Frequency rating (Hz).*
- (h) *Number of meter stator(s) or element(s).*
- (i) *Watt-hour meter or other descriptive term.*
- (j) *(MM) Number of wires (W).*
- (k) *(MM) Form designation (FM).*
- (l) *(EM) Watt-hour test constant (K_t).*

Instrument transformer-rated meters shall contain the following additional information:

- (m) *Instrument transformer ratio or transformer model number.*
- (n) *(MM) Primary watt-hour constant (PK_h).*
- (o) *Temperature Limits, if narrower than and within -20°C to $+50^{\circ}\text{C}$ (-4°F to 122°F).*

(Nonretroactive as of February 12, 2009)

S.5. Abbreviations and Symbols.

The following abbreviations or symbols may appear on a meter, instrument transformer, or indicator.

- (a) FM = Form
- (b) CL = Class
- (c) V = Volts
- (d) Hz = Hertz, Frequency or Cycles Per Second
- (e) TA = Test Amperes
- (f) K_h = Watt-hour Constant Per Rotor Revolution or Pulse
- (g) PK_h = Primary Watt-hour Constant
- (h) R_r = Register Ratio
- (i) CTR = Current Transformer Ratio
- (j) VTR or PTR = Voltage or Potential Transformer Ratio
- (k) MULT BY = Multiply By
- (l) W = Wire (example: 240V 3W)
- (m) Y = WYE Power Supply
- (n) ANSI = American National Standards Institute
- (o) B = Burden
- (p) BIL = Basic Lightning Impulse Insulation Factor
- (q) K_t = (EM) Watt-hour Test Constant
- (r) AC = Alternating Current (i.e. VAC)
- (s) Wh = Watt-hour
- (t) kWh = Kilowatt-hour
- (u) Δ = Delta Power Supply

S.6. Instrument Transformer.

S.6.1. Identification. *Each instrument transformer that is non-integral with the meter shall have a permanent identification label identifying the following:*

- (a) *Manufacturer's name, type designation, and non-repetitive serial number*
- (b) *True ratio, primary versus secondary, ampere or voltage values*
- (c) *Accuracy class*
- (d) *Burden designation (B)*
- (e) *Basic lightning impulse insulation level (BIL)*
- (f) *Rated Frequency (HZ)*

Note: If evident by the method of integration that instrument transformers are not intended to be detachable or replaceable, the required information may be located on the meter.

(Nonretroactive as of February 12, 2009)

S.6.2. Accuracy Class. *An instrument transformer that is not an integral part of the meter and is used for revenue metering shall be rated 0.3 accuracy class or more accurate for the burden of a particular meter type. If a meter system requires an instrument transformer more accurate than 0.3 accuracy class, the limitations shall be stated on the meter.*

(Nonretroactive as of February 12, 2009)

S.6.3. Polarity Marking. *A permanent mark indicating proper installation orientation is required on the instrument transformer when the accuracy of the meter is affected.*

S.7. (MM) Meter Register.

A meter register shall clearly indicate the number of kilowatthours measured by the meter. The register ratio shall be indicated on the front of the registers that are not an integral part of the meter nameplate. Means shall be provided for the tenant to read the meter register.

S.8. (EM) Meter Watthour Display.

S.8.1. *All submeters in a service system shall have an individual customer display on or at the meter and the minimum value shall not exceed one kilowatt hour.*

(Nonretroactive as of February 12, 2009)

S.8.2. *All submeter systems shall be capable of displaying at least one watthour test constant (K_t) output indication but not more than 20 watthour test constant output indications.*

Means for displaying watthour test constant output indications include but are not limited to: decimal point, contrasting display colors, shorting link, or a means for visual flashing pulse counts.

(Nonretroactive as of February 12, 2009)

S.8.3. *The minimum display value (unit of measure) shall be conspicuously identified on*

or near the customer display.

(Nonretroactive as of February 12, 2009)

S.8.4. *A segmented digital display shall have an easily accessible provision for checking that all segments are operational.*

(Nonretroactive as of February 12, 2009)

S.8.5. *If the display is not on continuously, it shall be accumulated continuously so that real-time measurement is displayed during activation.*

(Nonretroactive as of February 12, 2009)

S.9. Multiple Meter Indicating Elements.

An indicating or combination indicating-recording element coupled to two or more meter systems shall be provided with means to prohibit display of information from any meter system not selected, and shall be provided with automatic means to indicate clearly and definitely which meter system is associated with the indication.

S.10. (EM) Meter-Control Program.

The meter-control program shall be an integral part of the meter's firmware read-only memory that cannot be changed in its operating environment. This section does not apply to electronic meters that do not utilize a meter-control program.

S.11. (EM) Data Storage and Retrieval.

- (a) Watthour data accumulated and displayed on the indicator shall be permanent and accessible.
- (b) Values displayed or stored in memory shall not be affected by electrical, mechanical or temperature variations, radio-frequency interference, power failure, or any other environmental influences to the extent that accuracy is impaired.
- (c) Memory and/or display shall be recallable for the life of the meter. A replaceable battery shall not be used for this purpose.

S.12. Temperature Range for Metering Components.

Meters shall be accurate and correct over the temperature range of -20 °C to +50 °C (-4 °F to 122 °F). If the meter and/or components are not capable of meeting these requirements the installations shall be limited to temperature limits stated on the meter.

(Nonretroactive as of February 12, 2009)

NOTE: Authority cited: Sections 12027 and 12107, Business and Professions Code.

Reference: Section 12107, Business and Professions Code.

§ 4027.3. N. Notes.

N.1. Meter Creep Test.

A meter creep test shall be conducted by applying rated voltage to the meter under test and no load applied.

N.2. Meter Starting Load.

A meter starting load test shall be conducted by applying rated voltage and 0.5-ampere load.

N.3. (MM) Test Revolutions.

Full and light load tests shall require 8 or more revolutions of the test standard and at least one revolution of the meter under test.

N.4. (EM) Meter Test Constant Output Indications.

Full and light load tests shall consist of 8 or more watthour test constant (K_t) output indications of the test standard and at least one watthour test constant (K_t) output indication of the meter under test. Test standards that read out directly in watthours shall meet the watthour equivalent of 8 or more watthour test constant (K_t) output indications.

N.5. Meter and System Test Loads.

- (a) (MM) Mechanical self-contained meters shall be balanced load tested, and may be single element tested, for meter accuracy at full and light loads.
- (b) (MM) Instrument transformer rated systems shall be single element tested, and may be balanced load tested, for system accuracy at full and light loads. Meter testing shall be accomplished by applying the test load to the current transformer(s).
- (c) (EM) Instrument transformer(s) rated systems shall be single element tested, for system accuracy at full and light loads. Meter testing shall be accomplished by applying the test load to the instrument transformer(s) with the voltage circuits energized.
- (d) The reference voltage phases (A, B, or C) at the meter shall be the same phase as the load.

N.6. Test of a Meter System.

- (a) Each meter submitted for test shall be a complete system. For example: a meter body and any necessary instrument transformer(s), indicator(s), system software, etc., required to make up a complete system.
- (b) The test load applied for a full load test shall be the marked test amperes (TA) on the nameplate of the meter under test.

CCR Title 4, Div. 9, WEIGHING AND MEASURING DEVICES
Part 6 - Devices Not Included in NIST Handbook 44

- (c) The test load applied for a light load test shall be conducted at not less than 10% of the marked (TA) test amperes on the nameplate of the meter under test.
- (d) The test load applied for a full load test of a meter for a 0.5 power factor setting shall be the marked (TA) test amperes of the nameplate of the meter under test.
- (e) The test load applied for a light load test of a meter for a 0.5 power factor setting shall be conducted at not less than 20% of the (TA) test amperes of the meter.
- (f) All tests shall be made at the rated voltage \pm 10%.

NOTE: Authority cited: Sections 12027 and 12107, Business and Professions Code.
Reference: Section 12107, Business and Professions Code.

§ 4027.4. T. Tolerances.

T.1. Meters with Separate Components.

Where instrument transformers or other components are used, the provisions of this section shall apply to all metering components.

T.2. Meter Creep Test.

T.2.1. (EM) The meter indicator or display shall not change by more than one least significant digit with the voltage circuit(s) energized and current circuit(s) not energized for a duration of one hour using the watthour test constant (K_i) output indications.

T.2.2. (MM) A meter rotor shall rotate no more than one complete revolution in 10 minutes with the meter voltage circuit(s) energized and the current circuit(s) not energized.

T.3. Meter Starting Load Test.

T.3.1. (EM) The watthour test constant (K_i) output indication shall continue to advance when a load of 0.5 amperes is applied.

T.3.2. (MM) The meter rotor shall rotate continuously when a load of 0.5 amperes is applied.

T.4. Application to Underregistration and to Overregistration.

The following prescribed tolerances shall be applied to errors of underregistration and errors of overregistration.

T.4.1. Tolerance Values. Maintenance and acceptance tolerances for electric watthour meters shall be as follows for full and light load tests:

- (a) Maintenance tolerance shall be 2 percent for full and light loads.

CCR Title 4, Div. 9, WEIGHING AND MEASURING DEVICES
Part 6 - Devices Not Included in NIST Handbook 44

(b) Acceptance tolerance shall be 1 percent for full and light loads.

T.4.2. Power Factor Tests. Power factor tests shall be conducted at 0.5 power factor setting:

(a) Maintenance tolerance shall be 2 percent for full and light loads.

(b) Acceptance tolerance shall be 1 percent for full and light loads.

NOTE: 0.5 power factor light load tests shall be conducted at 20 percent of the Test Amperes (TA).

NOTE: Authority cited: Sections 12027 and 12107, Business and Professions Code.
Reference: Section 12107, Business and Professions Code.

§ 4027.5. UR. User Requirements.

UR.1. Selection Requirements.

UR.1.1. Meter Class. The meter class shall equal or exceed the total capacity in amperes of the thermal overload protectors of the tenant.

UR.1.2. Suitability of Equipment. A meter shall be suitable for use on its electrical system. A 3-wire two-phase load which is connected to a 120-208 volt network service shall be metered by a two-stator or two-element meter.

A meter shall accurately measure all loads 5 percent or greater of the electric service capacity of the tenant. Service capacity shall be determined by the master thermal overload protectors to the tenants' service or by the rated capacity of an electric cord and its connector used to provide power from the service panel to the tenant.

UR.1.3. Instrument Transformer Ratio. The instrument transformer shall be correctly matched to the meter indicator and multiplier

UR.2. Installation Requirements.

UR.2.1. Regulation Conflicts and Permit Compliance. *If any provision of this section (UR.2. Installation Requirements) is less stringent than that required of a similar installation by the serving utility, the installation shall be in accordance with those requirements of the serving utility.*

The installer of any new electric watthour submeter service shall obtain all necessary permits and shall conform to California Public Utilities Commission (CPUC) Decision D 05-05-026, including but not limited to conformance with Section 8 of Pacific Gas and Electric Company (PG&E) Greenbook requirements.

(Nonretroactive as of February 12, 2009).

UR.2.2 Certification by Serving Utility or Public Utilities Commission. *It is the responsibility of the owner of the submeter system to obtain written certification for each*

CCR Title 4, Div. 9, WEIGHING AND MEASURING DEVICES
Part 6 - Devices Not Included in NIST Handbook 44

submetered service connection from the serving utility or from a person designated as qualified by either the serving utility or by the California Public Utilities Commission (CPUC).

The required certification shall identify the address, space, or number, of the premise served by the submeter connection, be signed by an authorized serving utility representative or by a designee, and shall clearly state:

- a) the installation meets all serving utility installation and accessibility requirements for similar installations served directly by the serving utility,*
- b) the installation is on a tariff schedule that qualifies for submeter use,*
- c) the billing format, rates, and charges conform to Public Utilities Code Sections 739.5 or 12821.5 and to all applicable serving utility tariff rules,*
- d) the installation complies with CPUC Decision 05-05-026 and applicable Pacific Gas & Electric Company "Greenbook" requirements,*
- e) the date of such determination, and*
- f) if performed by a designee, the designee's name and title, and the name and title of the serving utility company or Public Utilities Commission representative authorizing the designee to make the determination.*

The certification shall be provided to the county sealer prior to a submeter being used for commercial purposes.

(Nonretroactive as of February 12, 2009).

UR.2.3. Meter Test Facilities. All meters shall be provided with the same test facilities required of a similar meter by the serving utility.

UR.2.4. (MM) Test Blocks. All three-phase self-contained meter installations shall be equipped with test blocks, which are approved by the serving utility, for safe meter testing.

UR.2.5. (MM) Test Switches. Meter installations that are equipped with current or potential transformers, or both, shall have test switches installed, which are approved by the serving utility, for safe meter testing.

UR.2.6. (MM) Circuit Closing Devices. All self-contained meter installations that cannot accept a short interruption of the electrical service, for the purpose of testing the meter, shall be equipped with a manual circuit closing device as approved by the serving utility. Automatic circuit closing devices shall not be used on any meter installation.

UR.2.7. Metered Circuits (Load Service). All electricity used by a tenant shall be taken exclusively from the load service of the tenant's meter. This service and its associated meter shall accurately measure the tenant's load and be capable of being used only at the discretion of the tenant.

UR.2.8. Unmetered Circuits (Line Service). The tenant's electric circuit shall not be taken from the line terminals of the meter, meter socket, or line service. The owner of the submeter system may utilize this service.

CCR Title 4, Div. 9, WEIGHING AND MEASURING DEVICES
Part 6 - Devices Not Included in NIST Handbook 44

UR.2.9. Dedicated Tenant Service. A meter shall serve only the space, lot, building, room, suite, stall, slip, or premise occupied by the tenant.

UR.2.10. Tenant Premise Identification. Tenant premise identification shall be clearly and permanently shown on or at the meter, and on all separate components of a meter system, including, but not limited to, instrument transformer(s), modem(s), and transmitter(s) if equipped. Remote indications and all printed indications shall be readily identifiable and readily associated with the tenant's premise. Printed indications shall also include time and date information.

U.R.3. Use Requirement.

UR.3.1. Submeter Required. When a tenant is not directly served by the serving utility, and charges for electric energy are not included in the fixed periodic rent charges, a dedicated electric watt-hour submeter that measures only the energy used at the discretion of the tenant shall be used.

NOTE: Authority cited: Sections 12027 and 12107, Business and Professions Code.
Reference: Sections 12107, 12500, Business and Professions Code.

**ARTICLE 2.3. Carbon Dioxide Liquid-Measuring Devices (See
the current edition of NIST Handbook 44 Section 3.38.)**



CALIFORNIA DEPARTMENT OF
FOOD & AGRICULTURE

Extracts from the
CALIFORNIA CODE OF REGULATIONS
TITLE 4, DIVISION 9

WEIGHTS AND MEASURES FIELD REFERENCE MANUAL (2023)

Chapter 1
Tolerances and Specifications for
Commercial Weighing and Measuring Devices

Part 7: NIST Handbook 44 Appendices

Appendix A: Fundamental Considerations

Appendix B: Units of Systems of Measurement

Appendix C: General Tables of Units of Measurements

Appendix D: Definitions



CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE
DIVISION OF MEASUREMENT STANDARDS

DISCLAIMER

This document represents the Division of Measurement Standards' field manual for enforcing regulations pertaining to weights and measures in California. This field manual is not to be considered as the official Code of Regulations, as published by Barclays Law Publishers.

To find the latest online version of the California Code of Regulations (CCR) Title 4, Division 9, visit the California Office of Administration Law (OAL) at:

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For information concerning the contents of this document, please contact the Division of Measurement Standards by e-mail at dms@cdfa.ca.gov.

Table of Contents

	Page
Appendix A. Fundamental Considerations Associated with the Enforcement of Handbook 44 Codes	A-1
1. Uniformity of Requirements	A-1
1.1. National Conference Codes.	A-1
1.2. Form of Promulgation.....	A-1
2. Tolerances for Commercial Equipment	A-2
2.1. Acceptance and Maintenance Tolerances	A-2
2.2. Theory of Tolerances.	A-2
2.3. Tolerances and Adjustments.....	A-3
3. Testing Apparatus	A-3
3.1. Adequacy.	A-3
3.2. Tolerances for Standards.....	A-3
3.3. Accuracy of Standards.	A-3
4. Inspection of Commercial Equipment	A-4
4.1. Inspection Versus Testing.	A-4
4.2. Necessity for Inspection.	A-4
4.3. Specification Requirements.....	A-4
4.4. General Considerations.	A-5
4.5. Misuse of Equipment.....	A-5
4.6. Recommendations.	A-5
4.7. Accurate and Correct Equipment.	A-5
5. Correction of Commercial Equipment	A-6
5.1. Adjustable Elements.	A-6
5.2. When Corrections Should Be Made.	A-6
5.3. Gauging.....	A-7
6. Rejection of Commercial Equipment	A-7
6.1. Rejection and Condemnation	A-7
7. Tagging of Equipment	A-8
7.1. Rejected and Condemned.....	A-8
7.2. Nonsealed and Noncommercial.	A-8
8. Records of Equipment	A-9
8.1. Records, General.....	A-9

9.	Sealing of Equipment	A-9
9.1.	Types of Seals and Their Locations.	A-9
9.2.	Exceptions.....	A-9
10.	Rounding Off Numerical Values	A-9
10.1.	Definition.	A-9
10.2.	General Rules.	A-10
10.3.	Rules for Reading of Indications.	A-10
10.4.	Rules for Common Fractions.....	A-11

Appendix A. Fundamental Considerations Associated with the Enforcement of Handbook 44 Codes

1. Uniformity of Requirements

1.1. National Conference Codes. – Weights and measures jurisdictions are urged to promulgate and adhere to the National Conference codes, to the end that uniform requirements may be in force throughout the country. This action is recommended even though a particular jurisdiction does not wholly agree with every detail of the National Conference codes. Uniformity of specifications and tolerances is an important factor in the manufacture of commercial equipment. Deviations from standard designs to meet the special demands of individual weights and measures jurisdictions are expensive, and any increase in costs of manufacture is, of course, passed on to the purchaser of equipment. On the other hand, if designs can be standardized by the manufacturer to conform to a single set of technical requirements, production costs can be kept down, to the ultimate advantage of the general public. Moreover, it seems entirely logical that equipment that is suitable for commercial use in the “specification” states should be equally suitable for such use in other states.

Another consideration supporting the recommendation for uniformity of requirements among weights and measures jurisdictions is the cumulative and regenerative effect of the widespread enforcement of a single standard of design and performance. The enforcement effort in each jurisdiction can then reinforce the enforcement effort in all other jurisdictions. More effective regulatory control can be realized with less individual effort under a system of uniform requirements than under a system in which even minor deviations from standard practice are introduced by independent state action.

Since the National Conference codes represent the majority opinion of a large and representative group of experienced regulatory officials, and since these codes are recognized by equipment manufacturers as their basic guide in the design and construction of commercial weighing and measuring equipment, the acceptance and promulgation of these codes by each state are strongly recommended.

1.2. Form of Promulgation. – A convenient and very effective form of promulgation already successfully used in a considerable number of states is promulgation by citation of National Institute of Standards and Technology Handbook 44. It is especially helpful when the citation is so made that, as amendments are adopted from time to time by the National Conference on Weights and Measures, these automatically go into effect in the state regulatory authority. For example, the following form of promulgation has been used successfully and is recommended for consideration:

The specifications, tolerances, and other technical requirements for weighing and measuring devices as recommended by the National Conference on Weights and Measures and published in the National Institute of Standards and Technology Handbook 44, “Specifications, Tolerances, and Other Technical Requirements for Weighing

and Measuring Devices,” and supplements thereto or revisions thereof, shall apply to commercial weighing and measuring devices in the state.

In some states, it is preferred to base technical requirements upon specific action of the state legislature rather than upon an act of promulgation by a state officer. The advantages cited above may be obtained and may yet be surrounded by adequate safeguards to insure proper freedom of action by the state enforcing officer if the legislature adopts the National Conference requirements by language somewhat as follows:

The specifications, tolerances, and other technical requirements for weighing and measuring devices as recommended by the National Conference on Weights and Measures shall be the specifications, tolerances, and other technical requirements for weighing and measuring devices of the state except insofar as specifically modified, amended, or rejected by a regulation issued by the state (insert title of enforcing officer).

2. Tolerances for Commercial Equipment

2.1. Acceptance and Maintenance Tolerances. – The official tolerances prescribed by a weights and measures jurisdiction for commercial equipment are the limits of inaccuracy officially permissible within that jurisdiction. It is recognized that errorless value or performance of mechanical equipment is unattainable. Tolerances are established, therefore, to fix the range of inaccuracy within which equipment will be officially approved for commercial use. In the case of classes of equipment on which the magnitude of the errors of value or performance may be expected to change as a result of use, two sets of tolerances are established: acceptance tolerances and maintenance tolerances.

Acceptance tolerances are applied to new or newly reconditioned equipment; equipment returned to service following official rejection for failure to conform to performance requirements; or equipment undergoing NTEP evaluation, and are smaller than (usually one-half of) the maintenance tolerances. Maintenance tolerances thus provide an additional range of inaccuracy within which equipment will be approved on subsequent tests, permitting a limited amount of deterioration before the equipment will be officially rejected for inaccuracy and before reconditioning or adjustment will be required. In effect, there is assured a reasonable period of use for equipment after it is placed in service before reconditioning will be officially required. The foregoing comments do not apply, of course, when only a single set of tolerance values is established, as is the case with equipment such as glass milk bottles and graduates, which maintain their original accuracy regardless of use, and measure-containers, which are used only once.

2.2. Theory of Tolerances. – Tolerance values are so fixed that the permissible errors are sufficiently small that there is no serious injury to either the buyer or the seller of commodities, yet not so small as to make manufacturing or maintenance costs of equipment disproportionately high. Obviously, the manufacturer must know what tolerances his equipment is required to meet, so that he can manufacture economically. His equipment must be good enough to satisfy commercial needs but should not be subject to such stringent tolerance values as to make it unreasonably costly, complicated, or delicate.

2.3. Tolerances and Adjustments. – Tolerances are primarily accuracy criteria for use by the regulatory official. However, when equipment is being adjusted for accuracy, either initially or following repair or official rejection, the objective should be to adjust as closely as practicable to zero error. Equipment owners should not take advantage of tolerances by deliberately adjusting their equipment to have a value, or to give performance, at or close to the tolerance limit. Nor should the repair or service personnel bring equipment merely within tolerance range when it is possible to adjust closer to zero error.¹

3. Testing Apparatus

3.1. Adequacy.² – Tests can be made properly only if, among other things, adequate testing apparatus is available. Testing apparatus may be considered adequate only when it is properly designed for its intended use, when it is so constructed that it will retain its characteristics for a reasonable period under conditions of normal use, when it is available in denominations appropriate for a proper determination of the value or performance of the commercial equipment under test, and when it is accurately calibrated.

3.2. Tolerances for Standards. – Except for work of relatively high precision, it is recommended that the accuracy of standards used in testing commercial weighing and measuring equipment be established and maintained so that the use of corrections is not necessary. When the standard is used without correction, its combined error and uncertainty must be less than one-third of the applicable device tolerance.

Device testing is complicated to some degree when corrections to standards are applied. When using a correction for a standard, the uncertainty associated with the corrected value must be less than one-third of the applicable device tolerance. The reason for this requirement is to give the device being tested as nearly as practicable the full benefit of its own tolerance.

3.3. Accuracy of Standards. – Prior to the official use of testing apparatus, its accuracy should invariably be verified. Field standards should be calibrated as often as circumstances require. By their nature, metal volumetric field standards are more susceptible to damage in handling than are standards of some other types. A field standard should be calibrated whenever damage is known or suspected to have occurred or significant repairs have been made. In addition, field standards, particularly volumetric standards, should be calibrated with sufficient frequency to affirm their continued accuracy, so that the official may always be in an unassailable position with respect to the accuracy of his testing apparatus. Secondary field standards, such as special fabric testing tapes, should be verified much more frequently than

¹ See General Code, Section 1.10.; User Requirement G-UR.4.3. Use of Adjustments.

² Recommendations regarding the specifications and tolerances for suitable field standards may be obtained from the Office of Weights and Measures of the National Institute of Standards and Technology. Standards will meet the specifications of the National Institute of Standards and Technology Handbook 105-Series standards (or other suitable and designated standards). This section shall not preclude the use of additional field standards and/or equipment, as approved by the Director, for uniform evaluation of device performance.

such basic standards as steel tapes or volumetric provers to demonstrate their constancy of value or performance.

Accurate and dependable results cannot be obtained with faulty or inadequate field standards. If either the service person or official is poorly equipped, their results cannot be expected to check consistently. Disagreements can be avoided and the servicing of commercial equipment can be expedited and improved if service persons and officials give equal attention to the adequacy and maintenance of their testing apparatus.

4. Inspection of Commercial Equipment

4.1. Inspection Versus Testing. – A distinction may be made between the inspection and the testing of commercial equipment that should be useful in differentiating between the two principal groups of official requirements; i.e., specifications and performance requirements. Although the term inspection is frequently loosely used to include everything that the official has to do in connection with commercial equipment, it is useful to limit the scope of that term primarily to examinations made to determine compliance with design, maintenance, and user requirements. The term testing may then be limited to those operations carried out to determine the accuracy of value or performance of the equipment under examination by comparison with the actual physical standards of the official. These two terms will be used herein in the limited senses defined.

4.2. Necessity for Inspection. – It is not enough merely to determine that the errors of equipment do not exceed the appropriate tolerances. Specification and user requirements are as important as tolerance requirements and should be enforced. Inspection is particularly important and should be carried out with unusual thoroughness whenever the official examines a type of equipment not previously encountered.

This is the way the official learns whether or not the design and construction of the device conform to the specification requirements. But even a device of a type with which the official is thoroughly familiar and that he has previously found to meet specification requirements should not be accepted entirely on faith. Some part may have become damaged, or some detail of design may have been changed by the manufacturer, or the owner or operator may have removed an essential element or made an objectionable addition. Such conditions may be learned only by inspection. Some degree of inspection is therefore an essential part of the official examination of every piece of weighing or measuring equipment.

4.3. Specification Requirements. – A thorough knowledge by the official of the specification requirements is a prerequisite to competent inspection of equipment. The inexperienced official should have his specifications before him when making an inspection and should check the requirements one by one against the equipment itself. Otherwise some important requirement may be overlooked. As experience is gained, the official will become progressively less dependent on the handbook, until finally observance of faulty conditions becomes almost automatic and the time and effort required to do the inspecting are reduced to a minimum. The printed specifications, however, should always be available for reference to refresh the official's memory or to be displayed to support his decisions, and they are an essential item of his kit.

Specification requirements for a particular class of equipment are not all to be found in the separate code for that class. The requirements of the General Code apply, in general, to all classes of equipment, and these must always be considered in combination with the requirements of the appropriate separate code to arrive at the total of the requirements applicable to a piece of commercial equipment.

4.4. General Considerations. – The simpler the commercial device, the fewer are the specification requirements affecting it, and the more easily and quickly can adequate inspection be made. As mechanical complexity increases, however, inspection becomes increasingly important and more time consuming, because the opportunities for the existence of faulty conditions are multiplied. It is on the relatively complex device, too, that the official must be on the alert to discover any modification that may have been made by an operator that might adversely affect the proper functioning of the device.

It is essential for the officials to familiarize themselves with the design and operating characteristics of the devices that he inspects and tests. Such knowledge can be obtained from the catalogs and advertising literature of device manufacturers, from trained service persons and plant engineers, from observation of the operations performed by service persons when reconditioning equipment in the field, and from a study of the devices themselves.

Inspection should include any auxiliary equipment and general conditions external to the device that may affect its performance characteristics. In order to prolong the life of the equipment and forestall rejection, inspection should also include observation of the general maintenance of the device and of the proper functioning of all required elements. The official should look for worn or weakened mechanical parts, leaks in volumetric equipment, or elements in need of cleaning.

4.5. Misuse of Equipment. – Inspection, coupled with judicious inquiry, will sometimes disclose that equipment is being improperly used, either through ignorance of the proper method of operation or because some other method is preferred by the operator. Equipment should be operated only in the manner that is obviously indicated by its construction or that is indicated by instructions on the equipment, and operation in any other manner should be prohibited.

4.6. Recommendations. – A comprehensive knowledge of each installation will enable the official to make constructive recommendations to the equipment owner regarding proper maintenance of his weighing and measuring devices and the suitability of his equipment for the purposes for which it is being used or for which it is proposed that it be used. Such recommendations are always in order and may be very helpful to an owner. The official will, of course, carefully avoid partiality toward or against equipment of specific makes and will confine his recommendations to points upon which he is qualified, by knowledge and experience, to make suggestions of practical merit.

4.7. Accurate and Correct Equipment. – Finally, the weights and measures official is reminded that commercial equipment may be accurate without being correct. A piece of equipment is accurate when its performance or value (that is, its indications, its deliveries, its recorded representations, or its capacity or actual value, etc., as determined by tests made

with suitable standards) conforms to the standard within the applicable tolerances and other performance requirements. Equipment that fails so to conform is inaccurate. A piece of equipment is correct when, in addition to being accurate, it meets all applicable specification requirements. Equipment that fails to meet any of the requirements for correct equipment is incorrect. Only equipment that is correct should be sealed and approved for commercial use.³

5. Correction of Commercial Equipment

5.1. Adjustable Elements. – Many types of weighing and measuring instruments are not susceptible to adjustment for accuracy by means of adjustable elements. Linear measures, liquid measures, graduates, measure-containers, milk and lubricating-oil bottles, farm milk tanks, dry measures, and some of the more simple types of scales are in this category. Other types (for example, taximeters and odometers and some metering devices) may be adjusted in the field, but only by changing certain parts such as gears in gear trains.

Some types, of which fabric-measuring devices and cordage-measuring devices are examples, are not intended to be adjusted in the field and require reconditioning in shop or factory if inaccurate. Liquid-measuring devices and most scales are equipped with adjustable elements, and some vehicle-tank compartments have adjustable indicators. Field adjustments may readily be made on such equipment. In the discussion that follows, the principles pointed out and the recommendations made apply to adjustments on any commercial equipment, by whatever means accomplished.

5.2. When Corrections Should Be Made. – One of the primary duties of a weights and measures official is to determine whether equipment is suitable for commercial use. If a device conforms to all legal requirements, the official “marks” or “seals” it to indicate approval. If it does not conform to all official requirements, the official is required to take action to ensure that the device is corrected within a reasonable period of time. Devices with performance errors that could result in serious economic injury to either party in a transaction should be prohibited from use immediately and not allowed to be returned to service until necessary corrections have been made. The official should consider the most appropriate action, based on all available information and economic factors.

Some officials contend that it is justifiable for the official to make minor corrections and adjustments if there is no service agency nearby or if the owner or operator depends on this single device and would be “out of business” if the use of the device were prohibited until repairs could be made. Before adjustments are made at the request of the owner or the owner’s representative, the official should be confident that the problem is not due to faulty installation or a defective part, and that the adjustment will correct the problem. The official should never undertake major repairs, or even minor corrections, if services of commercial agencies are readily available. The official should always be mindful of conflicts of interest before attempting to perform any services other than normal device examination and testing duties.

(Amended 1995)

³ See Section 1.10. General Code and Appendix D. Definitions.

5.3. Gauging. – In the majority of cases, when the weights and measures official tests commercial equipment, he is verifying the accuracy of a value or the accuracy of the performance as previously established either by himself or by someone else. There are times, however, when the test of the official is the initial test on the basis of which the calibration of the device is first determined or its performance first established. The most common example of such gauging is in connection with vehicle tanks the compartments of which are used as measures. Frequently the official makes the first determination on the capacities of the compartments of a vehicle tank, and his test results are used to determine the proper settings of the compartment indicators for the exact compartment capacities desired. Adjustments of the position of an indicator under these circumstances are clearly not the kind of adjustments discussed in the preceding paragraph.

6. Rejection of Commercial Equipment

6.1. Rejection and Condemnation. – The Uniform Weights and Measures Law contains a provision stating that the director shall reject and order to be corrected such physical weights and measures or devices found to be incorrect. Weights and measures and devices that have been rejected, may be seized if not corrected within a reasonable time or if used or disposed of in a manner not specifically authorized. The director shall remove from service and may seize weights and measures found to be incorrect that are not capable of being made correct.

These broad powers should be used by the official with discretion. The director should always keep in mind the property rights of an equipment owner and cooperate in working out arrangements whereby an owner can realize at least something from equipment that has been rejected. In cases of doubt, the official should initially reject rather than condemn outright. Destruction and confiscation of equipment are harsh procedures. Power to seize and destroy is necessary for adequate control of extreme situations, but seizure and destruction should be resorted to only when clearly justified.

On the other hand, rejection is clearly inappropriate for many items of measuring equipment. This is true for most linear measures, many liquid and dry measures, graduates, measure-containers, milk bottles, lubricating-oil bottles, and some scales. When such equipment is “incorrect,” it is either impractical or impossible to adjust or repair it, and the official has no alternative to outright condemnation. When only a few such items are involved, immediate destruction or confiscation is probably the best procedure. If a considerable number of items are involved (as, for example, a stock of measures in the hands of a dealer or a large shipment of bottles), return of these to the manufacturer for credit or replacement should ordinarily be permitted provided that the official is assured that they will not get into commercial use. In rare instances, confiscation and destruction are justified as a method of control when less harsh methods have failed.

In the case of incorrect mechanisms such as fabric-measuring devices, taximeters, liquid-measuring devices, and most scales, repair of the equipment is usually possible, so rejection is the customary procedure. Seizure may occasionally be justified, but in the large majority of instances this should be unnecessary. Even in the case of worn-out equipment, some salvage is usually possible, and this should be permitted under proper controls.

(Amended 1995)

7. Tagging of Equipment

7.1. Rejected and Condemned. – It will ordinarily be practicable to tag or mark as rejected each item of equipment found to be incorrect and considered susceptible of proper reconditioning. However, it can be considered justifiable not to mark as rejected incorrect devices capable of meeting acceptable performance requirements if they are to be allowed to remain in service for a reasonable time until minor problems are corrected since marks of rejection may tend to be misleading about a device’s ability to produce accurate measurements during the correction period. The tagging of equipment as condemned, or with a similar label to indicate that it is permanently out of service, is not recommended if there is any other way in which the equipment can definitely be put out of service. Equipment that cannot successfully be repaired should be dismantled, removed from the premises, or confiscated by the official rather than merely being tagged as “condemned.”

(Amended 1995)

7.2. Nonsealed and Noncommercial. – Rejection is not appropriate if measuring equipment cannot be tested by the official at the time of his regular visit—for example, when there is no gasoline in the supply tank of a gasoline-dispensing device. Some officials affix to such equipment a nonsealed tag stating that the device has not been tested and sealed and that it must not be used commercially until it has been officially tested and approved. This is recommended whenever considerable time will elapse before the device can be tested.

Where the official finds in the same establishment, equipment that is in commercial use and also equipment suitable for commercial use that is not presently in service, but which may be put into service at some future time, he may treat the latter equipment in any of the following ways:

- (a) Test and approve the same as commercial equipment in use.
- (b) Refrain from testing it and remove it from the premises to preclude its use for commercial purposes.
- (c) Mark the equipment nonsealed.

Where the official finds commercial equipment and noncommercial equipment installed or used in close proximity, he may treat the noncommercial equipment in any of the following ways:

- (a) Test and approve the same as commercial equipment.
- (b) Physically separate the two groups of equipment so that misuse of the noncommercial equipment will be prevented.
- (c) Tag it to show that it has not been officially tested and is not to be used commercially.

8. Records of Equipment

8.1. Records, General. - The official will be well advised to keep careful records of equipment that is rejected, so that he may follow up to ensure that the necessary repairs have been made. As soon as practicable following completion of repairs, the equipment should be retested. Complete records should also be kept of equipment that has been tagged as nonsealed or noncommercial. Such records may be invaluable should it subsequently become necessary to take disciplinary steps because of improper use of such equipment.

9. Sealing of Equipment

9.1. Types of Seals and Their Locations. – Most weights and measures jurisdictions require that all equipment officially approved for commercial use (with certain exceptions to be pointed out later) be suitably marked or sealed to show approval. This is done primarily for the benefit of the public to show that such equipment has been officially examined and approved. The seal of approval should be as conspicuous as circumstances permit and should be of such a character and so applied that it will be reasonably permanent. Uniformity of position of the seal on similar types of equipment is also desirable as a further aid to the public.

The official will need more than one form of seal to meet the requirements of different kinds of equipment. Good quality, weather-resistant, water-adhesive, or pressure-sensitive seals or decalcomania seals are recommended for fabric-measuring devices, liquid-measuring devices, taximeters, and most scales, because of their permanence and good appearance. Steel stamps are most suitable for liquid and dry measures, for some types of linear measures, and for weights. An etched seal, applied with suitable etching ink, is excellent for steel tapes, and greatly preferable to a seal applied with a steel stamp. The only practicable seal for a graduate is one marked with a diamond or carbide pencil, or one etched with glass-marking ink. For a vehicle tank, the official may wish to devise a relatively large seal, perhaps of metal, with provision for stamping data relative to compartment capacities, the whole to be welded or otherwise permanently attached to the shell of the tank. In general, the lead-and-wire seal is not suitable as an approval seal.

9.2. Exceptions. – Commercial equipment such as measure-containers, milk bottles, and lubricating-oil bottles are not tested individually because of the time element involved. Because manufacturing processes for these items are closely controlled, an essentially uniform product is produced by each manufacturer. The official normally tests samples of these items prior to their sale within his jurisdiction and subsequently makes spot checks by testing samples selected at random from new stocks.

Another exception to the general rule for sealing approved equipment is found in certain very small weights whose size precludes satisfactory stamping with a steel die.

10. Rounding Off Numerical Values

10.1. Definition. – To round off or round a numerical value is to change the value of recorded digits to some other value considered more desirable for the purpose at hand by dropping or changing certain figures. For example, if a computed, observed, or accumulated value is

4738, this can be rounded off to the nearest thousand, hundred, or ten, as desired. Such rounded-off values would be, respectively, 5000, 4700, and 4740. Similarly, a value such as 47.382 can be rounded off to two decimal places, to one decimal place, or to the units place. The rounded-off figures in this example would be, respectively, 47.38, 47.4, and 47.

10.2.General Rules. – The general rules for rounding off may be stated briefly as follows:

- (a) When the figure next beyond the last figure or place to be retained is less than 5, the figure in the last place retained is to be kept unchanged. When rounding off 4738 to the nearest hundred, it is noted that the figure 3 (next beyond the last figure to be retained) is less than 5. Thus, the rounded-off value would be 4700. Likewise, 47.382 rounded to two decimal places becomes 47.38.
- (b) When the figure next beyond the last figure or place to be retained is greater than 5, the figure in the last place retained is to be increased by 1. When rounding off 4738 to the nearest thousand, it is noted that the figure 7 (next beyond the last figure to be retained) is greater than 5. Thus, the rounded-off value would be 5000. Likewise, 47.382 rounded to one decimal place becomes 47.4.
- (c) When the figure next beyond the last figure to be retained is 5 followed by any figures other than zero(s), treat as in (b) above; that is, the figure in the last place retained is to be increased by 1. When rounding off 4501 to the nearest thousand, 1 is added to the thousands figure and the result becomes 5000.
- (d) When the figure next beyond the last figure to be retained is 5 and there are no figures, or only zeros, beyond this 5, the figure in the last place to be retained is to be left unchanged if it is even (0, 2, 4, 6, or 8) and is to be increased by 1 if it is odd (1, 3, 5, 7, or 9). This is the odd and even rule, and may be stated as follows: “If odd, then add.” Thus, rounding off to the first decimal place, 47.25 would become 47.2 and 47.15 would become 47.2. Also, rounded to the nearest thousand, 4500 would become 4000 and 1500 would become 2000.

It is important to remember that, when there are two or more figures to the right of the place where the last significant figure of the final result is to be, the entire series of such figures must be rounded off in one step and not in two or more successive rounding steps. [Expressed differently, when two or more such figures are involved, these are not to be rounded off individually, but are to be rounded off as a group.] Thus, when rounding off 47.3499 to the first decimal place, the result becomes 47.3. In arriving at this result, the figures “499” are treated as a group. Since the 4 next beyond the last figure to be retained is less than 5, the “499” is dropped (see subparagraph (a) above). It would be incorrect to round off these figures successively to the left so that 47.3499 would become 47.350 and then 47.35 and then 47.4.

10.3.Rules for Reading of Indications. – An important aspect of rounding off values is the application of these rules to the reading of indications of an indicator-and-graduated-scale combination (where the majority of the indications may be expected to lie somewhere between two graduations) if it is desired to read or record values only to the nearest graduation. Consider a vertical graduated scale and an indicator. Obviously, if the indicator is between two

graduations but is closer to one graduation than it is to the other adjacent graduation, the value of the closer graduation is the one to be read or recorded.

In the case where, as nearly as can be determined, the indicator is midway between two graduations, the odd-and-even rule is invoked, and the value to be read or recorded is that of the graduation whose value is even. For example, if the indicator lies exactly midway between two graduations having values of 471 and 472, respectively, the indication should be read or recorded as 472, this being an even value. If midway between graduations having values of 474 and 475, the even value 474 should be read or recorded. Similarly, if the two graduations involved had values of 470 and 475, the even value of 470 should be read or recorded.

A special case not covered by the foregoing paragraph is that of a graduated scale in which successive graduations are numbered by twos, all graduations thus having even values; for example, 470, 472, 474, etc. When, in this case, an indication lies midway between two graduations, the recommended procedure is to depart from the practice of reading or recording only to the value of the nearest graduation and to read or record the intermediate odd value. For example, an indication midway between 470 and 472 should be read as 471.

10.4. Rules for Common Fractions. – When applying the rounding-off rules to common fractions, the principles are to be applied to the numerators of the fractions that have, if necessary, been reduced to a common denominator. The principle of “5s” is changed to the one-half principle; that is, add if more than one-half, drop if less than one-half, and apply the odd-and even rule if exactly one-half.

For example, a series of values might be $1\frac{1}{32}$, $1\frac{2}{32}$, $1\frac{3}{32}$, $1\frac{4}{32}$, $1\frac{5}{32}$, $1\frac{6}{32}$, $1\frac{7}{32}$, $1\frac{8}{32}$, $1\frac{9}{32}$. Assume that these values are to be rounded off to the nearest eighth ($\frac{4}{32}$). Then,

$1\frac{1}{32}$ becomes 1. ($\frac{1}{32}$ is less than half of $\frac{4}{32}$ and accordingly is dropped.)

$1\frac{2}{32}$ becomes 1. ($\frac{2}{32}$ is exactly one-half of $\frac{4}{32}$; it is dropped because it is rounded (down) to the “even” eighth, which in this instance is $\frac{0}{8}$.)

$1\frac{3}{32}$ becomes $1\frac{4}{32}$ or $1\frac{1}{8}$. ($\frac{3}{32}$ is more than half of $\frac{4}{32}$, and accordingly is rounded “up” to $\frac{4}{32}$ or $\frac{1}{8}$.)

$1\frac{4}{32}$ remains unchanged, being an exact eighth ($\frac{1}{8}$).

$1\frac{5}{32}$ becomes $1\frac{4}{32}$ or $1\frac{1}{8}$. ($\frac{5}{32}$ is $\frac{1}{32}$ more than an exact $\frac{1}{8}$; $\frac{1}{32}$ is less than half of $\frac{4}{32}$ and accordingly is dropped.)

$1\frac{6}{32}$ becomes $1\frac{2}{8}$ or $1\frac{1}{4}$. ($\frac{6}{32}$ is $\frac{2}{32}$ more than an exact $\frac{1}{8}$; $\frac{2}{32}$ is exactly one-half of $\frac{4}{32}$, and the final fraction is rounded (up) to the “even” eighth, which in this instance is $\frac{2}{8}$.)

$1\frac{7}{32}$ becomes $1\frac{2}{8}$ or $1\frac{1}{4}$. ($\frac{7}{32}$ is $\frac{3}{32}$ more than an exact $\frac{1}{8}$; $\frac{3}{32}$ is more than one-half of $\frac{4}{32}$ and accordingly the final fraction is rounded (up) to $\frac{2}{8}$ or $\frac{1}{4}$.)

$1\frac{8}{32}$ remains unchanged, being an exact eighth ($\frac{1}{8}$ or $1\frac{1}{4}$.)

$1\frac{9}{32}$ becomes $1\frac{2}{8}$ or $1\frac{1}{4}$. ($\frac{9}{32}$ is $\frac{1}{32}$ more than an exact $\frac{1}{8}$; $\frac{1}{32}$ is less than half of $\frac{4}{32}$ and accordingly is dropped.)

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Table of Contents

	Page
Appendix B. Units and Systems of Measurement Their Origin, Development, and Present Status	1
1. Introduction	1
2. Units and Systems of Measurement	1
2.1. Origin and Early History of Units and Standards.	2
2.1.1. General Survey of Early History of Measurement Systems.	2
2.2. The Metric System.....	4
2.2.1. Definition, Origin, and Development.	4
2.2.2. International System of Units.	5
2.2.3. Units and Standards of the Metric System.....	6
2.2.4. International Bureau of Weights and Measures.	7
2.2.5. Status of the Metric System in the United States.	7
2.3. British and United States Systems of Measurement.....	10
2.4. Subdivision of Units.	11
2.5. Arithmetical Systems of Numbers.....	12
3. Standards of Length, Mass, and Capacity or Volume	12
3.1. Standards of Length.	12
3.1.1. Calibration of Length Standards.	13
3.2. Standards of Mass.....	13
3.2.1. Mass and Weight.	13
3.2.2. Effect of Air Buoyancy.	14
3.2.3. Calibrations of Standards of Mass.	15
3.3. Standards of Capacity.	15
3.3.1. Calibrations of Standards of Capacity.....	15
3.4. Maintenance and Preservation of Fundamental Standard of Mass.	15
4. Specialized Use of the Terms “Ton” and “Tonnage”	16

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Appendix B. Units and Systems of Measurement Their Origin, Development, and Present Status

1. Introduction

The National Institute of Standards and Technology (NIST) (formerly the National Bureau of Standards) was established by Act of Congress in 1901 to serve as a national scientific laboratory in the physical sciences, and to provide fundamental measurement standards for science and industry. In carrying out these related functions the Institute conducts research and development in many fields of physics, mathematics, chemistry, and engineering. At the time of its founding, the Institute had custody of two primary standards – the meter bar for length and the kilogram cylinder for mass. With the phenomenal growth of science and technology over the past century, the Institute has become a major research institution concerned not only with everyday weights and measures, but also with hundreds of other scientific and engineering standards that are necessary to the industrial progress of the nation. Nevertheless, the country still looks to NIST for information on the units of measurement, particularly their definitions and equivalents.

The subject of measurement systems and units can be treated from several different standpoints. Scientists and engineers are interested in the methods by which precision measurements are made. State weights and measures officials are concerned with laws and regulations that assure equity in the marketplace, protect public health and safety, and with methods for verifying commercial weighing and measuring devices. But a vastly larger group of people is interested in some general knowledge of the origin and development of measurement systems, of the present status of units and standards, and of miscellaneous facts that will be useful in everyday life. This material has been prepared to supply that information on measurement systems and units that experience has shown to be the common subject of inquiry.

2. Units and Systems of Measurement

The expression “weights and measures” is often used to refer to measurements of length, mass, and capacity or volume, thus excluding such quantities as electrical and time measurements and thermometry. This section on units and measurement systems presents some fundamental information to clarify the concepts of this subject and to eliminate erroneous and misleading use of terms.

It is essential that the distinction between the terms “units” and “standards” be established and kept in mind.

A unit is a special quantity in terms of which other quantities are expressed. In general, a unit is fixed by definition and is independent of such physical conditions as temperature. Examples: the meter, the liter, the gram, the yard, the pound, the gallon.

A standard is a physical realization or representation of a unit. In general, it is not entirely independent of physical conditions, and it is a representation of the unit only under specified conditions. For example, a meter standard has a length of one meter when at some definite temperature and supported in a certain manner. If supported in a different manner, it might have to be at a different temperature to have a length of one meter.

2.1. Origin and Early History of Units and Standards.

2.1.1. General Survey of Early History of Measurement Systems. – Weights and measures were among the earliest tools invented by humans. Primitive societies needed rudimentary measures for many tasks: constructing dwellings of an appropriate size and shape, fashioning clothing, or bartering food or raw materials.

Humans understandably turned first to parts of the body and the natural surroundings for measuring instruments. Early Babylonian and Egyptian records and the Bible indicate that length was first measured with the forearm, hand, or finger and that time was measured by the periods of the sun, moon, and other heavenly bodies. When it was necessary to compare the capacities of containers such as gourds or clay or metal vessels, they were filled with plant seeds which were then counted to measure the volumes. When means for weighing were invented, seeds and stones served as standards. For instance, the “carat,” still used as a unit for gems, was derived from the carob seed.

Our present knowledge of early weights and measures comes from many sources. Archaeologists have recovered some rather early standards and preserved them in museums. The comparison of the dimensions of buildings with the descriptions of contemporary writers is another source of information. An interesting example of this is the comparison of the dimensions of the Greek Parthenon with the description given by Plutarch from which a fairly accurate idea of the size of the Attic foot is obtained. In some cases, we have only plausible theories and we must sometimes select the interpretation to be given to the evidence.

For example, does the fact that the length of the double-cubit of early Babylonia was equal (within two parts per thousand) to the length of the seconds pendulum at Babylon suggest a scientific knowledge of the pendulum at a very early date, or do we merely have a curious coincidence? By studying the evidence given by all available sources, and by correlating the relevant facts, we obtain some idea of the origin and development of the units. We find that they have changed more or less gradually with the passing of time in a complex manner because of a great variety of modifying influences. We find the units modified and grouped into measurement systems: the Babylonian system, the Egyptian system, the Phileterian system of the Ptolemaic age, the Olympic system of Greece, the Roman system, and the British system, to mention only a few.

2.1.2. Origin and Development of Some Common Customary Units. – The origin and development of units of measurement has been investigated in considerable detail

and a number of books have been written on the subject. It is only possible to give here, somewhat sketchily, the story about a few units.

Units of length: The cubit was the first recorded unit used by ancient peoples to measure length. There were several cubits of different magnitudes that were used. The common cubit was the length of the forearm from the elbow to the tip of the middle finger. It was divided into the span of the hand (one-half cubit), the palm or width of the hand (one sixth), and the digit or width of a finger (one twenty-fourth). The Royal or Sacred Cubit, which was 7 palms or 28 digits long, was used in constructing buildings and monuments and in surveying. The inch, foot, and yard evolved from these units through a complicated transformation not yet fully understood. Some believe they evolved from cubic measures; others believe they were simple proportions or multiples of the cubit. In any case, the Greeks and Romans inherited the foot from the Egyptians. The Roman foot was divided into both 12 unciae (inches) and 16 digits. The Romans also introduced the mile of 1000 paces or double steps, the pace being equal to five Roman feet. The Roman mile of 5000 feet was introduced into England during the occupation. Queen Elizabeth, who reigned from 1558 to 1603, changed, by statute, the mile to 5280 feet or 8 furlongs, a furlong being 40 rods of 5½ yards each.

The introduction of the yard as a unit of length came later, but its origin is not definitely known. Some believe the origin was the double cubit, others believe that it originated from cubic measure. Whatever its origin, the early yard was divided by the binary method into 2, 4, 8, and 16 parts called the half-yard, span, finger, and nail. The association of the yard with the “gird” or circumference of a person’s waist or with the distance from the tip of the nose to the end of the thumb of Henry I are probably standardizing actions, since several yards were in use in Great Britain.

The point, which is a unit for measuring print type, is recent. It originated with Pierre Simon Fournier in 1737. It was modified and developed by the Didot brothers, Francois Ambroise and Pierre Francois, in 1755. The point was first used in the United States in 1878 by a Chicago type foundry (Marder, Luse, and Company). Since 1886, a point has been exactly 0.351 459 8 millimeters, or about 1 /72 inch.

Units of mass: The grain was the earliest unit of mass and is the smallest unit in the apothecary, avoirdupois, Tower, and Troy systems. The early unit was a grain of wheat or barleycorn used to weigh the precious metals silver and gold. Larger units preserved in stone standards were developed that were used as both units of mass and of monetary currency. The pound was derived from the mina used by ancient civilizations. A smaller unit was the shekel, and a larger unit was the talent. The magnitude of these units varied from place to place. The Babylonians and Sumerians had a system in which there were 60 shekels in a mina and 60 minas in a talent. The Roman talent consisted of 100 libra (pound) which were smaller in magnitude than the mina. The Troy pound used in England and the United States for monetary purposes, like the Roman pound, was divided into 12 ounces, but the Roman uncia (ounce) was smaller. The carat is a unit for measuring gemstones that had its origin in the carob seed, which later was standardized at 1 /444 ounce and then 0.2 gram.

Goods of commerce were originally traded by number or volume. When weighing of goods began, units of mass based on a volume of grain or water were developed. For example, the talent in some places was approximately equal to the mass of one cubic foot of water. Was this a coincidence or by design? The diverse magnitudes of units having the same name, which still appear today in our dry and liquid measures, could have arisen from the various commodities traded. The larger avoirdupois pound for goods of commerce might have been based on volume of water, which has a higher bulk density than grain. For example, the Egyptian hon was a volume unit about 11 % larger than a cubic palm and corresponded to one mina of water. It was almost identical in volume to the present U.S. pint.

The stone, quarter, hundredweight, and ton were larger units of mass used in Great Britain. Today only the stone continues in customary use for measuring personal body weight. The present stone is 14 pounds, but an earlier unit appears to have been 16 pounds. The other units were multiples of 2, 8, and 160 times the stone, or 28, 112, and 2240 pounds, respectively. The hundredweight was approximately equal to two talents. In the United States the ton of 2240 pounds is called the “long ton.” The “short ton” is equal to 2000 pounds.

Units of time and angle: We can trace the division of the circle into 360 degrees and the day into hours, minutes, and seconds to the Babylonians who had a sexagesimal system of numbers. The 360 degrees may have been related to a year of 360 days

2.2. The Metric System.

2.2.1. Definition, Origin, and Development. – Metric systems of units have evolved since the adoption of the first well-defined system in France in 1791. During this evolution the use of these systems spread throughout the world, first to the non-English-speaking countries, and more recently to the English-speaking countries. The first metric system was based on the units centimeter, gram, and second (cgs) for the quantities of length, mass, and time. These units were particularly convenient in science and technology. Later metric systems were based on the meter, kilogram, and second (mks) to improve the value of the units for practical applications. The present metric system is the International System of Units (SI). It uses the historical base units of the meter, kilogram and second as well as additional base units for the quantities thermodynamic temperature, electric current, luminous intensity, and amount of substance. The International System of Units is referred to as the modern metric system.

The adoption of the metric system in France was slow, but its desirability as an international system was recognized by geodesists and others. On May 20, 1875, an international treaty known as the International Metric Convention or the Treaty of the Meter was signed by seventeen countries including the United States. This treaty established the following organizations to conduct international activities relating to a uniform system for measurements:

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- (1) The General Conference on Weights and Measures (French initials: CGPM), an intergovernmental conference of official delegates of member nations and the supreme authority for all actions;
- (2) The International Committee of Weights and Measures (French initials: CIPM), consisting of selected scientists and metrologists, which prepares and executes the decisions of the CGPM and is responsible for the supervision of the International Bureau of Weights and Measures;
- (3) The International Bureau of Weights and Measures (French initials: BIPM), a permanent laboratory and world center of scientific metrology, the activities of which include the establishment of the basic standards and scales of the principal physical quantities and maintenance of the international prototype standards.

The National Institute of Standards and Technology provides official United States representation in these organizations. The CGPM, the CIPM, and the BIPM have been major factors in the continuing refinement of the metric system on a scientific basis and in the evolution of the International System of Units.

Multiples and submultiples of metric units are related by powers of ten. This relationship is compatible with the decimal system of numbers and it contributes greatly to the convenience of metric units.

2.2.2. International System of Units. – At the end of World War II, a number of different systems of measurement still existed throughout the world. Some of these systems were variations of the metric system, and others were based on the U.S. customary system of the English-speaking countries. It was recognized that additional steps were needed to promote a worldwide measurement system. As a result the 9th CGPM, in 1948, asked the CIPM to conduct an international study of the measurement needs of the scientific, technical, and educational communities. Based on the findings of this study, the 10th CGPM in 1954 decided that an international system should be derived from six base units to provide for the measurement of temperature and optical radiation in addition to mechanical and electromagnetic quantities. The six base units recommended were the meter, kilogram, second, ampere, Kelvin degree (later renamed the kelvin), and the candela.

In 1960, the 11th CGPM named the system based on the six base quantities the International System of Units, abbreviated SI from the French name: Le Système International d'Unités. In 1971, the 14th CGPM adopted the mole for the quantity of

substance as the seventh base unit. The SI metric system is now either obligatory or permissible throughout the world.

In 2018, the 26th CGPM approved the most significant change to the SI since its establishment in 1960, which is documented in NIST Special Publication 330. SP 330¹ itself is based on the definitive international reference known as the BIPM SI Brochure (available at <https://www.bipm.org/en/publications/si-brochure/>). The SI is now established in terms of seven defining constants, some of which are fundamental constants of nature such as the Planck constant and the speed of light in a vacuum. The seven SI base units can be derived from the defining constants.

The definitions for the SI no longer make reference to any artifact standard, material property, or measurement description. These changes enable the realization of all units with an accuracy that is ultimately limited only by the quantum structure of nature and our technical abilities, but not by the definitions themselves.

2.2.3 Units and Standards of the Metric System. – In the early metric system there were two fundamental or base units, the meter and the kilogram, for length and mass. The other units of length and mass, and all units of area, volume, and compound units such as density were derived from these two fundamental units.

The meter was originally intended to be one ten-millionth part of a meridional quadrant of the earth. The Meter of the Archives, the platinum length standard which was the standard for most of the 19th century, at first was supposed to be exactly this fractional part of the quadrant. More refined measurements over the earth's surface showed that this supposition was not correct. In 1889, a new international metric standard of length, the International Prototype Meter, a graduated line standard of platinum-iridium, was selected from a group of bars because precise measurements found it to have the same length as the Meter of the Archives. The meter was then defined as the distance, under specified conditions, between the lines on the International Prototype Meter without reference to any measurements of the earth or to the Meter of the Archives, which it superseded. Advances in science and technology have made it possible to improve the definition of the meter and reduce the uncertainties associated with artifacts. From 1960 to 1983, the meter was defined as the length equal to 1 650 763.73 wavelengths in a vacuum of the radiation corresponding to the transition between the specified energy levels of the krypton 86 atom. Since 1983 the meter has been defined as the length of the path traveled by light in a vacuum during an interval of $1/299792458$ of a second. With the decision of the 26th CGPM in 2018, the wording of the meter definition was revised to include the fixed numerical value of the speed of light and the definition of the second in terms of the hyperfine transition frequency of the cesium 133 atom. The kilogram, originally defined as the mass of one cubic decimeter of water at the temperature of maximum density, was known as the Kilogram of the Archives. After the International Metric Convention in 1875, in 1889 the definition of the kilogram was simply the mass of

¹ Newell, David B. and Tiesinga, Eite (2019) The International System of Units (SI). (National Institute of Standards and Technology, Gaithersburg, MD), NIST Special Publication (SP) 330. <https://doi.org/10.6028/NIST.SP.330-2019>.

the International Prototype Kilogram (IPK), an artifact made of platinum-iridium (it took from 1875 until 1889 to fabricate the IPK). Each country that subscribed to the International Metric Convention was assigned one or more copies of the international standard, known as National Prototype Kilogram. That IPK artifact was the definition of the kilogram from 1889 until the decision of the 26th CGPM in 2018 noted earlier that redefines the SI. The fundamental revision to the SI now defines the kilogram from the fixed value of the Planck constant, along with definitions of the meter and second. The numerical value of the Planck constant is such that at the time of its adoption, the kilogram was equal to the mass of the IPK of 1 kg. Going forward, primary realizations of base units will be determined according to the relevant Consultative Committees published on the BIPM website².

The liter is a unit of capacity or volume. In 1964, the 12th GCPM redefined the liter as being one cubic decimeter. By its previous definition – the volume occupied, under standard conditions, by a quantity of pure water having a mass of one kilogram – the liter was larger than the cubic decimeter by 28 parts per 1 000 000. The International System of Units (SI) includes two classes of units: (a) base units for length, mass, time, temperature, electric current, luminous intensity, and amount of substance; and (b) derived units for all other quantities (e.g., area, volume, force, pressure, power, Celsius temperature) expressed in terms of the seven base units. For details, see the current edition of NIST Special Publication 330 and NIST Special Publication 811.³

2.2.3. International Bureau of Weights and Measures. – . – The International Bureau of Weights and Measures (BIPM) was established at Sèvres, a suburb of Paris, France, by the International Metric Convention of May 20, 1875. The BIPM maintains the former International Prototype Kilogram (IPK), many secondary standards, and equipment for comparing standards and making precision measurements. The Bureau, funded by assessment of the signatory governments, is truly international. In recent years the scope of the work at the Bureau has been considerably broadened. It now carries on researches in the fields of electricity, photometry and radiometry, ionizing radiations, and time and frequency besides its work in mass, length, and thermometry.

2.2.4 Status of the Metric System in the United States. – The use of the metric system in this country was legalized by Act of Congress in 1866 and use is voluntary.⁴ Following the signing of the Convention of the Meter in 1875, the United States acquired

² International Bureau of Weights and Measures (BIPM) (2022) Practical realization of the definition of some important units. Available at <https://www.bipm.org/en/publications/mises-en-pratique>.

³ Thompson, Ambler and Taylor, Barry N. (2008) The NIST Guide for the use of the International System of Units (SI). (National Institute of Standards and Technology, Gaithersburg, MD), NIST Special Publication (SP) 811. <https://www.nist.gov/pml/special-publication-811>

⁴ Metric Act of 1866 (14 Stat 339) PDF legalized the use of the metric system in the United States. The law was amended by the America Competes Act of 2007 (U.S. Public Law 110-69), replacing the old metric system definition with the International System of Units (SI).

national prototype standards for the meter and the kilogram. Up to 2019, mass measurements in the U.S. were traceable to U.S. national prototype kilograms which were in turn traceable to the IKP. From 2019 onward, mass measurements in the U.S. are traceable to Planck's constant national prototype standards for the meter and the kilogram. The prototype meter was subsequently replaced by a *Mise en Pratique*, an internationally approved method to realize the unit, using stabilized lasers.⁵ At the same time, it was decided that any data expressed in feet derived from geodetic surveys within the United States would continue to bear the relationship as defined in 1893 (one foot equals 1200/3937 meter) until the basic geodetic survey networks of the United States were readjusted. Based on this decision, the 1893 definition of the foot is called the U.S. survey foot, while the foot definition adopted in 1959 is called the international foot. From 1893 until 1959, the yard was defined as equal exactly to 3600/3937 meter. In 1959, a small change was made in the definition of the yard to resolve discrepancies both in this country and abroad. Since 1959, the U.S. has defined the yard as equal exactly to 0.9144 meter; the new yard is shorter than the old yard by exactly two parts in a million.⁶ At the same time, it was decided that any data expressed in feet derived from geodetic surveys within the United States would continue to bear the relationship as defined in 1893 (one foot equals 1200/3937 meter) until the basic geodetic survey networks of the United States were readjusted. Based on this decision, the 1893 definition of the foot is called the U.S. survey foot, while the foot definition adopted in 1959 is called the international foot.

The intent of the 1959 action was that continued use of the U.S. survey foot would be temporary and that its use would be discontinued once the United States geodetic networks were readjusted. This was completed in 1986; however, use of the U.S. survey foot continued after 1986, creating a situation where it was used simultaneously with the international foot. This concurrent use of two nearly identical definitions of the foot caused confusion and errors. To remedy this situation, the National Oceanic and Atmospheric Administration (NOAA) and NIST took collaborative action to provide national uniformity in the measurement of length. In 2020, a Federal Register notice was published announcing the final decision to retire the U.S. survey foot with a deprecation date of December 31, 2022.⁷ Beginning on January 1, 2023, the U.S. survey foot should be avoided, except for historic and legacy applications, and will be superseded by the international foot definition (i.e., 1 foot = 0.3048 meter exactly) in all applications. Prior to this date, except for the mile and square mile, the units cable's length, chain, fathom, furlong, league, link, rod, pole, perch, acre, and acre-foot were previously only defined in terms of the U.S. survey foot. With this update, relationships are available in terms of the international foot, which

⁵ The *mise en pratique* for each SI base unit is prepared by the relevant Consultative Committee and published on the BIPM website, where they may be revised more frequently than the BIPM SI Brochure. Available at <https://www.bipm.org/en/publications/mises-en-pratique>.

⁶ Federal Register, July 1, 1959, Vol. 24, No. 128, p. 5348.

⁷ Federal Register, October 5, 2020, 85 FR 62698, p. 62698. Available at <https://www.govinfo.gov/content/pkg/FR2020-10-05/pdf/2020-21902.pdf>.

can simply be referred as the “foot.” Either the term “foot” or “international foot” may be used, as required for clarity in technical applications. This is particularly the case for surveying and mapping applications, although over time “foot” will become more prevalent. The preferred measurement unit of length in the United States is the meter (m) and surveyors, map makers, and engineers are encouraged to adopt the SI for their work.

Since 1970, actions have been taken to encourage the use of metric units of measurement in the United States. A brief summary of actions by Congress is provided below as reported in the Federal Register.⁸

Section 403 of Public Law 93-380, the Education Amendment of 1974, states that it is the policy of the United States to encourage educational agencies and institutions to prepare students to use the metric system of measurement as part of the regular education program.⁹ Under both this act and the Metric Conversion Act of 1975¹⁰, the “metric system of measurement” is defined as the International System of Units as established in 1960 by the General Conference on Weights and Measures and interpreted or modified for the United States by the Secretary of Commerce (Section 4(4)- Public Law 94-168; Section 403(a)(3)- Public Law 93-380). The Secretary has delegated authority under these subsections to the Director of the National Institute of Standards and Technology.

Section 5164 of Public Law 100-418, the Omnibus Trade and Competitiveness Act of 1988, amended Public Law 94-168, The Metric Conversion Act of 1975. In particular, Section 3, The Metric Conversion Act is amended to read as follows:

“Sec. 3. It is therefore the declared policy of the United States—

(1) to designate the metric system of measurement as the preferred system of weights and measures for United States trade and commerce;

(2) to require that each federal agency, by a date certain and to the extent economically feasible by the end of the fiscal year 1992, use the metric system of measurement in its procurements, grants, and other business-related activities, except to the extent that such use is impractical or is likely to cause significant inefficiencies or loss of markets to U.S. firms, such as when foreign competitors are producing competing products in non-metric units;

(3) to seek ways to increase understanding of the metric system of measurement through educational information and guidance and in government publications; and

⁸ Federal Register, July 28, 1998, Vol. 63, No. 144, p. 40334

⁹ Section 403 of Public Law 93 380, the Education Amendment of 1974. Available at <https://www.govinfo.gov/content/pkg/STATUTE-88/pdf/STATUTE-88-Pg484.pdf>

¹⁰ Metric Conversion Act of 1975 (15 U.S.C. 205a et seq.) amended by the Omnibus Trade and Competitiveness Act of 1988. Available at: <https://www.govinfo.gov/content/pkg/USCODE-2020-title15/pdf/USCODE-2020- title15-chap6-subchapII-sec205a.pdf>.

(4) to permit the continued use of traditional systems of weights and measures in nonbusiness activities.”

The Code of Federal Regulations makes the use of metric units mandatory for agencies of the federal government.¹¹

2.3. British and United States Systems of Measurement. – In the past, the customary system of weights and measures in the British Commonwealth countries and that in the United States were very similar; however, the SI is now the official system of units in the United Kingdom, while both the SI and the U.S. customary units are used in the United States. It is incorrect to use the terms “Imperial” or “British” to describe the U.S. customary system because there are significant differences between many of these traditional measurement systems and the customary units in the U.S. NIST recommends use of the term “U.S. customary system of measurement” to describe the collection of non-SI measurement units currently used in the U.S.¹²

Because references to the units of the old British customary system are still found, the following discussion describes the differences between the U.S. and British customary systems of units.

After 1959, the U.S. and the British inches were defined identically for scientific work and were identical in commercial usage¹³. A similar situation existed for the U.S. and the British pounds, and many relationships, such as 12 inches = 1 foot, 3 feet = 1 yard, and 1760 yards = 1 international mile, were the same in both countries; but there were some very important differences.

In the first place, the U.S. customary bushel and the U.S. gallon, and their subdivisions differed from the corresponding British Imperial units. Also the British ton is 2240 pounds, whereas the ton generally used in the United States is the short ton of 2000 pounds. The American colonists adopted the English wine gallon of 231 cubic inches. The English of that period used this wine gallon and they also had another gallon, the ale gallon of 282 cubic inches. In 1824, the British abandoned these two gallons when they adopted the British Imperial gallon, which they defined as the volume of 10 pounds of water, at a temperature of 62 °F, which, by calculation, is equivalent to 277.42 cubic inches. At the same time, they redefined the bushel as 8 gallons.

In the customary British system, the units of dry measure are the same as those of liquid measure. In the United States these two are not the same; the gallon and its subdivisions are used in the measurement of liquids and the bushel, with its subdivisions, is used in the measurement of certain dry commodities. The U.S. gallon is divided into four liquid quarts and the U.S. bushel into 32 dry quarts. All the units of capacity or volume mentioned thus far are larger in the customary British system than in the U.S. system. But the British fluid ounce is smaller

¹¹ *Federal Register*, January 2, 1991, Vol. 56, No. 1, p. 160.

¹² *Federal Register*, October 5, 2020, 85 FR 62698, p. 62698.

¹³ *Federal Register*, July 1, 1959, Vol. 24, No. 128, p. 5348.

than the U.S. fluid ounce, because the British quart is divided into 40 fluid ounces whereas the U.S. quart is divided into 32 fluid ounces.

From this we see that in the customary British system an avoirdupois ounce of water at 62 °F has a volume of one fluid ounce, because 10 pounds is equivalent to 160 avoirdupois ounces, and 1 gallon is equivalent to 4 quarts, or 160 fluid ounces. This convenient relation does not exist in the U.S. system because a U.S. gallon of water at 62 °F weighs about $8\frac{1}{3}$ pounds, or $133\frac{1}{3}$ avoirdupois ounces, and the U.S. gallon is equivalent to 4×32 , or 128 fluid ounces.

1 U.S. fluid ounce	= 1.041 British fluid ounces
1 British fluid ounce	= 0.961 U.S. fluid ounce
1 U.S. gallon	= 0.833 British Imperial gallon
1 British Imperial gallon	= 1.201 U.S. gallons

But the British fluid ounce is smaller than the U.S. fluid ounce, because the British quart is divided into 40 fluid ounces whereas the U.S. quart is divided into 32 fluid ounces.

Among other differences between the customary British and the United States measurement systems, we should note that they abolished the use of the troy pound in England January 6, 1879; they retained only the troy ounce and its subdivisions, whereas the troy pound is still legal in the United States, although it is not now greatly used. We can mention again the common use, for body weight, in England of the stone of 14 pounds, this being a unit now unused in the United States, although its influence was shown in the practice until World War II of selling flour by the barrel of 196 pounds (14 stone). In the apothecary system of liquid measure the British add a unit, the fluid scruple, equal to one third of a fluid drachm (spelled dram in the United States) between their minim and their fluid drachm. In the United States, the general practice now is to sell dry commodities, such as fruits and vegetables, by their mass.

2.4. Subdivision of Units. – In general, units are subdivided by one of three methods: (a) decimal, into tenths; (b) duodecimal, into twelfths; or (c) binary, into halves (twos). Usually the subdivision is continued by using the same method. Each method has its advantages for certain purposes, and it cannot properly be said that any one method is “best” unless the use to which the unit and its subdivisions are to be put is known.

For example, if we are concerned only with measurements of length to moderate precision, it is convenient to measure and to express these lengths in feet, inches, and binary fractions of an inch, thus 9 feet, $4\frac{3}{8}$ inches. However, if these lengths are to be subsequently used to calculate area or volume, that method of subdivision at once becomes extremely inconvenient. For that reason, civil engineers, who are concerned with areas of land, volumes of cuts, fills, excavations, etc., instead of dividing the foot into inches and binary subdivisions of the inch, divide it decimally; that is, into tenths, hundredths, and thousandths of a foot.

The method of subdivision of a unit is thus largely made based on convenience to the user. The fact that units have commonly been subdivided into certain subunits for centuries does not preclude their also having another mode of subdivision in some frequently used cases where

convenience indicates the value of such other method. Thus, while we usually subdivide the gallon into quarts and pints, most gasoline-measuring pumps, of the price-computing type, are graduated to show tenths, hundredths, or thousandths of a gallon.

Although the mile has for centuries been divided into rods, yards, feet, and inches, the odometer part of an automobile speedometer shows tenths of a mile. Although we divide our dollar into 100 parts, we habitually use and speak of halves and quarters. An illustration of rather complex subdividing is found on the scales used by draftsmen. These scales are of two types: (a) architects, which are commonly graduated with scales in which $\frac{3}{32}$, $\frac{3}{16}$, $\frac{1}{8}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{3}{4}$, 1, $1\frac{1}{2}$, and 3 inches, respectively, represent 1 foot full scale, and also having a scale graduated in the usual manner to $\frac{1}{16}$ inch; and (b) engineers, which are commonly subdivided to 10, 20, 30, 40, 50, and 60 parts to the inch.

The dictum of convenience applies not only to subdivisions of a unit but also to multiples of a unit. Land elevations above sea level are given in feet although the height may be several miles; the height of aircraft above sea level as given by an altimeter is likewise given in feet, no matter how high it may be.

On the other hand, machinists, toolmakers, gauge makers, scientists, and others who are engaged in precision measurements of relatively small distances, even though concerned with measurements of length only, find it convenient to use the inch, instead of the tenth of a foot, but to divide the inch decimally to tenths, hundredths, thousandths, etc., even down to millionths of an inch. Verniers, micrometers, and other precision measuring instruments are usually graduated in this manner. Machinist scales are commonly graduated decimally along one edge and are also graduated along another edge to binary fractions as small as $\frac{1}{64}$ inch. The scales with binary fractions are used only for relatively rough measurements.

It is seldom convenient or advisable to use binary subdivisions of the inch that are smaller than $\frac{1}{64}$. In fact, $\frac{1}{32}$ -, $\frac{1}{16}$ -, or $\frac{1}{8}$ -inch subdivisions are usually preferable for use on a scale to be read with the unaided eye.

2.5. Arithmetical Systems of Numbers. – The subdivision of units of measurement is closely associated with arithmetical systems of numbers. The systems of units used in this country for commercial and scientific work, having many origins as has already been shown, naturally show traces of the various number systems associated with their origins and developments. Thus, (a) the binary subdivision has come down to us from the Hindus, (b) the duodecimal system of fractions from the Romans, (c) the decimal system from the Chinese and Egyptians, some developments having been made by the Hindus, and (d) the sexagesimal system (division by 60) now illustrated in the subdivision of units of angle and of time, from the ancient Babylonians. The use of decimal numbers in measurements is becoming the standard practice.

3. Standards of Length, Mass, and Capacity or Volume

3.1. Standards of Length. – The meter, which is defined in terms of the speed of light in a vacuum, is the unit on which all length measurements are based.

The yard is defined¹⁴ as follows:

1 yard = 0.914 4 meter, and

1 inch = 25.4 millimeters exactly.

3.1.1. Calibration of Length Standards. – NIST calibrates standards of length including gage blocks, line standards, metal tapes, step gages, and a variety of other special length standards. In general, NIST accepts for calibration only apparatus of such material, design, and construction as to ensure accuracy and permanence sufficient to justify calibration by the Institute. NIST performs dimensional calibrations that are described in the online catalog and Special Publication 250 Measurement Services series.¹⁵

When carpenter rules, machinist scales, draftsman scales, and the like require calibration, they should be submitted to state or local weights and measures calibration laboratory officials.¹⁶

3.2. Standards of Mass. – Mass measurements in the US are traceable to Planck’s constant through the US national prototype kilograms.

In Colonial Times the British standards were considered the primary standards of the United States. Later, the U.S. avoirdupois pound was defined in terms of the Troy Pound of the Mint, which is a brass standard kept at the United States Mint in Philadelphia. In 1911, the Troy Pound of the Mint was superseded, for coinage purposes, by the Troy Pound of the Institute.

The avoirdupois pound is defined in terms of the kilogram by the relation:

1 avoirdupois pound = 0.453 592 37 kilogram.¹⁷

These changes in definition have not made any appreciable change in the value of the pound.

The grain is $\frac{1}{7000}$ of the avoirdupois pound and is identical in the avoirdupois, troy, and apothecary systems. The troy ounce and the apothecary ounce differ from the avoirdupois ounce but are equal to each other, and equal to 480 grains. The avoirdupois ounce is equal to 437.5 grains.

3.2.1. Mass and Weight. – The mass of a body is a measure of its inertial property or how much matter it contains. The weight of a body is a measure of the force exerted on it

¹⁴ Federal Register, July 1, 1959, Vol. 24, No. 128, p. 5348.

¹⁵ NIST Special Publication (SP) 250 Series on Measurement Services. Available at <https://shop.nist.gov/> and <https://www.nist.gov/calibrations/sp-250-publications>.

¹⁶ The current recognition status (NIST Handbook 143) and accreditation status (National Voluntary Laboratory Accreditation Program, NVLAP) of state and local calibration laboratories are available at <https://www.nist.gov/pml/owm/resources/state-laboratories> and measurement service scopes summarized at <https://www.nist.gov/pml/owm/state-calibration-scope>.

¹⁷ Federal Register, July 1, 1959, Vol. 24, No. 128, p. 5348.

by gravity or the force needed to support it. Gravity on earth gives a body a downward acceleration of about 9.8 m/s^2 . (In common parlance, weight is often used as a synonym for mass in weights and measures.) The incorrect use of weight in place of mass should be phased out, and the term mass used when mass is meant.

Standards of mass are ordinarily calibrated by comparison to a reference standard of mass. If two objects are compared on a balance and give the same balance indication, they have the same “mass” (excluding the effect of air buoyancy). The forces of gravity on the two objects are balanced. Even though the value of the acceleration of gravity, g , is different from location to location, because the two objects of equal mass in the same location (where both masses are acted upon by the same g) will be affected in the same manner and by the same amount by any change in the value of g , the two objects will balance each other under any value of g .

However, on a spring balance the mass of a body is not balanced against the mass of another body. Instead, the gravitational force on the body is balanced by the restoring force of a spring. Therefore, if a very sensitive spring balance is used, the indicated mass of the body would be found to change if the spring balance and the body were moved from one locality to another locality with a different acceleration of gravity. But a spring balance is usually used in one locality and is adjusted or calibrated to indicate mass at that locality.

3.2.2. Effect of Air Buoyancy. – Another point that must be taken into account in the calibration and use of standards of mass is the buoyancy or lifting effect of the air. A body immersed in any fluid is buoyed up by a force equal to the force of gravity on the displaced fluid. Two bodies of equal mass, if placed one on each pan of an equal-arm balance, will balance each other in a vacuum. A comparison in a vacuum against a known mass standard gives “true mass.” If compared in air, however, they will not balance each other unless they are of equal volume. If of unequal volume, the larger body will displace the greater volume of air and will be buoyed up by a greater force than will the smaller body, and the larger body will appear to be of less mass than the smaller body.

The greater the difference in volume, and the greater the density of the air in which we make the comparison weighing, the greater will be the apparent difference in mass. For that reason, in assigning a precise numerical value of mass to a standard, it is necessary to base this value on definite values for the air density and the density of the mass standard of reference.

The apparent mass of an object is equal to the mass of just enough reference material of a specified density (at $20 \text{ }^\circ\text{C}$) that will produce a balance reading equal to that produced by the object if the measurements are done in air with a density of 1.2 mg/cm^3 at $20 \text{ }^\circ\text{C}$. The original basis for reporting apparent mass is apparent mass versus brass. The apparent mass versus a density of 8.0 g/cm^3 is the more recent definition, and is used extensively throughout the world. The use of apparent mass versus 8.0 g/cm^3 is encouraged over apparent mass versus brass. The difference in these apparent mass

systems is insignificant in most commercial weighing applications. A full discussion of this topic is given in NIST Monograph 133.¹⁸

3.2.3. Calibrations of Standards of Mass. – Many mass laboratory and field standards typically used in ordinary trade should be calibrated by state or local weights and measures officials.¹⁹ NIST typically calibrates primary mass standards, but it does not manufacture or sell them. NIST mass calibration services are described in the online catalog and NIST Special Publication 250 series.²⁰

3.3. Standards of Capacity. – Units of capacity or volume, being derived units, are in this country defined in terms of linear units. Laboratory standards have been constructed and are maintained at NIST. These have validity only by calibration with reference either directly or indirectly to the linear standards. Similarly, NIST has made and distributed standards of capacity to the several states. Other standards of capacity have been verified by calibration for a variety of uses in science, technology, and commerce.

3.3.1. Calibrations of Standards of Capacity. – NIST makes calibrations on capacity or volume standards that are in the customary units of trade; that is, the gallon, its multiples, and submultiples, or in metric units. Further, NIST calibrates precision-grade volumetric glassware which is normally in metric units. NIST makes calibrations in accordance with fee schedules, copies of which may be obtained from NIST.

3.4. Maintenance and Preservation of Fundamental Standard of Mass. – It is a statutory responsibility of NIST to maintain and preserve the national standard of mass at NIST and to realize all the other base units. The U.S. Prototype Kilogram maintained at NIST is fully protected by an alarm system. All measurements made with this standard are conducted in special air-conditioned laboratories to which the standard is taken a sufficiently long time before the observations to ensure that the standard will be in a state of equilibrium under standard conditions when the measurements or comparisons are made. Hence, it is not necessary to maintain the standard at standard conditions, but care is taken to prevent large changes of temperature. More important is the care to prevent any damage to the standard because of careless handling.

¹⁸ Pontius, Paul E. (1974) Mass and Mass Values (National Institute of Standards and Technology, Gaithersburg, MD), NIST Monograph 133. Available at <https://nvlpubs.nist.gov/nistpubs/Legacy/MONO/nbsmonograph133.pdf>.

¹⁹ The current recognition status (NIST Handbook 143) and accreditation status (National Voluntary Laboratory Accreditation Program, NVLAP) of state and local calibration laboratories are available at <https://www.nist.gov/pml/owm/resources/state-laboratories> and measurement service scopes summarized at <https://www.nist.gov/pml/owm/state-calibration-scope>.

²⁰ NIST Special Publication (SP) 250 Series on Measurement Services. Available at <https://shop.nist.gov/> and <https://www.nist.gov/calibrations/sp-250-publications>.

4. Specialized Use of the Terms “Ton” and “Tonnage”

As weighing and measuring are important factors in our everyday lives, it is quite natural that questions arise about the use of various units and terms and about the magnitude of quantities involved. For example, the words “ton” and “tonnage” are used in widely different senses, and a great deal of confusion has arisen regarding the application of these terms.

The ton is used as a unit of measure in two distinct senses: (1) as a unit of mass, and (2) as a unit of capacity or volume.

In the first sense, the term has the following meanings:

- (a) The short, or net ton of 2000 pounds.
- (b) The long, gross, or shipper’s ton of 2240 pounds.
- (c) The metric ton of 1000 kilograms, or 2204.6 pounds.

In the second sense (capacity), it is usually restricted to uses relating to ships and has the following meaning:

- (a) The register ton of 100 cubic feet.
- (b) The measurement ton of 40 cubic feet.
- (c) The English water ton of 224 British Imperial gallons.

In the United States and Canada the ton (mass) most commonly used is the short ton. In Great Britain, it is the long ton, and in countries using the metric system, it is the metric ton. The register ton and the measurement ton are capacity or volume units used in expressing the tonnage of ships. The English water ton is used, chiefly in Great Britain, in statistics dealing with petroleum products.

There have been many other uses of the term ton such as the timber ton of 40 cubic feet and the wheat ton of 20 bushels, but their uses have been local and the meanings have not been consistent from one place to another.

Properly, the word “tonnage” is used as a noun only in respect to the capacity or volume and dimensions of ships, and to the amount of the ship’s cargo. There are two distinct kinds of tonnage; namely, vessel tonnage and cargo tonnage and each of these is used in various meanings. The several kinds of vessel tonnage are as follows:

Gross tonnage, or gross register tonnage, is the total cubical capacity or volume of a ship expressed in register tons of 100 cubic feet, or 2.83 cubic meters, less such space as hatchways, bakeries, galleys, etc., as are exempted from measurement by different governments. There is some lack of uniformity in the gross tonnages as given by different nations due to lack of agreement on the spaces that are to be exempted. Official merchant

marine statistics of most countries are published in terms of the gross register tonnage. Press references to ship tonnage are usually to the gross tonnage.

The net tonnage, or net register tonnage, is the gross tonnage less the different spaces specified by maritime nations in their measurement rules and laws. The spaces deducted are those totally unavailable for carrying cargo, such as the engine room, coal bunkers, crew quarters, chart and instrument room, etc. The net tonnage is used in computing how much cargo that can be loaded on a ship. It is used as the basis for wharfage and other similar charges.

The register under-deck tonnage is the cubical capacity of a ship under her tonnage deck expressed in register tons. In a vessel having more than one deck, the tonnage deck is the second from the keel.

There are several variations of displacement tonnage.

The dead weight tonnage is the difference between the “loaded” and “light” displacement tonnages of a vessel. It is expressed in terms of the long ton of 2240 pounds, or the metric ton of 2204.6 pounds, and is the weight of fuel, passengers, and cargo that a vessel can carry when loaded to its maximum draft.

The second variety of tonnage, cargo tonnage, refers to the weight of the particular items making up the cargo. In overseas traffic it is usually expressed in long tons of 2240 pounds or metric tons of 2204.6 pounds. The short ton is only occasionally used. Therefore, the cargo tonnage is very distinct from vessel tonnage.

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Table of Contents

Appendix C. General Tables of Units of Measurement	1
1. Tables of Metric Units of Measurement	1
Units of Length	1
Units of Area.....	2
Units of Liquid Volume.....	2
Units of Volume	2
Units of Mass.....	2
2. Tables of U.S. Customary Units of Measurement	3
Units of Length	3
Gunter’s or Surveyors Chain Units of Measurement	3
Units of Area.....	4
Units of Volume	4
Units of Liquid Volume.....	4
Apothecaries Units of Liquid Volume.....	4
Units of Dry Volume.....	4
Avoirdupois Units of Mass	5
Troy Units of Mass.....	5
[The “grain” is the same in avoirdupois, troy, and apothecaries units of mass.]	5
Apothecaries Units of Mass.....	5
3. Notes on British Units of Measurement	6
4. Tables of Units of Measurement	7
Units of Length	8
Units of Length – International Foot and Survey Equivalent Measurement	9
Units of Length - Survey Measure	10
Units of Length - Survey Measure	10
Units of Area.....	11
Units of Area - Survey Measure	12
Units of Volume	13
Units of Capacity or Volume - Dry Volume Measure	14
Units of Capacity or Volume - Liquid Volume Measure	16
(All underlined figures are exact)	16
Multiply by the Conversion Factor Below the Ending Unit	16
Units of Volume – International Foot and Survey Equivalent Measurements	18
(All underlined figures are exact)	18
Multiply by the Conversion Factor Below the Ending Unit	18
Units of Mass Not Less Than Avoirdupois Ounces.....	19
(all underlined figures are exact)	19

Multiply by the Conversion Factor Below the Ending Unit	19
Units of Mass Not Greater Than Pounds and Kilograms	20
Units of Pressure	23
Conversion Equations for Units of Temperature (exact)	23
5. Tables of Equivalents	24
Units of Length	24
Units of Area	26
Units of Capacity or Volume	27
Units of Mass	29

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Appendix C. General Tables of Units of Measurement

These tables have been prepared for the benefit of those requiring tables of units for occasional ready reference. In Section 4 of this Appendix, the tables are carried out to a large number of decimal places and exact values are indicated by underlining. In most of the other tables, only a limited number of decimal places are given, therefore, making the tables better adapted to the average user.

1. Tables of Metric Units of Measurement

In the metric system of measurement, designations of multiples and subdivisions of any unit may be arrived at by combining with the name of the unit the prefixes deka, hecto, and kilo meaning, respectively, 10, 100, and 1000, and deci, centi, and milli, meaning, respectively, one-tenth, one-hundredth, and one-thousandth. In some of the following metric tables, some such multiples and subdivisions have not been included for the reason that these have little, if any currency in actual usage.

In certain cases, particularly in scientific usage, it becomes convenient to provide for multiples larger than 1000 and for subdivisions smaller than one-thousandth. Accordingly, the following prefixes have been introduced and these are now generally recognized:

yotta, (Y), meaning 10^{24}	deci, (d), meaning 10^{-1}
zetta, (Z), meaning 10^{21}	centi, (c), meaning 10^{-2}
exa, (E), meaning 10^{18}	milli, (m), meaning 10^{-3}
peta, (P), meaning 10^{15}	micro, (μ), meaning 10^{-6}
tera, (T), meaning 10^{12}	nano, (n), meaning 10^{-9}
giga, (G), meaning 10^9	pico, (p), meaning 10^{-12}
mega, (M), meaning 10^6	femto, (f), meaning 10^{-15}
kilo, (k), meaning 10^3	atto, (a), meaning 10^{-18}
hecto, (h), meaning 10^2	zepto, (z), meaning 10^{-21}
deka, (da), meaning 10^1	yocto, (y), meaning 10^{-24}

Thus, a kilometer is 1000 meters and a millimeter is 0.001 meter.

Units of Length

10 millimeters (mm)	= 1 centimeter (cm)
10 centimeters	= 1 decimeter (dm) = 100 millimeters
10 decimeters	= 1 meter (m) = 1000 millimeters
10 meters	= 1 dekameter (dam)
10 dekameters	= 1 hectometer (hm) = 100 meters
10 hectometers	= 1 kilometer (km) = 1000 meters

Units of Area

100 square millimeters (mm ²)	= 1 square centimeter (cm ²)
100 square centimeters	= 1 square decimeter (dm ²)
100 square decimeters	= 1 square meter (m ²)
100 square meters	= 1 square dekameter (dam ²) = 1 are
100 square dekameters	= 1 square hectometer (hm ²) = 1 hectare (ha)
100 square hectometers	= 1 square kilometer (km ²)

Units of Liquid Volume

10 milliliters (mL)	= 1 centiliter (cL)
10 centiliters	= 1 deciliter (dL) = 100 milliliters
10 deciliters	= 1 liter ¹ = 1000 milliliters
10 liters	= 1 dekaliter (daL)
10 dekaliters	= 1 hectoliter (hL) = 100 liters
10 hectoliters	= 1 kiloliter (kL) = 1000 liters

Units of Volume

1000 cubic millimeters (mm ³)	= 1 cubic centimeter (cm ³)
1000 cubic centimeters	= 1 cubic decimeter (dm ³) or 1 000 000 cubic millimeters
1000 cubic decimeters	= 1 cubic meter (m ³), 1 000 000 cubic centimeters, or 1 000 000 000 cubic millimeters

Units of Mass

10 milligrams (mg)	= 1 centigram (cg)
10 centigrams	= 1 decigram (dg) = 100 milligrams
10 decigrams	= 1 gram (g) = 1000 milligrams
10 grams	= 1 dekagram (dag)
10 dekagrams	= 1 hectogram (hg) = 100 grams
10 hectograms	= 1 kilogram (kg) = 1000 grams
1000 kilograms	= 1 megagram (Mg) or 1 metric ton (t)

¹ By action of the 12th General Conference on Weights and Measures (1964), the liter is a special name for the cubic decimeter (dm³).

2. Tables of U.S. Customary Units of Measurement^{2, 3}

In these tables where foot or mile is underlined, it is survey foot or U.S. statute mile rather than international foot or mile that is meant.

Units of Length

12 inches (in)	= 1 foot (ft)
3 feet	= 1 yard (yd)
16½ <u>feet</u>	= 1 rod (rd), pole, or perch
40 rods	= 1 furlong (fur) = 660 feet
8 furlongs	= 1 mile (mi) ⁴ = 5280 feet
1852 meters(m)	= 6076.115 49 feet (approximately) or 1 international nautical mile

Gunter's or Surveyors Chain Units of Measurement

1 link (li)	= 0.66 foot (ft) = 0.04 rod (rd) = 0.01 chain (ch)
1 fathom	= 6 feet
1 rod, perch, or pole	= 25 links = 16.5 feet = 0.25 chain
1 chain	= 66 feet = 4 rods = 100 links
1 furlong (fur)	= 660 feet = 10 chains = 40 rods
1 cable's length	= 720 feet = 120 fathoms
1 mile (mi)	= 5280 feet = 8 furlongs = 80 chains = 320 rods
1 league	= 15 840 feet = 3 miles

² This section lists units of measurement traditionally used in the United States. In keeping with the Metric Conversion Act of 1975 (15 U.S.C. 205a et seq.) as amended by Omnibus Trade and Competitiveness Act of 1988, the ultimate objective is to make the International System of Units (SI) the primary measurement system used in the United States.

³ *Federal Register*, July 1, 1959, Vol. 24, No. 128, p. 5348. NOTICE: In collaboration, National Oceanic and Atmospheric Administration (NOAA) and NIST have taken action to provide national uniformity in the measurement of length. The final decision to retire the U.S. survey foot was published in the *Federal Register*, announcing the deprecation date of December 31, 2022. Beginning on January 1, 2023, the U.S. survey foot should be avoided, except for historic and legacy applications and will be superseded by the international foot definition (i.e., 1 foot = 0.3048 meter exactly) in all applications. Prior to this date, except for the mile and square mile, the cable's length, chain, fathom, furlong, league, link, rod, pole, perch, acre, and acre-foot were previously only defined in terms of the U.S. survey foot. With this update, relationships are available in terms of the international foot, which can simply be referred to as the "foot." Either the term "foot" or "international foot" may be used, as required for clarity in technical applications. This is particularly the case for surveying and mapping applications, although over time "foot" will become more prevalent. The preferred measurement unit of length in the United States is the meter (m) and surveyors, map makers, and engineers are encouraged to adopt the SI for their work. For more information see *Federal Register* (October 5, 2020, 85 FR 62698, p. 62698) available at <https://www.govinfo.gov/content/pkg/FR-2020-10-05/pdf/2020-21902.pdf>.

⁴ Originally referred to as the "statute mile," when Queen Elizabeth I changed the definition of the mile from the Roman mile of 5000 feet to the statute mile of 5280 feet. Although the U.S. statute mile was originally based on the U.S. survey foot (1200/3937 meter), its definition is now based the international foot (0.3048 meter), per *Federal Register* (October 5, 2020, 85 FR 62698, p. 62698), which states that definitions based on the U.S. survey foot should be avoided after December 31, 2022, except for historic and legacy applications. The mile based on the international foot is about 3 millimeters shorter than the mile based on the U.S. survey foot, although both are defined as being equal to 5280 feet.

Units of Area⁵

144 square inches (in ²)	= 1 square foot (ft ²)
9 square feet	= 1 square yard (yd ²), or 1296 square inches
272¼ square <u>feet</u>	= 1 square rod (rd ²)
160 square rods	= 1 acre = 43 560 square <u>feet</u>
640 acres	= 1 square <u>mile</u> (mi ²)
1 <u>mile</u> square	= 1 section of land
6 <u>miles</u> square	= 1 township, 36 sections, or 36 square <u>miles</u>

Units of Volume

1728 cubic inches (in ³)	= 1 cubic foot (ft ³)
27 cubic feet	= 1 cubic yard (yd ³)

Units of Liquid Volume⁶

4 gills (gi)	= 1 pint (pt) = 28.875 cubic inches (in ³)
2 pints	= 1 quart (qt) = 57.75 cubic inches
4 quarts	= 1 gallon (gal), 231 cubic inches, 8 pints or 32 gills

Apothecaries Units of Liquid Volume

60 minims	= 1 fluid dram (fl dr or <i>f</i> ʒ) or 0.225 6 cubic inch (in ³)
8 fluid drams	= 1 fluid ounce (fl oz or <i>f</i> ʒ) or 1.804 7 cubic inches
16 fluid ounces	= 1 pint (pt), 28.875 cubic inches or 128 fluid drams
2 pints	= 1 quart (qt) = 57.75 cubic inches, 32 fluid ounces or 256 fluid drams
4 quarts	= 1 gallon (gal) = 231 cubic inches, 128 fluid ounces or 1024 fluid drams

Units of Dry Volume⁷

2 pints (pt)	= 1 quart (qt) = 67.200 6 cubic inches (in ³)
8 quarts	= 1 peck (pk) = 537.605 cubic inches or 16 pints
4 pecks	= 1 bushel (bu), 2150.42 cubic inches or 32 quarts

⁵ Squares and cubes of U.S. customary but not of SI units are sometimes expressed by the use of abbreviations rather than symbols. For example, sq ft is an abbreviation that represents square foot, and cu ft is an abbreviation that represents cubic foot.

⁶ When necessary to distinguish the “liquid pint” or “liquid quart” from the “dry pint” or “dry quart,” the word “liquid” or the abbreviation “liq” should be used in combination with the name or abbreviation of the liquid unit.

⁷ When necessary to distinguish dry pint or quart from the liquid pint or quart, the word “dry” should be used in combination with the name or abbreviation of the dry unit.

Avoirdupois Units of Mass⁸

[The “grain” is the same in avoirdupois, troy, and apothecaries units of mass.]

1 μ lb	= 0.000 001 pound (lb)
27 ^{11/32} grains (gr)	= 1 dram (dr)
16 drams	= 1 ounce (oz) or 437½ grains
16 ounces	= 1 pound (lb), 256 drams or 7000 grains
100 pounds	= 1 hundredweight (cwt) ⁹
20 hundredweights	= 1 ton (tn) ¹⁰ or 2000 pounds ⁹

In “gross” or “long” measure, the following values are recognized:

112 pounds (lb)	= 1 gross (or long) hundredweight (cwt) ⁹
20 gross (or long) hundredweights	= 1 gross (or long) ton or 2240 pounds ⁹

Troy Units of Mass

[The “grain” is the same in avoirdupois, troy, and apothecaries units of mass.]

24 grains (gr)	= 1 pennyweight (dwt)
20 pennyweights	= 1 ounce troy (oz t) or 480 grains
12 ounces troy	= 1 pound troy (lb t), 240 pennyweights or 5760 grains

Apothecaries Units of Mass

[The “grain” is the same in avoirdupois, troy, and apothecaries units of mass.]

20 grains (gr)	= 1 scruple (s ap or \eth)
3 scruples	= 1 dram apothecaries (dr ap or $\mathfrak{3}$) or 60 grains
8 drams apothecaries	= 1 ounce apothecaries (oz ap or $\mathfrak{8}$), 24 scruples or 480 grains
12 ounces apothecaries	= 1 pound apothecaries (lb ap), 96 drams apothecaries, 288 scruples or 5760 grains

⁸ Use the measurement system name or the abbreviation when necessary to distinguish the avoirdupois dram from the apothecaries dram, or to distinguish the avoirdupois dram or ounce from the fluid dram or ounce, or to distinguish the avoirdupois ounce or pound from the troy or apothecaries ounce or pound. When necessary, the word “avoirdupois” or the abbreviation “avdp” should be used in combination with, following the name or abbreviation of the avoirdupois unit. However, if the term “avoirdupois” or “avdp” does not specifically appear in association with a measurement expressed in drams, ounces, or pounds, the value it is understood to represent the avoirdupois unit. The word “troy” or the abbreviation “t” should be used in combination with, following the name or abbreviation of the troy unit. The word “apothecaries” or the abbreviation “ap” should be used in combination with, following the name or abbreviation of the apothecaries unit. For example, “1 pound apothecaries (lb ap),” not “1 apothecaries pound (ap lb).”

⁹ When the terms “hundredweight” and “ton” are used unmodified, they are commonly understood to mean the 100-pound hundredweight and the 2000-pound ton, respectively; these units may be designated “net” or “short” when necessary to distinguish them from the corresponding units in gross or long measure.

¹⁰ As of January 1, 2014, “tn” is the required abbreviation for “short ton.” Devices manufactured between January 1, 2008, and December 31, 2013, may use an abbreviation other than “tn” to specify “short ton.”

(Added 2013)

3. Notes on British Units of Measurement

In Great Britain, the yard, the avoirdupois pound, the troy pound, and the apothecaries pound are identical with the units of the same names used in the United States. The tables of British linear measure, troy mass, and apothecaries mass are the same as the corresponding United States tables, except for the British spelling “drachm” in the table of apothecaries mass. The table of British avoirdupois mass is the same as the United States table up to 1 pound; above that point the table reads:

14 pounds	= 1 stone
2 stones	= 1 quarter = 28 pounds
4 quarters	= 1 hundredweight = 112 pounds
20 hundredweight	= 1 ton = 2240 pounds

The present British gallon and bushel – known as the “Imperial gallon” and “Imperial bushel” – are, respectively, about 20 % and 3 % larger than the United States gallon and bushel. The Imperial gallon is defined as the volume of 10 avoirdupois pounds of water under specified conditions, and the Imperial bushel is defined as 8 Imperial gallons. Also, the subdivision of the Imperial gallon as presented in the table of British apothecaries fluid measure differs in two important respects from the corresponding United States subdivision, in that the Imperial gallon is divided into 160 fluid ounces (whereas the United States gallon is divided into 128 fluid ounces), and a “fluid scruple” is included. The full table of British measures of capacity (which are used alike for liquid and for dry commodities) is as follows:

4 gills	= 1 pint
2 pints	= 1 quart
4 quarts	= 1 gallon
2 gallons	= 1 peck
8 gallons (4 pecks)	= 1 bushel
8 bushels	= 1 quarter

The full table of British apothecaries measure is as follows:

20 minims	= 1 fluid scruple
3 fluid scruples	= 1 fluid drachm or 60 minims
8 fluid drachms	= 1 fluid ounce
20 fluid ounces	= 1 pint
8 pints	= 1 gallon (160 fluid ounces)

4. Tables of Units of Measurement

Unit conversion is a multi-step process that involves multiplication or division by a numerical factor; selection of the correct number of significant digits; and rounding. Accurate unit conversions are obtained by selecting an appropriate conversion factor (a ratio which converts one unit of measure into another without changing the quantity), which are supplied in these tables.

Some unit conversions may be exact, without increasing or decreasing the precision of the original quantity. Exact unit conversion factors are underlined in these tables. It is good practice to keep all the digits, especially if other mathematical operations or conversions will follow. Rounding should be the last step of the conversion process and should be performed only once.

To convert a value from one unit of measurement to different unit of measurement follow the steps below.

- Find the table corresponding to the general category of measurement; for example, the table titled “Units of Volume” includes conversion factors for volume measurements.
- Locate the “starting unit” of measurement in the far, left column.
- Proceed horizontally to the right on the same row until you reach the column with the heading of the “ending unit” of measurement.
- The unit conversion factor is located at the intersection of the row and column.
- Multiply the quantity value of the starting unit of measurement by the conversion factor.
- The result is the equivalent quantity value in the ending unit of measurement.

Units of Length¹¹

(all underlined figures are exact)

NOTE: Multiply by the Conversion Factor Below the Ending Unit

Starting Unit ↓	Ending Unit →	Inches	Feet	Yards	Miles	Centimeters	Meters
1 inch =	Conversion Factor	<u>1</u>	0.083 333 33	0.027 777 78	0.000 015 782 83	<u>2.54</u>	<u>0.025 4</u>
1 foot =		<u>12</u>	<u>1</u>	0.333 333 3	0.000 189 393 9	<u>30.48</u>	<u>0.304 8</u>
1 yard =		<u>36</u>	<u>3</u>	<u>1</u>	0.000 568 181 8	<u>91.44</u>	<u>0.914 4</u>
1 mile =		<u>63 360</u>	<u>5 280</u>	<u>1 760</u>	<u>1</u>	<u>160 934.4</u>	<u>1609.344</u>
1 centimeter =		0.393 700 8	0.032 808 40	0.010 936 13	0.000 006 213 712	<u>1</u>	<u>0.01</u>
1 meter =		39.370 08	3.280 840	1.093 613	0.000 621 371 2	<u>100</u>	<u>1</u>

NOTE: Per *Federal Register*, July 1, 1959, Vol. 24, No. 128, p. 5348, the following are exact mathematical relationships:

- 1 U.S. survey foot = 1200/3937 meter (exactly)
- 1 international foot = 12 × 0.0254 meter = 0.304 8 (exactly)
- 1 international foot = 0.999 998 survey foot (exactly)
- 1 international foot = 0.0254 × 39.37 U.S. survey foot (exactly)
- 1 international mile = 0.999 998 survey mile (exactly)

¹¹ See Footnote 3

Units of Length – International Foot and Survey Equivalent Measurement¹²

(all underlined figures are exact)

NOTE: Multiply by the Conversion Factor Below the Ending Unit

Starting Unit ↓	Ending Unit →	International Foot Metric Equivalent - Meters	U.S. Survey Foot Metric Equivalent - Meters
1 foot =	Conversion Factor	<u>0.304 8</u>	0.304 800 609 601
1 cable's length =		<u>219.456</u>	219.456 438 913
1 chain (ch) =		<u>20.116 8</u>	20.116 840 234
1 fathom =		<u>1.828 8</u>	1.828 803 658
1 furlong (fur) =		<u>201.168</u>	201.168 402 337
1 league =		<u>4 828.032</u>	4 828.041 656 083
1 link (li) =		<u>0.201 168</u>	0.201 168 402
1 mile =		<u>1609.344</u>	1609.347 218 694
1 rod (rd), perch, or pole =		<u>5.029 2</u>	5.029 210 058

¹² *Federal Register* (October 5, 2020, 85 FR 62698, p. 62698). Units in this table were historically defined using the U.S. survey foot. They may now be defined using either the international definition of the foot or U.S. survey foot. Use of definitions based on the U.S. survey foot should be avoided after December 31, 2022, except for historic and legacy applications.

Units of Length - Survey Measure

(all underlined figures are exact¹³)

NOTE: Multiply by the Conversion Factor Below the Ending Unit

Starting Unit ↓	Ending Unit →	Links	Feet	Rods	Chains	Miles	Meters
1 link (li) =	Conversion Factor	<u>1</u>	<u>0.66</u>	<u>0.04</u>	<u>0.01</u>	<u>0.000 125</u>	<u>0.201 168</u>
1 foot (ft) =		1.515 151 5	<u>1</u>	0.060 606 06	0.015 151 5	0.000 189 393 9	<u>0.304 8</u>
1 rod (rd), pole, or perch =		<u>25</u>	<u>16.5</u>	<u>1</u>	<u>0.25</u>	<u>0.003 125</u>	<u>5.029 2</u>
1 chain (ch) =		<u>100</u>	<u>66</u>	<u>4</u>	<u>1</u>	<u>0.0125</u>	<u>20.116 8</u>
1 mile (mi) =		<u>8 000</u>	<u>5 280</u>	<u>320</u>	<u>80</u>	<u>1</u>	<u>1609.344</u>
1 meter (m) =		4.970 970	3.280 840	0.198 838 8	0.049 709 70	0.000 621 371 2	<u>1</u>

Units of Length - Survey Measure

(all underlined figures are exact)

NOTE: Multiply by the Conversion Factor Below the Ending Unit

Starting Unit ↓	Ending Unit →	Inches	Millimeters	Micrometers
1 mil =		<u>0.001</u>	<u>0.025 4</u>	<u>25.4</u>

NOTE: The unit “mil” is a unit traditionally used by some U.S. industry sectors for the measurement of thickness.

¹³ See Footnote 3.

Units of Area¹⁴

(all underlined figures are exact)

Multiply by the Conversion Factor Below the Ending Unit

Starting Unit ↓	Ending Unit →	Square Inches	Square Feet	Square Yards
1 square inch =	Conversion Factor	<u>1</u>	0.006 944 444	0.000 771 604 9
1 square foot =		<u>144</u>	<u>1</u>	0.111 111 1
1 square yard =		<u>1 296</u>	<u>9</u>	<u>1</u>
1 square mile =		<u>4 014 489 600</u>	<u>27 878 400</u>	<u>3 097 600</u>
1 square centimeter =		0.155 000 3	0.001 076 391	0.000 119 599 0
1 square meter =		1550.003	10.763 91	1.195 990
<p>Note: 1 survey foot = $\frac{1200}{3937}$ meter (exactly) 1 international foot = 12 × 0.0254 meter (exactly) 1 international foot = 0.0254 × 39.37 survey foot (exactly)</p>				

¹⁴ Area measurements are applied to both regular (e.g., regular polygons such as the square, rectangle, or equilateral triangle, or circle, ellipse, etc.) and irregular geometric shapes. For example, an acre is not necessarily a regular shape, such as a square or rectangle. If an acre is a square, then the length of one side is approximately equal to $\sqrt{43560 \text{ ft}^2} = 208.710 \text{ ft}$.

CCR Title 4, Div. 9, CCR §§ 4000
2023 Edition of NIST HB 44 Appendix C – General Tables of Units of Measurement

Multiply by the Conversion Factor Below the Ending Unit

Starting Unit ↓	Ending Unit →	Square Miles	Square Centimeters	Square Meters
1 square inch =	Conversion Factor	0.000 000 000 249 097 7	<u>6.451 6</u>	<u>0.000 645 16</u>
1 square foot =		0.000 000 035 870 06	<u>929.030 4</u>	<u>0.092 903 04</u>
1 square yard=		0.000 000 322 830 6	<u>8361.273 6</u>	<u>0.836 127 36</u>
1 square mile =		<u>1</u>	<u>25 899 881 103.36</u>	<u>2 589 988.110 336</u>
1 square centimeter =		0.000 000 000 038 610 22	<u>1</u>	<u>0.0001</u>
1 square meter =		0.000 000 386 102 2	<u>10 000</u>	<u>1</u>

Units of Area - Survey Measure¹⁵

(all underlined figures are exact; SI equivalents based on the international foot)

Multiply by the Conversion Factor Below the Ending Unit

Starting Unit ↓	Ending Unit →	Square Feet	Square Rods	Square Chains	Acres
1 square foot (ft ²) =	Conversion Factor	<u>1</u>	0.003 673 095	0.000 229 568 4	0.000 022 956 84
1 square rod (rd ²), square pole, or square perch =		<u>272.25</u>	<u>1</u>	<u>0.062 5</u>	<u>0.006 25</u>
1 square chain (ch ²) =		<u>4 356</u>	<u>16</u>	<u>1</u>	<u>0.1</u>
1 acre (ac) =		<u>43 560</u>	<u>160</u>	<u>10</u>	<u>1</u>
1 square mile (mi ²) =		<u>27 878 400</u>	<u>102 400</u>	<u>6 400</u>	<u>640</u>
1 square meter (m ²) =		10.763 87	0.039 536 70	0.002 471 044	0.000 247 104 4
1 hectare (ha) =		107 638.7	395.367 0	24.710 44	2.471 044

¹⁵ *Federal Register* (October 5, 2020, 85 FR 62698, p. 62698). Use of definitions based on the U.S. survey foot should be avoided after December 31, 2022, except for historic and legacy applications.

CCR Title 4, Div. 9, CCR §§ 4000
2023 Edition of NIST HB 44 Appendix C – General Tables of Units of Measurement

Multiply by the Conversion Factor Below the Ending Unit

Starting Unit ↓	Ending Unit →	Square Miles	Square Meters	Hectares
1 square foot (ft ²) =	Conversion Factor	0.000 000 035 870 06	<u>0.092 903 41</u>	<u>0.000 009 290 304</u>
1 square rod(rd ²), square pole, square perch =		<u>0.000 009 765 625</u>	<u>25.292 852 64</u>	<u>0.002 529 285 264</u>
1 square chain (ch ²) =		<u>0.000 156 25</u>	<u>404.687 3</u>	<u>0.040 468 564 224</u>
1 acre (a) =		<u>0.001 562 5</u>	<u>4 046.873</u>	<u>0.404 685 642 24</u>
1 square mile (mi ²) =		<u>1</u>	<u>2 589 998</u>	<u>258.998 811 033 6</u>
1 square meter (m ²) =		0.000 000 386 102 2	<u>1</u>	<u>0.000 1</u>
1 hectare (ha) =		0.003 861 022	<u>10 000</u>	<u>1</u>

Units of Volume¹⁶

(all underlined figures are exact)

Multiply by the Conversion Factor Below the Ending Unit

Starting Unit ↓	Ending Unit →	Cubic Inches	Cubic Feet	Cubic Yards
1 cubic inch (in ³) =	Conversion Factor	<u>1</u>	0.000 578 703 7	0.000 021 433 47
1 cubic foot (ft ³) =		<u>1 728</u>	<u>1</u>	0.037 037 04
1 cubic yard (yd ³) =		<u>46 656</u>	<u>27</u>	<u>1</u>
1 cubic centimeter (cm ³) =		0.061 023 74	0.000 035 314 67	0.000 001 307 951
1 cubic decimeter (dm ³) =		61.023 74	0.035 314 67	0.001 307 951
1 cubic meter (m ³) =		61 023.74	35.314 67	1.307 951

¹⁶ Volume or capacity measurement units are applied to both regular (e.g., cube, rectangular prism, cylinder, cone, pyramid, sphere, etc.) and irregular geometric objects.

CCR Title 4, Div. 9, CCR §§ 4000
2023 Edition of NIST HB 44 Appendix C – General Tables of Units of Measurement

Multiply by the Conversion Factor Below the Ending Unit

Starting Unit ↓	Ending Unit →	Milliliters (Cubic Centimeters)	Liters (Cubic Decimeters)	Cubic Meters
1 cubic inch (in ³) =	Conversion Factor	<u>16.387 064</u>	<u>0.016 387 064</u>	<u>0.000 016 387 064</u>
1 cubic foot (ft ³) =		<u>28 316.846 592</u>	<u>28.316 846 592</u>	<u>0.028 316 846 592</u>
1 cubic yard (yd ³) =		<u>764 554.857 984</u>	<u>764.554 857 984</u>	<u>0.764 554 857 984</u>
1 cubic centimeter (cm ³) =		<u>1</u>	<u>0.001</u>	<u>0.000 001</u>
1 cubic decimeter (dm ³) =		<u>1 000</u>	<u>1</u>	<u>0.001</u>
1 cubic meter (m ³) =		<u>1 000 000</u>	<u>1000</u>	<u>1</u>

Units of Capacity or Volume - Dry Volume Measure

(all underlined figures are exact)

Multiply by the Conversion Factor Below the Ending Unit

Starting Unit ↓	Ending Unit →	Dry Pints	Dry Quarts	Pecks	Bushels
1 dry pint (pt) =	Conversion Factor	<u>1</u>	<u>0.5</u>	<u>0.062 5</u>	<u>0.015 625</u>
1 dry quart (qt) =		<u>2</u>	<u>1</u>	<u>0.125</u>	<u>0.031 25</u>
1 peck (pk) =		<u>16</u>	<u>8</u>	<u>1</u>	<u>0.25</u>
1 bushel (bu) =		<u>64</u>	<u>32</u>	<u>4</u>	<u>1</u>
1 cubic inch (in ³) =		0.029 761 6	0.014 880 8	0.001 860 10	0.000 465 025
1 cubic foot (ft ³) =		51.428 09	25.714 05	3.214 256	0.803 563 95
1 liter (L) =		1.816 166	0.908 083 0	0.113 510 4	0.028 377 59
1 cubic meter (m ³) =		1 816.166	908.083 0	113.510 4	28.377 59

CCR Title 4, Div. 9, CCR §§ 4000
2023 Edition of NIST HB 44 Appendix C – General Tables of Units of Measurement

Multiply by the Conversion Factor Below the Ending Unit

Starting Unit	Ending Unit →	Cubic Inches	Cubic Feet	Liters	Cubic Meters
1 dry pint (pt) =	Conversion Factor	<u>33.600 312 5</u>	0.019 444 63	0.550 610 5	0.000 550 610 5
1 dry quart (qt) =		<u>67.200 625</u>	0.038 889 25	1.101 221	0.001 101 221
1 peck (pk) =		<u>537.605</u>	0.311 114	8.809 768	0.008 809 768
1 bushel (bu) =		<u>2 150.42</u>	1.244 456	<u>35.239 070 166 88</u>	<u>0.035 239 070 166 88</u>
1 cubic inch (in ³) =		<u>1</u>	0.000 578 703 7	<u>0.016 387 064</u>	<u>0.000 016 387 064</u>
1 cubic foot (ft ³) =		<u>1728</u>	<u>1</u>	28.316 846 592	<u>0.028 316 846 592</u>
1 liter (L) =		61.023 74	0.035 314 67	<u>1</u>	<u>0.001</u>
1 cubic meter (m ³) =		61 023.74	35.314 67	<u>1000</u>	<u>1</u>

Units of Capacity or Volume - Liquid Volume Measure

(All underlined figures are exact)

Multiply by the Conversion Factor Below the Ending Unit

Starting Unit ↓	Ending Unit →	Minims	Fluid Drams	Fluid Ounces	Gills
1 minim =	Conversion Factor	<u>1</u>	0.016 666 67	0.002 083 333	0.000 520 833 3
1 fluid dram (fl dr) =		<u>60</u>	<u>1</u>	<u>0.125</u>	<u>0.031 25</u>
1 fluid ounce (fl oz) =		<u>480</u>	<u>8</u>	<u>1</u>	<u>0.25</u>
1 gill (gi) =		<u>1 920</u>	<u>32</u>	<u>4</u>	<u>1</u>
1 liquid pint (pt) =		<u>7 680</u>	<u>128</u>	<u>16</u>	<u>4</u>
1 liquid quart (qt) =		<u>15 360</u>	<u>256</u>	<u>32</u>	<u>8</u>
1 gallon (gal) =		<u>61 440</u>	<u>1024</u>	<u>128</u>	<u>32</u>
1 cubic inch (in ³) =		265.974 0	4.432 900	0.554 112 6	0.138 528 1
1 cubic foot (ft ³) =		459 603.1	7660.052	957.506 5	239.376 6
1 milliliter (mL) =		16.230 73	0.270 512 2	0.033 814 02	0.008 453 506
1 liter (L) =		16 230.73	270.512 2	33.814 02	8.453 506

CCR Title 4, Div. 9, CCR §§ 4000
2023 Edition of NIST HB 44 Appendix C – General Tables of Units of Measurement

Multiply by the Conversion Factor Below the Ending Unit

Starting Unit ↓	Ending Unit →	Liquid Pints	Liquid Quarts	Gallons	Cubic Inches
1 minim =	Conversion Factor	0.000 130 208 3	0.000 065 104 17	0.000 016 276 04	0.003 759 766
1 fluid dram (fl dr) =		<u>0.007 812 5</u>	<u>0.003 906 25</u>	<u>0.000 976 562 5</u>	0.225 585 94
1 fluid ounce (fl oz) =		<u>0.062 5</u>	<u>0.031 25</u>	<u>0.007 812 5</u>	<u>1.804 687 5</u>
1 gill (gi) =		<u>0.25</u>	<u>0.125</u>	<u>0.031 25</u>	<u>7.218 75</u>
1 liquid pint (pt) =		<u>1</u>	<u>0.5</u>	<u>0.125</u>	<u>28.875</u>
1 liquid quart (qt) =		<u>2</u>	<u>1</u>	<u>0.25</u>	<u>57.75</u>
1 gallon (gal) =		<u>8</u>	<u>4</u>	<u>1</u>	<u>231</u>
1 cubic inch (in ³) =		0.034 632 03	0.017 316 02	0.004 329 004	<u>1</u>
1 cubic foot (ft ³) =		59.844 16	29.922 08	7.480 519	<u>1 728</u>
1 milliliter (mL) =		0.002 113 376	0.001 056 688	0.000 264 172 1	0.061 023 74
1 liter (L) =		2.113 376	1.056 688	0.264 172 1	61.023 74

CCR Title 4, Div. 9, CCR §§ 4000
2023 Edition of NIST HB 44 Appendix C – General Tables of Units of Measurement

Multiply by the Conversion Factor Below the Ending Unit

Starting Unit ↓	Ending Unit →	Cubic Feet	Milliliters	Liters
1 minim =	Conversion Factor	0.000 002 175 790	0.061 611 52	0.000 061 611 52
1 fluid dram (fl dr) =		0.000 130 547 4	3.696 691	0.003 696 691
1 fluid ounce (fl oz) =		0.001 044 379	29.573 53	0.029 573 53
1 gill (gi) =		0.004 177 517	118.294 1	0.118 294 1
1 liquid pint (pt) =		0.016 710 07	473.176 5	0.473 176 5
1 liquid quart (qt) =		0.033 420 14	946.352 9	0.946 352 9
1 gallon (gal) =		0.133 680 6	<u>3785.411 784</u>	<u>3.785 411 784</u>
1 cubic inch (in ³) =		0.000 578 703 7	16.387 06	0.016 387 06
1 cubic foot (ft ³) =		<u>1</u>	28 316.85	28.316 85
1 milliliter (mL) =		0.000 035 314 67	<u>1</u>	<u>0.001</u>
1 liter (L) =		0.035 314 67	<u>1 000</u>	<u>1</u>

Units of Volume – International Foot and Survey Equivalent Measurements¹⁷

(All underlined figures are exact)

Multiply by the Conversion Factor Below the Ending Unit

Starting Unit ↓	Ending Unit →	International Foot Metric Equivalent - Cubic Meters	U.S. Survey Foot Metric Equivalent - Cubic Meters
Acre-foot	Conversion Factor	<u>1233.481 837 547 52</u>	1233.489 238 468 149
Note: The following is an exact mathematical relationship for U.S. Customary Units. 1 acre-foot = 43 560 cubic feet			

¹⁷ *Federal Register* (October 5, 2020, 85 FR 62698, p. 62698). Units in this table were historically defined using the U.S. survey foot. They may now be defined using either the international definition of the foot or U.S. survey foot. Use of definitions based on the U.S. survey foot should be avoided after December 31, 2022, except for historic and legacy applications.

Units of Mass Not Less Than Avoirdupois Ounces

(all underlined figures are exact)

Multiply by the Conversion Factor Below the Ending Unit

Starting Unit ↓	Ending Unit →	Avoirdupois Ounces	Avoirdupois Pounds	Short Hundred-weights	Short Tons
1 avoirdupois ounce (oz) =	Conversion Factor	<u>1</u>	<u>0.0625</u>	<u>0.000 625</u>	<u>0.000 031 25</u>
1 avoirdupois pound (lb) =		<u>16</u>	<u>1</u>	<u>0.01</u>	<u>0.000 5</u>
1 short hundredweight (ctw) =		<u>1 600</u>	<u>100</u>	<u>1</u>	<u>0.05</u>
1 short ton (tn) =		<u>32 000</u>	<u>2 000</u>	<u>20</u>	<u>1</u>
1 long ton =		<u>35 840</u>	<u>2 240</u>	<u>22.4</u>	<u>1.12</u>
1 kilogram (kg) =		35.273 96	2.204 623	0.022 046 23	0.001 102 311
1 metric ton (t) =		35 273.96	2204.623	22.046 23	1.102 311

Multiply by the Conversion Factor Below the Ending Unit

Starting Unit ↓	Ending Unit →	Long Tons	Kilograms	Metric Tons
1 avoirdupois ounce (oz) =	Conversion Factor	0.000 027 901 79	<u>0.028 349 523 125</u>	<u>0.000 028 349 523 125</u>
1 avoirdupois pound (lb) =		0.000 446 428 6	<u>0.453 592 37</u>	<u>0.000 453 592 37</u>
1 short hundredweight (ctw) =		0.044 642 86	<u>45.359 237</u>	<u>0.045 359 237</u>
1 short ton (tn) =		0.892 857 1	<u>907.184 74</u>	<u>0.907 184 74</u>
1 long ton =		<u>1</u>	<u>1016.046 908 8</u>	<u>1.016 046 908 8</u>
1 kilogram (kg) =		0.000 984 206 5	<u>1</u>	<u>0.001</u>
1 metric ton (t) =		0.984 206 5	<u>1 000</u>	<u>1</u>

Units of Mass Not Greater Than Pounds and Kilograms

(all underlined figures are exact)

Multiply by the Conversion Factor Below the Ending Unit

Starting Unit ↓	Ending Unit →	Grains	Apothecaries Scruples	Pennyweights	Avoirdupois Drams
1 grain (gr) =	Conversion Factor	<u>1</u>	<u>0.05</u>	0.041 666 67	0.036 571 43
1 apoth. scruple (dr ap) =		<u>20</u>	<u>1</u>	0.833 333 3	0.731 428 6
1 pennyweight (dwt) =		<u>24</u>	<u>1.2</u>	<u>1</u>	0.877 714 3
1 avdp. dram (dr) =		<u>27.343 75</u>	<u>1.367 187 5</u>	1.139 323	<u>1</u>
1 apoth. dram (dr ap) =		<u>60</u>	<u>3</u>	<u>2.5</u>	2.194 286
1 avdp. ounce (oz) =		<u>437.5</u>	<u>21.875</u>	18.229 17	<u>16</u>
1 apoth ounce (oz) =		<u>480</u>	<u>24</u>	<u>20</u>	17.554 29
1 troy ounce (oz) =		<u>480</u>	<u>24</u>	<u>20</u>	17.554 29
1 apoth pound (lb ap) =		<u>5 760</u>	<u>288</u>	<u>240</u>	210.651 4
1 troy pound (lb t) =		<u>5 760</u>	<u>288</u>	<u>240</u>	210.651 4
1 avdp. pound =		<u>7 000</u>	<u>350</u>	291.666 7	<u>256</u>
1 milligram (mg) =		0.015 432 36	0.000 771 617 9	0.000 643 014 9	0.000 564 383 4
1 gram (g) =		15.432 36	0.771 617 9	0.643 014 9	0.564 383 4
1 kilogram (kg) =		15432.36	771.617 9	643.014 9	564.383 4

CCR Title 4, Div. 9, CCR §§ 4000
2023 Edition of NIST HB 44 Appendix C – General Tables of Units of Measurement

Multiply by the Conversion Factor Below the Ending Unit

Starting Unit ↓	Ending Unit →	Apothecaries Drams	Avoirdupois Ounces	Apothecaries or Troy Ounces	Apothecaries or Troy Pounds
1 grain (gr) =	Conversion Factor	0.016 666 67	0.002 285 714	0.002 083 333	0.000 173 611 1
1 apoth. scruple (s ap) =		0.333 333 3	0.045 714 29	0.041 666 67	0.003 472 222
1 pennyweight (dwt) =		<u>0.4</u>	0.054 857 14	<u>0.05</u>	0.004 166 667
1 avdp. dram (dr) =		0.455 729 2	<u>0.062 5</u>	0.56 966 15	0.004 747 179
1 apoth. dram (dr ap) =		<u>1</u>	0.137 142 9	<u>0.125</u>	0.010 416 67
1 avdp. ounce (oz) =		7.291 667	<u>1</u>	0.911 458 3	0.075 954 86
1 apoth. ounce (oz) =		<u>8</u>	1.097 143	<u>1</u>	0.083 333 333
1 troy ounce (oz) =		<u>8</u>	1.097 143	<u>1</u>	0.083 333 333
1 apoth. pound (lb) =		<u>96</u>	13.165 71	<u>12</u>	<u>1</u>
1 troy pound (lb t) =		<u>96</u>	13.165 71	<u>12</u>	<u>1</u>
1 avdp. pound (lb) =		116.666 7	<u>16</u>	14.583 33	1.215 278
1 milligram (mg) =		0.000 257 206 0	0.000 035 273 96	0.000 032 150 75	0.000 002 679 229
1 gram (g) =		0.257 206 0	0.035 273 96	0.032 150 75	0.002 679 229
1 kilogram (kg) =		257.206 0	35.273 96	32.150 75	2.679 229

CCR Title 4, Div. 9, CCR §§ 4000
2023 Edition of NIST HB 44 Appendix C – General Tables of Units of Measurement

Multiply by the Conversion Factor Below the Ending Unit

Starting Unit ↓	Ending Unit →	Avoirdupois Pounds	Milligrams	Grams	Kilograms
1 grain (gr) =	Conversion Factor	0.000 142 857 1	<u>64.798 91</u>	<u>0.064 798 91</u>	<u>0.000 064 798 91</u>
1 apoth. scruple (s ap) =		0.002 857 143	<u>1 295.978 2</u>	<u>1.295 978 2</u>	<u>0.001 295 978 2</u>
1 pennyweight (dwt) =		0.003 428 571	<u>1 555.173 84</u>	<u>1.555 173 84</u>	<u>0.001 555 173 84</u>
1 avdp. dram (dr) =		0.003 906 25	<u>1 771.845 195 312 5</u>	<u>1.771 845 195 312 5</u>	<u>0.001 771 845 195 312 5</u>
1 apoth. dram (dr ap) =		0.008 571 429	<u>3 887.934 6</u>	<u>3.887 934 6</u>	<u>0.003 887 934 6</u>
1 avdp. ounce (oz) =		<u>0.062 5</u>	<u>28 349.523 125</u>	<u>28.349 523 125</u>	<u>0.028 349 523 125</u>
1 apoth. ounce (oz) =		0.068 571 43	<u>31 103.476 8</u>	<u>31.103 476 8</u>	<u>0.031 103 476 8</u>
1 troy ounce (oz t) =		0.068 571 43	<u>31 103.476 8</u>	<u>31.103 476 8</u>	<u>0.031 103 476 8</u>
1 apoth. pound (lb ap) =		0.822 857 1	<u>373 241.721 6</u>	<u>373.241 721 6</u>	<u>0.373 241 721 6</u>
1 troy pound (lb t) =		0.822 857 1	<u>373 241.721 6</u>	<u>373.241 721 6</u>	<u>0.373 241 721 6</u>
1 avdp. pound (lb) =		<u>1</u>	<u>453 592.37</u>	<u>453.592 37</u>	<u>0.453 592 37</u>
1 milligram (mg) =		0.000 002 204 623	<u>1</u>	<u>0.001</u>	<u>0.000 001</u>
1 gram (g) =		0.002 204 623	<u>1 000</u>	<u>1</u>	<u>0.001</u>
1 kilogram (kg) =		2.204 623	<u>1 000 000</u>	<u>1 000</u>	<u>1</u>

Units of Pressure

(all underlined figures are exact)

Multiply by the Conversion Factor Below the Ending Unit

Starting Unit ↓	Ending Unit →	Pascal (Pa)	kilopascal (kPa)	megapascal (MPa)	pound-force per square inch (psi) (lbf/in ²)	millimeter of mercury (mm Hg (0 °C))	Inch of water (in H ₂ O (4 °C))
1 Pa =	Conversion Factor	<u>1</u>	<u>0.001</u>	<u>0.000 001</u>	0.000 145 037 74	0.007 5006 15	0.004 014 742 13
1 kPa =		<u>1000.0</u>	<u>1</u>	<u>0.001</u>	0.145 037 744	7.500 615 05	4.014 742 133
1 MPa =		<u>1 000 000</u>	<u>1 000</u>	<u>1</u>	145.037 744	7 500.615 05	4 014.742 13
1 psi (lbf/in ²) =		6 894.757	6.894 757	0.006 894 757	<u>1</u>	51.714 918 1	27.680 671 4
1 mmHg (0 °C) =		133.322 4	0.133 322 4	0.000 133 322 4	0.019 336 78	<u>1</u>	0.535 255 057
1 inH ₂ O (4 °C) =		249.082	0.249 082	0.000 249 082	0.036 126 291	1.868 268 198	<u>1</u>

Conversion Equations for Units of Temperature (exact)

Units	To Fahrenheit (°F)	To Celsius (°C)	To Kelvin (K)
Fahrenheit (°F)	°F	$\frac{(^{\circ}F - 32)}{1.8}$	$\frac{(^{\circ}F - 32)}{1.8} + 273.15$
Celsius (°C)	$(^{\circ}C \times 1.8) + 32$	°C	$(^{\circ}C) + 273.15$
Kelvin (K)	$(K - 273.15) * 1.8 + 32$	$K - 273.15$	K

Instructions for the Conversion Equations for Temperature:

Start at the left column of the table until you reach the row labeled with the starting unit. Then proceed horizontally to the right along that row until you reach the column of the desired unit. The unit conversion factor is located at the intersection of the row and column.

5. Tables of Equivalents¹⁸

In these tables, all SI equivalents that use the foot (or other U.S. Customary units derived from the foot) are based on the international foot.

When the name of a unit is enclosed in brackets (thus, [1 hand] . . .), this indicates (1) that the unit is not in general current use in the United States, or (2) that the unit is believed to be based on “custom and usage” rather than on formal authoritative definition.

Equivalents involving decimals are, in most instances, rounded off to the third decimal place except where they are exact, in which cases these exact equivalents are so designated. The equivalents of the imprecise units “tablespoon” and “teaspoon” are rounded to the nearest milliliter.

Units of Length

1 cable’s length	120 fathoms (exactly) 720 feet (exactly) 219 meters
1 centimeter (cm)	0.01 meter (exactly) 0.393 7 inch
1 chain (ch) (Gunter’s or surveyors)	66 feet (exactly) 20.116 8 meters
1 decimeter (dm)	0.1 meter (exactly) 3.937 inches
1 dekameter (dam)	10 m (exactly) 32.808 feet
1 fathom	6 feet (exactly) 1.828 8 meters
1 foot (ft)	12 inches (exactly) 0.304 8 meter (exactly)
1 furlong (fur)	10 chains (surveyors) (exactly) 660 feet (exactly) ¹ / ₈ U.S. statute mile (exactly) 201.168 meters

¹⁸ *Federal Register* (October 5, 2020, 85 FR 62698, p. 62698). Use of definitions based on the U.S. survey foot should be avoided after December 31, 2022, except for historic and legacy applications.

CCR Title 4, Div. 9, CCR §§ 4000
2023 Edition of NIST HB 44 Appendix C – General Tables of Units of Measurement

[1 hand]	4 inches
1 inch (in)	2.54 centimeters (exactly)
1 kilometer (km)	1000 meters (exactly) 0.621 mile
1 league (land)	3 miles (exactly) 4.828 kilometers
1 link (li) (Gunter's or surveyors)	0.66 foot (exactly) 0.201 168 meter
1 meter (m)	0.001 kilometer (exactly) 39.37 inches 1.094 yards
1 micrometer (μm) ¹⁹	0.001 millimeter (exactly) 0.000 001 m (exactly) 0.000 039 37 inch
1 mil	0.001 inch (exactly) 0.025 4 millimeter (exactly) 25.4 micrometer (exactly)
1 mile (mi) (U.S. statute)	5280 feet survey (exactly) 1.609 kilometers
1 mile (mi) (international)	5280 feet (exactly) 1.609 344 kilometers (exactly)
1 mile (mi) (international nautical) ²⁰	1852 meters (exactly) 1.852 kilometers (exactly) 1.151 miles
1 millimeter (mm)	0.001 meter (exactly) 0.039 370 1 inch (exactly)
1 nanometer (nm)	0.000 000 001 meter (exactly) 0.000 000 039 37 inch
1 point (typography)	0.013 837 inch (exactly) 1/72 inch (approximately) 0.351 millimeter ("point" is historically used in typography)
1 rod (rd), pole, or perch	16½ feet (exactly) 5.029 2 meters
1 yard (yd)	3 feet (exactly)

¹⁹ The SI symbol for the prefix micro is the Greek letter mu (μ).

²⁰ **NIST SP 447**, *Weights and Measures Standards of the United States, A Brief History* (1975). The international nautical mile of 1852 meters (6076.115 49 feet) was adopted by the First International Extraordinary Hydrographic Conference, Monaco, 1929, under the name "International nautical mile." It was later adopted for use in the United States (effective July 1, 1954) by identical directives of the U.S. Department of Commerce and Department of Defense. The value formerly used in the United States was 6080.20 feet = 1 nautical (geographical or sea) mile.

	0.914 4 meter (exactly)
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Units of Area

1 acre	43 560 square feet (exactly) 0.404 685 642 24 hectare (exactly)
1 are	100 square meters (exactly) 119.599 square yards 0.025 acre
1 hectare	10 000 square meters (exactly) 0.01 square kilometer (exactly) 2.471 acres
[1 section (of land)]	[1 mile square] (approximate)
[1 square (building)]	100 square feet
1 square centimeter (cm ²)	0.000 1 square meter (exactly) 0.155 square inch
1 square decimeter (dm ²)	0.01 square meter (exactly) 15.500 square inches
1 square foot (ft ²)	144 square inches (exactly) 929.030 4 square centimeters (exactly)
1 square inch (in ²)	0.006 944 444 square feet 6.451 6 square centimeters (exactly)
1 square kilometer (km ²)	1 000 000 square meters (exactly) 247.104 acres 0.386 square mile
1 square meter (m ²)	0.000 001 square kilometer (exactly) 1 000 000 square millimeters (exactly) 1.196 square yards 10.764 square feet
1 square mile (mi ²)	2.589 99 square kilometers 258.999 hectares
1 square millimeter (mm ²)	0.000 001 square meter (exactly) 0.002 square inch
1 square rod (rd ²), sq pole, or sq perch	25.292 852 64 square meters (exactly)
1 square yard (yd ²)	0.836 127 36 square meter (exactly) 9 square feet (exactly) 1296 square inches (exactly)
[1 township]	[6 miles square] (approximate) [36 sections (of land)] 36 square miles (approximate)

Units of Capacity or Volume

1 barrel (bbl), liquid	31 to 42 gallons ²¹
1 barrel (bbl), standard for fruits, vegetables, and other dry commodities, except cranberries	7056 cubic inches 105 dry quarts 3.281 bushels, struck measure
1 barrel (bbl), standard, cranberry	5826 cubic inches 86 ⁴⁵ /64 dry quarts 2.709 bushels, struck measure
1 bushel (bu) (U.S.) struck measure	2150.42 cubic inches (exactly) 35.238 liters
[1 bushel, heaped (U.S.)]	2747.715 cubic inches 1.278 bushels, struck measure ²²
[1 bushel (bu) (British Imperial) (struck measure)]	1.032 U.S. bushels, struck measure 2219.36 cubic inches
1 cord (cd) (firewood)	128 cubic feet (exactly)
1 cubic centimeter (cm ³)	0.001 cubic decimeter (exactly) 0.001 liter (exactly) 1 milliliter (exactly) 0.061 cubic inch
1 cubic decimeter (dm ³)	1000 cubic centimeters (exactly) 1000 milliliters (exactly) 1 liter (exactly) 61.024 cubic inches
1 cubic foot (ft ³)	7.481 gallons 28.316 cubic decimeters
1 cubic inch (in ³)	0.554 fluid ounce 4.433 fluid drams 16.387 cubic centimeters
1 cubic meter (m ³)	1000 cubic decimeters 1000 liters 1.308 cubic yards
1 cubic yard (yd ³)	0.765 cubic meter 27 cubic feet (exactly)
1 cup, measuring	8 fluid ounces (exactly) 237 milliliters

²¹ A variety of “barrels” are established by law or industry usage. Consult federal laws and regulations, state laws and regulations, and documentary standards for the industry application to ensure the use of the appropriate barrel definition. For example, federal taxes on fermented liquors are based on a barrel of 31 gallons; many state laws fix the “barrel for liquids” as 31½ gallons; a 36-gallon barrel has been used for cistern measurement; federal law recognizes a 40-gallon barrel for “proof spirits;” and by custom, 42 gallons comprise a barrel of crude oil or petroleum products for statistical purposes, and this equivalent is recognized “for liquids” by some states.

²² Frequently recognized as 1¼ bushels, struck measure.

CCR Title 4, Div. 9, CCR §§ 4000
2023 Edition of NIST HB 44 Appendix C – General Tables of Units of Measurement

	½ liquid pint (exactly)
1 dekaliter (daL)	10 liters (exactly) 2.642 gallons 1.135 pecks
1 dram, fluid (or liquid) (fl dr) (or <i>f</i> 3) (U.S.)	1/8 fluid ounce (exactly) 0.226 cubic inch 3.697 milliliters 1.041 British fluid drachms
[1 drachm, fluid (fl dr) (British)]	0.961 U.S. fluid dram 0.217 cubic inch 3.552 milliliters
1 gallon (gal) (U.S.)	231 cubic inches (exactly) 3.785 liters 0.833 British gallon 128 U.S. fluid ounces (exactly)
[1 gallon (gal) (British Imperial)]	277.42 cubic inches 1.201 U.S. gallons 4.546 liters 160 British fluid ounces (exactly)
1 gill (gi)	7.219 cubic inches 4 fluid ounces (exactly) 0.118 liter
1 hectoliter (hL)	100 liters 26.418 gallons 2.838 bushels
1 liter (L)	1 cubic decimeter (exactly) 1000 milliliters (exactly) 1.057 liquid quarts 0.908 dry quart 61.024 cubic inches
1 milliliter (mL)	0.001 cubic decimeter (exactly) 0.001 liter (exactly) 0.271 fluid dram 16.231 minims 0.061 cubic inch
1 ounce, fluid (or liquid) (fl oz) (or <i>f</i> 3) (U.S.)	1.805 cubic inches 29.573 milliliters 1.041 British fluid ounces
[1 ounce, fluid (fl oz) (British)]	0.961 U.S. fluid ounce 1.734 cubic inches 28.412 milliliters
1 peck (pk)	8.810 liters

CCR Title 4, Div. 9, CCR §§ 4000
2023 Edition of NIST HB 44 Appendix C – General Tables of Units of Measurement

1 pint (pt), dry	33.600 cubic inches 0.551 liter
1 pint (pt), liquid	28.875 cubic inches exactly 0.473 liter
1 quart (qt), dry (U.S.)	67.201 cubic inches 1.101 liters 0.969 British quart
1 quart (qt), liquid (U.S.)	57.75 cubic inches (exactly) 0.946 liter 0.833 British quart
[1 quart (qt) (British)]	69.354 cubic inches 1.032 U.S. dry quarts 1.201 U.S. liquid quarts
1 tablespoon, measuring	3 teaspoons (exactly) 15 milliliters 4 fluid drams ½ fluid ounce (exactly)
1 teaspoon, measuring	⅓ tablespoon (exactly) 5 milliliters 1⅓ fluid drams ²³
1 water ton (English)	270.91 U.S. gallons 224 British Imperial gallons (exactly)

Units of Mass

1 assay ton (AT) ²⁴	29.167 grams
1 carat (c) ²⁵	200 milligrams (exactly) 3.086 grains
1 dram apothecaries (dr ap or 3)	60 grains (exactly) 3.888 grams
1 dram avoirdupois (dr avdp)	27 ¹¹ /32 (= 27.344) grains 1.772 grams
1 gamma (γ)	1 microgram (exactly)
1 grain	64.798 91 milligrams (exactly)

²³ The equivalent “1 teaspoon = 4/3 fluid drams” has been found by NIST to correspond more closely with the actual capacities of “measuring” and silver teaspoons than the equivalent “1 teaspoon = 1 fluid dram,” which is given by a number of dictionaries.

²⁴ Used in assaying. The assay ton bears the same relation to the milligram that a ton of 2000 pounds avoirdupois bears to the troy ounce; hence the mass in milligrams of precious metal obtained from one assay ton of ore gives directly the number of troy ounces to the net ton.

²⁵ NIST Circular 43 (1913) The Metric Carat. As of July 1, 1913, the international metric carat was recognized as 200 milligrams for diamonds and other precious stones and expressed as decimal fractions. A carat is further divided where 1 carat equals 100 points. Available at <https://nvlpubs.nist.gov/nistpubs/Legacy/circ/nbscircular43.pdf>.

CCR Title 4, Div. 9, CCR §§ 4000
2023 Edition of NIST HB 44 Appendix C – General Tables of Units of Measurement

1 gram (g)	0.001 kilogram (exactly) 15.432 grains 0.035 ounce, avoirdupois
1 hundredweight, gross or long ²⁶ (gross cwt)	112 pounds (exactly) 50.802 kilograms
1 hundredweight, gross or short (cwt or net cwt)	100 pounds (exactly) 45.359 kilograms
1 kilogram (kg)	1000 grams exactly 2.205 pounds
1 microgram (μg) ²⁷	0.000 001 gram (exactly)
1 milligram (mg)	0.001 gram (exactly) 0.015 grain 0.005 carat (exactly)
1 ounce, avoirdupois (oz)	437.5 grains (exactly) 0.911 troy or apothecaries ounce 28.350 grams
1 ounce, troy or apothecaries (oz t or oz ap or $\frac{3}{3}$)	480 grains (exactly) 1.097 avoirdupois ounces 31.103 grams
1 ounce, troy	480 grains (exactly) 1.097 avoirdupois ounces 31.103 grams
1 ounce, apothecaries (oz ap or $\frac{3}{3}$)	480 grains (exactly) 1.097 avoirdupois ounces 31.103 grams
1 pennyweight (dwt)	1.555 grams
1 point	0.01 carat (exactly) 2 milligrams (exactly) ("point" is historically used in the jewelry industry to describe gemstones)
1 pound, avoirdupois (lb)	7000 grains (exactly) 1.215 troy or apothecaries pounds 453.592 37 grams (exactly)
1 micropound (μlb) ²⁸	0.000 001 pound (exactly)

²⁶ The gross or long ton and hundredweight are used commercially in the United States to only a very limited extent, usually in restricted industrial fields. The units are the same as the British "ton" and the "hundredweights."

²⁷ The SI symbol for the prefix micro is the Greek letter mu (μ).

²⁸ The SI symbol for the prefix micro is the Greek letter mu (μ). This is an example where SI writing style is applied to a non-SI unit abbreviation. The Greek letter mu prefix is used in combination with the abbreviation for pound (lb).

CCR Title 4, Div. 9, CCR §§ 4000
 2023 Edition of NIST HB 44 Appendix C – General Tables of Units of Measurement

1 pound, troy (lb t)	5760 grains (exactly) 0.823 avoirdupois pound 373.242 grams
1 pound, apothecaries (lb ap)	5760 grains (exactly) 0.823 avoirdupois pound 373.242 grams
1 scruple (s ap or ʒ)	20 grains (exactly) 1.296 grams
1 ton, gross or long	2240 pounds (exactly) 1.12 net tons (exactly) 1.016 metric tons
1 ton, metric (t)	2204.623 pounds 0.984 gross ton 1.102 net tons
1 ton, net or short (tn) ²⁹	2000 pounds (exactly) 0.893 gross ton 0.907 metric ton

²⁹ As of January 1, 2014, “tn” is the required abbreviation for “short ton.” Devices manufactured between January 1, 2008, and December 31, 2013, may use an abbreviation other than “tn” to specify “short ton.”
 (Added 2013)

Table of Contents

Appendix D. Definitions	1	belt-conveyor	4
A	1	belt-conveyor scale systems area	4
absolute value.	1	belt load	4
acceptance test.	1	belt revolution	4
accurate.....	1	billed weight.....	4
all-class.....	1	binary submultiples.....	5
alternating current (AC).	1	built-for-purpose device	5
ampere.	1	C	5
analog or digital recorder	1	calibration parameter	5
analog type	1	carbon dioxide liquid-measuring device.....	5
animal scale.....	1	car-wash timer	5
apparent mass versus 8.0 g/cm ³	2	center-reading tank.....	5
approval seal.	2	cereal grain and oil seeds.....	5
assumed atmospheric pressure.....	2	chart recorder	5
audit trail	2	check rate	5
automatic bulk weighing system.	2	checkweighing scale.....	5
automatic checkweigher	2	class of grain	5
automatic gravimetric filling machine (instrument).	2	clear interval between graduations	5
automatic-indicating scale	2	cleared.....	5
automatic temperature or density compensation	2	cold-tire pressure.....	6
automatic weighing system (AWS)	3	commercial equipment	6
automatic zero-setting mechanism (AZSM)..	3	computing scale.....	6
automatic zero-setting mechanism (belt- conveyor scale).	3	computing type or computing type device	6
automatic zero-tracking (AZT) mechanism...	3	concave curve	6
auxiliary indicator.....	3	concentrated load capacity (CLC).....	6
axle-load scale.....	3	configuration parameter.....	6
B	3	consecutive-car test train.....	6
badge.....	3	construction materials hopper scale	6
balance, zero-load	3	contract sale	6
balance indicator	3	conventional scale	6
balancing mechanism	3	conversion table	7
base pressure	4	convex curve	7
basic distance rate.....	4	conveyor stringers	7
basic time rate	4	correct	7
basic tolerances.....	4	correction table	7
batching system.....	4	counterbalance weight(s)	7
batching meter	4	counterpoise weight(s)	7
beam.....	4	coupled-in-motion railroad weighing system.	7
beam scale	4	crane scale	7
bell prover.....	4	creep	7
		cryogenic liquid-measuring device.....	7
		cryogenic liquids	7
		cubic foot, gas	7

CCR Title 4, Div. 9, CCR §§ 4000, 4001 and 4002
2023 Edition of NIST HB 44 Appendix D – Definitions

current	7	extras.....	12
D..... 8		F 12	
“d,” dimension division value	8	face.....	12
d, value scale division.....	8	face.....	12
D _{max} (maximum load of the measuring range)	8	fare	12
D _{min} (minimum load of the measuring range)	8	farm milk tank	12
data acquisition time (DAT)	8	feeding mechanism	12
dairy-product-test scale	8	ft ³ /h	12
decimal submultiples	8	fifth wheel	12
decreasing-load test	8	fifth-wheel test	12
deficiency.....	8	flat rate	12
digital type	8	fractional bar.....	12
dimensional offset.....	8	G 12	
dimensional weight (or dim, weight)	8	gauge pressure.....	12
direct current (DC)	8	gauging.....	13
direct sale	9	graduated interval.....	13
discharge hose	9	graduation.....	13
discharge line	9	grain class	13
discrimination (of an automatic-indicating scale).....	9	grain hopper scale	13
dispenser.....	9	grain moisture meter.....	13
distributed-car test train	9	grain sample.....	13
dry hose.....	9	grain-test scale	13
dry-hose type.....	9	grain type.....	13
dynamic monorail weighing system	9	gravity discharge	13
E..... 9		H..... 13	
e, value of verification scale division.....	9	head pulley	13
E _{max} (maximum capacity).....	9	hertz (Hz).....	13
E _{min} (minimum dead load).....	10	hexahedron.....	13
e _{min} (minimum verification scale division) ...	10	hired	13
electric vehicle, plug-in	10	hopper scale	14
electric vehicle supply equipment (EVSE) .	10	idlers or idler rollers	14
electricity as vehicle fuel	10	idler space	14
electronic link.....	10	increasing-load test	14
element.....	10	increment.....	14
energy.....	10	index of an indicator	14
energy flow	10	indicating element.....	14
equal-arm scale	11	indicator, balance	14
equipment, commercial.....	11	initial distance or time interval.....	14
event counter.....	11	initial zero-setting mechanism	14
event logger.....	11	in-service light indicator	14
EVSE field reference standard	11	integrator	14
excess and deficiency.....	11	interval, clear, between graduations	14
		interval, graduated.....	14
		irregularly-shaped object	14

CCR Title 4, Div. 9, CCR §§ 4000, 4001 and 4002
2023 Edition of NIST HB 44 Appendix D – Definitions

J	15				
jewelers' scale	15			measurement field	18
		K	15	measuring element	18
kilowatt (kW)	15			megajoule (MJ)	18
kilowatt-hour (kWh)	15			meter, electricity	18
kind of grain	15			meter register	18
		L	15	metrological components	18
label	15			metrological integrity (of a device)	18
large-delivery device	15			minimum capacity	18
laundry-drier timer	15			minimum clear interval	18
liquefied petroleum gas	15			minimum delivery	18
liquefied petroleum gas liquid-measuring device	15			minimum load cell verification interval	18
liquefied petroleum gas retail motor-fuel device	15			minimum measured quantity (MMQ)	19
liquefied petroleum gas vapor-measuring device	15			minimum tolerance	19
liquid fuel	16			minimum totalized load	19
liquid-fuel device	16			moisture content (wet basis)	19
liquid-measuring device	16			money drop	19
liquid volume correction factor	16			money-operated type	19
livestock scale	16			motor-fuel	19
load, full	16			motor-fuel device or motor-fuel dispenser or retail motor-fuel device	19
load, light	16			multi-class	19
load cell	16			multi-interval scale	19
load cell verification interval (v)	16			multi-jet water meter	19
loading point	16			multiple	20
load-receiving element	16			multiple cell application load cell	20
location services	16			multiple range scale	20
low-flame test	16			multiple of a scale	20
lubricant device	17			multi-revolution scale	20
		M	17	multiple-tariff taximeter	20
m ³ /h	17				
main bar	17			N	20
main graduation	17			nationally recognized testing laboratory (NRTL)	20
main-weighbeam elements	17			NBP	20
manual zero-setting mechanism	17			NTP	20
manufactured device	17			NTP density and volume correction factor ..	20
mass flow meter	17			natural gas	20
master meter, electric	17			negotiated rate	20
master meter test method	17			n _{max} (maximum number of scale divisions) ..	21
master weight totalizer	17			no-load reference value	21
material test	17			nominal	21
maximum capacity	17			nominal capacity	21
maximum cargo load	18			nominal capacity, batching scale	21
				nominal capacity, hopper scale	21
				non-automatic checkweigher	21
				Notes	21
				non-automatic weighing instrument	22

CCR Title 4, Div. 9, CCR §§ 4000, 4001 and 4002
2023 Edition of NIST HB 44 Appendix D – Definitions

non-resettable totalizer	22	reference weight car	26
nonretroactive	22	reference vehicle	27
nose-iron.....	22	remanufactured element.....	27
notes.....	22	remote configuration capability	27
O.....	22	retail device	27
odometer	22	retroactive.....	27
official grain samples	23	road test.....	27
official with statutory authority.....	23	rolling circumference	27
ohm (Ω)	23	S.....	27
operating tire pressure.....	23	scale	27
over-and-under indicator.....	23	scale area, belt-conveyor.....	27
overregistration and underregistration	23	scale division, number of (n).....	27
P.....	23	scale division, value of (d)	28
parallax	23	scale section.....	28
parking meter.....	23	seal.....	28
passenger vehicles.....	23	section capacity	28
percent registration	23	section test	28
performance requirements.....	24	security means	28
point-based railroad weighing systems.....	24	security seal.....	28
point-of-sale system	24	selector-type	28
poise.....	24	semi-automatic zero-setting mechanism	28
postal scale.....	24	sensitivity (of a nonautomatic-indicating scale).....	28
power factor (PF).....	24	sensitivity requirement (SR).....	28
prepackaging scale.....	24	serving utility.....	28
prescription scale.....	25	shift test	28
pressure type (device)	25	side.....	29
primary indicating or recording elements	25	simulated-road test	29
prover method	25	simulated test	29
prover oil.....	25	single cell application load cell.....	29
proving indicator	25	single-tariff taximeter	29
R.....	25	skirting	29
“r” factor	25	slow-flow meter.....	29
radio frequency interference (RFI).....	25	small-delivery device	29
random error(s).....	25	span (structural).....	29
ranges, weight	26	specification.....	29
rated capacity	26	starting load.....	29
rated scale capacity	26	static monorail weighing system	29
ratio test.....	26	strain-load test.....	29
reading face.....	26	submeter.....	29
reading-face capacity	26	subordinate graduation.....	30
recorded representation.....	26	subsequent distance or time intervals	30
recorded representation.....	26	substitution test.....	30
recording element.....	26	substitution test load.....	30
recording element.....	26	surface gauge.....	30
recording scale	26	systematic (average) error.....	30

CCR Title 4, Div. 9, CCR §§ 4000, 4001 and 4002
 2023 Edition of NIST HB 44 Appendix D – Definitions

<p style="text-align: right;">T 30</p> <p>tail pulley..... 30</p> <p>take-up..... 30</p> <p>tare mechanism 30</p> <p>tare-weighbeam elements 30</p> <p>test accuracy – in-service 30</p> <p>test amperes (TA)..... 31</p> <p>test chain 31</p> <p>test liquid 31</p> <p>test object 31</p> <p>test puck 31</p> <p>test train..... 31</p> <p>test weight car 31</p> <p>testing 31</p> <p>thermal overload protector..... 31</p> <p>time recorder 31</p> <p>timing device..... 31</p> <p>tolerance..... 31</p> <p>training idlers 32</p> <p>transfer standard 32</p> <p>tripper 32</p> <p style="text-align: right;">U..... 32</p> <p>uncoupled-in-motion railroad weighing system 32</p> <p>underregistration..... 32</p> <p>unit price 32</p> <p>unit train..... 32</p> <p>unit weight 32</p> <p>user requirement 32</p> <p>usual and customary 32</p> <p>utility-type water meter..... 32</p> <p style="text-align: right;">V..... 32</p> <p>value of minimum graduated interval 32</p> <p>vapor equalization credit..... 32</p> <p>vapor equalization line 33</p> <p>vehicle connector..... 33</p> <p>vehicle coupler..... 33</p> <p>vehicle inlet..... 33</p> <p>vehicle on-board weighing system..... 33</p> <p>vehicle scale 33</p> <p>verification scale division, value of (e) 33</p> <p>visible type..... 33</p> <p>V_{min} (minimum load cell verification interval) 33</p> <p>volt..... 33</p>	<p style="text-align: right;">W..... 34</p> <p>watt..... 34</p> <p>watthour (Wh) 34</p> <p>weighbeam 34</p> <p>weigh-belt system 34</p> <p>weighing element..... 34</p> <p>weigh-in-motion (WIM) vehicle scale 34</p> <p>weigh-labeler 34</p> <p>weigh module 34</p> <p>weightment 34</p> <p>weight, unit 34</p> <p>weight classifier 34</p> <p>weight ranges 35</p> <p>wet basis..... 35</p> <p>wet hose 35</p> <p>wet-hose type 35</p> <p>wheel-load weighers..... 35</p> <p>wholesale device 35</p> <p>wing pulley..... 35</p> <p style="text-align: right;">Z..... 35</p> <p>zero-load balance 35</p> <p>zero-load balance, automatic-indicating scale 35</p> <p>zero-load balance, nonautomatic-indicating scale 35</p> <p>zero-load balance for a recording scale..... 35</p> <p>zero-load reference (belt-conveyor scales). 35</p> <p>zero-setting mechanism..... 36</p> <p>automatic zero-setting mechanism (AZSM) 36</p> <p>automatic zero-tracking (AZT) mechanism. 36</p> <p>initial zero-setting mechanism 36</p> <p>manual zero-setting mechanism..... 36</p> <p>semiautomatic zero-setting mechanism 36</p> <p>zero-setting mechanism (belt-conveyor scale) 36</p> <p>zero-tracking mechanism..... 36</p> <p>zone of uncertainty 36</p>
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Appendix D. Definitions

The specific code to which the definition applies is shown in [brackets] at the end of the definition. Definitions for the General Code [1.10] apply to all codes in Handbook 44.

A

absolute value. – The absolute value of a number is the magnitude of that number without considering the positive or negative sign. [2.20]

acceptance test. – The first official test of a farm milk tank, at a particular location, in which the tank is accepted as correct. This test applies to newly constructed tanks, relocated used tanks, and recalibrated tanks. [4.42]

accurate. – A piece of equipment is “accurate” when its performance or value – that is, its indications, its deliveries, its recorded representations, or its capacity or actual value, etc., as determined by tests made with suitable standards - conforms to the standard within the applicable tolerances and other performance requirements. Equipment that fails so to conform is “inaccurate.” (Also see “correct.”) [Appendix A]

all-class. – A description of a multi-class calibration that includes all the classes of a grain type. [5.56(a), 5.57]

(Added 2007)

alternating current (AC). – An electric current that reverses direction in a circuit at regular intervals. [3.40]

(Added 2022)

ampere. – The practical unit of electric current. It is the quantity of current caused to flow by a potential difference of one volt through a resistance of one ohm. One ampere (A) is equal to the flow of one coulomb of charge per second. One coulomb (C) is the unit of electric charge equal in magnitude to the charge of 6.24×10^{18} electrons. [3.40]

(Added 2022)

analog or digital recorder. – An element used with a belt-conveyor scale that continuously records the rate-of-flow of bulk material over the scale (formerly referred to as a chart recorder). [2.21]

(Amended 1989)

analog type. – A system of indication or recording in which values are presented as a series of graduations in combination with an indicator, or in which the most sensitive element of an indicating system moves continuously during the operation of the device. [1.10]

animal scale. – A scale designed for weighing single heads of livestock. [2.20]

(Amended 1987)

apparent mass versus 8.0 g/cm³. – The apparent mass of an object versus 8.0 g/cm³ is the mass of material of density 8.0 g/cm³ that produces exactly the same balance reading as the object when the comparison is made in air with a density of 1.2 mg/cm³ at 20 °C. [3.37]

approval seal. – A label, tag, stamped or etched impression, or the like, indicating official approval of a device. (Also see “security seal.”) [1.10]

assumed atmospheric pressure. – The average atmospheric pressure agreed to exist at the meter at various ranges of elevation, irrespective of variations in atmospheric pressure from time to time. [3.33]

audit trail. – An electronic count and/or information record of the changes to the values of the calibration or configuration parameters of a device. [1.10, 2.20, 2.21, 2.24, 3.30, 3.31, 3.32, 3.34, 3.35, 3.36, 3.37, 3.38, 3.39, 3.40, 5.54, 5.56(a), 5.58]

(Added 1993) (Amended 2019 and 2022)

automatic bulk weighing system. – A weighing system adapted to the automatic weighing of bulk commodities in successive drafts of predetermined amounts, automatically recording the no-load and loaded weight values and accumulating the net weight of each draft. [2.22]

automatic checkweigher. – An automatic weighing system that does not require the intervention of an operator during the weighing process and used to subdivide items of different weights into one or more subgroups, such as identifying packages that have acceptable or unacceptable fill levels according to the value of the difference between their weight and a pre-determined set point. These systems may be used to fill standard packages for compliance with net weight requirements. [2.24]

(Amended 2004)

automatic gravimetric filling machine (instrument). – A filling machine or instrument that fills containers or packages with predetermined and virtually constant mass of product from bulk by automatic weighing, and which comprises essentially an automatic feeding device or devices associated with one or more weighing unit and the appropriate discharge devices. [2.24]

(Added 2004)

automatic-indicating scale. – One on which the weights of applied loads of various magnitudes are automatically indicated throughout all or a portion of the weighing range of the scale. (A scale that automatically weighs out commodity in predetermined drafts, such as an automatic hopper scale, a packaging scale, and the like, is not an “automatic-indicating” scale.) [2.20, 2.22]

automatic temperature or density compensation. – The use of integrated or ancillary equipment to obtain from the output of a volumetric meter an equivalent mass, or an equivalent liquid volume at the assigned reference temperature below and a pressure of 14.696 lb/in² absolute.

CCR Title 4, Div. 9, CCR §§ 4000, 4001 and 4002
2023 Edition of NIST HB 44 Appendix D – Definitions

Cryogenic liquids	21 °C (70 °F) [3.34]
Hydrocarbon gas vapor	15 °C (60 °F) [3.33]
Hydrogen gas	21 °C (70 °F) [3.39]
Liquid carbon dioxide	21 °C (70 °F) [3.38]
Liquefied petroleum gas (LPG) and Anhydrous ammonia	15 °C (60 °F) [3.32]
Petroleum liquid fuels and lubricants	15 °C (60 °F) [3.30]

(Amended 2019)

automatic weighing system (AWS). – An automatic weighing system is a weighing device that, in combination with other hardware and/or software components, automatically weighs discrete items and that does not require the intervention of an operator during the weighing process. Examples include, but are not limited to, weigh-labelers and checkweighers. [2.24]

(Amended 2004)

automatic zero-setting mechanism (AZSM). – See “automatic zero-setting mechanism” under “zero-setting mechanism.” [2.22]

(Amended 2010)

automatic zero-setting mechanism (belt-conveyor scale). – A zero setting device that operates automatically without intervention of the operator after the belt has been running empty. [2.21]

(Added 2002)

automatic zero-tracking (AZT) mechanism. – Automatic means provided to maintain the zero-balance indication, within specified limits, without the intervention of an operator. [2.20, 2.22, 2.24]

(Amended 2010)

auxiliary indicator. – Any indicator other than the master weight totalizer that indicates the weight of material determined by the scale. [2.21]

axle-load scale. – A scale permanently installed in a fixed location, having a load-receiving element specially adapted to determine the combined load of all wheels (1) on a single axle or (2) on a tandem axle of a highway vehicle. [2.20]

B

badge. – A metal plate affixed to the meter by the manufacturer showing the manufacturer’s name, serial number and model number of the meter, and its rated capacity. [3.33]

balance, zero-load. – See “zero-load balance.” [2.20]

balance indicator. – A combination of elements, one or both of which will oscillate with respect to the other, for indicating the balance condition of a nonautomatic indicating scale. The combination may consist of two indicating edges, lines, or points, or a single edge, line, or point and a graduated scale. [2.20]

balancing mechanism. – A mechanism (including a balance ball) that is designed for adjusting a scale to an accurate zero-load balance condition. [2.20]

base pressure. – The absolute pressure used in defining the gas measurement unit to be used, and is the gauge pressure at the meter plus an agreed atmospheric pressure. [3.33]

basic distance rate. – The charge for distance for all intervals except the initial interval. [5.54]

basic time rate. – The charge for time for all intervals except the initial interval. [5.54]

basic tolerances. – Tolerances on underregistration and on overregistration, or in excess and in deficiency, that are established by a particular code for a particular device under all normal tests, whether maintenance or acceptance. Basic tolerances include minimum tolerance values when these are specified. Special tolerances, identified as such and pertaining to special tests, are not basic tolerances. [2.20, 2.22., 3.34, 3.38, 4.42, 5.54]

batching system. – One in which raw materials are proportioned in pre-determined quantities by weight and/or liquid measure for inclusion in a finished product. [2.22, 3.36]

(Added 2018)

batching meter. – A device used for the purpose of measuring quantities of water to be used in a batching operation. [3.36]

beam. – See “weighbeam.” [2.20]

beam scale. – One on which the weights of loads of various magnitudes are indicated solely by means of one or more weighbeam bars either alone or in combination with counterpoise weights. [2.20]

bell prover. – A calibrated cylindrical metal tank of the annular type with a scale thereon that, in the downward travel in a surrounding tank containing a sealing medium, displaces air through the meter being proved or calibrated. [3.33]

belt-conveyor. – An endless moving belt for transporting material from place to place. [2.21] material being conveyed and the speed (travel) of the material, and integrates these values to produce total delivered weight. [2.21]

belt-conveyor scale systems area. – The scale system area refers to the scale suspension, weigh idlers attached to the scale suspension, 5 approach (-) idlers, and 5 retreat (+) idlers. [2.21]

(Added 2001)

belt load. – The weight of the material carried by the conveyor belt, expressed in terms of weight units per unit of length (e.g., pounds per foot, kilograms per meter). Also called “belt loading.” [2.21]

(Added 2013)

belt revolution. – The amount of conveyor belt movement or travel that is equivalent to the total length of the conveyor belt. Also referred to as “belt circuit.” [2.21]

(Added 2013)

billed weight. – The weight used in the computation of the freight, postal, or storage charge, whether actual weight or dimensional weight. [5.58]

binary submultiples. – Fractional parts obtained by successively dividing by the number two. Thus, one-half, one-fourth, one-eighth, one-sixteenth, and so on, are binary submultiples. [1.10]

built-for-purpose device. – Any main device or element which was manufactured with the intent that it be used as, or part of, a weighing or measuring device or system. [1.10]

(Added 2003)

C

calibration parameter. – Any adjustable parameter that can affect measurement or performance accuracy and, due to its nature, needs to be updated on an ongoing basis to maintain device accuracy (e.g., span adjustments, linearization factors, and coarse zero adjustments). [2.20, 2.21, 2.24, 3.30, 3.31, 3.32, 3.34, 3.35, 3.36, 3.37, 3.38, 3.39, 3.40, 5.54, 5.56(a), 5.58.]

(Added 1993) (Amended 2016, 2019, and 2022)

carbon dioxide liquid-measuring device. – A system including a mechanism or machine of (a) the meter or (b) a weighing type of device mounted on a vehicle designed to measure and deliver liquid carbon dioxide. Means may be provided to indicate automatically, for one of a series of unit prices, the total money value of the quantity measured. [3.38]

car-wash timer. – A timer used in conjunction with a coin-operated device to measure the time during which car-wash water, cleaning solutions, or waxing solutions are dispensed. [5.55]

center-reading tank. – One so designed that the gauge rod or surface gauge, when properly positioned for use, will be approximately in the vertical axis of the tank, centrally positioned with respect to the tank walls. [4.43]

cereal grain and oil seeds. – Agricultural commodities including, but not limited to, corn, wheat, oats, barley, flax, rice, sorghum, soybeans, peanuts, dry beans, safflower, sunflower, fescue seed, etc. [5.56(a), 5.56(b)]

chart recorder. – See analog or digital recorder.

(Amended 1989)

check rate. – A rate of flow usually 20 % of the capacity rate. [3.33]

checkweighing scale. – One used to verify predetermined weight within prescribed limits. [2.24]

class of grain. – Hard Red Winter Wheat as distinguished from Hard Red Spring Wheat as distinguished from Soft Red Winter Wheat, etc. [5.56(a), 5.56(b), 5.57]

clear interval between graduations. – The distance between adjacent edges of successive graduations in a series of graduations. If the graduations are “staggered,” the interval shall be measured, if necessary, between a graduation and an extension of the adjacent graduation. (Also see “minimum clear interval.”) [1.10]

cleared. – A taximeter is “cleared” when it is inoperative with respect to all fare indication, when no indication of fare or extras is shown and when all parts are in those positions in which

they are designed to be when the vehicle on which the taximeter is installed is not engaged by a passenger. [5.54]

cold-tire pressure. – The pressure in a tire at ambient temperature. [5.53, 5.54]

commercial equipment. – See “equipment.”

(Added 2008)

computing scale. – One that indicates the money values of amounts of commodity weighed, at predetermined unit prices, throughout all or part of the weighing range of the scale. [2.20]

computing type or computing type device. – A device designed to indicate, in addition to weight or measure, the total money value of product weighed or measured, for one of a series of unit prices. [1.10]

concave curve. – A change in the angle of inclination of a belt conveyor where the center of the curve is above the conveyor. [2.21]

concentrated load capacity (CLC). – (also referred to as Dual Tandem Axle Capacity[DTAC]). – A capacity rating of a vehicle or axle-load scale, specified by the manufacturer, defining the maximum load applied by a group of two axles with a centerline spaced four feet apart and an axle width of eight feet for which the weighbridge is designed. The concentrated load capacity rating is for both test and use. [2.20]

(Added 1988) (Amended 1991, 1994, and 2003)

configuration parameter. – Any adjustable or selectable parameter for a device feature that can affect the accuracy of a transaction or can significantly increase the potential for fraudulent use of the device and, due to its nature, needs to be updated only during device installation or upon replacement of a component (e.g., division value (increment), sensor range, and units of measurement). [2.20, 2.21, 2.24, 3.30, 3.31, 3.32, 3.34, 3.35, 3.36, 3.37, 3.38, 3.39, 3.40, 5.54, 5.56(a), 5.58]

(Added 1993) (Amended 2019 and 2022)

consecutive-car test train. – A train consisting of cars weighed on a reference scale, then coupled consecutively and run over the coupled-in-motion railway track scale under test. [2.20]

(Added 1990)

construction materials hopper scale. – A scale adapted to weighing construction materials such as sand, gravel, cement, and hot oil. [2.20]

contract sale. – A sale where a written agreement exists, prior to the point of sale, in which both buyer and seller have accepted pricing conditions of the sale. Examples include, but are not limited to: e-commerce, club sales, or pre-purchase agreements. Any devices used in the determination of quantity must comply with NIST Handbook 44. [3.30, 3.32, 3.37]

(Added 1993) (Amended 2002)

conventional scale. – If the use of conversion tables is necessary to obtain a moisture content value, the moisture meter indicating scale is called “conventional scale.” The values indicated by the scale are dimensionless. [5.56(b)]

conversion table. – Any table, graph, slide rule, or other external device used to determine the moisture content from the value indicated by the moisture meter. [5.56(b)]

convex curve. – A change in the angle of inclination of a belt conveyor where the center of the curve is below the conveyor. [2.21]

conveyor stringers. – Support members for the conveyor on which the scale and idlers are mounted. [2.21]

correct. – A piece of equipment is “correct” when, in addition to being accurate, it meets all applicable specification requirements. Equipment that fails to meet any of the requirements for correct equipment is “incorrect.” (Also see “accurate.”) [Appendix A]

correction table. – Any table, graph, slide rule, or other external device used to determine the moisture content from the value indicated by the moisture meter when the indicated value is altered by a parameter not automatically corrected for in the moisture meter (for example, temperature or test weight). [5.56(b)]

counterbalance weight(s). – One intended for application near the butt of a weighbeam for zero-load balancing purposes. [2.20]

counterpoise weight(s). – A slotted or “hanger” weight intended for application near the tip of the weighbeam of a scale having a multiple greater than one. [2.20]

coupled-in-motion railroad weighing system. – A device and related installation characteristics consisting of (1) the associated approach trackage, (2) the scale (i.e., the weighing element, the load-receiving element, and the indicating element with its software), and (3) the exit trackage, which permit the weighing of railroad cars coupled in motion. [2.20, 2.23]

(Added 1992)

crane scale. – One with a nominal capacity of 5000 pounds or more designed to weigh loads while they are suspended freely from an overhead, track-mounted crane. [2.20]

creep. – A continuous apparent measurement of energy indicated by a system with operating voltage applied and no power consumed (load terminals open circuited). [3.40]

(Added 2022)

cryogenic liquid-measuring device. – A system including a liquid-measuring element designed to measure and deliver cryogenic liquids in the liquid state. [3.34]

(Amended 1986 and 2003)

cryogenic liquids. – Fluids whose normal boiling point is below 120 kelvin (– 243 °F). [3.34]

cubic foot, gas. – The amount of a cryogenic liquid in the gaseous state at a temperature of 70 °F and under a pressure of 14.696 lb/in² absolute that occupies one cubic foot (1 ft³). (See NTP.) [3.34]

current. – The rate of the flow of electrical charge past any one point in a circuit. The unit of measurement is amperes (A) or coulombs (C) per second. [3.40]

(Added 2022)

D

“d,” dimension division value. – The smallest increment that the device displays for any axis and length of object in that axis. [5.58]

d, value scale division. – See “scale division, value of (d).” [2.20, 2.22]

Dmax (maximum load of the measuring range). – Largest value of a quantity (mass) which is applied to a load cell during test or use. This value shall not be greater than **E_{max}**. [2.20]

(Added 2005)

Dmin (minimum load of the measuring range). – Smallest value of a quantity (mass) which is applied to a load cell during test or use. This value shall not be less than **E_{min}**. [2.20]

(Added 2006)

data acquisition time (DAT). – The total time an object is completely on a load-receiving element while it is being weighed in motion. An object is completely on a load-receiving element from the time the trailing edge of an object to be weighed first moves onto the load-receiving element up to the time the leading edge of the object first moves off the load-receiving element. This time duration is affected by the length of the load-receiving element, speed of the object to be weighed, and the length of the object to be weighed. [2.20]

(Added 2021)

dairy-product-test scale. – A scale used in determining the moisture content of butter and/or cheese or in determining the butterfat content of milk, cream, or butter. [2.20]

decimal submultiples. – Parts obtained by successively dividing by the number 10. Thus 0.1, 0.01, 0.001, and so on are decimal submultiples. [1.10]

decreasing-load test. – A test for automatic-indicating scales only, wherein the performance of the scale is tested as the load is reduced. [2.20, 2.22]

(Amended 1987)

deficiency. – See “excess and deficiency.” [1.10]

digital type. – A system of indication or recording of the selector type or one that advances intermittently in which all values are presented digitally, or in numbers. In a digital indicating or recording element, or in digital representation, there are no graduations. [1.10]

dimensional offset. – The effect of eliminating the conveyance material on a measurement made by a multiple dimension measuring device resulting in only the object intended to be measured being measured. [5.58.]

(Added 2021)

dimensional weight (or dim, weight). – A value computed by dividing the object’s volume by a conversion factor; it may be used for the calculation of charges when the value is greater than the actual weight. [5.58]

(Added 2004)

direct current (DC). – An electric current that flows in one direction. [3.40]

(Added 2022)

direct sale. – A sale in which both parties in the transaction are present when the quantity is being determined. An unattended automated or customer-operated weighing or measuring system is considered to represent the device/business owner in transactions involving an unattended device. [1.10]

(Amended 1993)

discharge hose. – A flexible hose connected to the discharge outlet of a measuring device or its discharge line. [3.30, 3.31, 3.32, 3.34, 3.37, 3.38, 3.39]

(Added 1987) (Amended 2019)

discharge line. – A rigid pipe connected to the outlet of a measuring device. [3.30, 3.31, 3.32, 3.34, 3.37, 3.39]

(Added 1987) (Amended 2019)

discrimination (of an automatic-indicating scale). – The value of the test load on the load-receiving element of the scale that will produce a specified minimum change of the indicated or recorded value on the scale. [2.20, 2.22]

dispenser. – See motor-fuel device. [3.30, 3.37]

distributed-car test train. – A train consisting of cars weighed first on a reference scale, cars coupled consecutively in groups at different locations within the train, then run over the coupled-in-motion railway track scale under test. The groups are typically placed at the front, middle, and rear of the train. [2.20]

(Added 1990)

dry hose. – A discharge hose intended to be completely drained at the end of each delivery of product. (Also see “dry-hose type.”) [3.30, 3.31]

(Amended 2002)

dry-hose type. – A type of device in which it is intended that the discharge hose be completely drained following the mechanical operations involved in each delivery. (Also see “dry hose.”) [3.30, 3.31, 3.34, 3.35]

dynamic monorail weighing system. – A weighing system which employs hardware or software to compensate for dynamic effects from the load or the system that do not exist in static weighing, in order to provide a stable indication. Dynamic factors may include shock or impact loading, system vibrations, oscillations, etc., and can occur even when the load is not moving across the load-receiving element. [2.20]

(Added 1999)

E

e, value of verification scale division. – See “verification scale division, value of (e).” [2.20]

E_{\max} (maximum capacity). – Largest value of a quantity (mass) which may be applied to a load cell without exceeding the mpe. [2.20]

(Added 2005)

E_{\min} (minimum dead load). – Smallest value of a quantity (mass) which may be applied to a load cell during test or use without exceeding the mpe. [2.20]

(Added 2006)

e_{\min} (minimum verification scale division). – The smallest scale division for which a weighing element complies with the applicable requirements. [2.20, 2.21, 2.24]

(Added 1997)

electric vehicle, plug-in. – A vehicle that employs electrical energy as a primary or secondary mode of propulsion. Plug-in electric vehicles may be all-electric vehicles (EVs) or plug-in hybrid electric vehicles (PHEVs). All-electric vehicles are powered by an electric motor and battery at all times. All-electric vehicles may also be called battery-electric vehicles (BEVs). Plug-in hybrid electric vehicles employ both an electric motor and an internal combustion engine that consumes either conventional or alternative fuel or a fuel cell. In a parallel type hybrid-electric vehicle, either the electric motor or the engine may propel the vehicle. In a series type hybrid-electric vehicle, the engine or fuel cell generates electricity that is then used by the electric motor to propel the vehicle. EVs, BEVs, and PHEVs are capable of receiving and storing electricity via connection to an external electrical supply. Not all hybrid-electric vehicles are of the plug-in type. Hybrid-electric vehicles that do not have the capability to receive electrical energy from an external supply (HEVs) generate electrical energy onboard with the internal combustion engine, regenerative braking, or both. [3.40]

(Added 2022)

electric vehicle supply equipment (EVSE). – A device or system designed and used specifically to transfer electrical energy to an electric vehicle, either as charge transferred via physical or wireless connection, by loading a fully charged battery, or by other means. [3.40]

(Added 2022)

electricity as vehicle fuel. – Electrical energy transferred to and/or stored onboard an electric vehicle primarily for the purpose of propulsion. [3.40]

(Added 2022)

electronic link. – An electronic connection between the weighing/load-receiving or other sensing element and indicating element where one recognizes the other and neither can be replaced without calibration. [2.20]

(Added 2001)

element. – A portion of a weighing or measuring device or system which performs a specific function and can be separated, evaluated separately, and is subject to specified full or partial error limits.

(Added 2002)

energy. – The integral of active power with respect to time. [3.40]

(Added 2022)

energy flow. – The flow of energy between line and load terminals (conductors) of an electricity system. Flow from the line to the load terminals is considered energy delivered.

Energy flowing in the opposite direction (i.e., from the load to line terminals) is considered as energy received. [3.40]

(Added 2022)

equal-arm scale. – A scale having only a single lever with equal arms (that is, with a multiple of one), equipped with two similar or dissimilar load-receiving elements (pan, plate, platter, scoop, or the like), one intended to receive material being weighed and the other intended to receive weights. There may or may not be a weighbeam. [2.20]

equipment, commercial. – Weights, measures, and weighing and measuring devices, instruments, elements, and systems or portion thereof, used or employed in establishing the measurement or in computing any basic charge or payment for services rendered on the basis of weight or measure. As used in this definition, measurement includes the determination of size, quantity, value, extent, area, composition (limited to meat and poultry), constituent value (for grain), or measurement of quantities, things, produce, or articles for distribution or consumption, purchased, offered, or submitted for sale, hire, or award. [1.10, 2.20, 2.21, 2.22, 2.24, 3.30, 3.31, 3.32, 3.33, 3.34, 3.35, 3.36, 3.37, 3.38, 3.39, 3.40, 4.40, 5.51, 5.56.(a), 5.56.(b), 5.57, 5.58, 5.59]

(Added 2008) (Amended 2019 and 2022)

event counter. – A non-resettable counter that increments once each time the mode that permits changes to sealable parameters is entered and one or more changes are made to sealable calibration or configuration parameters of a device. [2.20, 2.21, 2.24, 3.30, 3.31, 3.32, 3.34, 3.35, 3.36, 3.37, 3.38, 3.39, 3.40, 5.54, 5.56(a), 5.56(b), 5.57, 5.58]

(Added 1993) (Amended 2019 and 2022)

event logger. – A form of audit trail containing a series of records where each record contains the number from the event counter corresponding to the change to a sealable parameter, the identification of the parameter that was changed, the time and date when the parameter was changed, and the new value of the parameter. [2.20, 2.21, 2.24, 3.30, 3.31, 3.32, 3.34, 3.35, 3.36, 3.37, 3.38, 3.39, 3.40, 5.54, 5.56(a), 5.56(b), 5.57, 5.58]

(Added 1993) (Amended 2019 and 2022)

EVSE field reference standard. – A portable apparatus that is traceable to NIST and is used as a standard to test EVSEs in commercial applications. This instrument is also known as a portable standard or working standard. [3.40]

(Added 2022)

excess and deficiency. – When an instrument or device is of such a character that it has a value of its own that can be determined, its error is said to be “in excess” or “in deficiency,” depending upon whether its actual value is, respectively, greater or less than its nominal value. (Also see “nominal.”) Examples of instruments having errors “in excess” are: a linear measure that is too long; a liquid measure that is too large; and a weight that is “heavy.” Examples of instruments having errors “in deficiency” are: a lubricating-oil bottle that is too small; a vehicle tank compartment that is too small; and a weight that is “light.” [1.10]

extras. – Charges to be paid by a passenger in addition to the fare, including any charge at a flat rate for the transportation of passengers in excess of a stated number and any charge for the transportation of baggage. [5.54]

F

face. – That side of a taximeter on which passenger charges are indicated. [5.54]

face. – That portion of a computing-type pump or dispenser which displays the actual computation of price per unit, delivered quantity, and total sale price. In the case of some electronic displays, this may not be an integral part of the pump or dispenser. [3.30, 3.32, 3.37, 3.39, and 3.40]

(Added 1987) (Amended 2022)

fare. – That portion of the charge for the hire of a vehicle that is automatically calculated by a taximeter through the operation of the distance and/or time mechanism. [5.54]

farm milk tank. – A unit for measuring milk or other fluid dairy product, comprising a combination of (1) a stationary or portable tank, whether or not equipped with means for cooling its contents, (2) means for reading the level of liquid in the tank, such as a removable gauge rod or a surface gauge, and (3) a chart for converting level-of-liquid readings to volume; or such a unit in which readings are made on a gauge rod or surface gauge directly in terms of volume. Each compartment of a subdivided tank shall, for purposes of this code, be construed to be a “farm milk tank.” [4.43]

feeding mechanism. – The means for depositing material to be weighed on the belt conveyor. [2.21]

ft³/h. – Cubic feet per hour. [3.33]

fifth wheel. – A commercially-available distance-measuring device which, after calibration, is recommended for use as a field transfer standard for testing the accuracy of taximeters and odometers on rented vehicles. [5.53, 5.54]

fifth-wheel test. – A distance test similar to a road test, except that the distance traveled by the vehicle under test is determined by a mechanism known as a “fifth wheel” that is attached to the vehicle and that independently measures and indicates the distance. [5.53, 5.54]

flat rate. – A rate selection that when applied results in the indication of a fixed (non-incrementing) amount for passenger charges. This rate shall be included on the statement of established rates that is required to be posted in the vehicle. [5.54.]

(Added 2016)

fractional bar. – A weighbeam bar of relatively small capacity for obtaining indications intermediate between notches or graduations on a main or tare bar. [2.20]

G

gauge pressure. – The difference between the pressure at the meter and the atmospheric pressure (psi). [3.33]

read at the point where the liquid surface crosses the rod. [4.42]

gauging. – The process of determining and assigning volumetric values to specific graduations on the gauge or gauge rod that serve as the basis for the tank volume chart. [4.42]

graduated interval. – The distance from the center of one graduation to the center of the next graduation in a series of graduations. (Also see “value of minimum graduated interval.”) [1.10]

graduation. – A defining line or one of the lines defining the subdivisions of a graduated series. The term includes such special forms as raised or indented or scored reference “lines” and special characters such as dots. (Also see “main graduation” and “subordinate graduation.”) [1.10]

grain class. – Different grains within the same grain type. For example, there are six classes for the grain type “wheat:” Durum Wheat, Hard Red Spring Wheat, Hard Red Winter Wheat, Soft Red Winter Wheat, Hard White Wheat, and Soft White Wheat. [5.56(a), 5.57]

(Added 2007)

grain hopper scale. – One adapted to the weighing of individual loads of varying amounts of grain. [2.20]

grain moisture meter. – Any device indicating either directly or through conversion tables and/or correction tables the moisture content of cereal grains and oil seeds. Also termed “moisture meter.” [5.56(a), 5.56(b)]

grain sample. – That portion of grain or seed taken from a bulk quantity of grain or seed to be bought or sold and used to determine the moisture content of the bulk. [5.56(a), 5.56(b)]

grain-test scale. – A scale adapted to weighing grain samples used in determining moisture content, dockage, weight per unit volume, etc. [2.20]

grain type. – See “kind of grain.” [5.56(a), 5.57]

(Added 2007)

gravity discharge. – A type of device designed for discharge by gravity. [3.30, 3.31]

H

head pulley. – The pulley at the discharge end of the belt conveyor. The power drive to drive the belt is generally applied to the head pulley. [2.21]

hertz (Hz). – Frequency or cycles per second. One cycle of an alternating current or voltage is one complete set of positive and negative values of the current or voltage. [3.40]

(Added 2022)

hexahedron. – A geometric solid (i.e., box) with six rectangular or square plane surfaces. [5.58]

(Added 2008)

hired. – A taximeter is “hired” when it is operative with respect to all applicable indications of fare or extras. The indications of fare include time and distance where applicable unless qualified by another indication of “Time Not Recording” or an equivalent expression. [5.54]

hopper scale. – A scale designed for weighing bulk commodities whose load-receiving element is a tank, box, or hopper mounted on a weighing element. (Also see “automatic hopper scale,” “grain hopper scale,” and “construction materials hopper scale.”) [2.20]

idlers or idler rollers. – Freely turning cylinders mounted on a frame to support the conveyor belt. For a flat belt, the idlers consist of one or more horizontal cylinders transverse to the direction of belt travel. For a troughed belt, the idlers consist of one or more horizontal cylinders and one or more cylinders at an angle to the horizontal to lift the sides of the belt to form a trough. [2.21]

idler space. – The center-to-center distance between idler rollers measured parallel to the belt. [2.21]

increasing-load test. – The normal basic performance test for a scale in which observations are made as increments of test load are successively added to the load-receiving element of the scale. [2.20, 2.22]

increment. – The value of the smallest change in value that can be indicated or recorded by a digital device in normal operation. [1.10]

index of an indicator. – The particular portion of an indicator that is directly utilized in making a reading. [1.10]

indicating element. – An element incorporated in a weighing or measuring device by means of which its performance relative to quantity or money value is “read” from the device itself as, for example, an index-and-graduated-scale combination, a weighbeam-and-poise combination, a digital indicator, and the like. (Also see “primary indicating or recording element.”) [1.10]

indicator, balance. – See “balance indicator.” [2.20]

initial distance or time interval. – The interval corresponding to the initial money drop. [5.54]

initial zero-setting mechanism. – See “initial zero-setting mechanism” under “zero-setting mechanism.” [2.20]

(Added 1990)

in-service light indicator. – A light used to indicate that a timing device is in operation. [5.55]

integrator. – A device used with a belt-conveyor scale that combines conveyor belt load (e.g., lb/ft) and belt travel (e.g., feet) to produce a total weight of material passing over the belt-conveyor scale. An integrator may be a separate, detached mechanism or may be a component within a totalizing device. (Also see “master weight totalizer.”) [2.21]

(Added 2013)

interval, clear, between graduations. – See “clear interval between graduations.” [1.10]

interval, graduated. – See “graduated interval.” [1.10]

irregularly-shaped object. – Any object that is not a hexahedron shape. [5.58]

(Added 2008)

J

jewelers' scale. – One adapted to weighing gems and precious metals. [2.20]

K

kilowatt (kW). – A unit of power equal to 1000 watts (W). [3.40]

(Added 2022)

kilowatt-hour (kWh). – A unit of energy equal to 1000 watthours (W h). [3.40]

(Added 2022)

kind of grain. – Corn as distinguished from soybeans as distinguished from wheat, etc. [5.56(a), 5.56(b)]

L

label. – A printed ticket, to be attached to a package, produced by a printer that is a part of a prepackaging scale or that is an auxiliary device. [2.20]

large-delivery device. – Devices used primarily for single deliveries greater than 200 gallons, 2000 pounds, 20 000 cubic feet, 2000 liters, or 2000 kilograms. [3.34, 3.38]

laundry-drier timer. – A timer used in conjunction with a coin-operated device to measure the period of time that a laundry drier is in operation. [5.55]

liquefied petroleum gas. – A petroleum product composed predominantly of any of the following hydrocarbons or mixtures thereof: propane, propylene, butanes (normal butane or isobutane), and butylenes. [3.31, 3.32, 3.33, 3.34, 3.37]

liquefied petroleum gas liquid-measuring device. – A system including a mechanism or machine of the meter type designed to measure and deliver liquefied petroleum gas in the liquid state by a definite quantity, whether installed in a permanent location or mounted on a vehicle. Means may or may not be provided to indicate automatically, for one of a series of unit prices, the total money value of the liquid measured. [3.33]

(Amended 1987)

liquefied petroleum gas retail motor-fuel device. – A device designed for the measurement and delivery of liquefied petroleum gas used as a fuel for internal combustion engines in vehicles bearing a state or federal license plate for use on public roads. The term means the same as “retail motor-fuel dispenser” and “retail motor-fuel device” as it appears in section 3.32 LPG and Anhydrous Ammonia Liquid-Measuring Devices. [3.32]

(Added 2022)

liquefied petroleum gas vapor-measuring device. – A system including a mechanism or device of the meter type, equipped with a totalizing index, designed to measure and deliver liquefied petroleum gas in the vapor state by definite volumes, and generally installed in a permanent location. The meters are similar in construction and operation to the conventional natural- and manufactured-gas meters. [3.33]

liquid fuel. – Any liquid used for fuel purposes, that is, as a fuel, including motor-fuel. [3.30, 3.31]

liquid-fuel device. – A device designed for the measurement and delivery of liquid fuels. [3.30]

liquid-measuring device. – A mechanism or machine designed to measure and deliver liquid by definite volume. Means may or may not be provided to indicate automatically, for one of a series of unit prices, the total money value of the liquid measured, or to make deliveries corresponding to specific money values at a definite unit price. [3.30]

liquid volume correction factor. – A correction factor used to adjust the liquid volume of a cryogenic product at the time of measurement to the liquid volume at NBP. [3.34]

livestock scale. – A scale equipped with stock racks and gates and adapted to weighing livestock standing on the scale platform. [2.20]

(Amended 1989)

load, full. – A test condition with rated voltage, current at 100 % of test amps level, and power factor of 1.0. [3.40]

(Added 2022)

load, light. – A test condition with rated voltage, current at 10 % of test amps level, and power factor of 1.0. [3.40]

(Added 2022)

load cell. – A device, whether electric, hydraulic, or pneumatic, that produces a signal (change in output) proportional to the load applied. [2.20, 2.21, 2.23]

load cell verification interval (v). – The load cell interval, expressed in units of mass, used in the test of the load cell for accuracy classification. [2.20, 2.21]

(Added 1996)

loading point. – A location on a conveyor where the material is received by the belt. The location of the discharge from a hopper, chute, or pre-feed device used to supply material to a conveyor. [2.21]

(Amended 2013)

load-receiving element. – That element of a scale that is designed to receive the load to be weighed; for example, platform, deck, rail, hopper, platter, plate, scoop. [2.20, 2.21, 2.23]

location services. – Any of the various technologies used to determine the geographical location of a receiving unit in or physically attached to a vehicle. These technologies may include but are not limited to: global positioning services; cellular networks; or wi-fi networks. [5.54]

(Added 2017)

low-flame test. – A test simulating extremely low-flow rates such as caused by pilot lights. [3.33]

lubricant device. – A device designed for the measurement and delivery of liquid lubricants, including, but not limited to, heavy gear lubricants and automatic transmission fluids (automotive). [3.30]

M

m³/h. – Cubic meters per hour. [3.33]

main bar. – A principal weighbeam bar, usually of relatively large capacity as compared with other bars of the same weighbeam. (On an automatic-indicating scale equipped with a weighbeam, the main weighbeam bar is frequently called the “capacity bar.”) [2.20]

main graduation. – A graduation defining the primary or principal subdivisions of a graduated series. (Also see “graduation.”) [1.10]

main-weighbeam elements. – The combination of a main bar and its fractional bar, or a main bar alone if no fractional bar is associated with it. [2.20]

manual zero-setting mechanism. – See “manual zero-setting mechanism” under “zero-setting mechanism.” [2.20]

manufactured device. – Any commercial weighing or measuring device shipped as new from the original equipment manufacturer. [1.10]

(Amended 2001)

mass flow meter. – A device that measures the mass of a product flowing through the system. The mass measurement may be determined directly from the effects of mass on the sensing unit or may be inferred by measuring the properties of the product, such as the volume, density, temperature, or pressure, and displaying the quantity in mass units. [3.37]

master meter, electric. – An electric watt-hour meter owned, maintained, and used for commercial billing purposes by the serving utility. All the electric energy served to a submetered service system is recorded by the master meter. [3.40]

(Added 2022)

master meter test method. – A method of testing milk tanks that utilizes an approved master meter system for measuring test liquid removed from or introduced into the tank. [4.42]

master weight totalizer. – A primary indicating element used with a belt-conveyor scale that incorporates the function of an integrator to indicate the totalized weight of material passed over the scale. (Also see “integrator.”) [2.21]

(Amended 2013)

material test. – The test of a belt-conveyor scale using material (preferably that for which the device is normally used) that has been weighed to an accuracy of 0.1 %. [2.21]

(Amended 1989)

maximum capacity. – The largest load that may be accurately weighed. [2.20, 2.24]

(Added 1999)

maximum cargo load. – The maximum cargo load for trucks is the difference between the manufacturer’s rated gross vehicle weight and the actual weight of the vehicle having no cargo load. [5.53]

measurement field. – A region of space or the measurement pattern produced by the measuring instrument in which objects are placed or passed through, either singly or in groups, when being measured by a single device. [5.58]

measuring element. – That portion of a complete multiple dimension measuring device that does not include the indicating element. [5.58]

megajoule (MJ). – An SI unit of energy equal to 1 000 000 joules (J). [3.40]

(Added 2022)

meter, electricity. – An electric watt-hour meter. [3.40]

(Added 2022)

meter register. – An observation index for the cumulative reading of the gas flow through the meter. In addition, there are one or two proving circles in which one revolution of the test hand represents ½, 1, 2, 5, or 10 cubic feet, or 0.025, 0.05, 0.1, 0.2, or 0.25 cubic meter, depending on meter size. If two proving circles are present, the circle representing the smallest volume per revolution is referred to as the “leak-test circle.” [3.33]

metrological components. – Elements or features of a measurement device or system that perform the measurement process or that may affect the final quantity determination or resulting price determinations. This includes accessories that can affect the validity of transactions based upon the measurement process. The measurement process includes determination of quantities; the transmission, processing, storage, or other corrections or adjustments of measurement data or values; and the indication or recording of measurement values or other derived values such as price or worth or charges. [3.40]

(Added 2022)

metrological integrity (of a device). – The design, features, operation, installation, or use of a device that facilitates (1) the accuracy and validity of a measurement or transaction, (2) compliance of the device with weights and measures requirements, or (3) the suitability of the device for a given application. [1.10, 2.20]

(Added 1993)

minimum capacity. – The smallest load that may be accurately weighed. The weighing results may be subject to excessive error if used below this value. [2.20, 2.24]

(Added 1999)

minimum clear interval. – The shortest distance between adjacent graduations when the graduations are not parallel. (Also see “clear interval.”) [3.30, 3.31, 3.32, 3.33, 3.34, 3.35, 3.36, 3.38, 5.50, 5.51, 5.56(b)]

minimum delivery. – The least amount of weight that is to be delivered as a single weighment by a belt-conveyor scale system in normal use. [2.21]

minimum load cell verification interval. – See *v_{min}*

minimum measured quantity (MMQ). – The smallest quantity delivered for which the measurement is to within the applicable tolerances for that system. [3.37, 3.39, 3.40]

(Added 2019) (Amended 2022)

minimum tolerance. – Minimum tolerances are the smallest tolerance values that can be applied to a scale. Minimum tolerances are determined on the basis of the value of the minimum graduated interval or the nominal or reading face capacity of the scale. (Also see definition for basic tolerances.) [2.20, 2.22, 2.24]

minimum totalized load. – The least amount of weight for which the scale is considered to be performing accurately. [2.21]

moisture content (wet basis). – The mass of water in a grain or seed sample (determined by the reference method) divided by the mass of the grain or seed sample expressed as a percentage (%). [5.56(a), 5.56(b)]

money drop. – An increment of fare indication. The “initial money drop” is the first increment of fare indication following activation of the taximeter. [5.54]

money-operated type. – A device designed to be released for service by the insertion of money, or to be actuated by the insertion of money to make deliveries of product. [1.10]

motor-fuel. – Liquid used as fuel for internal-combustion engines. [3.30]

motor-fuel device or motor-fuel dispenser or retail motor-fuel device. – A device designed for the measurement and delivery of liquids used as fuel for internal-combustion engines. The term “motor-fuel dispenser” means the same as “motor-fuel device;” the term “retail motor-fuel device” applies to a unique category of device. (Also see definitions of “retail device” and “liquefied petroleum gas retail motor-fuel device.”) [3.30 and 3.37]

(Amended 2022)

multi-class. – A description of a grouping of grain classes, from the same grain type, in one calibration. A multi-class grain calibration may include (1) all the classes of a grain type (all-class calibration), or (2) some of the classes of a grain type within the calibration. [5.56(a), 5.57.]

(Added 2007)

multi-interval scale. – A scale having one weighing range which is divided into partial weighing ranges (segments), each with different scale intervals, with each partial weighing range (segment) determined automatically according to the load applied, both on increasing and decreasing loads. [2.20]

(Added 1995)

multi-jet water meter. – A water meter in which the moving element takes the form of a multiblade rotor mounted on a vertical spindle within a cylindrical measuring chamber. The liquid enters the measuring chamber through several tangential orifices around the circumference and leaves the measuring chamber through another set of tangential orifices placed at a different level in the measuring chamber. These meters register by recording the revolutions of a rotor set in motion by the force of flowing water striking the blades. [3.36]

(Added 2003)

multiple. – An integral multiple; that is, a result obtained by multiplying by a whole number. (Also see “multiple of a scale.”) [1.10]

multiple cell application load cell. – A load cell intended for use in a weighing system which incorporates more than one load cell. A multiple cell application load cell is designated with the letter “M” or the term “Multiple.” (Also see “single cell application load cell.”) [2.20]

(Added 1999)

multiple range scale. – A scale having two or more weighing ranges with different maximum capacities and different scale intervals for the same load receptor, each range extending from zero to its maximum capacity. [2.20]

(Added 1995)

multiple of a scale. – In general, the multiplying power of the entire system of levers or other basic weighing elements. (On a beam scale, the multiple of the scale is the number of pounds on the load-receiving element that will be counterpoised by one pound applied to the tip pivot of the weighbeam.) [2.20]

multi-revolution scale. – An automatic-indicating scale having a nominal capacity that is a multiple of the reading-face capacity and that is achieved by more than one complete revolution of the indicator. [2.20]

multiple-tariff taximeter. – One that may be set to calculate fares at any one of two or more rates. [5.54]

N

nationally recognized testing laboratory (NRTL). – A laboratory that conducts testing and certification that is recognized by the Occupational Safety and Health Administration (OSHA). [3.40]

(Added 2022)

NBP. – Normal Boiling Point of a cryogenic liquid at 14.696 lb/in² absolute. [3.34]

NTP. – Normal Temperature and Pressure of a cryogen at a temperature of 21 °C (70 °F) and a pressure of 101.325 kPa (14.696 lb/in² absolute). [3.34]

NTP density and volume correction factor. – A correction factor used to adjust the liquid volume of a cryogenic product at the time of measurement to the gas equivalent at NTP. [3.34]

natural gas. – A gaseous fuel, composed primarily of methane, that is suitable for compression and dispensing into a fuel storage container(s) for use as an engine fuel. [3.37]

(Added 1994)

negotiated rate. – A rate selection that, when applied, results in a fixed (non-incrementing) amount for passenger charges and is based on a value that has been agreed upon by the operator and passenger. [5.54]

(Added 2016)

n_{\max} (maximum number of scale divisions). – The maximum number of scale divisions for which a main element or load cell complies with the applicable requirements. The maximum number of scale divisions permitted for an installation is limited to the lowest n_{\max} marked on the scale indicating element, weighing element, or load cell. [2.20, 2.21, 2.24]

(Added 1997)

no-load reference value. – A positive weight value indication with no load in the load-receiving element (hopper) of the scale. (Used with automatic bulk-weighing systems and certain single-draft, manually-operated receiving hopper scales installed below grade and used to receive grain.) [2.20]

nominal. – Refers to “intended” or “named” or “stated,” as opposed to “actual.” For example, the “nominal” value of something is the value that it is supposed or intended to have, the value that it is claimed or stated to have, or the value by which it is commonly known. Thus, “1-pound weight,” “1-gallon measure,” “1-yard indication,” and “500-pound scale” are statements of nominal values; corresponding actual values may be greater or lesser. (Also see nominal capacity of a scale.) [1.10]

nominal capacity. – The nominal capacity of a scale is (a) the largest weight indication that can be obtained by the use of all of the reading or recording elements in combination, including the amount represented by any removable weights furnished or ordinarily furnished with the scale, but excluding the amount represented by any extra removable weights not ordinarily furnished with the scale, and excluding also the capacity of any auxiliary weighing attachment not contemplated by the original design of the scale, and excluding any fractional bar with a capacity less than 2½ % of the sum of the capacities of the remaining reading elements, or (b) the capacity marked on the scale by the manufacturer, whichever is less. (Also see “nominal capacity, batching scale”; “nominal capacity, hopper scale.”) [2.20]

nominal capacity, batching scale. – The nominal capacity of a batching scale is the capacity as marked on the scale by the scale manufacturer, or the sum of the products of the volume of each of the individual hoppers, in terms of cubic feet, times the weight per cubic foot of the heaviest material weighed in each hopper, whichever is less. [2.20]

nominal capacity, hopper scale. – The nominal capacity of a hopper scale is the capacity as marked on the scale by the scale manufacturer, or the product of the volume of the hopper in bushels or cubic feet times the maximum weight per bushel or cubic foot, as the case may be, of the commodity normally weighed, whichever is less. [2.20]

non-automatic checkweigher. – A weighing instrument that requires the intervention of an operator during the weighing process, used to subdivide items of different weights into one or more subgroups, such as identifying packages that have acceptable or unacceptable fill levels according to the value of the difference between their weight and a pre-determined set point. [2.24]

Notes: Determining the weighing result includes any intelligent action of the operator that affects the result, such as deciding and taking an action when an indication is stable or adjusting the weight of the weighed load.

Deciding the weighing result is acceptable means making a decision regarding the acceptance of each weighing result on observing the indication or releasing a print-out.

The weighing process allows the operator to take an action which influences the weighing result in the case where the weighing result is not acceptable.

(Added 2004)

non-automatic weighing instrument. – A weighing instrument or system that requires the intervention of an operator during the weighing process to determine the weighing result or to decide that it is acceptable. [2.20, 2.24]

Notes: Determining the weighing result includes any intelligent action of the operator that affects the result, such as deciding and taking an action when an indication is stable or adjusting the weight of the weighed load.

Deciding the weighing result is acceptable means making a decision regarding the acceptance of each weighing result on observing the indication or releasing a print-out. The weighing process allows the operator to take an action which influences the weighing result in the case where the weighing result is not acceptable.

(Added 2004) (Amended 2005)

non-resettable totalizer. – An element interfaced with the measuring or weighing element that indicates the cumulative registration of the measured quantity with no means to return to zero. [3.30, 3.37, 3.39, 3.40]

(Added 2019) (Amended 2022)

nonretroactive. – “Nonretroactive” requirements are enforceable after the effective date for:

- 1.devices manufactured within a state after the effective date;
- 2.both new and used devices brought into a state after the effective date; and
- 3.devices used in noncommercial applications which are placed into commercial use after the effective date.

Nonretroactive requirements are not enforceable with respect to devices that are in commercial service in the state as of the effective date or to new equipment in the stock of a manufacturer or a dealer in the state as of the effective date. (*Nonretroactive requirements are printed in italic type.*) [1.10]

(Amended 1989)

nose-iron. – A slide-mounted, manually-adjustable pivot assembly for changing the multiple of a lever. [2.20]

notes. – A section included in each of a number of codes, containing instructions, pertinent directives, and other specific information pertaining to the testing of devices. Notes are primarily directed to weights and measures officials.

O

odometer. – A device that automatically indicates the total distance traveled by a vehicle. For the purpose of this code, this definition includes hub odometers, cable-driven odometers, and

the distance-indicating or odometer portions of “speedometer” assemblies for automotive vehicles. [5.53]

official grain samples. – Grain or seed used by the official as the official transfer standard from the reference standard method to test the accuracy and precision of grain moisture meters. [5.56(a), 5.56(b)]

official with statutory authority. – The representative of the jurisdiction(s) responsible for certifying the accuracy of the device. [2.20, 2.21, 2.22]

(Added 1991)

ohm (Ω). – The practical unit of electric resistance that allows one ampere of current to flow when the impressed potential is one volt. [3.40]

(Added 2022)

operating tire pressure. – The pressure in a tire immediately after a vehicle has been driven for at least 5 miles or 8 kilometers. [5.53, 5.54]

over-and-under indicator. – An automatic-indicating element incorporated in or attached to a scale and comprising an indicator and a graduated scale with a central or intermediate “zero” graduation and a limited range of weight graduations on either side of the zero graduation, for indicating weights greater than and less than the predetermined values for which other elements of the scale may be set. (A scale having an over-and-under indicator is classed as an automatic-indicating scale.) [2.20]

overregistration and underregistration. – When an instrument or device is of such a character that it indicates or records values as a result of its operation, its error is said to be in the direction of overregistration or underregistration, depending upon whether the indications are, respectively, greater or less than they should be. Examples of devices having errors of “overregistration” are: a fabric-measuring device that indicates more than the true length of material passed through it; and a liquid-measuring device that indicates more than the true amount of the liquid delivered by the device. Examples of devices having errors of “underregistration” are: a meter that indicates less than the true amount of product that it delivers; and a weighing scale that indicates or records less than the true weight of the applied load. [1.10]

P

parallax. – The apparent displacement, or apparent difference in height or width, of a graduation or other object with respect to a fixed reference, as viewed from different points. [1.10]

parking meter. – A coin-operated device for measuring parking time for vehicles. [5.55]

passenger vehicles. – Vehicles such as automobiles, recreational vehicles, limousines, ambulances, and hearses. [5.53]

percent registration. – Percent registration is calculated as follows:

$$\text{Percent Registration} = \frac{\text{Wh measured by EVSE}}{\text{Wh measured by STANDARD}} \times 100$$

[3.40]

(Added 2022)

performance requirements. – Performance requirements include all tolerance requirements and, in the case of nonautomatic-indicating scales, sensitivity requirements (SR). (Also see definitions for “tolerance” and “sensitivity requirement.”) [1.10]

point-based railroad weighing systems. – An in-motion-railroad weighing system designed to weigh wheel(s) of a railway car when centered on the load sensor within a weighing zone typically of 2 inches or less. The weight of the wheels are added to obtain the total weight of the cars and train which are used for any transaction. [2.20]

(Added 2021)

point-of-sale system. – An assembly of elements including a weighing or measuring element, an indicating element, and a recording element (and may also be equipped with a “scanner”) used to complete a direct sales transaction. The system components, when operated together, must be capable of the following:

- 1.determining the weight or measure of a product or service offered;
- 2.calculating a charge for the product or service based on the weight or measure and an established price/ratestructure;
- 3.determining a total cost that includes all associated charges involved with the transaction; and
- 4.providing a sales receipt.

[2.20, 3.30, 3.32, 3.37, 3.39]

(Added 1986) (Amended 1997, 2015, and 2019)

poise. – A movable weight mounted upon or suspended from a weighbeam bar and used in combination with graduations, and frequently with notches, on the bar to indicate weight values. (A suspended poise is commonly called a “hanging poise.”) [2.20]

postal scale. – A scale (usually a computing scale) designed for use to determine shipping weight or delivery charges for letters or parcels delivered by the U.S. Postal Service or private shipping companies. A weight classifier may be used as a postal scale. [2.20]

(Added 1987)

power factor (PF). – The ratio of “active power” to “apparent power” in an AC circuit. It describes the efficient use of available power. [3.40]

(Added 2022)

prepackaging scale. – A computing scale specially designed for putting up packages of random weights in advance of sale. [2.20]

prescription scale. – A scale or balance adapted to weighing the ingredients of medicinal and other formulas prescribed by physicians and others and used or intended to be used in the ordinary trade of pharmacists. [2.20]

pressure type (device). – A type of device designed for operation with the liquid under artificially produced pressure. [3.30, 3.31]

primary indicating or recording elements. – The term “primary” is applied to those principal indicating (visual) elements and recording elements that are designed to, or may, be used by the operator in the normal commercial use of a device. The term “primary” is applied to any element or elements that may be the determining factor in arriving at the sale representation when the device is used commercially. (Examples of primary elements are the visual indicators for meters or scales not equipped with ticket printers or other recording elements and both the visual indicators and the ticket printers or other recording elements for meters or scales so equipped.) The term “primary” is not applied to such auxiliary elements as, for example, the totalizing register or predetermined-stop mechanism on a meter or the means for producing a running record of successive weighing operations, these elements being supplementary to those that are the determining factors in sales representations of individual deliveries or weights. (Also see “indicating element” and “recording element.”) [1.10, 3.40]

(Amended 2022)

prover method. – A method of testing milk tanks that utilizes approved volumetric prover(s) for measuring the test liquid removed from or introduced into the tank. [4.42]

prover oil. – A light oil of low vapor pressure used as a sealing medium in bell provers, cubic-foot bottles, and portable cubic-foot standards. [3.33]

proving indicator. – The test hand or pointer of the proving or leak-test circle on the meter register or index. [3.33, 3.36.]

R

“r” factor. – A computation for determining the suitability of a vehicle scale for weighing vehicles with varying axle configurations. The factor was derived by dividing the weights in FHWA Federal Highway Bridge Gross Weight Table B by 34 000 lbs. (The resultant factors are contained in Table UR.3.2.1.) [2.20]

radio frequency interference (RFI). – Radio frequency interference is a type of electrical disturbance that, when introduced into electronic and electrical circuits, may cause deviations from the normally expected performance. [1.10]

random error(s). – The sample standard deviation of the error (indicated values) for a number of consecutive automatic weighings of a load, or loads, passed over the load receptor, shall be expressed mathematically as:

$$s = \sqrt{\frac{1}{n-1} \sum (x_i - \bar{x})^2} \text{ or } s = \sqrt{\frac{1}{n-1} \left(\sum x_i^2 - \frac{(\sum x_i)^2}{n} \right)}$$

where: x = error of a load indication
 n = the number of loads

[2.24]

ranges, weight. – See “weight ranges.” [2.20]

rated capacity. – The rate of flow in cubic meters per hour of a hydrocarbon gas vapor-measuring device as recommended by the manufacturer. This rate of flow should cause a pressure drop across the meter not exceeding ½-inch water column. [3.33]

rated scale capacity. – That value representing the weight that can be delivered by the device in one hour. [2.21]

ratio test. – A test to determine the accuracy with which the actual multiple of a scale agrees with its designed multiple. This test is used for scales employing counterpoise weights and is made with standard test weights substituted in all cases for the weights commercially used on the scale. (It is appropriate to use this test for some scales not employing counterpoise weights.) [2.20]

reading face. – That portion of an automatic-indicating weighing or measuring device that gives a visible indication of the quantity weighed or measured. A reading face may include an indicator and a series of graduations or may present values digitally, and may also provide money-value indications. [1.10, 2.20]

(Amended 2005)

reading-face capacity. – The largest value that may be indicated on the reading face, exclusive of the application or addition of any supplemental or accessory elements. [1.10]

recorded representation. – The printed, embossed, or other representation that is recorded as a quantity by a weighing or measuring device. [1.10]

recorded representation. – The printed, electronically recorded, or other representation that retains a copy of the quantity and any other required information generated by a weighing or measuring device. [3.40]

(Added 2022)

recording element. – An element incorporated in a weighing or measuring device by means of which its performance relative to quantity or money value is permanently recorded on a tape, ticket, card, or the like, in the form of a printed, stamped, punched, or perforated representation. [1.10, 2.21]

recording element. – An element incorporated, connected to, or associated with a weighing or measuring device by means of which its performance relative to quantity or money value is permanently recorded in a printed or electronic form. [3.40]

(Added 2022)

recording scale. – One on which the weights of applied loads may be permanently recorded on a tape, ticket, card, or the like in the form of a printed, stamped, punched, or perforated representation. [2.20]

reference weight car. – A railcar that has been statically weighed for temporary use as a mass standard over a short period of time, typically the time required to test one scale.

Note: A test weight car that is representative of the types of cars typically weighed on the scale under test may be used wherever reference weight cars are specified. [2.20]

(Added 1991) (Amended 2012)

reference vehicle. – A vehicle with an associated load, including the driver, that has been statically weighed for temporary use as a field standard, typically the time required to test on weigh-in-motion vehicle scale. [2.20]

(Added 2021)

remanufactured element. – An element that is disassembled, checked for wear, parts replaced or fixed, reassembled and made to operate like a new element of the same type. [1.10]

(Added 2001)

remote configuration capability. – The ability to adjust a weighing or measuring device or change its sealable parameters from or through some other device that is not itself necessary to the operation of the weighing or measuring device or is not a permanent part of that device. [2.20, 2.21, 2.24, 3.30, 3.31, 3.32, 3.34, 3.35, 3.36, 3.37, 3.38, 3.39, 3.40, 5.54, 5.56(a), 5.58]

(Added 1993) (Amended 2019 and 2022)

retail device. – A measuring device primarily used to measure product for the purpose of sale to the end user. [3.30, 3.32, 3.37, 3.39, 3.40]

(Amended 1987, 2004, 2019, and 2022)

retroactive. – “Retroactive” requirements are enforceable with respect to all equipment. Retroactive requirements are printed herein in upright roman type. (Also see “nonretroactive.”) [1.10]

road test. – A distance test, over a measured course, of a complete taximeter assembly when installed on a vehicle, the mechanism being actuated as a result of vehicle travel. [5.53, 5.54]

rolling circumference. – The rolling circumference is the straight-line distance traveled per revolution of the wheel (or wheels) that actuates the taximeter or odometer. If more than one wheel actuates the taximeter or odometer, the rolling circumference is the average distance traveled per revolution of the actuating wheels. [5.53, 5.54]

S

scale. – See specific type of scale. [2.20]

scale area, belt-conveyor. – See belt-conveyor scale systems area. [2.21]

(Added 2001)

scale division, number of (n). – Quotient of the capacity divided by the value of the verification scale division. [2.20]

$$n = \frac{\text{Capacity}}{e}$$

scale division, value of (d). – The value of the scale division, expressed in units of mass, is the smallest subdivision of the scale for analog indication or the difference between two consecutively indicated or printed values for digital indication or printing. (Also see “verification scale division.”) [2.20, 2.22]

scale section. – A part of a vehicle, axle-load, livestock, or railway track scale consisting of two main load supports, usually transverse to the direction in which the load is applied. [2.20]

seal. – See “approval seal,” “security seal.” [1.10]

section capacity. – The section capacity of a scale is the maximum live load that may be divided equally on the load pivots or load cells of a section. [2.20]

(Added 2001)

section test. – A shift test in which the test load is applied over individual sections of the scale. This test is conducted to disclose the weighing performance of individual sections, since scale capacity test loads are not always available and loads weighed are not always distributed evenly over all main load supports. [2.20]

security means. – A method used to prevent access by other than qualified personnel, or to indicate that access has been made to certain parts of a scale that affect the performance of the device. [2.21]

security seal. – A uniquely identifiable physical seal, such as a lead-and-wire seal or other type of locking seal, a pressure-sensitive seal sufficiently permanent to reveal its removal, or similar apparatus attached to a weighing or measuring device for protection against or indication of access to adjustment. (Also see “approval seal.”) [1.10]

(Amended 1994)

selector-type. – A system of indication or recording in which the mechanism selects, by means of a ratchet-and-pawl combination or by other means, one or the other of any two successive values that can be indicated or recorded. [1.10]

semi-automatic zero-setting mechanism. – See “semi-automatic zero-setting mechanism” under “zero-setting mechanism.” [2.20]

sensitivity (of a nonautomatic-indicating scale). – The value of the test load on the load-receiving element of the scale that will produce a specified minimum change in the position of rest of the indicating element or elements of the scale. [2.20]

sensitivity requirement (SR). – A performance requirement for a non automatic-indicating scale; specifically, the minimum change in the position of rest of the indicating element or elements of the scale in response to the increase or decrease, by a specified amount, of the test load on the load-receiving element of the scale. [2.20]

servicing utility. – The utility distribution company that owns the master meter and sells electric energy to the owner of a submeter system. [3.40]

(Added 2022)

shift test. – A test intended to disclose the weighing performance of a scale under off-center loading. [2.20]

side. – That portion of a pump or dispenser which faces the consumer during the normal delivery of product. [3.30]

(Added 1987)

simulated-road test. – A distance test during which the taximeter or odometer may be actuated by some means other than road travel. The distance traveled is either measured by a properly calibrated roller device or computed from rolling circumference and wheel-turn data. [5.53, 5.54]

simulated test. – A test using artificial means of loading the scale to determine the performance of a belt-conveyor scale. [2.21]

single cell application load cell. – A load cell intended for use in a weighing system which incorporates one or more load cells. A single cell application load cell is designated with the letter “S” or the term “Single.” (Also see “multiple cell application load cell.”) [2.20]

(Added 1999)

single-tariff taximeter. – One that calculates fares at a single rate only. [5.54]

skirting. – Stationary side boards or sections of belt conveyor attached to the conveyor support frame or other stationary support to prevent the bulk material from falling off the side of the belt. [2.21]

slow-flow meter. – A retail device designed for the measurement, at very slow rates (less than 40 L (10 gal) per hour), of liquid fuels at individual domestic installations. [3.30]

small-delivery device. – Any device other than a large-delivery device. [3.34, 3.38]

span (structural). – The distance between adjoining sections of a scale. [2.20]

(Added 1988)

specification. – A requirement usually dealing with the design, construction, or marking of a weighing or measuring device. Specifications are directed primarily to the manufacturers of devices. [1.10]

starting load. – The minimum load above which the device will indicate energy flow continuously. [3.40]

(Added 2022)

static monorail weighing system. – A weighing system in which the load being applied is stationary during the weighing operation. [2.20]

(Added 1999)

strain-load test. – The test of a scale beginning with the scale under load and applying known test weights to determine accuracy over a portion of the weighing range. The scale errors for a strain-load test are the errors observed for the known test loads only. The tolerances to be applied are based on the known test load used for each error that is determined. [2.20, 2.22]

submeter. – A meter or meter system downstream of the electric master meter. [3.40]

(Added 2022)

subordinate graduation. – Any graduation other than a main graduation. (Also see “graduation.”) [1.10]

subsequent distance or time intervals. – The intervals corresponding to money drops following the initial money drop. [5.54]

substitution test. – A scale testing process used to quantify the weight of material or objects for use as a known test load. [2.20]

(Added 2003)

substitution test load. – The sum of the combination of field standard test weights and any other applied load used in the conduct of a test using substitution test methods. [2.20]

(Added 2003)

surface gauge. – A combination of (1) a stationary indicator, and (2) a movable, graduated element designed to be brought into contact with the surface of the liquid from above. [4.42]

systematic (average) error. – The mean value of the error (of indication) for a number of consecutive automatic weighings of a load, or loads, passed over the load-receiving element (e.g., weigh-table), shall be expressed mathematically as:

$$\bar{x} = \frac{\sum x}{n}$$

where: x = error of a load indication
 n = the number of loads

[2.24]

T

tail pulley. – The pulley at the opposite end of the conveyor from the head pulley. [2.21]

take-up. – A device to provide sufficient tension in a conveyor belt so that the belt will be positively driven by the drive pulley. – A counter-weighted take-up consists of a pulley free to move in either the vertical or horizontal direction with dead weights applied to the pulley shaft to provide the tension required. [2.21]

tare mechanism. – A mechanism (including a tare bar) designed for determining or balancing out the weight of packaging material, containers, vehicles, or other materials that are not intended to be included in net weight determinations. [2.20]

tare-weightbeam elements. – The combination of a tare bar and its fractional bar, or a tare bar alone if no fractional bar is associated with it. [2.20]

taximeter. – A device that automatically calculates, at a predetermined rate or rates, and indicates the charge for hire of a vehicle. [5.54]

test accuracy – in-service. – The device accuracy determined by a test made during the period that the system is in service. It may be made on the customer’s premises without removing the system from its mounting or by removing the EVSE for testing either on the premises or in a laboratory or shop. [3.40]

(Added 2022)

test amperes (TA). – The full load current (amperage) specified by the EVSE manufacturer for testing and calibration adjustment. (Example: TA 30). [3.40]

(Added 2022)

test chain. – A device used for simulated tests consisting of a series of rollers or wheels linked together in such a manner as to assure uniformity of weight and freedom of motion to reduce wear, with consequent loss of weight, to a minimum. [2.21]

test liquid. – The liquid used during the test of a device. [3.30, 3.31, 3.34, 3.35, 3.36, 3.37, 3.38]

test object. – An object whose dimensions are verified by appropriate reference standards and intended to verify compliance of the device under test with certain metrological requirements. [5.58]

test puck. – A metal, plastic, or other suitable object that remains stable for the duration of the test, used as a test load to simulate a package. Pucks can be made in a variety of dimensions and have different weights to represent a wide range of package sizes. Metal versions may be covered with rubber cushions to eliminate the possibility of damage to weighing and handling equipment. The puck mass is adjusted to an accuracy specified in N.1.2. Accuracy of Test Pucks or Packages. [2.24]

(Amended 2004)

test train. – A train consisting of or including reference weight cars and used to test coupled-in-motion railway track scales. The reference weight cars may be placed consecutively or distributed in different places within a train. [2.20]

(Added 1990) (Amended 1991)

test weight car. – A railroad car designed to be a stable mass standard to test railway track scales. The test weight car may be one of the following types: a self-contained composite car, a self-propelled car, or a standard rail car. [2.20]

(Added 1991)

testing. – An operation consisting of a series of volumetric determinations made to verify the accuracy of the volume chart that was developed by gauging. [4.42]

thermal overload protector. – A circuit breaker or fuse that automatically limits the maximum current in a circuit. [3.40]

(Added 2022)

time recorder. – A clock-operated mechanism designed to record the time of day. Examples of time recorders are those used in parking garages to record the “in” and “out” time of day for parked vehicles. [5.55]

timing device. – A device used to measure the time during which a particular paid-for service is dispensed. Examples of timing devices are laundry driers, car-wash timers, parking meters, and parking-garage clocks and recorders. [5.55]

tolerance. – A value fixing the limit of allowable error or departure from true performance or value. (Also see “basic tolerances.”) [1.10]

training idlers. – Idlers of special design or mounting intended to shift the belt sideways on the conveyor to assure the belt is centered on the conveying idlers. [2.21]

transfer standard. – A measurement system designed for use in proving and testing cryogenic liquid-measuring devices. [3.38]

tripper. – A device for unloading a belt conveyor at a point between the loading point and the head pulley. [2.21]

U

uncoupled-in-motion railroad weighing system. – A device and related installation characteristics consisting of (1) the associated approach trackage, (2) the scale (i.e., the weighing element, the load-receiving element, and the indicating element with its software), and (3) the exit trackage, which permit the weighing of railroad cars uncoupled in motion. [2.20]

(Added 1993)

underregistration. – See “overregistration” and “underregistration.” [1.10]

unit price. – The price at which the product is being sold and expressed in whole units of measurement. [1.10, 2.20, 3.30, 3.31, 3.32, 3.37, 3.39, 3.40]

(Added 1992) (Amended 2019 and 2022)

unit train. – A unit train is defined as a number of contiguous cars carrying a single commodity from one consignor to one consignee. The number of cars is determined by agreement among the consignor, consignee, and the operating railroad. [2.20]

unit weight. – One contained within the housing of an automatic-indicating scale and mechanically applied to and removed from the mechanism. The application of a unit weight will increase the range of automatic indication, normally in increments equal to the reading-face capacity. [2.20]

user requirement. – A requirement dealing with the selection, installation, use, or maintenance of a weighing or measuring device. User requirements are directed primarily to the users of devices. (Also see Introduction, Section D.) [1.10]

usual and customary. – Commonly or ordinarily found in practice or in the normal course of events and in accordance with established practices. [1.10]

utility-type water meter. – A device used for the measurement of water, generally applicable to meters installed in residences or business establishments. excluding batching meters. [3.36]

(Added 2011)

V

value of minimum graduated interval. – (1) The value represented by the interval from the center of one graduation to the center of the succeeding graduation. (2) The increment between successive recorded values. (Also see “graduated interval.”) [1.10]

vapor equalization credit. – The quantity deducted from the metered quantity of liquid carbon dioxide when a vapor equalizing line is used to facilitate the transfer of liquid during a metered delivery. [3.38]

vapor equalization line. – A hose or pipe connected from the vapor space of the seller’s tank to the vapor space of the buyer’s tank that is used to equalize the pressure during a delivery. [3.38]

vehicle connector. – A device that by insertion into a vehicle inlet, establishes an electrical connection to the electric vehicle for the purpose of providing power and information exchange, with means for attachment of an electric vehicle cable. This device is a part of the vehicle coupler. [3.40]

(Added 2022)

vehicle coupler. – A means enabling the connection, at will, of an electric vehicle cable to the equipment. It consists of a vehicle connector and a vehicle inlet. [3.40]

(Added 2022)

vehicle inlet. – The part incorporated in, or fixed to the vehicle, which receives power from a vehicle connector. [3.40]

(Added 2022)

vehicle on-board weighing system. – A weighing system designed as an integral part of or attached to the frame, chassis, lifting mechanism, or bed of a vehicle, trailer, industrial truck, industrial tractor, or forklift truck. [2.20]

(Amended 1993)

vehicle scale. – A scale (including weigh-in-motion vehicle scales) adapted to weighing highway, farm, or other large industrial vehicles (except railroad freight cars), loaded or unloaded. [2.20]

(Amended 2021)

verification scale division, value of (e). – A value, expressed in units of weight (mass) and specified by the manufacturer of a device, by which the tolerance values and the accuracy class applicable to the device are determined. The verification scale division is applied to all scales, in particular to ungraduated devices since they have no graduations. The verification scale division (e) may be different from the displayed scale division (d) for certain other devices used for weight classifying or weighing in pre-determined amounts, and certain other Class I and II scales. [2.20]

visible type. – A type of device in which the measurement takes place in a see-through glass measuring chamber. [3.30]

v_{\min} (minimum load cell verification interval). – The smallest load cell verification interval, expressed in units of mass* into which the load cell measuring range can be divided. [2.20, 2.24]

[*Nonretroactive as of January 1, 2001]

(Added 1996) (Amended 1999)

volt. – The practical unit of electromotive force. One volt will cause one ampere to flow when impressed across a resistance of one ohm. [3.40]

(Added 2022)

W

watt. – The practical unit of electric power. In an alternating-current (AC) circuit, the power in watts is volts times amperes multiplied by the circuit power factor. [3.40]

(Added 2022)

watthour (Wh). – The practical unit of electric energy that is expended in one hour when the average power consumed during the hour is one watt. [3.40]

(Added 2022)

weighbeam. – An element comprising one or more bars, equipped with movable poises or means for applying counterpoise weights or both. [2.20]

weigh-belt system. – A type of belt-conveyor scale system designed by the manufacturer as a self-contained conveyor system and that is installed as a unit. A unit is comprised of integral components and, at minimum, includes a: conveyor belt; belt drive; conveyor frame; and weighing system. A weigh-belt system may operate at single or multiple flow rates and may use variable-speed belt drives. [2.21]

(Added 2015)

weighing element. – That portion of a scale that supports the load-receiving element and transmits to the indicating element a signal or force resulting from the load applied to the load-receiving element. [2.20, 2.21, 2.22]

(Added 1988)

weigh-in-motion (WIM) vehicle scale. – A vehicle scale adapted to weighing vehicles as they travel across the scale without stopping. [2.20]

(Added 2021)

weigh-labeler. – An automatic weighing system that determines the weight of a package and prints a label or other document bearing a weight declaration for each discrete item (usually a label also includes unit and total price declarations). Weigh-labelers are sometimes used to weigh and label standard and random packages (also called “Prepackaging Scales”). [2.24]

(Amended 2004)

weigh module – The portion of a load-receiving element supported by two sections. The length of a module is the distance to which load can be applied. [2.20]

(Added 2013)

weighment. – A single complete weighing operation. [2.20, 2.21]

(Added 1986)

weight, unit. – See “unit weight.” [2.20]

weight classifier. – A digital scale that rounds weight values up to the next scale division. These scales usually have a verification scale division (e) that is smaller than the displayed scale division. [2.20]

(Added 1987)

weight ranges. – Electrical or electro-mechanical elements incorporated in an automatic indicating scale through the application of which the range of automatic indication of the scale is increased, normally in increments equal to the reading-face capacity. [2.20]

wet basis. – See “moisture content (wet basis).” [5.56(a), 5.56(b)]

wet hose. – A discharge hose intended to be full of product at all times. (Also see “wet-hose type.”) [3.30, 3.31, 3.38, 3.39]

(Amended 2002 and 2019)

wet-hose type. – A type of device designed to be operated with the discharge hose full of product at all times. (Also see “wet hose.”) [3.30, 3.32, 3.34, 3.37, 3.38, 3.39]

(Amended 2002 and 2019)

wheel-load weighers. – Compact, self-contained, portable weighing elements specially adapted to determining the wheel loads or axle loads of vehicles on highways for the enforcement of highway weight laws only. [2.20]

wholesale device. – Any device other than a retail device. (Also see “retail device.”) [3.30, 3.32]

wing pulley. – A pulley made of widely spaced metal bars in order to set up a vibration to shake loose material off the underside (return side) of the belt. [2.21]

Z

zero-load balance. – A correct weight indication or representation of zero when there is no load on the load-receiving element. (Also see “zero-load balance for an automatic-indicating scale,” “zero-load balance for a nonautomatic-indicating scale,” “zero-load balance for a recording scale.”) [2.20]

zero-load balance, automatic-indicating scale. – A condition in which the indicator is at rest at, or oscillates through approximately equal arcs on either side of, the zero graduation. [2.20]

zero-load balance, nonautomatic-indicating scale. – A condition in which (a) the weighbeam is at rest at, or oscillates through approximately equal arcs above and below, the center of a trig loop; (b) the weighbeam or lever system is at rest at, or oscillates through approximately equal arcs above and below, a horizontal position or a position midway between limiting stops; or (c) the indicator of a balance indicator is at rest at, or oscillates through approximately equal arcs on either side of, the zero graduation. [2.20]

zero-load balance for a recording scale. – A condition in which the scale will record a representation of zero load. [2.20]

zero-load reference (belt-conveyor scales). – A zero-load reference value represents no load on a moving conveyor belt. This value can be either; a number representing the electronic load cell output, a percentage of full scale capacity, or other reference value that accurately represents the no load condition of a moving conveyor belt. The no load reference value can only be updated after the completion of a zero load test.[2.21]

(Added 2002)

zero-setting mechanism. – Means provided to attain a zero balance indication with no load on the load-receiving element. The types of zero-setting mechanisms are: [2.20, 2.22, 2.24]

automatic zero-setting mechanism (AZSM). – Automatic means provided to set the zero-balance indication without the intervention of an operator. [2.22]

(Added 2010)

automatic zero-tracking (AZT) mechanism. – See “automatic zero-tracking (AZT) mechanism.” (NOTE: AZT maintains zero with specified limits. “Zero-setting sets/establishes zero with limits based on scale capacity.”) [2.20, 2.22, 2.24]

initial zero-setting mechanism. – Automatic means provided to set the indication to zero at the time the instrument is switched on and before it is ready for use. [2.20]

(Added 1990)

manual zero-setting mechanism. – Nonautomatic means provided to attain a zero balance indication by the direct operation of a control. [2.20]

semiautomatic zero-setting mechanism. – Automatic means provided to attain a direct zero balance indication requiring a single initiation by an operator. [2.20]

(Amended 2010)

zero-setting mechanism (belt-conveyor scale). – A mechanism enabling zero totalization to be obtained over a whole number of belt revolutions. [2.21, 2.23]

(Added 2002)

zero-tracking mechanism. – See “automatic zero-tracking mechanism” under “zero-setting mechanism.” [2.20, 2.22, 2.24]

zone of uncertainty. – The zone between adjacent increments on a digital device in which the value of either of the adjacent increments may be displayed. [2.20]

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CALIFORNIA DEPARTMENT OF
FOOD & AGRICULTURE

Extracts from the
CALIFORNIA CODE OF REGULATIONS
TITLE 4, DIVISION 9

WEIGHTS AND MEASURES FIELD REFERENCE MANUAL (2023)

Chapter 2
Special Equipment
Sections 4050. through 4055.

Article 1. Compressed Gas in Cylinders

Article 2. Vapor Recovery



CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE
DIVISION OF MEASUREMENT STANDARDS

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CHAPTER 2. SPECIAL EQUIPMENT

§§ 4050. - 4055.

Article 1. Compressed Gas in Cylinders.....1
§ 4050. Application.1
§ 4051. Cylinder Labeling.1
§ 4052. Notes.2
 N.1. Specific Volume.....2
 N.2. Verification of Net Quantity.2
 N.3. Allowable Difference.2
§ 4053. Definitions.2

Article 2. Procedures for Type Approval Certification and Field Compliance Testing of Vapor Recovery1
§ 4054. A. Application.....1
 A.1. Vapor recovery systems.1
 A.2. Responsibility of Director and manufacturer.1
 A.3. Procedure.2
 A.5. General code application.2
§ 4054.1. S. Specifications.2
 S.1. Systems Components.....2
 S.2. Field compliance test unit.3
 S.3. Assist system inches of H₂O column vacuum.....4
§ 4054.2. N. Notes -Type Approval Certification Evaluation.5
 N.1. System installation.....5
 N.2. Dispenser measurement accuracy.5
 N.3. Performance accuracy - primary and secondary shut-off devices.5
 N.4. Delivery accuracy - 150 vehicle test.6
 N.5. Performance accuracy - assist system evaporation and volume change.6
 N.6. Independent laboratory evaluation.6
§ 4054.3. T. Tolerances.....7
 T.1. Performance accuracy - primary and secondary shut-off devices.....7
 T.2. Assist system inches of H₂ O column vacuum.7
 T.3. Delivery accuracy - 150 vehicle test.....7
§ 4055. N. Notes-Field Compliance Testing.7
 N.1. Test methods - primary and secondary shut-off devices.7
 N.2. Test procedure - primary and secondary shut-off devices.....7

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS
Title 4, Division 9, Chapter 2, Article 1
2023 Weighing and Measuring Devices §§ 4050 - 4055

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Chapter 2. Special Equipment

Article 1. Compressed Gas in Cylinders

§ 4050. Application.

This code applies to refillable cylinders used for dispensing industrial, domestic and medicinal gases. Compressed gas shall include liquefied as well as non-liquefied gases. The requirements are not in lieu of those of other codes under which a cylinder was constructed, but may be in addition thereto. The code does not apply to cylinders filled for and in the presence of a customer.

Note: Authority cited: Sections 12027 and 12107, Business and Professions Code. Reference: Section 12107, Business and Professions Code.

§ 4051. Cylinder Labeling.

(a) Tare Weight. Cylinders used for the sale of gases by weight or that are filled by weight which in turn is converted to volume shall meet the following conditions:

- (1) Cylinders shall have the tare weight legibly stamped on the cylinder.
- (2) All tare weight values required in this article shall be preceded with the letters "T.W." or the words "Tare Weight."
- (3) The tare weight shall include the weight of the cylinder, the valve and other permanent attachments. The weight of the protective cap shall not be included in either the tare weight or the gross weight.

(b) Actual Tare Weight. When acetylene cylinders are filled but are not acetoned to the stenciled tare weight, the actual tare weight must be shown on the tag with the net contents statement.

(c) Net Contents. The net contents must be expressed in terms of cubic feet, or pounds and ounces, or units of the metric system.

(d) Identity. The identity of the product must be shown.

(e) Name and Address. The name, address and zip code of the responsible company must be shown on cylinder.

(f) Liquefied Petroleum Gas Cylinder Contents. Cylinders or bottles which are prefilled with liquefied petroleum gas prior to sale, shall be labeled with the weight of the contents.

Note: Authority cited: Sections 12027, 12107 and 12609, Business and Professions Code. Reference: Sections 12107 and 12609, Business and Professions Code.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS
Title 4, Division 9, Chapter 2, Article 1
2023 Weighing and Measuring Devices §§ 4050 - 4055

§ 4052. Notes.

N.1. Specific Volume.

The specific volume of acetylene gas at one atmosphere and at the temperature of 70°F shall be 14.7 cubic feet per pound.

N.2. Verification of Net Quantity.

Verification of net quantity statements for cylinders of argon, helium, hydrogen, nitrogen and oxygen shall be in accordance with the Tables of Industrial Gas Container Contents and Density for Oxygen, Argon, Nitrogen, Helium and Hydrogen listed on National Bureau of Standards Technical Note issued in June 1985 and incorporated herein by reference.

N.3. Allowable Difference.

If the stamped or stenciled tare is used to determine the net contents of the cylinder, the allowable difference between the actual tare weight and the stamped (or stenciled) tare weight, or the tare weight on a tag attached to the cylinder, for a new or used cylinder shall be:

- (1) 1/2 percent for tare weights of 20 lb. or less or
- (2) 1/4 percent for tare weights of more than 20 lb.

Average Requirements. When used to determine the net contents of cylinders, the stamped or stenciled tare weights of cylinders at a single place of business found to be in error predominately in a direction favorable to the seller and near the allowable difference limit shall be considered to not be in conformance with these requirements.

Note: Authority cited: Sections 12027 and 12107, Business and Professions Code. Reference: Sections 12100 and 12107, Business and Professions Code.

§ 4053. Definitions.

(a) Cubic Foot. A standard cubic foot of gas which at a temperature of 70 °F and a pressure of 14.696 pounds per square inch absolute occupies one cubic foot.

Note: Authority cited: Sections 12027 and 12107, Business and Professions Code. Reference: Sections 12100 and 12107, Business and Professions Code.

Chapter 2. Special Equipment

Article 2. Procedures for Type Approval Certification and Field Compliance Testing of Vapor Recovery

§ 4054. A. Application.

A.1. Vapor recovery systems.

This code applies to Stage II vapor recovery systems designed to control motor vehicle fuel vapors which result from fueling operations pursuant to Sections 41954, 41956, and 41956.1 of the Health and Safety Code. This code establishes regulations to govern some design characteristics of those systems and their operation to ensure liquid recirculation is prevented.

A.1.1. Balance system. The balance vapor recovery system utilizes fuel delivery nozzles with a bellows and face plate designed to make an “intended tight seal” with the vehicle fill pipe opening. Liquid filling a fuel tank displaces the existing vapor space creating a positive pressure in the tank. That higher pressure achieves equilibrium with the supply tank’s vapor pressure through the vapor return line making the system “balanced”.

A.1.2. Assist system. Assist vapor recovery systems may utilize more than one type of fuel delivery nozzle. One has a bellows and face plate designed to make a “non-intended tight seal” with the vehicle fill pipe opening. Another has no bellows, uses a coaxial metal fill spout with perforations in the outer tube to remove vapors, and allows visual observation of the fill pipe opening. These systems employ a mechanism to create vacuum which “evacuates” displaced vehicle fuel tank vapors by a negative pressure in the vapor return line.

A.2. Responsibility of Director and manufacturer.

A.2.1. Director.

As specified in subsection A.1., a system submitted for type approval certification shall be evaluated by the Director applying the procedures established in this article plus any additional tests he determines necessary to assure compliance of the system with the specifications and performance requirements contained herein.

A.2.2. Manufacturer.

Prior to type approval certification testing, the applicant shall submit information to the Director pertaining to the design of the system, including schematics, blueprints, instruction manuals, brochures, components, and all other information necessary for preliminary review. If defects are found in the design, manufacture, service, repair, or any other characteristic of the system, the Director may permit the applicant to modify and resubmit the system for further review. After successful completion of preliminary review, the applicant shall be authorized to install its system of a specified number of components in a prescribed location for use in the type approval certification testing.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 2, Article 1

2023 Weighing and Measuring Devices §§ 4050 - 4055

A.3. Procedure.

The Secretary shall, in cooperation with the county sealer of weights and measures for the designated location, observe and examine the system in operation normally within 30 to 90 days. One or more examinations shall be conducted during the prescribed test period to determine compliance with Sections 4054.1 and 4054.2 which relate to specifications, performance, and accuracy. If, during or at the conclusion of any examination, the system fails to maintain reliability and accuracy within the tolerances specified in the submission for type approval certification, the Secretary shall so advise the applicant and may refuse further testing unless the defects are corrected. However, type approval certification shall not be issued until the applicant, following successful Division of Measurement Standards field tests, submits a report of evaluation by an independent testing laboratory as specified in Section 4054.2, N.6.

A.5. General code application.

The general code requirements for weighing and measuring devices as specified in Section 4001 shall also apply.

Note: Authority cited: Sections 12107 and 12500.5, Business and Professions Code; and Sections 41956(a) and 41956(c), Health and Safety Code. Reference: Sections 12107 and 12500.5, Business and Professions Code; and Sections 41956(a) and 41956(c), Health and Safety Code.

§ 4054.1. S. Specifications.

S.1. Systems Components.

Systems governed by this article utilizing motor vehicle fuel nozzles shall contain in each nozzle adequate and automatic means to prevent measured liquid from either recirculating (entering the vapor return line) or overflowing a vehicle fill pipe opening.

S.1.1. Nozzles.

- (a) All nozzle types shall have a primary shut-off device which automatically activates when liquid covers the nozzle primary shut-off sensing mechanism.
- (b) Balance type nozzles shall have a secondary shut-off device or other effective means to prevent liquid recirculation. Secondary shut-off devices shall automatically activate after liquid has entered the vapor return line because the primary shut-off device has failed. (Typically, secondary shut-off devices are pressure-activated and shut off when liquid in the vapor return line blocks the return of vapors).
- (c) Assist type nozzles may have a secondary shut-off device or else some other effective means to avoid liquid overflowing a vehicle fuel tank because the primary shut-off device has failed. "Other effective means" include, but are not limited to, permitting liquid to be seen either by observing the fill pipe opening or hearing and seeing liquid overflow spillage.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS
Title 4, Division 9, Chapter 2, Article 1
2023 Weighing and Measuring Devices §§ 4050 - 4055

S.2. Field compliance test unit.

S.2.1. Use. The field compliance test unit shall be used to examine the proper operation of:

- (a) primary shut-off devices,
- (b) secondary shut-off devices, and
- (c) inches of H₂O column vacuum for assist systems.

S.2.2. Design.

S.2.2.1. Tank.

The test unit shall be a rigid metal vessel 13-inches high and 9-inches in diameter with a liquid capacity of 3 gallons (all measurements approximate). A commercial-sized, 30 pound Freon recharging tank is typically used.

S.2.2.2. Base support/stand. The test unit may be supported either:

- (a) on a metal base 3/16-inch thick, 6-inches wide, and 17-1/2 inches long (all measurements approximate) or,
- (b) by a stand which elevates the test unit to accommodate a bottom-inserted 3/4 inch ball valve for emptying purposes.

S.2.2.3. Fuel fill pipe. The test unit shall have a metal fuel fill pipe welded to the tank at a 45 degree angle from horizontal. Placement of the fill pipe is critical. It shall enter the test unit at the middle of the curvature between the top and sides of the vessel so that a specified ullage (vapor space) is created. The fill pipe shall have no internal vent, shall be 2-1/4-inch outside diameter and 10 inches long (both measurements approximate), and shall extend inside the tank no more than 1/4 inch. A longitudinal part of the fill pipe near its fill opening shall be cut away in order to observe that the nozzle primary shut-off device sensing mechanism is immersed in liquid. The cut-away is approximately 5 inches long to a depth of 1/2 the pipe's diameter. The fill pipe shall have transparent flexible tubing slipped over its entire length. The fill opening shall be modified to accommodate nozzle spouts at least 15/16 inch outside diameter (leaded fuel). The test unit shall be airtight when the fill pipe opening is sealed.

S.2.2.4. Other Equipment. A rigid, transparent plastic tube approximately 12 inches long and 3-7/8 inches inside diameter shall be installed around the fill pipe to contain liquid overflow. A 5/16-inch valve with an outlet to attach a hose shall be installed at the top center of the vessel for obtaining pressure readings. Handles for carrying and emptying the test unit may be attached. All metal part of the test unit shall be electrically bonded together. Refer to the test unit illustrations in Figure 1.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS
Title 4, Division 9, Chapter 2, Article 1
2023 Weighing and Measuring Devices §§ 4050 - 4055

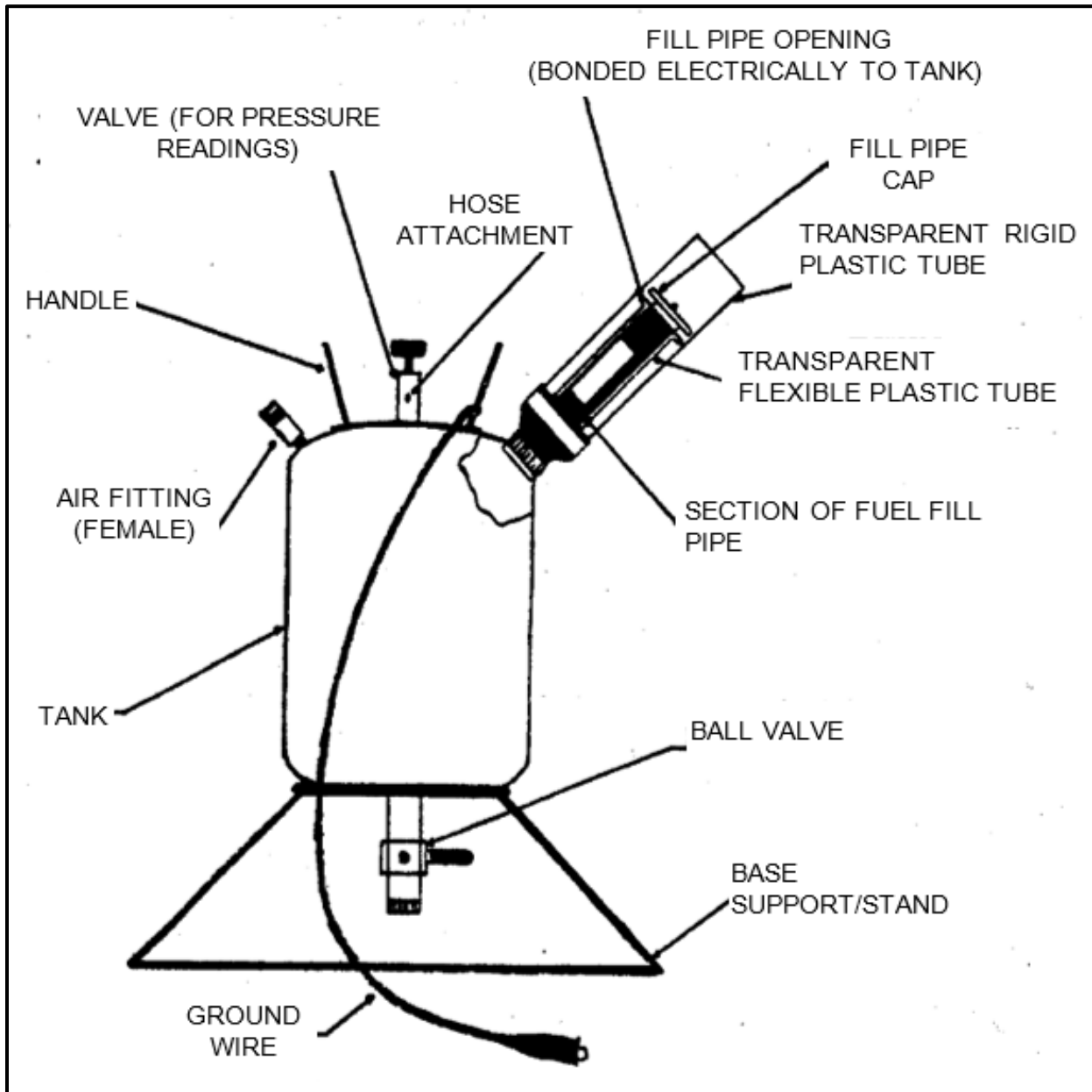


Figure 1 - Field Compliance Vapor Recovery Test Unit

S.3. Assist system inches of H₂O column vacuum.

Assist vapor recovery systems with booted nozzle spouts that can form a closed seal around the vehicle filler neck shall be designed to operate at not more than -10 inches H₂O column vacuum as measured at the nozzle or test unit during a delivery typical of customer usage.

Note: Authority cited: Sections 12107 and 12500.5, Business and Professions Code; and Sections 41956(a) and 41956(c), Health and Safety Code. Reference: Sections 12107 and 12500.5, Business and Professions Code; and Sections 41956(a) and 41956(c), Health and Safety Code.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS
Title 4, Division 9, Chapter 2, Article 1
2023 Weighing and Measuring Devices §§ 4050 - 4055

§ 4054.2. N. Notes -Type Approval Certification Evaluation.

N.1. System installation.

A minimum of 6 nozzles shall be installed in a test location for evaluation purposes. Hoses shall be selected to anticipate maximum customer usage and efficient observer interaction. The test nozzles shall not fail to operate as designed for the duration of the evaluation.

N.2. Dispenser measurement accuracy.

Prior to the field examination of a vapor recovery system, the dispenser meters for the test nozzles shall be tested and adjusted, if necessary, to be within maintenance tolerance.

N.3. Performance accuracy - primary and secondary shut-off devices.

N.3.1. Test method. Examination of the test nozzles shall be performed with a field compliance test unit as specified in subsection S.2.

Note: Two or more test units will expedite the examination significantly.

N.3.1.1. Test procedure - primary shut-off device.

N.3.1.1.1. Initial test. Dispense fuel into the test unit with each nozzle. All nozzles shall shut off automatically at any delivery flow rate as the test unit becomes full as specified in subsection S.1.1.(a).

N.3.1.1.2. Override test. After the initial primary shut-off device activates, dispense enough additional fuel into the test unit to immerse the nozzle primary shut-off sensing mechanism in liquid. Record the dispenser indicator gallons.

Make 10 additional consecutive override attempts duplicating a range of customer usage and record the new indicated gallons. All 10 attempts shall result in automatic nozzle shut off before the dispenser volume indicator increases more than the 1/10 gallon limit as specified in subsection T.1.1. The 10 override attempts shall be performed on a minimum of 6 nozzles, each tested a minimum of 3 times during this examination.

N.3.1.2. Test procedures - secondary shut-off device (if equipped). Introduce sufficient fuel into the vapor return line (approximately 1/10 gallon or 375 milliliter) to block the return of vapors through the line. Hold in place a "U-shaped" configuration of the fuel discharge hose at a level lower than the nozzle to concentrate the liquid. Make a minimum of 10 attempts to dispense fuel into an empty test unit. Record the dispenser indicator gallons before and after each attempt. (Balance-type nozzles must make their intended tight seal at the fill pipe opening.) The nozzle shall shut off automatically before the dispenser volume indicator increases more than the 3/10 gallon limit for each attempt as specified in subsection T.1.2. This procedure shall be performed on a minimum of 6 nozzles.

Notes: (1) The test unit must be empty initially to insure liquid does NOT interact with the primary shut-off device sensing mechanism. (2) For some hose configurations,

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 2, Article 1

2023 Weighing and Measuring Devices §§ 4050 - 4055

introducing additional fuel into the vapor return line during the test procedure may be necessary. Introduced liquid can be returned to storage by building vapor line pressure produced by this procedure.

N.4. Delivery accuracy - 150 vehicle test.

N.4.1. Test method. Compliance with delivery accuracy requirements shall be based upon data recorded for at least 150 vehicles while observing customers fueling (self-serve) with the test nozzles under normal field conditions.

N.4.2. Test procedure. Install a transparent trap, or other suitable means, between each nozzle and dispenser outlet connection for the hose. Any liquid entering a vapor return line will be collected while observing the fueling operations. Then after each fueling, the liquid shall be drained into the trap, removed, and measured. Trap placement and observer actions shall produce the least possible interference with normal operations at the test location.

The liquid collected from both one individual delivery and the total of all individual deliveries shall not exceed the tolerances as specified in subsections T.3.(a) and T.3.(b), respectively.

The 150 or more vehicles shall be representative of California vehicles, including various sizes of passenger vehicles, vans, and trucks. This examination shall include varied fuel delivery rates and nozzle orientations plus complete and partial fills. The system may be retested if the Director by his own initiative, or at the request of the applicant, determines the test was not representative of field conditions.

N.5. Performance accuracy - assist system evaporation and volume change.

N.5.1. Test method. An appropriate means (manometer, column gauge, etc.) shall be used to determine the inches of H₂O column vacuum for nozzles where the spout is booted and can form a closed seal around the vehicle filler neck. Excessive vacuum may result in artificial evaporation of customer fuel which would decrease the measured volume and also cause possible implosion of vehicle fuel tanks.

N.5.2. Test procedure. Install the vacuum indicator at the nozzle or test unit. Record the value of the reading while the system is operating in a normal manner to determine if it is functioning within the -10 inches H₂O column vacuum limit as specified in subsection T.2.

N.6. Independent laboratory evaluation.

Pursuant to Section 41958 of the Health and Safety Code, type approval certification regarding recirculation shall include evaluations by Underwriters Laboratories (U.L.) or a similar independent laboratory selected by the Secretary. Reports required by other State agencies may be used to determine compliance with this section. The laboratory evaluation shall determine but is not limited to, proper secondary shut-off device operation for nozzles where the spout is booted and can form a closed seal around the vehicle filler neck with the primary shut-off device inoperable.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 2, Article 1

2023 Weighing and Measuring Devices §§ 4050 - 4055

Note: Authority cited: Sections 12107 and 12500.5, Business and Professions Code; and Sections 41956(a) and 41956(c), Health and Safety Code. Reference: Sections 12107 and 12500.5, Business and Professions Code; and Sections 41956(a) and 41956(c), Health and Safety Code.

§ 4054.3. T. Tolerances.

T.1. Performance accuracy - primary and secondary shut-off devices.

T.1.1. Primary shut-off device overrides. The required, additional attempts, in total, to override any nozzle primary shut-off device shall not increase the dispenser volume indication by more than 1/10 gallon.

T.1.2. Secondary shut-off device. With the vapor return line blocked by fuel (simulating recirculation due to primary shut-off device failure), each attempt to dispense fuel shall result in automatic nozzle shut off before the dispenser volume indication increases more than 3/10 gallon.

T.2. Assist system inches of H₂O column vacuum.

Assist vapor recovery systems shall operate at the inches of H₂O column vacuum recommended by the manufacturer, but shall not exceed -10 inches of H₂O column vacuum for nozzles where the spout is booted and can form a closed seal around the vehicle filler neck.

T.3. Delivery accuracy - 150 vehicle test.

The quantity of measured liquid collected in the vapor return line/lines shall not exceed both:

- (a) 0.2 percent of any one individual vehicle fuel delivery, and
- (b) 0.02 percent of the sum of the fuel deliveries to all vehicles observed (150 or more) during the delivery accuracy tests.

Note: Authority cited: Sections 12107 and 12500.5, Business and Professions Code; and Sections 41956(a) and 41956(c), Health and Safety Code. Reference: Sections 12107 and 12500.5, Business and Professions Code; and Sections 41956(a) and 41956(c), Health and Safety Code.

§ 4055. N. Notes-Field Compliance Testing.

N.1. Test methods - primary and secondary shut-off devices.

Examination of primary and secondary shut-off devices to determine the acceptability of an individual nozzle shall be performed using motor vehicles with fuel tanks and fill pipes representative of California vehicles and/or a field compliance test unit as specified in subsection S.2.

N.2. Test procedure - primary and secondary shut-off devices.

N.2.1 Initial test - primary shut-off device. Dispense fuel into the fill pipe opening of a vehicle fuel tank or test unit in accordance with the instructions for the vapor recovery

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 2, Article 1

2023 Weighing and Measuring Devices §§ 4050 - 4055

device, if any, and common public usage. The nozzle shall shut off automatically when the nozzle primary shut-off sensing mechanism is covered by the liquid. Automatic nozzle shut off shall occur with the dispenser operating at discharge rates both greater than and equal to the minimum rate allowed by the slowest hold-open clip setting, if any, or 3 gallons per minute, whichever is less.

N.2.2. Override test - primary shut-off device. After the initial primary shut-off device activates, dispense enough additional fuel into the test unit to immerse the nozzle primary shut-off sensing mechanism in liquid. Record the dispenser indicator gallons. Make 6 additional, consecutive override attempts duplicating a full range of potential customer usage and record the new indicated gallons. All 6 attempts shall result in automatic nozzle shut off before the dispenser volume indicator increases more than the 1/10 gallon limit as specified in subsection T.1.1.

Note: A test unit must be used for this procedure so the primary shut-off device sensing mechanism can be seen immersed in liquid.

N.2.3. Secondary shut-off device (if equipped). Introduce sufficient fuel into the vapor return line (approximately 1/10 gallon or 375 milliliter) to block the return of vapors through the line. Hold in place a “U-shaped” configuration of the fuel discharge hose at a level lower than the nozzle to concentrate the liquid. Make one or more attempts to dispense fuel into an empty test unit or vehicle fuel tank that is within 3 gallons of being full, including the fill pipe. (Balance-type nozzles must make their intended tight seal at the fill pipe opening.) The nozzles shall shut off automatically before the dispenser volume indicator increases more than the 3/10 gallon limit for each attempt as specified in subsection T.1.2.

N.3. Assist systems.

To test assist systems for proper operation at the specified inches of H₂O column vacuum, refer to Section 4054.2, N.5.

NOTE: Authority cited: Sections 12107 and 12500.5, Business and Professions Code; and Sections 41956(a), and 41956(c), Health and Safety Code. Reference: Sections 12107 and 12500.5, Business and Professions Code; and Sections 41956(a) and 41956(c), Health and Safety Code.



CALIFORNIA DEPARTMENT OF
FOOD & AGRICULTURE

Extracts from the
CALIFORNIA CODE OF REGULATIONS
TITLE 4, DIVISION 9

WEIGHTS AND MEASURES FIELD REFERENCE MANUAL (2023)

Chapter 3
Device Inspection
Sections 4070. through 4075.

Article 1. Frequency of Inspection

Article 2. Alternatives to Specified Frequency of Inspection

Article 3. Device Administration Fee



CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE
DIVISION OF MEASUREMENT STANDARDS

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This document represents the Division of Measurement Standards' field manual for enforcing regulations pertaining to weights and measures in California. This field manual is not to be considered as the official Code of Regulations, as published by Barclays Law Publishers.

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EXTRACT FROM CALIFORNIA CODE OF REGULATIONS
Title 4, Division 9, Chapter 3
2023 Device Inspection Devices §§ 4070 - 4075

Chapter 3. Device Inspection §§ 4070. – 4075.....1

Article 1. Inspection Frequency1
Section 4070. Inspection Frequencies.1

Article 2. Alternatives to the Specified Inspection Frequencies2
Section 4071. Alternative Inspection Plan Requests.2
Section 4072. [Repealed]3
Section 4073. Submittal and Approval of an Alternative Plans.....3
Section 4074. Approved Alternative Activities Related to Weights and Measures.4

Article 3. Annual Device Administrative Fee4
Section 4075. Administration.....4

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS
Title 4, Division 9, Chapter 3
2023 Device Inspection Devices §§ 4070 – 4075

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Chapter 3. Device Inspection §§ 4070. – 4075.

Article 1. Inspection Frequency

Section 4070. Inspection Frequencies.

The inspection frequencies for weighing and measuring devices used for commercial and law enforcement purposes, and other devices required by law to be inspected by a sealer, are established in Table 1: Inspection Frequencies (By Device Type). The specified times are maximum times between inspections. More frequent inspections may be conducted if requested by the device user, during a complaint investigation, or on the initiative of a sealer. For purposes of this chapter, the term “inspection” applies to a sealer inspecting, trying, and testing a device for applicable specifications, tolerances, and other technical requirements adopted in Chapter 1 of this division.

Table 1: Inspection Frequencies (By Device Type)

Submeter/Meter/Measuring Devices.	Scales/Weighing Devices.	Frequency.
<ul style="list-style-type: none"> • Electric Watt-Hour Submeter. • Hydrocarbon Vapor Submeter. • Water Submeter (Domestic Service). 	NA	10 years.
<ul style="list-style-type: none"> • Electric Vehicle Fueling Systems/Electric Vehicle Supply Equipment (EVSE). 	<ul style="list-style-type: none"> • Prescription (Pharmacies). 	2 years.
<ul style="list-style-type: none"> • Fabric-/Wire- and Cordage-Measuring Device. • Grain Moisture Meter. • Grease and Lubricant Meter. • Hydrogen Gas-Measuring Device. 	<ul style="list-style-type: none"> • Automatic Bulk Weighing System for Grain. • Belt Conveyors. • Class I (Other Than Prescription). • Class II (Other Than Prescription). 	Annual
<ul style="list-style-type: none"> • Liquefied Gas Meters: <ul style="list-style-type: none"> • Carbon Dioxide Liquid-Measuring Device (CO₂). • Cryogenic Liquid-Measuring Device. • Liquefied Petroleum Gas (LPG). 	<ul style="list-style-type: none"> • Class III (Other Than Prescription). • Computing. 	Annual
<ul style="list-style-type: none"> • Mass Flow Meters: <ul style="list-style-type: none"> • Compressed Natural Gas Meter (CNG). • Liquefied Natural Gas Meter (LNG). 	<ul style="list-style-type: none"> • Counter. • Crane. • Dormant. 	Annual

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS
 Title 4, Division 9, Chapter 3
 2023 Device Inspection Devices §§ 4070 – 4075

Submeter/Meter/Measuring Devices.	Scales/Weighing Devices.	Frequency.
<ul style="list-style-type: none"> • Odometer. • Retail Meter. • Retail Motor Fuel Dispenser. • Retail Water Meter. • Tank (Liquid Test). • Taximeter. • Vehicle-Tank Meter. • Water Submeter (All Others). • Wholesale Meter. • Miscellaneous Measuring Device¹. • Miscellaneous Weighing Device². 	<ul style="list-style-type: none"> • Hanging. • Hopper and Tank. • Livestock/Animal. • Meat Beam/Monorail. • Portable Platform. • Railway Track. • Spring. • Vehicle. • Vehicle On-Board (Forklift). 	Annual
<ul style="list-style-type: none"> • Farm Milk Tank. • Linear Measure (Standard). 	NA	Initial, Plus Annual Visual Inspection.
<ul style="list-style-type: none"> • Dry Measure (Standard). • Dry, Measured (Tank or Container). • Glass Graduate (Standard). • Liquid Gauged (Tank or Container). 	NA	Initial Only.
¹ "Miscellaneous Measuring Device" includes all other commercial measuring device types that are not specified in Table 1. ² "Miscellaneous Weighing Device" includes all other commercial weighing device types that are not specified in Table 1.		

Note: Authority cited: Sections 12027 and 12212, Business and Professions Code. Reference: Section 12212, Business and Professions Code.

Article 2. Alternative to the Specified Inspection Frequencies

Section 4071. Alternative Inspection Plan Requests.

A county sealer may submit a written request to the Secretary to implement an alternative inspection plan including inspection frequencies different from those specified in Section 4070, Table 1. For purposes of this article, an alternative inspection plan is referred to as an alternative plan. Upon written approval by the Secretary, a portion of the county sealer's resources shall be made available for other activities related to weights and measures specified in Section 4074. Upon granting such approval, the Secretary will instruct the county sealer to perform such alternative activities related to weights and measures.

Note: Authority cited: Sections 12027 and 12212, Business and Professions Code. Reference: Section 12212, Business and Professions Code.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 3

2023 Device Inspection Devices §§ 4070 – 4075

Section 4072. [Repealed]

Note: Authority cited: Sections 12027 and 12212, Business and Professions Code. Reference: Section 12212, Business and Professions Code.

Section 4073. Submittal and Approval of an Alternative Plan.

- (a) The written request specified in Section 4071 shall include, but is not limited to:
- (1) A listing of devices formatted similar to Section 4070, Table 1, proposing the alternate inspection frequency for each specified device type. The alternative plan shall stipulate which device types will be inspected on a regular frequency, a variable frequency, or on the basis of a statistical sampling procedure.
 - (2) A description of the justification and findings that support the county's request. This includes, but is not limited to:
 - (A) Evidence of satisfactory and continuing accuracy of weighing and measuring devices that may be affected by the alternative plan;
 - (B) The alternative activities related to weights and measures that will be performed; and
 - (C) A description of the added benefits to consumers and businesses in the county.
- (b) Once approved by the Secretary, the county sealer shall submit any reports requested by the Secretary regarding implementation of the alternative plan.
- (c) The Secretary's approval will remain in effect for five years, after which the alternative plan will expire and all device inspection frequencies will revert to those established in Section 4070, Table 1. Alternative plans approved by the Secretary prior to July 1, 2021, will remain in effect until July 1, 2026.
- (d) Notwithstanding subsection (c), the Secretary may withdraw, modify, or terminate the alternative plan at any time it is determined that the provisions of this chapter are not being fulfilled by the county sealer.
- (e) If an alternative plan expires, requires modification, or has been withdrawn or terminated, a county sealer may submit a new written request in accordance with subsection (a). The Secretary shall evaluate the county's new request to implement an alternative plan and perform other activities related to weights and measures based upon the county's current resources and needs.

Note: Authority cited: Sections 12027 and 12212, Business and Professions Code. Reference: Sections 12210 and 12212, Business and Professions Code.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 3

2023 Device Inspection Devices §§ 4070 – 4075

Section 4074. Approved Alternative Activities Related to Weights and Measures.

- (a) The additional resources made available to a county sealer by provision of this article shall be used to implement one or more of the following alternative activities related to weights and measures:
- (1) Inspection of consumer commodities and packages.
 - (2) Verifying accuracy of retail delivery of weighed, measured and counted commodities.
 - (3) Educational activities related to weights and measures enforcement.
 - (4) Other activities related to weights and measures proposed by the county sealer and approved by the Secretary.
- (b) Unless otherwise designated by the Secretary, the county sealer shall apportion the resources needed to implement such alternative activities at the county sealer's discretion to best accomplish the purpose of this article.

Note: Authority cited: Sections 12027 and 12212, Business and Professions Code. Reference: Sections 12210 and 12212, Business and Professions Code.

Article 3. Annual Device Administrative Fee

Section 4075. Administration.

- (a) Each county office of weights and measures shall:
- (1) Collect for the Department an annual device administrative fee (administrative fee) as specified in Table A: Annual Device Administrative Fee Schedule (By Device Type) for every weighing, measuring, and counting device registered in that county.
 - (2) Collect administrative fees at the same time it collects its business location and device fees for each device registered in that county.
 - (3) Remit to the Department the administrative fees collected between January 1 and June 30 no later than July 31 of the same year and the administrative fees collected between July 1 and December 31 no later than January 31 of the following calendar year.
 - (4) Include with payment of administrative fees a letter of remittance, on county letterhead, that indicates the payment period, the number of devices in each device fee category, the total administrative fees paid for each category, and the grand total administrative fees paid to the Department.
- (b) Each county office of weights and measures may retain up to a maximum of 12% of the total administrative fees collected to recover, but not exceed, its necessary and reasonable costs of assessing, collecting, and remitting administrative fees in accordance with this section.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS
Title 4, Division 9, Chapter 3
2023 Device Inspection Devices §§ 4070 – 4075

Table A: Annual Device Administrative Fee Schedule (By Device Type)			
Fee Category.	Submeter/Meter/Measuring Devices.	Scales/Weighing Devices.	Administrative Fee.
1	<ul style="list-style-type: none"> • Electric Watt-Hour Submeter. • Hydrocarbon Vapor Submeter. • Water Submeter (Domestic Service). 	NA	\$0.50.
2	<ul style="list-style-type: none"> • Electric Vehicle Fueling Systems/Electric Vehicle Supply Equipment (EVSE). • Fabric-/Wire- and Cordage-Measuring Device. • Grain Moisture Meter. • Grease and Lubricant Meter. • Odometer. • Retail Meter. • Retail Motor Fuel Dispenser. • Retail Water Meter. • Tank (Liquid Test). • Taximeter. • Vehicle-Tank Meter. • Wholesale Meter. • Miscellaneous Measuring Device¹. 	Weighing device with <2,000 pounds capacity.	\$2.20.
3	<ul style="list-style-type: none"> • Hydrogen Gas-Measuring Device. • Liquefied Gas Meters: <ul style="list-style-type: none"> – Carbon Dioxide Liquid-Measuring Device (CO₂). – Cryogenic Liquid-Measuring Device. – Liquefied Petroleum Gas (LPG). • Mass Flow Meters: <ul style="list-style-type: none"> – Compressed Natural Gas Meter (CNG). – Liquefied Natural Gas Meter (LNG). 	Weighing device with ≥2,000 pounds but ≤10,000 pounds capacity.	\$16.00.
4	NA	Weighing device with >10,000 pounds capacity.	\$24.00.

¹ “Miscellaneous Measuring Device” includes all other commercial measuring device types that are not specified in Table A.

Note: Authority cited: Sections 12027, 12107 and 12241, Business and Professions Code.
Reference: Sections 12107 and 12241, Business and Professions Code.



Extracts from the
CALIFORNIA CODE OF REGULATIONS
TITLE 4, DIVISION 9

WEIGHTS AND MEASURES FIELD REFERENCE MANUAL (2023)

Chapter 4
Registration of Service Agencies for Commercial
Weighing and Measuring Devices
Sections 4080. through 4088.



CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE
DIVISION OF MEASUREMENT STANDARDS

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Chapter 4 Registered Service Agencies
§§ 4080. – 4088.

Chapter 4. Registration of Service Agencies For Commercial Weighing and Measuring Devices 1

§ 4080. Application..... 1

§ 4081. Registration of Service Agencies and Service Agents Required. 1

§ 4082. Fees..... 1

§ 4083. Examinations/Licenses..... 1

§ 4084. Authority for Service Agency to Place a Device into Service..... 2

§ 4085. Responsibility of a Service Agency..... 3

§ 4086. Certification of Service Agency Standards..... 4

§ 4087. Payments to Counties..... 4

§ 4088. Advisory Committee..... 5

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS
Title 4, Division 9, Chapter 4
2023 Commercial Weighing and Measuring Devices §§ 4080 – 4088

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Chapter 4. Registration of Service Agencies For Commercial Weighing and Measuring Devices

§ 4080. Application.

This chapter applies to any person performing duties as a service agency or service agent.

NOTE: Authority cited: Section 12027, Business and Professions Code. Reference: Section 12531, Business and Professions Code.

§ 4081. Registration of Service Agencies and Service Agents Required.

- (a) Each service agency shall forward to the Department, with the appropriate registration fee (Business and Professions Code Section 12535), the name and license number of a service agent within 30 days of hiring by the service agency.
- (b) The registration of a service agent shall expire upon termination of employment with the service agency.
- (c) Each service agency shall notify the Department within 30 days of the termination of a service agent.

NOTE: Authority cited: Section 12027, Business and Professions Code. Reference: Sections 12531 and 12532, Business and Professions Code.

§ 4082. Fees.

- (a) Any fee not paid when due, or sent by mail and post-marked five days or more after the due date, is overdue.
- (b) To any fee that is overdue and paid within 30 days of the due date, a penalty equal to 30 percent of the amount of the original fee shall be added.
- (c) To any fee paid more than 30 days after the due date, a penalty equal to 50 percent of the amount of the original fee shall be added.

NOTE: Authority cited: Section 12027, Business and Professions Code. Reference: Section 12535, Business and Professions Code.

§ 4083. Examinations/Licenses.

(a) License Application: Applicants for a service agent license must provide their name, address, and proof of identity by means of a picture identification. At the time of examination, applicants shall pay an examination fee of \$35. Applicants renewing an existing license shall also provide the current license number.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS
Title 4, Division 9, Chapter 4
2023 Commercial Weighing and Measuring Devices §§ 4080 – 4088

(b) Examination Procedure: Written examinations will be administered by a county weights and measures office or the Division of Measurement Standards. The examination shall be administered according to instructions issued by the Division of Measurement Standards “Administration of Service Agent Examination” (Est. 8/00), which is incorporated by reference. Applicants will be advised of the results on the day of the examination. The proctor and applicant shall certify under penalty of perjury that the examination was given in accordance with the procedures specified.

(c) Qualification for a License: An applicant must receive a minimum score of 70 percent to qualify for a service agent license. Successful applicants will be provided with a service agent license at that time. Except as provided for in subsection (g), such license shall be valid for a period of five years from date of issue.

(d) Retention and Notification: Examination information will be retained in the county or state office where administered for a period of five years. County offices will provide to the Division of Measurement Standards within 30 days the names of individuals to whom service agent licenses have been issued.

(e) Failure and Reexamination: Applicants failing to receive a passing score may schedule an appointment to be reexamined. The fee specified in subsection (a) shall be paid each time the examination is taken. Reexaminations are subject to all the above conditions.

(f) Replacement License: A lost or mutilated license may only be replaced by the Division of Measurement Standards. Before a replacement license is issued, the licensee must provide a written request including the following information: the name as it appeared on the original license, the licensee’s signature and current address, and a fee of \$10. If a licensee satisfies these requirements, a replacement license will be issued.

(g) License Renewal: To maintain a service agent license, applicants may take the examination on or up to 90 days before the expiration date of their current license. Successful applicants will receive a five year extension of the license period.

NOTE: Authority cited: Section 12027, Business and Professions Code. Reference: Section 12540, Business and Professions Code.

§ 4084. Authority for Service Agency to Place a Device into Service.

Pursuant to Business and Professions Code Sections 12509 and 12532(d), a service agency may perform any of the following:

- (a) place a correct device into service,
- (b) remove an “out-of-order” notice to perform the service, and must replace the notice if the device cannot be corrected, or
- (c) remove an “out-of-order” notice from a corrected device and place it into service.

NOTE: Authority cited: Sections 12027, 12532(b) and 12509, Business and Professions Code. Reference: Sections 12531 and 12532, Business and Professions Code.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS
Title 4, Division 9, Chapter 4
2023 Commercial Weighing and Measuring Devices §§ 4080 – 4088

§ 4085. Responsibility of a Service Agency.

(a) Each service agency shall be responsible for compliance with the following:

(1) Repairing or Placing Devices into Service. - Each service agency shall place into service, upon installation or following repair, a device in such a manner that it meets all the requirements of Division 5 of the California Business and Professions Code and all the requirements of the California Code of Regulations, Title 4, Division 9. Weighing or measuring devices which are not “correct”, as defined by Section 12500(c) of the Business and Professions Code, shall not be placed into service.

(2) Notice to County Sealer of Repairing or Placing of Device into Service by Service Agency. - Each service agency shall notify the county sealer of the repairing or placing in service of any device. The notice shall be in writing, and transmitted to the county sealer within the 24-hour period following the repair, except as provided by Business and Professions Code Section 12515(b).

The notification shall include the following minimum identifying information;

- (i) Name and address of service agency.
- (ii) Location of device(s). Name and address, including if available the unique identifier used by the business (e.g., pump or checkstand number).
- (iii) Name of service agent.
- (iv) Date of adjustment, repair, placing, or replacing into service.
- (v) Name of device manufacturer(s).
- (vi) Model designation(s) and serial number(s) of the device(s).
- (vii) On new installations, the National Institute of Standards and Technology or National Conference on Weights and Measures Certificate of Conformance number(s) for each separately approved component or device, if marked on the component or device.

(3) Security Seal. - Service agents shall replace a security seal on any adjustment mechanism where the seal was required to be removed for service, repair, or installation. Before placing a device into service, service agents shall install a security seal on any adjustment mechanism designed to be sealed.

(4) Identification of Service Agency Work. - Service agents shall identify their work on each device by applying an adhesive tag or label in a conspicuous location on the device. The adhesive tag or label shall show the name, registration number and business telephone number of the service agency, the license number of the service agent performing the work, and the date. Any security seal required pursuant to Section 12107 of the California Business and Professions Code shall show the registration number of the service agency and the year the security seal was placed on the device.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS
Title 4, Division 9, Chapter 4
2023 Commercial Weighing and Measuring Devices §§ 4080 – 4088

(5) Certificate of Accuracy of Standards. - A service agency shall, on request from a sealer, show a copy of the certification of accuracy for the standards used to place a device into service.

NOTE: Authority cited: Sections 12027 and 12107, Business and Professions Code.
Reference: Sections 12515(a), 12531, 12532(h) and 12533, Business and Professions Code.

§ 4086. Certification of Service Agency Standards.

Each service agency shall have its standards certified at the service agency's expense. Standards shall be tested and certified by either the Department or other metrology laboratories traceable to the National Institute of Standards and Technology (NIST). These laboratories include those in county weights and measures programs, industry, and other states that have been approved, certified, or accredited by NIST, or the Department in accordance with criteria established by NIST, or by other appropriate national or international accrediting organizations. The standards shall be certified as often as the Department deems necessary, based upon a review of supporting statistical data resulting from previous certifications, but in no event shall the period of time between certifications exceed 10 years. In the absence of supporting statistical data, standards shall be certified at least every two years.

NOTE: Authority cited: Sections 12027 and 12314, Business and Professions Code.
Reference: Sections 12531(e), 12533 (a)(1), 12533(a)(2) and 12534, Business and Professions Code.

§ 4087. Payments to Counties.

Payment to counties shall be subject to the following conditions:

- (a) Each county shall report annually, before November 1, expenditures for the prior fiscal year, which shall be the period from July 1 through June 30.
- (b) The county report, which shall be subject to audit, shall be submitted on form number 40-008A "County Annual Report" (Rev. 8/00), which is incorporated by reference.
- (c) Any county not submitting a report by the prescribed date may be excluded from payment for that year.
- (d) Payment for each fiscal year shall be based on the registration fees received for the same fiscal year.
- (e) Payments to counties, based on expenditures which occurred during the previous fiscal year, will be made on or about January 31 of each year.

NOTE: Authority cited: Sections 12027 and 12537, Business and Professions Code.
Reference: Sections 12209(c) and 12537, Business and Professions Code.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS
Title 4, Division 9, Chapter 4
2023 Commercial Weighing and Measuring Devices §§ 4080 – 4088

§ 4088. Advisory Committee.

- (a) Members of the Committee shall receive no compensation, but are entitled to payment of necessary traveling expenses in accordance with State Administrative Manual Section 0774 (Rev. 9/91) and the rules of the Department of Personnel Administration.
- (b) The Committee shall be advisory to the Department and may make recommendations on all matters pertaining to service agencies and/or service agents.
- (c) The Committee shall elect a chairman and other officers as it deems advisable.
- (d) The Committee shall meet at the call of the chairman or the Department, or at the request of any four members of the Committee. The Committee shall meet at least once a year.
- (e) A quorum shall consist of five members. A vote of the majority of the members present at a meeting at which there is a quorum shall constitute an act of the Committee.

NOTE: Authority cited: Sections 12027 and 12541(a), Business and Professions Code; Government Code 19815.4(d). Reference: Section 12541(a)(d), Business and Professions Code.



Extracts from the
CALIFORNIA CODE OF REGULATIONS
TITLE 4, DIVISION 9

WEIGHTS AND MEASURES FIELD REFERENCE MANUAL (2023)

Chapter 5
Billing for Utility Services
Section 4090.



CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE
DIVISION OF MEASUREMENT STANDARDS

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This document represents the Division of Measurement Standards' field manual for enforcing regulations pertaining to weights and measures in California. This field manual is not to be considered as the official Code of Regulations, as published by Barclays Law Publishers.

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For information concerning the contents of this document, please contact the Division of Measurement Standards by e-mail at dms@cdfa.ca.gov.

Chapter 5. Billing for Utility Services

§ 4090. Billing for Utility Service.

Application. This section applies to operators who provide utility service(s) to customers through commercial weighing or measuring devices.

Definition. Utility service, for the purpose of this section, means gas, water and electric service or any combination thereof.

Invoices. The operator of a utility service system shall provide each customer with an invoice for each billing period. The invoice shall clearly and separately show the following for each of the utility services provided:

- (a) The opening and closing meter readings and the dates of those readings.
- (b) The identification of all rates and quantities attributable to each block in the applicable rate structure.
- (c) The total charge for the billing period.

Records. The operator of a metered utility service system shall retain records of all pertinent rate schedules, and individual customer billings for a period of at least 12 months. Such records shall be made available at reasonable times for inspection and copying by the customer and county sealer.

NOTE: Authority: Section 12027, Business and Professions Code. Reference: Sections 12024, 12024.1 and 12024.2, Business and Professions Code.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS
Title 4, Division 9, Chapter 5
2023 Commercial Weighing and Measuring Devices §§ 4090

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CALIFORNIA DEPARTMENT OF
FOOD & AGRICULTURE

Extracts from the
CALIFORNIA CODE OF REGULATIONS
TITLE 4, DIVISION 9

WEIGHTS AND MEASURES FIELD REFERENCE MANUAL (2023)

Chapter 6

Automotive Products Specifications

Sections 4100. through 4191.

Article 1. Brake Fluid Standards

Article 2. Brake Fluid Labeling

Article 5. Automotive Spark Ignition Engine Fuel Standards

Article 6. Engine Oil Labeling and Exemptions

**Article 7. Labeling and Specifications of Antifreezes and
Coolants**

**Article 8. Specifications for Hydrogen Gas Used in Internal
Combustion Engines and Fuel Cells**

**Article 9. Specifications for Dimethyl Ether Used as a Motor
Vehicle Fuel**



CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE
DIVISION OF MEASUREMENT STANDARDS

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EXTRACT FROM CALIFORNIA CODE OF REGULATIONS
 Title 4, Division 9, Chapter 6
 2023 Weights and Measures Automotive Product Specifications §§ 4100. – 4191.

Chapter 6. Automotive Products Specifications §§ 4100. through 4991.	1
Article 1. Brake Fluid Standards	1
§ 4100. Specifications.	1
§§ 4100. – 4111. - Repealed 11-19-85	1
Article 2. Brake Fluid Labeling	1
§ 4112. Container Labeling.	1
Article 3. Automatic Transmission Fluid Standards	1
§§ 4120. - 4126. - Repealed 8-18-87	1
Article 4. Automatic Transmission Fluid Registration	1
§§ 4130. - Repealed 11-19-85	1
Article 5. Engine Fuel Standards	1
§ 4140. Definitions Used in Title 4, Division 9, Chapters 6 and 7	1
§ 4141. Specifications-Automotive Spark Ignition Engine Fuel.	2
§ 4142. Specifications-Kerosene.	2
§ 4143. Specifications-Fuel Oil.	3
§ 4144. Specifications-Diesel Fuel.	3
§ 4145. Specifications – Developmental Fuels.	3
§ 4147. Specifications – M85 Fuel Methanol.	4
§ 4149. Specifications – Non-Ester Renewable Diesel Blends.	5
Article 6. Engine Oil Labeling and Exemptions	6
§ 4151. Exemptions - Prediluted Oil.	6
§ 4152. Tolerances.	6
Article 7. Labeling and Specifications of Engine Coolants	6
§ 4160. Definitions Used in This Article.	6
§ 4163. Specifications – Recycled Glycol Base Engine Coolant for Automobiles and Light Duty Service.	8
§ 4164. Specifications - Recycled and Reconditioned Glycol Base Prediluted Engine Coolant for Automobiles and Light Duty Service.	8
§ 4165. Exemptions - Reserve Alkalinity.	8
§ 4166. Variance from Chloride Standard - Specifications for Recycled Engine Coolant.	8
§ 4167. Variance from Chloride Standard – Specifications for Recycled Prediluted Engine Coolant or Reconditioned Engine Coolant.	9
§ 4168. Availability of ASTM Standards and Test Procedures.	10
§ 4169. Evaluation of Test Results	10
§ 4170. Verification of Claim for Recycled Engine Coolant.	11
§ 4171. Verification of Claim for Recycled Prediluted Engine Coolant or Reconditioned Engine Coolant.	11
§ 4172. - 4175. Repealed 8-16-02	11
Article 8. Hydrogen Fuel	11
§ 4180. Definitions Used in This Article	11

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS
Title 4, Division 9, Chapter 6
2023 Weights and Measures Automotive Product Specifications §§ 4100. – 4191.

§ 4181. Specifications – Hydrogen Fuel Used in Internal Combustion Engines.12
Article 9. Specifications for Dimethyl Ether Used as a Motor Vehicle Fuel12
§ 4190. Definitions Used in This Article12
§ 4191. Specifications – Dimethyl Ether used as a Motor Vehicle Fuel.12

**Chapter 6. Automotive Products Specifications
§§ 4100. through 4991.**

Article 1. Brake Fluid Standards

§ 4100. Specifications.

Brake fluid shall conform to the current specifications of the National Highway Traffic Safety Administration, United States Department of Transportation.

NOTE: Authority cited: Sections 12027 and 13710(c), Business and Professions Code.
Reference: Section 13710(c), Business and Professions Code.

§§ 4100. – 4111. - Repealed 11-19-85

Article 2. Brake Fluid Labeling

§ 4112. Container Labeling.

In addition to the requirements of Section 13711(d), Business and Professions Code, the label of each container of brake fluid shall bear the brand name in letters not less than one-eighth inch (3.18 mm) in height.

Numerals used in connection with the brand name or merits of the product shall not exceed the actual dry equilibrium reflux boiling point of the product. Nothing in this section prohibits the use of any numeral or combination thereof in such a manner that it cannot reasonably be confused with the dry equilibrium reflux boiling point of the product.

NOTE: Authority cited: Sections 12027, 12609 and 13710(c), Business and Professions Code. Reference: Sections 12602 and 13711(d), Business and Professions Code.

Article 3. Automatic Transmission Fluid Standards

§§ 4120. - 4126. - Repealed 8-18-87

Article 4. Automatic Transmission Fluid Registration

§§ 4130. - Repealed 11-19-85

Article 5. Engine Fuel Standards

§ 4140. Definitions Used in Title 4, Division 9, Chapters 6 and 7

- (a) "Biodiesel" means a fuel comprised of mono-alkyl esters of long chain fatty acids derived from vegetable oils or animal fats, designated B100, and meeting the

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 6

2023 Weights and Measures Automotive Product Specifications §§ 4100. – 4191.

specifications set forth by the ASTM International in the latest version of Standard Specification for Biodiesel Fuel Blend Stock (B100) for Middle Distillate Fuels D6751 contained in the ASTM publication entitled: Annual Book of ASTM Standards, Section 5.

- (b) “Diesel fuel” means a light middle or middle distillate fuel which may be blended up to 5. volume percent biodiesel, and meeting the specifications set forth by the ASTM International in the latest version of Standard Specification for Diesel Fuel Oils D975 contained in the ASTM publication entitled: Annual Book of ASTM Standards, Section 5.
- (c) “Biodiesel blend” means biodiesel blended with petroleum-based diesel fuel.
- (d) “Non-ester renewable diesel” means a diesel fuel registered as a motor vehicle fuel or fuel additive under 40 CFR Part 79, as amended by Pub. L. 91-604, produced from nonpetroleum renewable resources that is not a mono-alkyl ester.
- (e) “Non-ester renewable diesel blend” means non-ester renewable diesel blended with petroleum-based diesel fuel.
- (f) “Biomass-based diesel” means a renewable diesel fuel that meets the definition of either biodiesel or non-ester renewable diesel.

NOTE: Authority cited: Sections 12027, 13440 and 13450, Business and Professions Code.
Reference: Sections 13401, 13440, 13441, 13450 and 13451, Business and Professions Code.

§ 4141. Specifications-Automotive Spark Ignition Engine Fuel.

Automotive spark ignition engine fuel specifications shall conform to the latest standards set forth in the ASTM International D 4814 with the following exception:

Vapor pressure specifications shall not be more than the maximum specified by any California state law. When the maximum Reid Vapor Pressure specification for automotive spark-ignition engine fuel is below that established by D 4814, the Vapor Pressure/Distillation Class AA specification for distillation temperatures may be applied in the manufacture of automotive spark-ignition engine fuel.

NOTE: Authority cited: Sections 12027 and 13440, Business and Professions Code.
Reference: Sections 13401(m), 13440 and 13441, Business and Professions Code.

§ 4142. Specifications-Kerosene.

Kerosene shall meet the specifications set forth by the ASTM International in the latest version of Standard Specification for Kerosene D-3699 contained in ASTM publication entitled: Annual Book of ASTM Standards, Section 5, Volume 05:03.

NOTE: Authority cited: Sections 12027, 12609 and 13450, Business and Professions Code.
Reference: Sections 13401(c) and 13450, Business and Professions Code.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS
Title 4, Division 9, Chapter 6
2023 Weights and MeasuresAutomotive Product Specifications §§ 4100. – 4191.

§ 4143. Specifications-Fuel Oil.

Fuel oil shall meet the specifications set forth by the ASTM International in the latest version of Standard Specification for Fuel Oils D-396 contained in the ASTM publication entitled: Annual Book of ASTM Standards, Section 5, Volume 05:01, except the sulfur content shall not exceed the maximum specified by any California state law.

NOTE: Authority cited: Sections 12027 and 13450, Business and Professions Code.
Reference: Sections 13401(l) and 13450, Business and Professions Code.

§ 4144. Specifications-Diesel Fuel.

Diesel fuel shall meet the specifications set forth by the ASTM International in the latest version of Standard Specification for Diesel Fuel Oils D-975 contained in the ASTM publication entitled: Annual Book of ASTM Standards, Section 5, Volume 05:01, except the sulfur content shall not exceed the maximum specified by any California state law. This standard is available from the ASTM International office at 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, Pennsylvania 19428-2959; or by calling (610) 832-9585 or by accessing the internet at: <http://www.astm.org> website.

NOTE: Authority cited: Sections 12027 and 13450, Business and Professions Code.
Reference: Sections 13401(j), 13450, and 13451, Business and Professions Code.

§ 4145. Specifications – Developmental Fuels.

- (a) Sales of developmental engine fuels authorized by the Department are not subject to restrictions imposed upon the sale of non-conforming fuel products as set forth in Business and Professions Code Sections 13441, 13442 and 13451, but the Department's authorization does not create a variance or waiver from any other applicable California statute or regulation.
- (b) An applicant for authorization to sell developmental engine fuel must submit the following information to the Department:
 - (1) a statement of the potential benefit of the fuel to the people of California; and
 - (2) a description of test conditions associated with the use of the fuel, including control and monitoring practices, and the method of distribution and storage.
- (c) Any authorization provided by the Department is subject to the following terms and conditions:
 - (1) The authorization is limited to a period of two years, with an automatic renewal for an additional two years in the absence of action to revoke the authorization by the Department; and,

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 6

2023 Weights and Measures Automotive Product Specifications §§ 4100. – 4191.

- (2) Damages caused by sale, delivery, storage, handling and usage of the fuel shall be addressed in accordance with contractual provisions negotiated and agreed upon by the authorization holder and the user; and,
- (3) The authorization holder shall report information to the Department as required to monitor the use of the fuel during the process of developing a generally recognized chemical and performance standard through a recognized consensus organization or standards writing organization, such as ASTM International or SAE International. The Department shall specify the reporting requirements on a case by case basis at the time the authorization is granted.
- (4) Any device used for the sale or distribution of a developmental engine fuel must comply with the Business and Professions Code Section § 12500 (e).
- (d) The Department may take action to revoke the authorization at any time. Revocation of the authorization is effective and final upon receipt of written notification by the authorization holder. The Department may take action to revoke the authorization if the Department finds:
 - (1) the authorization holder has violated any of the terms and conditions of the authorization; or,
 - (2) the authorization holder has abandoned efforts to develop a generally recognized chemical and performance standard for the fuel through a recognized consensus organization or standards writing organization.
 - (3) there is a high probability of equipment harm with the continued use of the developmental fuel or to protect the public safety.
- (e) The authorization shall cease to exist upon publication of a generally recognized chemical and performance standard for the fuel.

NOTE: Authority cited: Sections 12027 and 13405, Business and Professions Code.
Reference: Sections 13401, 13440 - 13443 and 13450 - 13451, Business and Professions Code.

§ 4146. Specifications – E85 Fuel Ethanol.

E85 Fuel Ethanol shall meet the specifications set forth by ASTM International in the latest version of “Standard Specification for Fuel Ethanol (Ed75 – Ed85) for Automotive Spark-Ignition Engines D 5798”, contained in the ASTM publication entitled: Annual Book of ASTM Standards, Section 5.

NOTE: Authority cited: Sections 12027 and 13440, Business and Professions Code.
Reference: Sections 13401(m), 13440 and 13441, Business and Professions Code.

§ 4147. Specifications – M85 Fuel Methanol.

M85 Fuel Methanol shall meet the specifications set forth by ASTM International in the latest version of “Standard Specification for Fuel Methanol (M70 – M85) for Automotive Spark-

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 6

2023 Weights and Measures Automotive Product Specifications §§ 4100. – 4191.

Ignition Engines D 5797”, contained in the ASTM publication entitled: Annual Book of ASTM Standards, Section 5.

NOTE: Authority cited: Sections 12027 and 13440, Business and Professions Code.
Reference: Sections 13401(m), 13440 and 13441, Business and Professions Code.4074.
Instructions to Sealers.

§ 4148. Specifications – Biodiesel Blends.

Biodiesel Fuel Blends shall meet the following specifications:

- (a) Biodiesel blends with a concentration of 5. volume percent biodiesel or less shall meet the specification set forth by ASTM International in the latest version of the “Standard Specification for Diesel Fuel Oils” D975, publication entitled: Annual Book of ASTM Standards, Section 5.
- (b) Biodiesel blends with a concentration from 6. to 20. volume percent biodiesel shall meet the specifications set forth by ASTM International in the latest version of the “Standard Specification for Diesel Fuel Oil, Biodiesel Blend (B6 to B20)” D7467, contained in the ASTM publication entitled: Annual Book of ASTM Standards, Section 5.
- (c) Any finished biodiesel fuel blend greater than 20. volume percent biodiesel, shall meet the specifications set forth by ASTM International in the latest version of the specifications set forth for biodiesel blends greater than 20. volume percent biodiesel.
 - (1) Absent an ASTM International specification, the CDFA shall establish specifications pursuant to Business and Professions Code, Division 5, Chapter 14, Section 13450 using the data determined upon completion of the California Energy Commission Interagency Agreement, wherein the CDFA will perform test methods and standards development for biodiesel blends greater than 20 volume percent.
 - (2) These interim standards will remain in place until such time as a recognized consensus organization or standards writing organization, such as ASTM International or SAE International, adopts specifications for biodiesel blends greater than 20. volume percent.
 - (3) Biodiesel blends greater than 20. volume percent may only be sold under a developmental engine fuel variance obtained pursuant to Section 4145 of this article. Any variance granted will expire at such time as the CDFA adopts specifications for biodiesel blends greater than 20. volume percent biodiesel.

NOTE: Authority cited: Sections 12027 and 13450, Business and Professions Code.
Reference: Sections 13401(j) and 13450, Business and Professions Code.

§ 4149. Specifications – Non-Ester Renewable Diesel Blends.

Non-ester Renewable Diesel Blends shall meet the specifications set forth by the ASTM International in the latest version of Standard Specification for Diesel Fuel Oils D975 contained in the ASTM publication entitled: Annual Book of ASTM Standards, Section 5.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS
Title 4, Division 9, Chapter 6
2023 Weights and Measures Automotive Product Specifications §§ 4100. – 4191.

NOTE: Authority cited: Sections 12027 and 13450, Business and Professions Code.
Reference: Sections 13401(j) and 13450, Business and Professions Code

Article 6. Engine Oil Labeling and Exemptions

§ 4150. Labeling.

In addition to the requirements of Section 13482, Business and Professions Code, the label of each container of motor oil products shall contain the SAE/API Service Classification in letters not less than one-eighth inch (3.18 mm) in height.

NOTE: Authority cited: Sections 12027 and 12609, Business and Professions Code.
Reference: Section 13482, Business and Professions Code.

§ 4151. Exemptions - Prediluted Oil.

Prediluted oil intended only for mixture with gasoline or other motor fuel in a two-cycle engine is exempt from the following requirements of the Business and Professions Code:

- (a) Section 13460(b) - Flash Points for the Various SAE Classifications;
- (b) Section 13460(a) - Service Classifications SAE J183;
- (c) Section 13480(b) - Viscosity Grade Classification Number;
- (d) Section 13482 - SAE/API Service Classification Markings on Containers.

NOTE: Authority cited: Sections 12027 and 12609, Business and Professions Code.
Reference: Sections 13460, 13480 and 13482, Business and Professions Code.

§ 4152. Tolerances.

The ratio of gasoline to motor oil or to motor oil solvent mixture, as required by Sections 13480 and 13490(b) of the Business and Professions Code, shall be within plus or minus 10 percent of the stated ratio on the dispenser.

NOTE: Authority cited: Sections 12027 and 12609, Business and Professions Code.
Reference: Sections 13480 and 13490, Business and Professions Code.

Article 7. Labeling and Specifications of Engine Coolants

§ 4160. Definitions Used in This Article.

- (a) "Engine Coolant" means any substance or preparation, regardless of its origin, intended to be diluted before use as the cooling medium in the cooling system of an internal combustion engine to provide protection against freezing, overheating, and corrosion of the cooling system, or any product intended to be diluted before use which is labeled to

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 6

2023 Weights and Measures Automotive Product Specifications §§ 4100. – 4191.

indicate or imply that it will prevent freezing or overheating of the cooling system of an internal combustion engine. The term “engine coolant”, as used in this article, also means “antifreeze.”

- (b) “Prediluted Engine Coolant” means any substance or preparation, regardless of its origin, intended or labeled for use full strength as the cooling medium or as a top off in the cooling system of an internal combustion engine to provide supplemental protection against freezing, overheating, and corrosion of the cooling system. The term “prediluted engine coolant”, as used in this article, also means “prediluted antifreeze.”
- (c) “Recycled Engine Coolant” means engine coolant that contains recycled ingredients.
- (d) “Recycled Prediluted Engine Coolant” means prediluted engine coolant that contains recycled ingredients.
- (e) “Virgin Engine Coolant” means engine coolant that does not contain recycled or reconditioned ingredients.
- (f) “Virgin Prediluted Engine Coolant” means prediluted engine coolant that does not contain recycled or reconditioned ingredients.
- (g) “Reconditioned Engine Coolant” means recycled prediluted engine coolant produced from prediluted engine coolant that has been removed from a vehicle, reconditioned and is intended to be returned to the same vehicle.

NOTE: Authority cited: Section 12027, Business and Professions Code. Reference: Sections 13700, 13710(a) and 13713, Business and Professions Code.

§ 4161. Labeling.

In addition to the requirements of Section 13711(a) and (b), Business and Professions Code, the label of each container of engine coolant, prediluted engine coolant, recycled engine coolant, and recycled prediluted engine coolant shall bear a distinctive brand name in letters not less than one-eighth inch (3.18 mm) in height. Additionally, each container packaged after January 1, 2003, shall clearly identify the applicable American Society for Testing and Materials (ASTM) Standard Designation which the product meets.

NOTE: Authority cited: Sections 12027 and 12609, Business and Professions Code. Reference: Sections 13700 and 13711(a) (b), Business and Professions Code.

§ 4162. Specifications - Glycol Base Virgin Engine Coolant and Virgin Prediluted Engine Coolant for Automobiles and Light Duty Service.

Glycol base virgin engine coolant and virgin prediluted engine coolant for use in automobiles and light duty service shall meet the specifications set forth by the American Society for Testing and Materials (ASTM) in the Standard Specifications for Glycol Base Engine Coolant for Automobiles and Light Duty Service D 3306-00a. In addition, the reserve alkalinity of virgin engine coolants shall not be less than 10.0 mL of .1N hydrochloric acid and virgin prediluted engine coolants shall not be less than 5.0 mL of .1N hydrochloric acid when tested by ASTM procedure D 1121-98.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS
Title 4, Division 9, Chapter 6
2023 Weights and Measures Automotive Product Specifications §§ 4100. – 4191.

NOTE: Authority cited: Sections 12027, and 13710(a), Business and Professions Code.
Reference: Sections 13710(a) and 13713, Business and Professions Code.

§ 4163. Specifications – Recycled Glycol Base Engine Coolant for Automobiles and Light Duty Service.

Glycol base recycled engine coolant for use in automobiles and light duty service shall meet the specifications set forth by the American Society for Testing and Materials (ASTM) in the Standard Specification for Recycled Glycol Base Engine Coolant for Automobiles and Light Duty Service D 6472-00. In addition, the reserve alkalinity shall not be less than 10.0 mL of .1N hydrochloric acid when tested by ASTM procedure D 1121-98.

NOTE: Authority cited: Sections 12027 and 13710(a), Business and Professions Code.
Reference: Sections 13710(a) and 13713, Business and Professions Code.

§ 4164. Specifications - Recycled and Reconditioned Glycol Base Prediluted Engine Coolant for Automobiles and Light Duty Service.

Glycol base recycled prediluted engine and reconditioned engine coolant for use in automobiles and light duty service shall meet the specifications set forth by the American Society for Testing and Materials (ASTM) in the Standard Specification for Recycled Prediluted Aqueous Glycol Base Engine Coolant (50 Volume % Minimum) for Automobile and Light Duty Service D6471-99. In addition, the reserve alkalinity shall not be less than 5.0 mL of .1N hydrochloric acid when tested by ASTM procedure D 1121-98.

NOTE: Authority cited: Sections 12027 and 13710(a), Business and Professions Code.
Reference: Sections 13710(a) and 13713, Business and Professions Code.

§ 4165. Exemptions - Reserve Alkalinity.

The Department may exempt any engine coolant, prediluted engine coolant, recycled engine coolant, recycled prediluted engine coolant or reconditioned engine coolant formulation from the reserve alkalinity requirement if the manufacturer, packer, seller, or distributor presents test data showing that the formulation meets the performance requirements specified for the Standard Test Methods for: “Corrosion Test for Engine Coolants in Glassware” - ASTM D 1384-7a, “Simulated Service Corrosion Testing of Engine Coolants” - ASTM D-2570-96, and “Corrosion of Aluminum Alloys in Engine Coolants Under Heat - Rejecting Conditions” - ASTM D 4340 96.

NOTE: Authority cited: Section 12027, Business and Professions Code. Reference: Sections 13710(a) and 13713, Business and Professions Code.

§ 4166. Variance from Chloride Standard - Specifications for Recycled Engine Coolant.

The Department may grant a variance for recycled engine coolant from the chloride standard contained in the ASTM specification referenced in Section 4163, if the engine coolant producer

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 6

2023 Weights and Measures Automotive Product Specifications §§ 4100. – 4191.

or manufacturer of the engine coolant recycling system provides test data that the recycled engine coolant meets all the following conditions:

- (a) The chloride content is less than one hundred fifty parts per million (150 ppm);
The recycled engine coolant meets all other requirements as specified in Section 4163;
- (c) The recycled engine coolant, when tested in accordance with Annex 3 of ASTM D 6472 00 shall visually provide a similar or smaller amount of precipitate when compared to the results obtained when testing the reference coolant specified in Annex 2 of ASTM D 6472-00;
- (d) The recycled engine coolant shows a Protection Potential, E_G , of greater (more positive) than or equal to -400 mV v SHE (standard hydrogen electrode) when tested in accordance with the ASTM Standard Test Method for Repassivation Potential of Aluminum and Its Alloy by Galvanostatic Measurement D 6208-97.

Variances granted under this section shall remain in effect until January 1, 2003.

NOTE: Authority cited: Section 12027, Business and Professions Code. Reference: Sections 13710(a), 13710.5 and 13713, Business and Professions Code.

§ 4167. Variance from Chloride Standard – Specifications for Recycled Prediluted Engine Coolant or Reconditioned Engine Coolant.

The Department may grant a variance for recycled prediluted engine coolant from the chloride standard contained in the ASTM specifications referenced in Section 4164, if the engine coolant producer or manufacturer of the engine coolant recycling system provides test data that the recycled prediluted engine coolant or reconditioned engine coolant meets all the following conditions:

- (a) The chloride content is less than one hundred fifty parts per million (150 ppm);
- (b) The recycled prediluted engine coolant meets all other requirements as specified in Section 4164;
- (c) The recycled prediluted engine coolant, when tested in accordance with Annex 3 of ASTM D 6471-99 shall provide a similar or smaller amount of precipitate when compared to the results obtained when testing the reference coolant specified in Annex 2 of ASTM D 6471-99;
- (d) The recycled prediluted engine coolant shows a Protection Potential, E_G , of greater (more positive) than or equal to -400 mV v SHE (standard hydrogen electrode) when tested in accordance with ASTM Standard Test Method for Repassivation Potential of Aluminum and Its Alloys by Galvanostatic Measurement D 6208-97. The test solution shall be prepared as follows: Mix 50 volume percent of the recycled prediluted engine coolant or reconditioned engine coolant with 25 volume percent corrosive water (as specified in ASTM D 6208-97) and 25 percent volume deionized water at room temperature.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS
Title 4, Division 9, Chapter 6
2023 Weights and Measures Automotive Product Specifications §§ 4100. – 4191.

Variances granted under this section shall remain in effect until January 1, 2003.

NOTE: Authority cited: Section 12027, Business and Professions Code. Reference: Sections 13710(a) and 13713, Business and Professions Code.

§ 4168. Availability of ASTM Standards and Test Procedures.

The American Society for Testing and Materials (ASTM) product standards and test procedures incorporated by reference in this article, with the exception of ASTM D 3306-00a, are available in the 2000 version of the Annual Book of ASTM Standards, Volume 15.05. ASTM D 3306-00a, is only available as a separate publication until September 2001. After September 2001, ASTM D 3306-00a will be available in the 2001 version of the Annual Book of ASTM Standards, Volume 15.05. These documents are available from the American Society for Testing and Materials (ASTM) located at 100 Barr Harbor Drive, West Conshohocken, Pennsylvania 19428 2959.

NOTE: Authority cited: Section 12027, Business and Professions Code. Reference: Sections 13710(a) and 13713, Business and Professions Code.

§ 4169. Evaluation of Test Results

No adjustments for test precision or bias shall be applied in the evaluation of specifications established in this article for which repeatability, reproducibility, or bias statements have not been established.

- (a) Evaluation of Suspended Matter and Sediment in Engine Coolant and Recycled Engine Coolant. – Shake the engine coolant to insure a homogeneous mixture and combine 140 mL of this mixture with 60 mL of deionized water at room temperature. Immediately pour the blended mixture into a 250 mL Griffin beaker and allow it to stand at room temperature undisturbed for 24 hours. Visually examine the blend for suspended matter and sediment. A flashlight or other similar source of illumination shall be used to aid in the evaluation. The mixture shall not contain visually identifiable suspended matter or sediment.
- (b) Evaluation of Suspended Matter and Sediment in Prediluted Engine Coolant and Prediluted Recycled Engine Coolant. - Shake the prediluted engine coolant to insure a homogeneous mixture. Immediately pour 200 mL of the mixture into a 250 mL Griffin beaker and allow it to stand at room temperature undisturbed for 24 hours. Visually examine the blend for suspended matter and sediment. A flashlight or other similar source of illumination shall be used to aid in the evaluation. The mixture shall not contain visually identifiable suspended matter or sediment.

NOTE: Authority cited: Section 12027, Business and Professions Code. Reference: Sections 13710(a) and 13713, Business and Professions Code.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 6

2023 Weights and Measures Automotive Product Specifications §§ 4100. – 4191.

§ 4170. Verification of Claim for Recycled Engine Coolant.

Any distributor, manufacturer, producer, or seller of recycled engine coolant which has a chloride ion concentration greater than 25 parts per million (ppm) or a sulfate ion concentration greater than 100 ppm shall provide, upon request of a duly authorized representative of the Department, fleet testing results as specified in ASTM D 6472-00. Any product for which test results are not provided to the Department within 30 days of request shall be deemed adulterated. Verification of fleet testing data by a manufacturer of an engine coolant recycling system is prima facie evidence that the product produced using the same equipment, technique and formulation meets the fleet testing requirements in ASTM D 6472-00.

NOTE: Authority cited: Section 12027, Business and Professions Code. Reference: Sections 13710(a) and 13713, Business and Professions Code.

§ 4171. Verification of Claim for Recycled Prediluted Engine Coolant or Reconditioned Engine Coolant.

Any distributor, manufacturer, producer, or seller of recycled prediluted engine coolant or reconditioned engine coolant which has a chloride ion concentration greater than 33 parts per million (ppm) or a sulfate ion concentration greater than 140 ppm shall provide, upon request of a duly authorized representative of the Department, fleet testing results as specified in ASTM D 6471-99. Any product for which test results are not provided to the Department within 30 days of request shall be deemed adulterated. Verification of fleet testing data by a manufacturer of an engine coolant recycling system is prima facie evidence that the product produced using the same equipment, technique and formulation meets the fleet testing requirements in ASTM D 6471-99.

NOTE: Authority cited: Section 12027, Business and Professions Code. Reference: Sections 13710(a) and 13713, Business and Professions Code.

§ 4172. - 4175. Repealed 8-16-02

Article 8. Specifications for Hydrogen Gas Used in Internal Combustion Engines and Fuel Cells

§ 4180. Definitions Used in This Article

- (a) "Fuel Cell" means an electrochemical energy conversion device in which fuel and an oxidant react to generate electricity without any consumption, physical or chemical, of its electrodes or electrolytes.
- (b) "Internal Combustion Engine" means a device used to generate power by converting chemical energy bound in the fuel via spark-ignition or compression ignition combustion into mechanical work to power a vehicle or other device.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS
Title 4, Division 9, Chapter 6
2023 Weights and Measures Automotive Product Specifications §§ 4100. – 4191.

- (c) “Hydrogen Fuel” means a fuel composed of molecular hydrogen intended for consumption in a surface vehicle or electricity production device with an internal combustion engine or fuel cell.

NOTE: Authority cited: Sections 12027 and 13446, Business and Professions Code.
Reference: Sections 13401(c), 13401(h), 13401(i), 13401(m), 13401(r), 13413(a) and 13595(a), Business and Professions Code.

§ 4181. Specifications – Hydrogen Fuel Used in Internal Combustion Engines.

Hydrogen fuel used in internal combustion engines and fuel cells shall meet the most recent version of SAE International J2719, “Hydrogen Fuel Quality for Fuel Cell Vehicles”.

NOTE: Authority cited: Sections 12027 and 13446, Business and Professions Code.
Reference: Sections 13401(c), 13401(h), 13401(i), 13401(m), 13401(r), 13413(a) 13595(a), Business and Professions Code.

Article 9. Specifications for Dimethyl Ether Used as a Motor Vehicle Fuel

§ 4190. Definitions Used in This Article

“Dimethyl Ether Fuel” or DME Fuel is the chemical compound (CH₃OCH₃) which is intended for consumption in a surface vehicle.

NOTE: Authority cited: Sections 12027, 13450 and 13451, Business and Professions Code.
Reference: Sections 13401(c), 13401(h), 13401(i), 13401(n), 13413(a), 13591, 13592 and 13595(a), Business and Professions Code.

§ 4191. Specifications – Dimethyl Ether used as a Motor Vehicle Fuel.

Dimethyl Ether used as a motor vehicle fuel shall meet the requirements found in the most recent version of ASTM International D7901, “Dimethyl Ether for Fuel Purposes”.

NOTE: Authority cited: Sections 12027, 13450 and 13451, Business and Professions Code.
Reference: Sections 13401(c), 13401(h), 13401(i), 13401(n), 13413(a), 13591, 13592 and 13595(a), Business and Professions Code.



Extracts from the
CALIFORNIA CODE OF REGULATIONS
TITLE 4, DIVISION 9

WEIGHTS AND MEASURES FIELD REFERENCE MANUAL (2023)

Chapter 7

Advertising of Gasoline and Other Motor Vehicle Fuels

Section 4200. through 4207.



CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE
DIVISION OF MEASUREMENT STANDARDS

DISCLAIMER

This document represents the Division of Measurement Standards' field manual for enforcing regulations pertaining to weights and measures in California. This field manual is not to be considered as the official Code of Regulations, as published by Barclays Law Publishers.

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For information concerning the contents of this document, please contact the Division of Measurement Standards by e-mail at dms@cdfa.ca.gov.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 4

2023 Advertising and Labeling of Gasoline and Other Motor Vehicle Fuels §§ 4200. – 4207.

Chapter 7. Advertising of Gasoline and Other Motor Vehicle Fuels §§ 4200. – 4207..... 1

- § 4200. Advertising Medium. 1
- § 4201. Price Sign Display on Dispensing Apparatus. 1
- § 4202. Labeling and Price Sign Advertising Requirements for Biodiesel and Biodiesel Blends. 1
- § 4203. Labeling and Price Sign Advertising Requirements for Biomass-Based Diesel and Biomass-Based Diesel Blends..... 2
- § 4204. Labeling and Price Sign Advertising Requirements for E85 Fuel Ethanol and M85 Fuel Methanol..... 2
- § 4205. Illumination..... 2
- § 4206. Dispenser Labeling Requirements for Compressed Natural Gas and Liquefied Natural Gas. 3
- § 4207. Additional Dispenser Labeling Requirements for Liquefied Natural Gas and Compressed Natural Gas. 4

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 4

2023 Advertising and Labeling of Gasoline and Other Motor Vehicle Fuels §§ 4200. – 4207.

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Chapter 7. Advertising and Labeling of Gasoline and Other Motor Vehicle Fuels §§ 4200. – 4207.

§ 4200. Advertising Medium.

“Advertising medium,” as used in this chapter, includes banner, sign, placard, poster, streamer and card, whether or not mounted, whether appearing on the same or different standards, or whether or not physically connected with each other, provided, the advertised statements can reasonably be read as one advertising message.

NOTE: Authority cited: Sections 12027 and 12609, Business and Professions Code.
Reference: Sections 13531, 13532, 13534, 13535, 13536, 13537, 13538, 13539, and 13540 Business and Professions Code.

§ 4201. Price Sign Display on Dispensing Apparatus.

In addition to the requirements of Sections 13470 and 13480, Business and Professions Code, any sign referring to the price of gasoline or other motor vehicle fuel displayed on any dispensing apparatus from which gasoline or other motor vehicle fuel is being offered for sale or sold, shall be limited to the following:

- (a) Actual price per gallon, liter, gasoline gallon equivalent (GGE), or diesel gallon equivalent (DGE), and
- (b) Conversion chart information required for liter sales per Section 13470.5, Business and Professions Code.
- (c) Brand name and the name of the product may be displayed.

NOTE: Authority cited: Sections 12027 and 12609, Business and Professions Code.
Reference: Sections 13470, 13470.5 and 13480, Business and Professions Code.

§ 4202. Labeling and Price Sign Advertising Requirements for Biodiesel and Biodiesel Blends.

- (a) The labeling on biodiesel and biodiesel blend dispensers shall meet the requirements of the Federal Trade Commission (FTC) 16 CFR Part 306 “Automotive Fuel Ratings, Certification and Posting” Rule, as published in the Federal Register Volume 75, Number 50, dated March 16, 2010, which are hereby incorporated.
- (b) The name of the product and grade designation shall be on all dispensers, advertising signs, and storage tank labels as required in Section 13480 and 13532 of the Business and Professions Code.
- (c) Every biodiesel dispenser dispensing blends greater than 5. volume percent shall display on each customer side, as required by Section 13484 of the Business and Professions Code, a sign clearly visible which reads as follows:

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 4

2023 Advertising and Labeling of Gasoline and Other Motor Vehicle Fuels §§ 4200. – 4207.

“THIS FUEL CONTAINS BIODIESEL. CHECK THE OWNER’S MANUAL OR WITH YOUR ENGINE MANUFACTURER BEFORE USING.”

NOTE: Authority cited: Sections 12027 and 13450, Business and Professions Code.

Reference: Sections 13480 and 13484, Business and Professions Code.

§ 4203. Labeling and Price Sign Advertising Requirements for Biomass-Based Diesel and Biomass-Based Diesel Blends.

- (a) The labeling on biomass-based diesel and biomass-based diesel blend dispensers shall meet the requirements found in the Federal Trade Commission (FTC) 16 CFR Part 306 “Automotive Fuel Ratings, Certification and Posting” Rule, as published in the Federal Register Volume 75, Number 50, dated March 16, 2010, which are hereby incorporated.
- (b) The name of the product and grade designation shall be on all dispensers, advertising signs, and storage tank labels as required in Section 13480 and 13532 of the Business and Professions Code.

NOTE: Authority cited: Sections 12027 and 13450, Business and Professions Code.

Reference: Sections 13480 and 13484, Business and Professions Code.

§ 4204. Labeling and Price Sign Advertising Requirements for E85 Fuel Ethanol and M85 Fuel Methanol.

- (a) The labeling on E85 Fuel Ethanol and M85 Fuel Methanol dispensers shall meet the requirements found in FTC 16 CFR Part 306 “Automotive Fuel Ratings, Certification and Posting” Rule, as published in the Federal Register Volume 75, Number 50, dated March 16, 2010, which are hereby incorporated.
- (b) All dispensers, advertising signs and storage tank labels shall comply with the requirements of Section 13480 and 13532 of the Business and Professions Code. E85 Fuel Ethanol and M85 Fuel Methanol shall use, at a minimum, the words “E85” “Ethanol”, or “M85” “Methanol” in close proximity to describe the name of the product.
- (c) E85 Fuel Ethanol and M85 Fuel Methanol are defined as alternative fuels by the Federal Trade Commission (FTC) and therefore no grade designation is required.

NOTE: Authority cited: Sections 12027, 13480 and 13484, Business and Professions Code.

Reference: Sections 13401(m), 13440 and 13441, Business and Professions Code.

§ 4205. Illumination.

In addition to the requirements of Section 13536, Business and Professions Code, when any advertising message is illuminated, the entire message shall be uniformly illuminated.

NOTE: Authority cited: Section 12027, Business and Professions Code. Reference: Section 13536, Business and Professions Code.

§ 4206. Dispenser Labeling Requirements for Compressed Natural Gas and Liquefied Natural Gas.

(a) Definitions Used in This Section:

- (1) “Consumer” means, with respect to any item, the first person who purchases such item for purposes other than resale.
- (2) “Fuel dispenser” means the dispenser through which a retailer sells the fuel to a consumer.
- (3) “Methane Number” means the antiknock index of compressed natural gas or liquefied natural gas motor vehicle fuel. The Methane Number of compressed natural gas or liquefied natural gas is a calculated value determined by the chemical composition of the fuel, including inert components.
- (4) “MWM Method” means the algorithm for the calculation of the Methane Number of a natural gas fuel from its composition. The MWM Method algorithm is available in the European Committee for Standardization (CEN) standard EN 16726 “Gas infrastructure - Quality of gas - Group H” (EN16726), Annex A, pages 9 through 30, published December 2015, which is herein incorporated by reference.

A spreadsheet calculator implementing the MWM Method algorithm and a pdf file of instructions for its use (“readme.pdf”) are available for download at no cost at: http://euromot.org/media_and_events/publications/mn.

- (5) “Minimum MWM Methane Number” means the lowest MWM Methane Number of natural gas fuel offered for retail sale.
 - (6) “Producer” means any person who purchases component elements and combines them to produce and market natural gas motor vehicle fuels.
 - (7) “Retailer” means any person who markets natural gas motor vehicle fuels to the general public for ultimate consumption.
- (b) The name of the product and grade designation, if any, shall be conspicuously displayed on each customer side of all natural gas fuel dispensers. For all natural gas fuels, the name of the product and grade designation, if any, shall also appear on all advertising signs and storage tank labels as required in Sections 13480 and 13532 of the Business and Professions Code.
- (c) (1) A person shall not sell at retail to the general public any compressed or liquefied natural gas for use as a motor vehicle fuel from any place of business in this state unless there is displayed and labeled on the fuel dispenser in a conspicuous place on the customer side the following statement: “MINIMUM METHANE NUMBER XX BY THE MWM METHOD (4 CCR 4206),” where XX is the MWM Methane Number of the dispensed natural gas fuel expressed in a number rounded down to a whole number. This statement shall be displayed in

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 4

2023 Advertising and Labeling of Gasoline and Other Motor Vehicle Fuels §§ 4200. – 4207.

Helvetica Black or equivalent font type with characters not less than 1/2 inch in height.

- (2) Natural gas motor vehicle fuel producers shall be responsible for determining the minimum MWM Methane Number to be displayed for the fuel they produce for retail sale to the general public. In making this determination, they may rely on information received from the utility supplying the pipeline gas used to produce their fuel, independent laboratory testing of the composition of the pipeline gas, or any other reliable information available to them. The minimum MWM Methane Number shall be accurate at all times.
- (d)
 - (1) A person shall not sell at retail to the general public any compressed natural gas for use as a motor vehicle fuel from any place of business in this state unless there is displayed and labeled on the fuel dispenser in a conspicuous place on each customer side the following statement: “1 Gasoline Gallon Equivalent (GGE) equals 5.66 lb of Compressed Natural Gas”.
 - (2) The statement “1 Gasoline Gallon Equivalent (GGE) equals 5.66 lbs. of Compressed Natural Gas” shall be in characters of Helvetica Black or equivalent font type, no less than 3/4 inch in height and on a contrasting background. All lines or marks used in the making or forming of all the characters which are a part of the label shall be at least one-eighth of an inch in width.
- (e)
 - (1) A person shall not sell at retail to the general public any liquefied natural gas for use as a motor vehicle fuel from any place of business in this state unless there is displayed and labeled on the fuel dispenser in a conspicuous place on each customer side the following statement: “1 Diesel Gallon Equivalent (DGE) equals 6.06 lb of Liquefied Natural Gas”.
 - (2) The statement “1 Diesel Gallon Equivalent (DGE) equals 6.06 lbs. of Liquefied Natural Gas” shall be in characters of Helvetica Black or equivalent font type, no less than 3/4 inch in height and on a contrasting background. All lines or marks used in the making or forming of all the characters that are a part of the label shall be at least one-eighth of an inch in width.

NOTE: Authority cited: Sections 12027 and 13480, Business and Professions Code.
Reference: Sections 13400, 13404, 13440, 13451, 13470, 13471, 13473, 13474, 13480, 13484, 13531, 13532 and 13536, Business and Professions Code.

§ 4207. Additional Dispenser Labeling Requirements for Liquefied Natural Gas and Compressed Natural Gas.

The labeling of all natural gas dispensers shall meet the following retail sale requirements of the Federal Trade Commission for the natural gas fuel rating:

- (a) 16 CFR Part 306 “Automotive Fuel Ratings, Certification and Posting,” for liquefied natural gas.
- (b) 16 CFR Part 309 “Labeling Requirements for Alternative Fuels and Alternative Fueled Vehicles,” for compressed natural gas.

Extract from California Code of Regulations
CCR Title 4, Division 9, Chapter 7 §§ 4200. – 4207.
2023 Advertising and Labeling of Gasoline and Other Motor Vehicle Fuels

NOTE: Authority cited: Sections 12027 and 13480, Business and Professions Code.
Reference: Sections 12026, 13400, 13480, 13590 and 13591, Business and Professions Code.



CALIFORNIA DEPARTMENT OF
FOOD & AGRICULTURE

Extracts from the
CALIFORNIA CODE OF REGULATIONS
TITLE 4, DIVISION 9

WEIGHTS AND MEASURES FIELD REFERENCE MANUAL (2023)

Chapter 8
Motor Oil Fee
Section 4300. through 4309.



CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE
DIVISION OF MEASUREMENT STANDARDS

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Extract from California Code of Regulations
CCR Title 4, Division 9, Chapter 8
2023 Motor Oil Fee §§ 4300. – 4309.

Chapter 8. Motor Oil Fee §§ 4300. through 4309. 1

§ 4300. Definition of “Motor Oil” and Other Terms for Purposes of Fee Responsibility. 1

§ 4302. Fee Responsibility and Exemption.2

§ 4304. Fees and Remittance Forms.2

§ 4305. Authority to Determine Compliance.....4

§ 4306. Penalties.....4

§ 4307. Refund of Fees Paid.....4

§ 4308. Records.....5

§ 4309. Motor Oil Fee Reimbursement5

Extract from California Code of Regulations
CCR Title 4, Division 9, Chapter 8
2023 Motor Oil Fee §§ 4300. – 4309.

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Chapter 8. Motor Oil Fee §§ 4300. through 4309.

§ 4300. Definition of “Motor Oil” and Other Terms for Purposes of Fee Responsibility.

For purposes of fee responsibility under Sections 13430 and 13431 of the Business and Professions Code the following definitions apply:

(a) “Motor oil” includes natural, synthetic and re-refined motor oils, whether or not in retail containers, and in addition, any product used as an additive to a motor oil used in the lubrication of internal combustion engines. Refinery base stocks, manufacturing additives used by motor oil dealers in the commercial compounding and production of motor oils, and other motor oil components are not motor oils for the purposes of fee responsibility unless they are used separately in the lubrication of internal combustion engines, in which case they are “motor oils” for the purpose of the fee responsibility.

(b) For purposes of this Chapter, the term “additive” when used alone, means any product to be added to the motor oil in the crankcase of an internal combustion engine for the purpose of reducing friction, heat or wear of the internal moving parts.

(c) “Internal combustion engine” means all engines producing power by internal combustion and includes 2-cycle and 4-cycle internal combustion engines and turbine engines. Internal combustion engines include engines powered by gasoline, ethanol, methanol, alcohol blended fuels, diesel, biodiesel, biodiesel blends, kerosene, hydrogen, compressed natural gas, liquefied petroleum gas, propane, or butane.

(d) “Motor oil dealer” means any person, firm or corporation engaged in the business of producing, importing, packaging or otherwise preparing motor oil for market or selling or distributing motor oil.

(e) “Motor oil dealer permit number” means the registration number provided by the Department to each motor oil dealer.

(f) “Date of sale” is the date of transfer of the motor oil to the purchaser, as evidenced by an invoice, voucher or bill of lading.

(g) “Quarter” means a three-month period during a fiscal year. For each fiscal year, the first quarter commences July 1 and ends September 30, the second quarter commences October 1 and ends December 31, the third quarter commences January 1 and ends March 31, and the fourth quarter commences April 1 and ends June 30, all inclusive.

(h) “Export” or “Exported” means the delivery or shipment of motor oil by the dealer from a point in California to a point outside of California when, pursuant to the contract of sale, the motor oil is delivered by the motor oil dealer to:

- (1) The out of state point by facilities operated by the dealer; or

Extract from California Code of Regulations
CCR Title 4, Division 9, Chapter 8
2023 Motor Oil Fee §§ 4300. – 4309.

(2) A carrier, customs broker or forwarding agent for shipment to a location outside of California.

(3) A forwarding agent, export packer, customs broker or other person engaged in the business of preparing property for export, or arranging for its export to a location outside of California, or

(4) A vessel clearing from a port in California for a port outside of California. However, motor oil consumed during a voyage clearing a California port is not exempt.

The motor oil is not exported if it is diverted in transit, for any reason, and is not actually delivered outside of California; regardless of documentary evidence held by the dealer for delivery of that motor oil for out-of-state shipment.

NOTE: Authority cited: Section 12027 and 13433, Business and Professions Code.

Reference: Section 13430, Business and Professions Code.

§ 4302. Fee Responsibility and Exemption.

- (a) The first motor oil dealer that produces, sells or distributes motor oil in California, whether or not packaged in retail containers, shall pay the fee for all such motor oil sold in California.
- (b) Motor oil exported for sale outside California is exempt from the motor oil fee.
- (c) A person assigned a motor oil dealer permit number and not actively engaged in the business of producing, distributing, or selling motor oil is required to notify the Department in writing within the next reporting period upon ceasing operations dealing with motor oil.

Note: Authority cited: Sections 12027 and 13433, Business and Professions Code. Reference: Sections 13430 and 13431, Business and Professions Code.

§ 4304. Fees and Remittance Forms.

- (a) The motor oil fee provided for in Section 13431 of the Business and Professions Code is established at five cents (\$0.05) per gallon effective January 1, 2018.
- (b) Each person responsible for the payment of the motor oil fee shall file a remittance form with the Department no later than 30 days after each quarter ending September 30, December 31, March 31 and June 30. The "Motor Oil Fee Remittance Form" (Form 41-054, Rev. 1/1/18), hereby incorporated by reference, shall be completed and accompanied with payment of the motor oil fee due for the reporting period. All motor oil dealers must prepare and submit to the Department the remittance form in accordance with the general requirements for reporting contained in this Chapter.
 - (1) A remittance form for each quarter shall include:
 - (A) The amount, in gallons of motor oil purchased, sold, manufactured in California, or imported into California.

Extract from California Code of Regulations
CCR Title 4, Division 9, Chapter 8 §§ 4300. – 4309.
2023 Motor Oil Fee

- (B) The total amount of gallons of motor oil with fees paid to suppliers.
 - (C) The net amount of motor oil gallons to which the fee is applied. This is calculated by the gallons reported in subparagraph (A) of this paragraph minus the gallons reported in subparagraph (B) of this paragraph.
 - (D) The signature and title of the representative of the entity authorized to prepare the return.
 - (E) The date the remittance form was signed.
- (2) Remittance forms and applicable supporting data shall be accurate and complete; and shall be computer generated, typed or legibly handwritten in English.
- (c) Any remittance form and accompanying motor oil fee received by the Department that is postmarked more than 35 days after the end of the reporting period as described in subdivisions (b) and (f) of this section, is considered delinquent. Delinquent payments are subject to a late penalty fee under the provisions of Section 4306 of this Chapter.
 - (d) A motor oil dealer may not take a credit on the Motor Oil Fee Remittance Form for motor oil that is used for an exempt purpose pursuant to Business and Professions Code, Section 13431, during any quarter. Motor oil fees paid on motor oil later used for an exempt purpose may be refunded upon request of the motor oil dealer under the provisions of Section 4307 of this Chapter.
 - (e) The Department will reject any remittance form that is incomplete, not accompanied by the full fee due, or fails to comply with the reporting requirements of this Chapter. All payments to the Department must be made by check, draft, money order or cashier's check payable to the Cashier, California Department of Food and Agriculture.
 - (f) Notwithstanding subdivision (b) of this section, any motor oil dealer with an annual volume of sales or purchases of motor oil less than or equal to 30,000 gallons may apply in writing to the Department for authorization to file an annual remittance form in lieu of a quarterly remittance form. The annual reporting period shall be established beginning July 1 through June 30 after the written request is accepted by the Department. The annual remittance form and accompanying motor oil fee shall be filed with the Department no later than 30 days after the end of the annual reporting period.

Note: Authority cited: Sections 12027 and 13433, Business and Professions Code. Reference: Sections 13431, 13432 and 13433, Business and Professions Code.

Extract from California Code of Regulations
CCR Title 4, Division 9, Chapter 8
2023 Motor Oil Fee §§ 4300. – 4309.

§ 4305. Authority to Determine Compliance.

Nothing in this Chapter limits the authority of the Department to audit, examine, review, inspect, or otherwise determine the compliance or noncompliance of any motor oil dealer.

NOTE: Authority cited: Sections 12027 and 13433, Business and Professions Code.
Reference: Sections 13431, 13432 and 13433, Business and Professions Code.

§ 4306. Penalties.

For any delinquency with filing a remittance form, or any deficiency in payment, the Department shall add to such delinquent payment a penalty of ten percent of the amount due.

NOTE: Authority cited: Sections 12027 and 13433, Business and Professions Code.
Reference: Sections 13431 and 13433, Business and Professions Code.

§ 4307. Refund of Fees Paid.

All requests for refund of payments made pursuant to Section 4304 of this Chapter shall be submitted to the Department within three years from the date the Department received the remittance form with the payment of the motor oil fee. Requests for refund shall contain the following information:

- (a) A letter requesting the refund, signed by the owner or an authorized person within the company;
- (b) A ledger sheet tabulating purchases and exports for which the refund is being requested;
- (c) Copies of invoices, vouchers, delivery receipts, etc., documenting that the Motor Oil Fee was paid; and,
- (d) Copies of invoices, vouchers, bills of lading, shipping documents, etc., documenting that the motor oil was exported from California.

Any person, who has reported and paid the motor oil fee on motor oil, which is later transported out of California, may request a refund.

Requests for refunds submitted later than three years from the date the Department received the remittance form with payment of the motor oil fee, or not supported by the required documentation, will be returned unprocessed to the sender.

Note: Authority cited: Sections 12027 and 13433, Business and Professions Code. Reference: Sections 13431, 13432 and 13433, Business and Professions Code.

Extract from California Code of Regulations
CCR Title 4, Division 9, Chapter 8 §§ 4300. – 4309.
2023 Motor Oil Fee

§ 4308. Records.

Each person required to file a remittance form pursuant to Section 13431, Business and Professions Code, shall maintain in California or, with the Department's permission at another location, an accurate record of all transactions subject to motor oil fee assessment. Such records shall be subject to audit by the Department. The Department may require records kept outside of California to be copied and sent to California for audit. Alternatively, if the motor oil dealer elects to have all audits conducted out-of-state, the costs for the out-of-state audits will be reimbursed to the Department by the motor oil dealer under audit.

Any records which are required to be maintained pursuant to this Chapter or the Business and Professions Code must be kept in accordance with the following provisions:

- (a) Motor oil dealers must maintain records for a minimum of four years.
- (b) All records maintained pursuant to this Chapter must include the books of account that are ordinarily maintained by the average prudent businessperson.
- (c) Records shall include sales invoices, purchase invoices, paid receipts, bills of lading, vouchers, shipping documents or other documents of original entry. An Automatic Data Processing (ADP) system must have built into its program a method of producing visible and legible records that will provide the necessary information to determine compliance with the requirements of this Chapter.

Note: Authority cited: Sections 12027 and 13433, Business and Professions Code. Reference: Sections 13431 and 13433, Business and Professions Code.

§ 4309. Motor Oil Fee Reimbursement

Nothing in this Chapter prohibits the motor oil dealer who has reported and paid the motor oil fee to the Department from obtaining reimbursement from their customers. When seeking reimbursement, the motor oil dealer must demonstrate on the invoice that the motor oil fee is collected by one of the following methods:

- (1) The motor oil fee may be stated separately on the invoice; or
- (2) The motor oil fee may be included in the selling price provided the invoice clearly states that the fee is included in the invoiced amount.

Note: Authority cited: Sections 12027 and 13433, Business and Professions Code. Reference: Sections 13431 and 13433, Business and Professions Code.

Extract from California Code of Regulations
CCR Title 4, Division 9, Chapter 8
2023 Motor Oil Fee §§ 4300. – 4309.

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CALIFORNIA DEPARTMENT OF
FOOD & AGRICULTURE

Extracts from the
CALIFORNIA CODE OF REGULATIONS
TITLE 4, DIVISION 9

WEIGHTS AND MEASURES FIELD REFERENCE MANUAL (2023)

Chapter 9

Weighmaster Enforcement

Sections 4400. through 4496.6.

- Article 1. General Provisions**
- Article 2. Weighmaster Certificates**
- Article 3. Predetermined Individual Tare Weights**
- Article 4. Seasonal Tare Weights**
- Article 5. Common Tare Weights**
- Article 6. Limits of Permissible Error**
- Article 7. Average Tare Weights**
- Article 8. Volumetric Conversion to Weight of Squid**
- Article 9. Director's Approval of Inspection of Weighmaster Records**
- Article 10. Timber Tare Weights**
- Article 11. Multiple Draft Weighing Operations**
- Article 12. Unattended Weighing Systems**



CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE
DIVISION OF MEASUREMENT STANDARDS

DISCLAIMER

This document represents the Division of Measurement Standards' field manual for enforcing regulations pertaining to weights and measures in California. This field manual is not to be considered as the official Code of Regulations, as published by Barclays Law Publishers.

To find the latest online version of the California Code of Regulations (CCR) Title 4, Division 9, visit the California Office of Administration Law at:

<http://ccr.oal.ca.gov/linkedslice/default.asp?SP=CCR-000&Action=Welcome>

The CCR may also be accessed at <http://oal.ca.gov/> by clicking the "Publications" tab at the top of the OAL home page.

For information concerning the contents of this document, please contact the Division of Measurement Standards by e-mail at dms@cdfa.ca.gov.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9

Weighmaster Enforcement §§ 4400. – 4496.6.

Chapter 9. Weighmaster Enforcement §§ 4400. – 4496.6.	1
Article 1. General Provisions	1
§ 4400. Definition. Repealed 4-25-86.	1
§ 4401. Licenses.	1
§ 4402. Requirement for Zero-Load Balance Condition.	1
§ 4403. Legally Relevant Data.	1
Article 2. Weighmaster Certificates	1
§ 4410. Recording Procedures.	1
§§ 4411. - 4415. Repealed 4-25-86.	2
Article 3. Predetermined Individual Tare Weights	2
§ 4420. Predetermined Individual Tare Weight.	2
§ 4421. Establishing.	2
§ 4422. Certificate Requirements.	3
Article 4. Seasonal Tare Weights	3
§ 4430. Seasonal Tare Weight.	3
§ 4431. Establishing.	4
§ 4432. Certificate Requirement.	4
§ 4433. Conditions of Use.	4
Article 5. Common Tare Weights	5
§ 4440. Common Tare Weight.	5
§ 4441. Establishing.	5
§ 4442. Sample Size.	6
§ 4443. Rounding Procedures.	6
§ 4444. Certificate Requirements.	6
§ 4445. Conditions of Use.	7
§ 4446. Verification and Enforcement.	7
Article 6. Limits of Permissible Error	8
§ 4450. Tolerance Levels.	8
Article 7. Average Tare Weights	8
§ 4460. Average Tare Weight.	8
§ 4461. Establishing.	8
Article 8. Volumetric Conversion to Weight of Squid	9
§ 4470. Container Requirements.	9
§ 4471. Container Markings.	9
§ 4472. Certificate Requirements.	9
Article 9. Director’s Approval of Inspection of Weighmaster Records	11
§ 4480. Application.	11

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9

Weighmaster Enforcement §§ 4400. – 4496.6.

§ 4481. Definition of Designated Agent.	11
§ 4482. Information Required by the Director.	11
§ 4483. Approval of Request.	11
§ 4484. Denial of Request.	12
§ 4485. Applicability-District Attorney.	12
§ 4486. Applicability--Other Law Enforcement Agencies.	12
Article 10. Timber Tare Weights.....	12
§ 4490. Definitions.	12
§ 4491. Establishing.	13
§ 4492. Certificate Requirements.	13
§ 4493. Conditions of Use.	13
Article 11. Multiple Draft Weighing Operations	14
§ 4495. Application.	14
§ 4495.1. Definitions.	14
§ 4495.2. Request for Authorization.	15
§ 4495.3. Conditions of Use.	15
§ 4495.4. Certificate Requirements.	16
§ 4495.5. Establishment and Tolerance.	16
§ 4495.6. Verification and Enforcement.	17
Article 12. Unattended Weighing Systems.....	17
§ 4496. Application.	17
§ 4496.1. Definitions.	18
§ 4496.2. Conditions of Use.	18
§ 4496.3. Certificate and Records Requirements.	20
§ 4496.4. Specifications.	20
§ 4496.5. License Fees When Updated to Include Unattended Weighing Systems.	21
§ 4496.6. Additional Requirements.	22

Chapter 9. Weighmaster Enforcement §§ 4400. – 4496.6.

Article 1. General Provisions

§ 4400. Definition. - Repealed 4-25-86.

§ 4401. Licenses. - A copy of the current weighmaster license shall be maintained at each weighing or measuring location and made available to a Sealer upon request.

NOTE: Authority cited: Sections 12027 and 12735, Business and Professions Code. Reference: Sections 12703 and 12704, Business and Professions Code.

§ 4402. Requirement for Zero-Load Balance Condition. - The weighing system shall provide a means to indicate that the system is in a zero-load balance condition prior to each weighment. This indication must be verified by the deputy weighmaster prior to the vehicle entering onto the load-receiving element.

Note: Authority cited: Sections 12027, 12107 and 12735, Business and Professions Code. Reference: Sections 12107 and 12500, Business and Professions Code.

§ 4403. Legally Relevant Data. - Information necessary to complete a weighmaster certificate and that is used as a basis of payment for the transaction. Information includes, but is not limited to the final results of the weighment, gross weight, net weight, tare, stored tare, worksheets, other weighmaster certificates, photographs, analysis of materials, and any other records that are used to determine the basis of payment.

Note: Authority cited: Sections 12027, 12107 and 12735, Business and Professions Code. Reference: Sections 12715 and 12716, Business and Professions Code.

Article 2. Weighmaster Certificates

§ 4410. Recording Procedures. - In addition to the provisions of the Business and Professions Code, information shall be recorded on weighmaster certificates as follows:

(a) Certificates issued for gross weight only shall have the words “gross only” entered on the certificate in the space provided for recording the tare weight.

(b) Certificates issued for tare weight only shall have the words “tare only” entered on the certificate in the space provided for recording the gross weight.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9

Weighmaster Enforcement §§ 4400. – 4496.6.

(c) Certificates issued for net quantity only that contain gross and tare spaces shall have the words “Net Only” entered on the certificate in the spaces provided for recording the gross and tare weights.

NOTE: Authority cited: Sections 12027 and 12735, Business and Professions Code. Reference: Sections 12713 and 12715, Business and Professions Code.

§§ 4411. - 4415. - Repealed 4-25-86.

Article 3. Predetermined Individual Tare Weights

§ 4420. Predetermined Individual Tare Weight. - A pre-determined individual tare weight is the weight of a vehicle, container or pallet determined by a weighmaster prior to the time of delivery of a product and is established and used in accordance with the following provisions.

NOTE: Authority cited: Sections 12027, 12723 and 12735, Business and Professions Code. Reference: Sections 12722 and 12723, Business and Professions Code.

§ 4421. Establishing. - Predetermined individual tare weights shall be established as follows:

(a) A weighmaster shall weigh the vehicle, container or pallet and issue a “tare only” certificate.

(b) Each vehicle for which a predetermined individual tare weight has been established shall be clearly marked on both sides with the company name or code, license number and predetermined tare weight. The tare weight shall be permanently marked either on the vehicle or on a placard secured thereto. The tare weight shall be identified in numbers and letters not less than three (3) inches (7.62 cm) in height. In the case of gondola units, the required identification shall be applied to both sides of the container portion.

(c) Each container or pallet for which a predetermined individual tare weight has been established shall be clearly marked on both sides with the company name or code, company identification number and predetermined tare weight. The tare weight shall be identified in letters and numbers not less than three (3) inches (7.62 cm) in height.

NOTE: Authority cited: Sections 12027, 12723 and 12735, Business and Professions Code. Reference: Sections 12722 and 12723, Business and Professions Code.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9

Weighmaster Enforcement §§ 4400. – 4496.6.

§ 4422. Certificate Requirements. - A predetermined individual vehicle, container or pallet tare weight may be used by a weighmaster to determine the net weight of a commodity, provided the following information appears on the certificate:

(a) the fact that a predetermined individual tare weight is being used. This may be designated by the letters "P.T."; and

(b) the predetermined tare weight, company name or code, and license number or serial number of each vehicle, container and/or pallet.

NOTE: Authority cited: Sections 12027, 12723 and 12735, Business and Professions Code. Reference: Sections 12715, 12722 and 12723, Business and Professions Code.

§ 4423. Conditions of Use. - The following conditions apply to the use of predetermined individual tare weights:

(a) predetermined individual tare weights may be used by a weighmaster unless a party having a legal or financial interest in the transaction notifies the weighmaster prior to the issuance of the certificate that a predetermined individual tare weight shall not be used; and

(b) a weighmaster shall not use a predetermined individual tare weight which is not based on weighmaster records in his/her possession unless furnished with a copy of the "tare only" certificate which established the predetermined individual tare weight; and

(c) a weighmaster shall not use a predetermined individual tare weight if for any reason it appears that the tare weight may be beyond the tolerance levels prescribed by Section 4450 of this Subchapter.

NOTE: Authority cited: Sections 12027, 12723 and 12735, Business and Professions Code. Reference: Sections 12722 and 12723, Business and Professions Code.

Article 4. Seasonal Tare Weights

§ 4430. Seasonal Tare Weight. - A seasonal tare weight is the tare weight of a fuel consuming vehicle used to transport bulk loads of tomatoes and is established and used in accordance with the following provisions. Seasonal tare weights are determined by weighmasters and are officially established with the issuance of a cab card.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9

Weighmaster Enforcement §§ 4400. – 4496.6.

NOTE: Authority cited: Sections 12027, 12723 and 12735, Business and Professions Code. Reference: Sections 12722, 12723 and 12729, Business and Professions Code.

§ 4431. Establishing. - Seasonal tare weights shall be established as follows:

(a) A weighmaster shall weigh each unladen vehicle after the driver has confirmed that the vehicle has full fuel tanks. (An unladen vehicle is a vehicle without commodity or persons.)

(b) The weighmaster shall:

- (1) Complete and issue a “tare only” weighmaster certificate.
- (2) Complete and issue an original cab card which officially establishes the seasonal tare weight. The cab card shall be furnished by the Division of Measurement Standards. The seasonal tare weight stated on the cab card shall be 250 pounds less than the weight shown on the “tare only” weighmaster certificate.
- (3) Enter the required information on a daily seasonal truck tare recap sheet, furnished by the Division of Measurement Standards. This recap sheet will be mailed to the Division within two business days.

NOTE: Authority cited: Sections 12027, 12723 and 12735, Business and Professions Code. Reference: Sections 12722, 12723 and 12729, Business and Professions Code.

§ 4432. Certificate Requirement. - A seasonal tare weight may be used by a weighmaster to determine the net weight of a commodity, provided the number of the cab card appears on the certificate.

NOTE: Authority cited: Sections 12027, 12723 and 12735, Business and Professions Code. Reference: Sections 12715, 12722, 12723 and 12729, Business and Professions Code.

§ 4433. Conditions of Use. - The following conditions apply to the use of cab cards:

- (a) a cab card shall be valid for a single tomato harvest season only; and
- (b) the cab card shall be carried at all times in the vehicle for which the seasonal tare weight has been established; and
- (c) the cab card shall be presented to the weighmaster when using the seasonal tare weight to certify the net weight of a load; and
- (d) the cab card shall not be used if the actual vehicle tare weight varies by more than 300 pounds from the tare weight stated on the cab card; and

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9

Weighmaster Enforcement §§ 4400. – 4496.6.

(e) a cab card on which the weight figures have been changed or altered in any manner shall not be used; and

(f) a new cab card shall be obtained when the weight or vehicle identification information on the cab card changes; and

(g) the cab card may be used by a weighmaster to determine the net weight of a load unless a party having a legal or financial interest in the transaction notifies the weighmaster prior to the issuance of the certificate that a seasonal tare weight (cab card) shall not be used.

NOTE: Authority cited: Sections 12027, 12723 and 12735, Business and Professions Code. Reference: Sections 12722, 12723 and 12729, Business and Professions Code.

Article 5. Common Tare Weights

§ 4440. Common Tare Weight. A common tare weight is the average weight of a group (lot) of containers or pallets, determined by a weighmaster prior to the time of delivery of the product.

NOTE: Authority cited: Sections 12027, 12723 and 12735, Business and Professions Code. Reference: Sections 12722 and 12723, Business and Professions Code.

§ 4441. Establishing. - Common tare weights shall be established as follows:

(a) The container or pallets within the group (lot) shall each weigh 1,000 lbs. or less, shall be under the control of one user and shall be within a uniform weight range. "Uniform weight range" is defined to mean within a variation (plus or minus) of 0.2 pounds or 20%, whichever is greater.

(b) The weighmaster shall weigh a randomly selected sample of containers or pallets, either individually or in sample sub-groups, as prescribed in Section 4442 of this Article. The common tare weight for each container or pallet shall be determined by mathematically dividing the total weight of the random sample by the number of containers or pallets in the sample. At the time the random sample is weighed, all containers and pallets shall be free from foreign matter and in usable condition.

(c) The common tare weight determined from the sample shall be rounded as prescribed in Section 4443 of this Article.

(d) The weighmaster establishing the common tare weight shall issue a weighmaster certificate and complete a "Common Tare Notice" containing information prescribed by the Director. The originals of the weighmaster certificate and the Common Tare Notice shall be mailed to the Division of Measurement

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9

Weighmaster Enforcement §§ 4400. – 4496.6.

Standards within five (5) days. A copy of the Common Tare Notice shall also be maintained at each weighing location where the common tare weight will be used for certification purposes.

(e) The common tare weight established by the weighmaster shall only apply to the containers or pallets in the lot from which the random sample was selected.

Note: Authority cited: Sections 12027, 12723 and 12735, Business and Professions Code. Reference: Sections 12722 and 12723, Business and Professions Code.

§ 4442. Sample Size. - When determining or verifying common tare weights, the following sample size shall be used:

(a) For all pallets and any container used individually, the minimum size of the random sample shall be 96 or 100% of the lot, whichever is less.

(b) For all palletized containers, the minimum size of the random sample shall be determined from the following table:

Number of Containers Per Pallet	Minimum Number of Pallets (with containers) in Random Sample
Less than 10	96 or 100%, whichever is less
10 to 19	37 or 100%, whichever is less
20 to 49	22 or 100%, whichever is less
50 or more	11 or 100%, whichever is less

Note: Authority cited: Sections 12027, 12723 and 12735, Business and Professions Code. Reference: Sections 12722 and 12723, Business and Professions Code.

§ 4443. Rounding Procedures. - Common and average tare weights shall be rounded (digits of 5 or greater are rounded up) as follows:

(a) If the container tare weight is less than 30 pounds, the weight shall be rounded to the nearest one-tenth (0.1) pounds.

(b) If the container tare weight is at least 30 pounds or more, the weight shall be rounded to the nearest one (1) pound.

NOTE: Authority cited: Sections 12027, 12723 and 12735, Business and Professions Code. Reference: Sections 12722 and 12723, Business and Professions Code.

§ 4444. Certificate Requirements. - A common tare weight may be used by a weighmaster to determine the net weight of a commodity, provided the following information appears on the weighmaster certificate:

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9

Weighmaster Enforcement §§ 4400. – 4496.6.

(a) the fact that a common tare weight is being used. This may be designated by the letters “C.T.”; and

(b) the common tare weight, description of the container, and a name of the person or firm for whom the common tare weight has been established. A code designation may be used in lieu of the description of the container, provided this code also appears on the Common Tare Notice.

NOTE: Authority cited: Sections 12027, 12723 and 12735, Business and Professions Code. Reference: Sections 12715, 12722 and 12723, Business and Professions Code.

§ 4445. Conditions of Use. - The following conditions apply to the use of common tare weights:

(a) common tare weights may only be used by a weighmaster licensed at a location at which a copy of the Common Tare Notice is maintained; and

(b) common tare weights may be used by a weighmaster unless a party having a legal or financial interest in the transaction notifies the weighmaster prior to issuance of the certificate that a common tare weight shall not be used; and

(c) the weighmaster certifying to a common tare weight shall verify that the total number of containers includes not more than 10% of other users' containers and that all containers are within uniform weight range (as defined by Section 4441(a) of this Article); and

(d) a weighmaster shall not use a common tare weight if for any reason it appears that the common tare weight may not meet the tolerance levels prescribed by Section 4450.

NOTE: Authority cited: Sections 12027, 12723 and 12735, Business and Professions Code. Reference: Sections 12722 and 12723, Business and Professions Code.

§ 4446. Verification and Enforcement. - The Director may verify the accuracy of an established common tare weight by weighing a representative sample of containers, as prescribed by Section 4441 of this Article, and by rounding as prescribed by Section 4443, also of this Article. If a common tare weight is found to be beyond the tolerance levels established by Section 4450 of this subchapter, the Director shall issue an order that the common tare weight not be used until re-established by a weighmaster.

NOTE: Authority cited: Sections 12027, 12723 and 12735, Business and Professions Code. Reference: Sections 12722 and 12723, Business and Professions Code.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9

Weighmaster Enforcement §§ 4400. – 4496.6.

Article 6. Limits of Permissible Error

§ 4450. Tolerance Levels. - Except as provided in Section 12722(b) of Chapter 7, Division 5, of the Business and Professions Code, vehicles and containers for which pre-determined individual tare weights and common tare weights have been established shall be maintained as close as practicable to the established tare weight, but in no event shall such tare weights exceed the tolerance level of two-tenths (0.2) pound or two percent (2%) of the established tare weight, whichever is greater.

NOTE: Authority cited: Sections 12027, 12723 and 12735, Business and Professions Code. Reference: Sections 12722 and 12723, Business and Professions Code.

Article 7. Average Tare Weights

§ 4460. Average Tare Weight. - An average tare weight is the average weight of a group (lot) of containers within uniform weight range (as defined by Section 4441(a) of this subchapter) and established by a weighmaster. Average tare weights are determined for each load at the time of certification and are not used for subsequent loads.

NOTE: Authority cited: Sections 12027, 12723 and 12735, Business and Professions Code. Reference: Sections 12722 and 12723, Business and Professions Code.

§ 4461. Establishing.

(a) Average tare weights for containers of uniform weight range, under the control of one user, and used to transport any commodity, may either be established according to the procedures prescribed in Sections 4440-4445 (Common Tare Weights) of this Subchapter, or according to subsection (b) below.

If, however, the containers are of such construction or treatment as to vary in weight as a result of hydrocooling, the average tare weight must be established according to subsection (b) below.

(b) A weighmaster shall randomly select two (2) containers for the first fifty (50) containers in the lot, and one (1) additional container for each fifty (50) additional containers in the lot. However, at no time shall the random sample size be less than three (3) containers.

The average tare weight shall be determined by mathematically dividing the total weight of the random sample by the number of containers in the sample.

The average tare weight determined from the sample shall be rounded as prescribed in Section 4443 of this Subchapter. The weighmaster certificate issued for

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9

Weighmaster Enforcement §§ 4400. – 4496.6.

containers shall show the total number of containers, the number of sample containers, and the average tare weight.

NOTE: Authority cited: Sections 12027, 12723 and 12735, Business and Professions Code. Reference: Sections 12722 and 12723, Business and Professions Code.

Article 8. Volumetric Conversion to Weight of Squid

§ 4470. Container Requirements. - The following conditions apply to containers used in volumetric conversion:

(a) containers used for removing squid from fishing boats shall be constructed of nonabsorbent material and of such construction that they retain their shape when filled; and

(b) only full containers removed from the boat shall be subject to volumetric conversion; squid removed in partially filled containers shall be weighed.

NOTE: Authority cited: Sections 12027, 12734 and 12735, Business and Professions Code. Reference: Section 12734, Business and Professions Code.

§ 4471. Container Markings. - Each container shall be permanently marked on two sides, in numbers and letters at least three (3) inches (7.62 cm) in height, with the following information:

(a) the company name or code;

(b) the volume in cubic feet to the nearest 1/100 cubic foot; and

(c) the tare weight of the container.

NOTE: Authority cited: Sections 12027, 12734 and 12735, Business and Professions Code. Reference: Section 12734, Business and Professions Code.

§ 4472. Certificate Requirements. - A weighmaster certificate which determines the weight of squid by volumetric conversion shall contain the following information:

(a) number of full containers removed;

(b) volume of each container (Volume = Height x Width x Length);

(c) weight of squid per cubic foot, as established by the Director;

(d) net weight determined by volumetric conversion (Total Weight = Number of Containers x Volume of Containers x Weight Per Cubic Foot);

(e) number of partially filled containers;

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9

Weighmaster Enforcement §§ 4400. – 4496.6.

(f) net weight of squid in partially filled containers; and

(g) total weight of squid received.

The above information may be shown in equation form:

EXAMPLE

Number of full containers	}	=	Net weight determined by volumetric conversion
X Volume of each container			
X Weight per Cubic foot			
+			
Number of partially filled of containers (actually weighed)	}	=	(Summed) Net weight of squid in partially filled containers
TOTAL WEIGHT OF SQUID RECEIVED			

Figure 1 - Example of the Equation determining the weighmaster certificate which determines the weight of squid by volumetric conversion shall contain the listed information above.

NOTE: Authority cited: Sections 12027, 12734 and 12735, Business and Professions Code. Reference: Sections 12713(b) and 12734, Business and Professions Code.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9

Weighmaster Enforcement §§ 4400. – 4496.6.

Article 9. Director's Approval of Inspection of Weighmaster Records

§ 4480. Application. - These regulations shall apply to requests made to the Department of Food and Agriculture by a district attorney or district attorney's designated agent for inspection of weighmaster weight certificates or related documents pursuant to Vehicle Code Section 35557(a).

NOTE: Authority cited: Section 12027, Business and Professions Code; and Section 35557, Vehicle Code. Reference: Section 35557, Vehicle Code.

§ 4481. Definition of Designated Agent. - As used in these regulations, a designated agent of the district attorney is an individual within the district attorney's office and designated by the district attorney and authorized to make requests for inspection of weighmaster weight certificates or other related documents. Such designation shall be made in writing to the Director of the Department of Food and Agriculture by the district attorney.

NOTE: Authority cited: Section 12027, Business and Professions Code; and Section 35557, Vehicle Code. Reference: Section 35557, Vehicle Code.

§ 4482. Information Required by the Director. - Any district attorney or designated agent of the district attorney who shall request inspection of any weighmaster weight certificates or related documents through the Department of Food and Agriculture shall certify that:

- (a) He/she is the district attorney or district attorney's designated agent.
- (b) He/she possesses a citation or copy of a citation issued for gross vehicle overweight, which has been referred by an Area Commander of the California Highway Patrol along with their reasons for believing that there may be an act of unlawful business practice, and requests the right to review records pertaining to trucks operated by the named company in the possession of specified weighmasters.
- (c) He/she has served a copy of the request on an official of the named company, or is declining to do so for reasons specifically stated.
- (d) He/she will reveal and discuss the findings from the review of these records with the named company prior to initiating any civil action against the company which is based in whole or in part on these records.

NOTE: Authority cited: Section 12027, Business and Professions Code; and Section 35557, Vehicle Code. Reference: Section 35557, Vehicle Code.

§ 4483. Approval of Request. - If the Director of the Department of Food and Agriculture finds that the above conditions have been met, he/she shall issue a letter to the district attorney authorizing the district attorney or employees of the district

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9

Weighmaster Enforcement §§ 4400. – 4496.6.

attorney to inspect the records of those weighmasters to determine the number and extent of violations of Division 15, Chapter 5, Article 1 of the California Vehicle Code that may exist, related to the named company, covering a period of 30 days prior to and 30 days subsequent to the issuance of the identified citation.

NOTE: Authority cited: Section 12027, Business and Professions Code; and Section 35557, Vehicle Code. Reference: Section 35557, Vehicle Code.

§ 4484. Denial of Request. - If the Director of the Department of Food and Agriculture finds that any of the above conditions have not been met, he/she shall issue a letter to the district attorney informing the district attorney that a letter authorizing inspection of weighmaster weight certificates or related documents has been denied, as well as the specific finding or findings upon which the denial was based.

NOTE: Authority cited: Section 12027, Business and Professions Code; and Section 35557, Vehicle Code. Reference: Section 35557, Vehicle Code.

§ 4485. Applicability-District Attorney. - Nothing in these regulations shall be deemed to apply to any request by any district attorney or district attorney employee to obtain weighmaster weight certificates or related documents for purposes other than prosecuting a civil or criminal violation arising out of Division 15, Chapter 5, Article 1 of the California Vehicle Code.

NOTE: Authority cited: Section 12027, Business and Professions Code; and Section 35557, Vehicle Code. Reference: Section 35557, Vehicle Code.

§ 4486. Applicability--Other Law Enforcement Agencies. -Nothing in these regulations shall be deemed to apply to or limit the rights of any law enforcement agency other than any district attorney's office to obtain such weighmaster weight certificates or related documents for any law enforcement purpose other than prosecuting a civil or criminal violation arising out of Division 15, Chapter 5, Article 1 of the California Vehicle Code.

NOTE: Authority cited: Section 12027, Business and Professions Code; and Section 35557, Vehicle Code. Reference: Section 35557, Vehicle Code.

Article 10. Timber Tare Weights

§ 4490. Definitions. - The following definitions apply to timber tare weights.

(a) A timber tare weight is the unladen weight of a vehicle or combination of vehicles, used to transport loads of logs, where an automated weight scaling program is used to determine the board foot volume of the load.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9

Weighmaster Enforcement §§ 4400. – 4496.6.

(b) Sample scale frequency is the number of loads of logs to be measured by a log scaler at a frequency agreed to by the buyer and seller, e.g., 1 in 4 loads must be measured by a log scaler.

NOTE: Authority cited: Sections 12027, 12723 and 12735, Business and Professions Code. Reference: Sections 12722, 12723 and 12729, Business and Professions Code.

§ 4491. Establishing. - Timber tare weights shall be established in accordance with the following provisions:

(a) A timber tare weight shall be established, by a weighmaster, as the mathematical average of the actual tare weights of a vehicle for the first five consecutive loads hauled into the mill.

(b) After establishment, a timber tare weight for any vehicle shall be calculated from the mathematical average of the five most current actual tare weights. The frequency for updating the timber tare weight, after its establishment, shall be the same as the sample scale frequency and in no case less frequent than one in ten.

NOTE: Authority cited: Sections 12027, 12723 and 12735, Business and Professions Code. Reference: Sections 12722 and 12723, Business and Professions Code.

§ 4492. Certificate Requirements. - A timber tare weight may be used by a weighmaster to determine the net weight of timber: provided, disclosure that a timber tare weight is being used appears on the certificate immediately adjacent to the tare weight entry. This shall be designated by the letters "T.T." and is in addition to any information required by California Business and Professions Code, Division 5, Chapter 7.

NOTE: Authority cited: Sections 12027, 12723 and 12735, Business and Professions Code. Reference: Sections 12715, 12722 and 12723, Business and Professions Code.

§ 4493. Conditions of Use. - The following conditions apply to the use of timber tare weights:

(a) Timber tare weights shall be limited to sales where agreed to by all parties having a legal or financial interest.

(b) A weighmaster shall not use a timber tare weight which is not based on weighmaster records in their possession.

(c) Whenever the timber tare weight has not been updated for more than one hundred and twenty (120) days, a new timber tare weight shall be established for that vehicle.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9

Weighmaster Enforcement §§ 4400. – 4496.6.

(d) A current actual tare weight that differs from the timber tare weight for that vehicle by more than plus or minus two percent (+ 2%) must automatically cause the establishment of a new timber tare weight for that vehicle.

(e) When any vehicle fails to obtain a current tare weight when required by the program to update the timber tare weight, the existing timber tare weight shall be used for that load and the system must automatically cause the establishment of a new timber tare weight for that vehicle.

(f) Vehicles with cribs or inserts for short logs, mule trains, and self loaders shall not use a timber tare weight unless the cribs, inserts, or self-loading apparatus are permanently installed.

(g) Timber tare weight information must be kept as part of the weighmaster records for a period of four (4) years. These records are to include, but are not limited to, tare weight records supporting timber tare weight updates, tare frequency and sample scaling frequency.

NOTE: Authority cited: Sections 12027, 12723 and 12735, Business and Professions Code. Reference: Sections 12716, 12722 and 12723, Business and Professions Code.

Article 11. Multiple Draft Weighing Operations

§ 4495. Application.

(a) These regulations shall apply to written requests made to the Department for authorization to use multiple draft static weighing operations.

(b) Also see General and Scales Code requirements, California Code of Regulations, Title 4, Division 9, Chapter 1.

NOTE: Authority cited: Sections 12027, 12107 and 12735, Business and Professions Code. Reference: Section 12728(d)(2), Business and Professions Code.

§ 4495.1. Definitions. - As used in this article:

(a) A multiple draft static weighing operation of a combination of vehicles is a weighing procedure whereby individual weights of connected vehicles in the combination are determined without the entire combination of vehicles resting on the scale platform simultaneously and without disconnecting the vehicles. Multiple draft static weighing operations and multiple draft weighing operations have the same meaning for the purpose of this article.

(b) A single draft static weighing operation is a weighing procedure whereby the entire vehicle or combination of vehicles is resting on the scale platform simultaneously.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9

Weighmaster Enforcement §§ 4400. – 4496.6.

NOTE: Authority cited: Sections 12027, 12107 and 12735, Business and Professions Code. Reference: Section 12728(d)(2), Business and Professions Code.

§ 4495.2. Request for Authorization. - A written request for authorization is limited to those operations where the applicant has complete control of all the vehicles and weighing device(s). The written request shall be submitted to the Department and shall contain the following information:

(a) The procedures that will be used in the multiple draft weighing operation. This shall include the specific weighing location, the weighing device(s) to be used, and the position of vehicles relative to the load-receiving element of the scale.

(b) The make, model and a unique identification designation for each individual vehicle.

(c) The test data supporting accuracy of the proposed multiple draft weighing operation.

NOTE: Authority cited: Sections 12027, 12107 and 12735, Business and Professions Code. Reference: Section 12728(d)(2), Business and Professions Code.

§ 4495.3. Conditions of Use.

(a) The pulled vehicle shall not be equipped with a braking system.

(b) The pulled vehicle shall have a minimum of two axles separated by such a distance that they completely support the load and also shall be equipped with a free-floating, non-rigidly mounted tongue.

(c) A copy of the letter issued by the Department authorizing the multiple draft weighing operation shall be maintained at the weighing location and made available to a Sealer upon request.

(d) All weights (gross and tare) shall be determined using the same authorized multiple draft weighing operation. "Gross Only" or "Tare Only" certificates are prohibited from being used when using a multiple draft weighing operation.

(e) The use of predetermined individual tare or common tare weights for pulled vehicles are prohibited when using a multiple draft weighing operation.

(f) A weighmaster shall not use a multiple draft weighing operation if for any reason it appears that the weights so determined may be beyond the tolerance level prescribed in Section 4495.5(f).

(g) Multiple draft weighing operations may not be used by a weighmaster if a party having a legal or financial interest in the transaction notifies the weighmaster prior to the issuance of the certificate that a multiple draft weighing operation shall not be used.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9

Weighmaster Enforcement §§ 4400. – 4496.6.

NOTE: Authority cited: Sections 12027, 12107 and 12735, Business and Professions Code. Reference: Section 12728(d)(2), Business and Professions Code.

§ 4495.4. Certificate Requirements. - When a multiple draft weighing operation is used by a weighmaster to determine the net weight of a product, the following information shall appear on the certificate:

(a) The fact that a multiple draft weighing operation is being used to determine the weights. This shall be designated by the words "Multiple Draft" immediately adjacent to both the gross and tare weights. As of January 1, 2000, the letters "M.D." may be substituted for the words "Multiple Draft".

(b) The identification of any connected vehicle not resting on the scale platform during certification.

These requirements are in addition to any other information required by California Business and Professions Code, Division 5, Chapter 7.

NOTE: Authority cited: Sections 12027, 12107 and 12735, Business and Professions Code. Reference: Section 12728(d)(2), Business and Professions Code.

§ 4495.5. Establishment and Tolerance. - Data shall be compiled showing that the method used in the multiple draft weighing operation for the specific location, vehicles, and connected combinations does not introduce or result in errors not in conformance with the requirements of this article when compared to a single draft weighing operation. All testing by the Department shall be consistent with verifying the accuracy of this method. If for any reason the verification testing fails or cannot be performed safely, testing will be terminated until the deficiencies are corrected and the written request for authorization is re-submitted to the Department.

The following procedures shall be used by weights and measures officials for authorizing multiple draft weighing procedures:

(a) The applicant shall provide accessibility to all identified equipment and they shall also provide assistance from trained facility representative(s) during the verification procedures.

(b) All single draft weighings will be performed with the vehicle(s) positioned in approximately the same location on the load-receiving element of the weighing device.

(c) Vehicles shall be tested as used in the normal course of business.

(d) Multiple draft weighings shall be performed in accordance with the applicant's written procedures.

(e) A maximum of 30 single draft and 30 multiple draft net weighments shall be

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9

Weighmaster Enforcement §§ 4400. – 4496.6.

performed for each requested authorization.

(f) At no time shall the net weights determined using a multiple draft weighing operation differ from those using a single draft weighing operation by more than twice the scale tolerance for that net load. A weighment that exceeds the established tolerance shall be sufficient grounds for the Department to deny authorization to use the multiple draft weighing procedure.

The Department shall issue a letter either authorizing use of the multiple draft weighing operation or rejecting the application within 30 days following the completion of verification procedures.

NOTE: Authority cited: Sections 12027, 12107 and 12735, Business and Professions Code. Reference: Section 12728(d)(2), Business and Professions Code.

§ 4495.6. Verification and Enforcement.

(a) When the gross weight or tare weight of a vehicle and connected combination is recorded on a weighmaster certificate, verification of that weight shall be made by reweighing the combination using the same multiple draft weighing operation authorized by the Department. At no time shall the reweigh weight differ from the recorded weight by more than twice the scale tolerance for that weighment.

(b) If a multiple draft weighing operation is found to produce weights that are beyond the established tolerance, the Department shall issue an order stating that the multiple draft weighing operation shall not be used until it is reestablished and reauthorized by the Department.

(c) Only the approved procedure shall be used when using a multiple draft weighing operation.

NOTE: Authority cited: Sections 12027, 12107 and 12735, Business and Professions Code. Reference: Section 12728(d)(2), Business and Professions Code.

Article 12. Unattended Weighing Systems

§ 4496. Application.

(a) This Article shall apply to unattended systems for weighing any vehicle moving construction materials, including, but not limited to, earth, stone, rock, sand, gravel, limestone, ready mixed concrete, cementitious materials, recycled construction materials, or asphalt paving materials to issue a weighmaster certificate to buyers who opt to utilize the unattended system.

(b) In addition to the requirements of this Chapter, unattended weighing systems

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9

Weighmaster Enforcement §§ 4400. – 4496.6.

shall meet the requirements of Chapter 1, sections 4000, 4001, and 4002 for applicable selection, installation, use, and maintenance requirements.

(c) This Article does not apply to:

- (1) Weighing systems where a human weighmaster or deputy weighmaster actions are required to accept and complete the weighing transaction, and
- (2) Determining the weight of palletized rock, decorative rock, pavers, landscaping materials and products not being used for construction purposes.

Note: Authority cited: Sections 12027, 12107 and 12735, Business and Professions Code. Reference: Sections 12500, 12500.5 and 12737, Business and Professions Code.

§ 4496.1. Definitions. - As Used in this Article:

(a) “Unattended weighing system” Means an automated system not directly under the supervision of a weighmaster that meets the approval, testing, and sealing requirements of Sections 12717 and 12500.5, Business and Professions Code and is intended to be operated by the vehicle driver.

(b) “Deputy Weighmaster” means the person employed or designated by the principal weighmaster to act on their behalf. In the case of an unattended weighing system, the weighing system serves as the deputy weighmaster.

(c) “Zero-load balance” means a representation of zero on the indicator when there is no load on the load-receiving element.

Note: Authority cited: Sections 12027, 12107, 12500.5 and 12735, Business and Professions Code. Reference: Sections 12500, 12500.5 and 12737, Business and Professions Code.

§ 4496.2. Conditions of Use.

The following conditions apply to the use of an unattended weighing system:

(a) Zero-balance condition. The unattended weighing system shall provide a means to indicate that the system is in a zero-load balance condition and ready for use. This indication shall be visible to the driver prior to the vehicle entering onto the load-receiving element. The unattended weighing system shall not complete a weighing operation if:

- (1) The scale is not at a zero-load balance at the start of the weighment (no load on the scale).
- (2) The indicating element is unable to automatically reset the zero-load balance when there is no load on the load-receiving element.

(b) Position of vehicle. The unattended weighing system shall have sufficient gates,

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9

Weighmaster Enforcement §§ 4400. – 4496.6.

sensors or other automatic means to prohibit a weighment unless the entire vehicle rests on the load-receiving element. The unattended weighing system shall not record a weighment when it determines that the vehicle is not correctly positioned on the scale.

(c) Indication and recording elements. The unattended weighing system shall be equipped with an onsite recording element, and either: 1) an audio and visual, or 2) a visual indicating element that communicates the status of the weighing process to the operator (driver) of the vehicle. The recording element shall print the weighmaster certificate at the end of the weighment. For systems equipped with the capability to issue an electronic receipt, the customer may be given the option to receive the weighmaster certificate electronically, e.g., via cell phone, computer, etc.

(d) Records security. The unattended weighing system shall be designed with a means to secure, maintain, and provide true copies of weighmaster certificates in either hard copy or electronic formats. All legally relevant data shall be stored and adequately protected against accidental or intentional changes.

(e) Access for testing and inspection of records. The unattended weighing system shall be designed with a means to access all records, and with the capability to print records for the purpose of inspection. Contact information for the principal weighmaster shall be posted at the location to facilitate compliance with this requirement.

(f) Tare capability. The unattended weighing system shall be designed with one or more of the following tare mechanisms:

- (1) Semi-automatic tare mechanism (load balanced automatically following a single operation initiated by the operator (driver));
- (2) Pre-set tare; tare that is stored in the system memory for recall at a later time and used for multiple weighments and is valid unless the actual tare of the vehicle and/or trailer(s) has been altered. The weighmaster certificate shall note the fact that a “stored tare” or “recalled tare” weight is being used.
- (3) Manual entry of tare by the driver into the system. The weighmaster certificate shall note the fact that “manual tare” weight is being used.
- (4) Predetermined tares; if a predetermined tare is used, the system shall be capable of receiving all information required under Article 3. of this chapter and indicate on the certificate that a predetermined tare was used.

(g) Prohibited operations. The unattended weighing system shall not complete a weighing operation under the following conditions:

- (1) The unattended weighing system is designed to produce a printed ticket and one cannot be generated, e.g., if there is no paper in the printer.
- (2) The system loses communication or power, no weighing will be allowed until the system is reset; i.e., either manually or by other means returned to its normal operating condition.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9

Weighmaster Enforcement §§ 4400. – 4496.6.

(3) The gross weight is above legal highway limits of 80,000 lb.

(h) California Type Evaluation Program Certificate of Approval. California Type Evaluation Program (CTEP) or National Type Evaluation Program (NTEP) evaluated and approved components may be used as part of an unattended weighing system. The installation and use of unattended weighing systems or separable indicating elements and software controlling the metrological functions of the unattended weighing system shall be evaluated and approved by the CTEP.

(i) Posting of weighmaster license. A copy of the current weighmaster license must be posted or continuously displayed and available at the location of the unattended weighing system. The system's unique identification number shall be listed on the license as the deputy weighmaster.

Note: Authority cited: Sections 12027, 12107 and 12735, Business and Professions Code. Reference: Sections 12500, 12500.5, 12716 and 12737, Business and Professions Code.

§ 4496.3. Certificate and Records Requirements.

(a) When an unattended weighing system is being used for weighments, the words "Unattended Weighing System" shall be included on the weighmaster certificate. The weighmaster certificate shall identify the principal weighmaster's name as it appears on the license and the unique system identification number in lieu of the deputy weighmaster's name as required in Business and Professions Code Section 12715 (c).

This requirement is in addition to any other information required by the California Business and Professions Code, Division 5, Chapter 7.

(b) For the purposes of this regulation, records include synchronized photographs or video of the tractor, trailers, license plates, the commodity being weighed, and any others necessary to document the transaction. Failure to maintain legible video, photographs, etc., would be a violation of Business and Professions Code Section 12716.

Note: Authority cited: Sections 12027, 12107 and 12735, Business and Professions Code. Reference: Sections 12715, 12716 and 12737, Business and Professions Code.

§ 4496.4. Specifications.

(a) Tare. An unattended weighing system shall be designed to automatically clear from its memory any indicated tare value between transactions (i.e., printing the weighmaster certificate). This does not prohibit the use of stored tares assigned to vehicles or trailers that are on the scale for a new weighment.

(b) Additional Markings: In addition to the applicable marking requirements in Chapter 1, Sections 4000, 4001, and 4002, an unattended weighing system shall be conspicuously and permanently marked or continuously displayed to the driver with the following information:

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9

Weighmaster Enforcement §§ 4400. – 4496.6.

- (1) For systems that operate in unattended mode only, a statement such as “For unattended vehicle weighing applications only” or similar.
- (2) For systems that can operate in both attended and unattended modes, a statement such as “For unattended vehicle weighing applications only” shall be visible when in the unattended mode.
- (3) Operator (driver) instructions and activated controls on the system or through the driver's use of electronic equipment communicating with the system shall be clearly and conspicuously identified.
- (4) The contact information and business hours of the principle weighmaster for inspection and testing, or for reporting.
- (5) California Type Evaluation Program (CTEP) Certificate of Approval number or a corresponding CTEP addendum number, using the terms “CTEP TA” or “CTEP Approval” followed by the word “number,” “No.” or “#”.

(c) The required information shall be located so that it is readily observable without the necessity of disassembly of the system.

Note: Authority cited: Sections 12027, 12107 and 12735, Business and Professions Code. Reference: Sections 12500, 12500.5 and 12737, Business and Professions Code.

§ 4496.5. License Fees When Updated to Include Unattended Weighing Systems. - Weighmasters that wish to change operations to include unattended weighing systems will be required to pay additional fees consistent with Business and Professions Code Section 12737.

(a) License fees - Regardless of the number of months remaining for the license year and at the time the change is made, the Weighmaster shall pay to the Department an additional amount to complete the licensing fees to the amounts required for unattended weighing systems of:

- (1) One hundred twenty-five dollars (\$125) if the weighmaster is operating at a fixed location.
- (2) Forty-five dollars (\$45) for each additional fixed location the weighmaster is operating.
- (3) One hundred dollars (\$100) if the weighmaster is operating at other than a fixed location.
- (4) Thirty dollars (\$30) for each deputy weighmaster.

(b) For subsequent years following the initial switch to an unattended weighing system, weighmasters will pay fees according to BPC 12737.

(c) Weighmasters using a combination of unattended weighing systems and attended weighing systems shall pay to the Department the fees set forth in Business and Professions Code 12737.

Note: Authority cited: Sections 12027 and 12735, Business and Professions Code.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9

Weighmaster Enforcement §§ 4400. – 4496.6.

Reference: Section 12737, Business and Professions Code.

§ 4496.6. Additional Requirements.

(a) There shall be visible to the sealer and/or to the operator (driver), contact information of the responsible party in case the unattended weighing system fails to operate properly (e.g., failures of hardware, software, printer, etc.).

(b) The weighmaster is responsible for ensuring that the unattended weighing system is capable of voiding an incorrect weighmaster certificate and then issuing a corrected certificate. This requirement shall be verified as part of the unattended weighing system's type evaluation required by Business and Professions Code 12500.5.

(c) If the operator (driver) makes an error entering any information that is necessary for the transaction, e.g., tare, causing an incorrect certificate to be generated, the operator (driver) must make corrections upon recognition of the error. It is unlawful for a driver to manipulate a tare so as to facilitate fraud.

(d) Also see Chapter 1, Sections 4000, 4001, and 4002 for applicable selection, installation, use, and maintenance requirements.

Note: Authority cited: Sections 12027 and 12735, Business and Professions Code.

Reference: Sections 12716.5, 12719 and 12737, Business and Professions Code.



CALIFORNIA DEPARTMENT OF
FOOD & AGRICULTURE

Extracts from the
CALIFORNIA CODE OF REGULATIONS
TITLE 4, DIVISION 9

WEIGHTS AND MEASURES FIELD REFERENCE MANUAL (2023)

Chapter 10
Quantity Control
Sections 4500. through 4532.

Article 1. General

Article 2. Uniform Packaging and Labeling Regulation (UPLR)
NIST UPLR with Exceptions and Additions

Article 3. Fireplace and Stove Wood



CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE
DIVISION OF MEASUREMENT STANDARDS

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS
Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

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For information concerning the contents of this document, please contact the Division of Measurement Standards by e-mail at dms@cdfa.ca.gov.

Chapter 10 - Quantity Control

Table of Contents

SECTION	PAGE
ARTICLE 1. GENERAL §§ 4500. THROUGH 4512.	1
§ 4500. STANDARDS FOR FRESH BERRIES.	1
§ 4501. FISH SALES BY WEIGHT.	1
§ 4502. WOOD FOR FUEL PURPOSES. (REPEALED 4-01-2020) SEE NIST HANDBOOK 133: CHECKING THE NET CONTENTS OF PACKAGED GOODS - CURRENT EDITION	1
§ 4503. GRAVIMETRIC TESTING OF FLUID PRODUCTS AND PRODUCTS SOLD BY COUNT.	1
ARTICLE 2. UNIFORM PACKAGING AND LABELING REGULATION	2
§ 4510. APPLICATION	2
§ 4511. EXCEPTIONS	2
§ 4512. REQUIREMENTS DIFFERENT THAN HANDBOOK 130 UPLR.....	2
§ 4512.1. POLYETHYLENE PRODUCTS. THE DECLARATION OF QUANTITY OF CONTENTS FOR POLYETHYLENE PRODUCTS SHALL BE AS FOLLOWS:.....	2
ARTICLE 3. FIREPLACE AND STOVE WOOD	4
§ 4530. METHOD OF SALE.....	4
§ 4531. ADDITIONAL REQUIREMENTS FOR KINDLING.....	4
§ 4532. VOLUMETRIC SAMPLING AND TEST PROCEDURES.	4
A. UNIFORM PACKAGING AND LABELING REGULATION	6
1. BACKGROUND.....	6
2. STATUS OF PROMULGATION	7
PREAMBLE	7
SECTION 1. APPLICATION	7
SECTION 2. DEFINITIONS	8
2.1. PACKAGE.....	8
2.2. CONSUMER PACKAGE OF CONSUMER COMMODITY.	8
2.3. NON-CONSUMER PACKAGE: PACKAGE OF NON-CONSUMER COMMODITY.	8
2.4. RANDOM PACKAGE.	8
2.5. LABEL.	8
2.6. PERSON.....	9
2.7. PRINCIPAL DISPLAY PANEL OR PANELS.....	9
2.8. MULTI-UNIT PACKAGE.....	9
2.9. COMBINATION PACKAGE.	9
2.10. VARIETY PACKAGE.....	9
2.11. PETROLEUM PRODUCTS. – [NOT ADOPTED - § 4511. EXCEPTIONS].....	10
2.12. SPOT LABEL.	10
2.13. HEADER STRIP.....	10

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

2.14. STANDARD PACKAGE. 10
2.15. SI OR SI UNITS. 11
SECTION 3. DECLARATION OF IDENTITY: CONSUMER PACKAGE..... 11
3.1. DECLARATION OF IDENTITY: CONSUMER PACKAGE. 11
SECTION 4. DECLARATION OF IDENTITY: NON-CONSUMER PACKAGE 11
**SECTION 5. DECLARATION OF RESPONSIBILITY: CONSUMER AND NON-CONSUMER
PACKAGES 12**
SECTION 6. DECLARATION OF QUANTITY: CONSUMER PACKAGES..... 12
6.1. GENERAL. 12
6.2. LARGEST WHOLE UNIT..... 13
6.3. NET QUANTITY..... 13
6.4. TERMS: WEIGHT, MEASURE, VOLUME, OR COUNT. 14
6.5. SI UNITS: MASS, MEASURE. 14
6.6. PRESCRIBED UNITS, SI. [NOTE 3] 18
6.7. U.S. CUSTOMARY UNITS: WEIGHT, MEASURE. 18
6.8. PRESCRIBED UNITS, U.S. CUSTOMARY SYSTEM..... 20
6.9. BI-DIMENSIONAL COMMODITIES. 21
6.10. COUNT: PLY..... 22
6.11. FRACTIONS..... 23
6.12. SUPPLEMENTARY QUANTITY DECLARATIONS. 23
6.13. ROUNDING. [NOT ADOPTED – CCR § 4511. EXCEPTIONS]..... 24
6.14. QUALIFICATION OF DECLARATION PROHIBITED. 24
6.15. CHARACTER OF DECLARATION: AVERAGE..... 24
6.16. RANDOM PACKAGES..... 24
SECTION 7. DECLARATION OF QUANTITY: NON-CONSUMER PACKAGES..... 25
7.1. GENERAL. 25
7.2. LOCATION..... 25
7.3. TERMS: WEIGHT, LIQUID MEASURE, DRY MEASURE, OR COUNT..... 25
7.4. SI UNITS: MASS, MEASURE. – A DECLARATION OF QUANTITY: 25
7.5. U.S. CUSTOMARY UNITS: WEIGHT, MEASURE..... 26
7.6. CHARACTER OF DECLARATION: AVERAGE. – [NOT ADOPTED – CCR § 4511. EXCEPTIONS]
..... 27
SECTION 8. PROMINENCE AND PLACEMENT: CONSUMER PACKAGES 27
8.1. GENERAL. 27
8.2. CALCULATION OF AREA OF PRINCIPAL DISPLAY PANEL FOR PURPOSES OF TYPE SIZE. 28
SECTION 9. PROMINENCE AND PLACEMENT: NON-CONSUMER PACKAGES..... 30
9.1. GENERAL. 30
**SECTION 10. REQUIREMENTS: SPECIFIC CONSUMER COMMODITIES, NON-
CONSUMER COMMODITIES, PACKAGES, CONTAINERS..... 30**

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

10.1. DISPLAY CARD PACKAGE.....	31
10.2. EGGS.....	31
10.3. AEROSOLS AND OTHER PRE-PRESSURIZED CONTAINERS DISPENSING PRODUCT UNDER PRESSURE.....	31
10.4. MULTI-UNIT PACKAGES. [NOTE 8 CCR PAGE QC-25] / [NOTE 8, HB 130 PAGE 78].....	31
10.5. COMBINATION PACKAGES.....	32
10.6. VARIETY PACKAGES.....	33
10.7. CYLINDRICAL CONTAINERS.....	33
10.8. MEASUREMENT OF CONTAINER-TYPE COMMODITIES, HOW EXPRESSED.....	34
10.9. TEXTILE PRODUCTS, THREADS, AND YARNS.....	36
10.10. PACKAGED SEED.....	38
SECTION 11. EXEMPTIONS [NOTE 9, CCR PAGE 31] [NOTE 9, HB 130 PAGE 83]	38
11.1. RANDOM PACKAGES.....	39
11.2. SMALL CONFECTIONS.....	40
11.3. SMALL PACKAGES OF MEAT OR MEAT PRODUCTS.....	40
11.4. INDIVIDUAL SERVINGS.....	40
11.5. CUTS, PLUGS, AND TWISTS OF TOBACCO AND CIGARS.....	40
11.6. REUSABLE (RETURNABLE) GLASS CONTAINERS.....	40
11.7. CIGARETTES AND SMALL CIGARS.....	40
11.8. PACKAGED COMMODITIES WITH LABELING REQUIREMENTS SPECIFIED IN FEDERAL LAWS AND REGULATIONS.....	40
11.9. FLUID DAIRY PRODUCTS, ICE CREAM, AND SIMILAR FROZEN DESSERTS.....	41
11.10. SINGLE STRENGTH AND LESS THAN SINGLE-STRENGTH FRUIT JUICE BEVERAGES, IMITATIONS THEREOF, AND DRINKING WATER.....	41
11.11. SOFT DRINK BOTTLES.....	42
11.12. MULTI-UNIT SOFT DRINK PACKAGES.....	42
11.13. BUTTER.....	42
11.14. EGGS.....	42
11.15. FLOUR.....	42
11.16. SMALL PACKAGES.....	42
11.17. DECORATIVE CONTAINERS.....	43
11.18. COMBINATION AND VARIETY PACKAGES.....	43
11.19. MARGARINE.....	43
11.20. CORN FLOUR AND CORN MEAL.....	43
11.21. PRESCRIPTION AND INSULIN CONTAINING DRUGS.....	43
11.22. CAMERA FILM, VIDEO RECORDING TAPE, AUDIO RECORDING TAPE, AND OTHER IMAGE AND AUDIO RECORDING MEDIA INTENDED FOR RETAIL SALE AND CONSUMER USE.....	43
11.23. TINT BASE PAINT.....	44
11.24. MOTOR OIL IN CANS.....	45
11.25. PILLOWS, CUSHIONS, COMFORTERS, MATTRESS PADS, SLEEPING BAGS, AND SIMILAR PRODUCTS.....	45
11.26. COMMODITIES' VARIABLE WEIGHTS AND SIZES.....	45
11.27. PACKAGED COMMODITIES SOLD BY COUNT.....	45
11.28. TEXTILE PACKAGES.....	46

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

11.29. SPOT LABEL.....	46
11.30. HEADER STRIP.....	46
11.31. DECORATIVE WALLCOVERING BORDERS.....	46
11.32. SI UNITS, EXEMPTIONS - CONSUMER COMMODITIES.....	46
11.33. U.S. CUSTOMARY UNITS, EXEMPTIONS - CONSUMER COMMODITIES.....	47
11.34. BACON.....	47
SECTION 12. VARIATIONS TO BE ALLOWED [NOT ADOPTED – CCR § 4511. EXCEPTIONS][NOT ADOPTED – CCR § 4511. EXCEPTIONS].....	47
SECTION 13. RETAIL SALE PRICE REPRESENTATIONS [NOT ADOPTED – CCR § 4511. EXCEPTIONS] [NOT T ADOPTED - CCR § 4511. EXCEPTIONS].....	47
SECTION 14. REVOCATION OF CONFLICTING REGULATIONS [NOT ADOPTED – CCR § 4511. EXCEPTIONS] [NOT ADOPTED - CCR § 4511. EXCEPTIONS].....	47
SECTION 15. EFFECTIVE DATE [NOT ADOPTED – CCR § 4511. EXCEPTIONS] CCR § 4511. EXCEPTIONS]	47
§ 4512. ADDITIONAL REQUIREMENTS.....	47
CCR § 4512.1. POLYETHYLENE PRODUCTS.....	48
CCR § 4512.2. ANIMAL BEDDING.....	48
CCR § 4512.3. ENFORCEMENT.....	49
UPLR APPENDIX A: SI/U.S. CUSTOMARY CONVERSION FACTORS **	49
UPLR APPENDIX B: CONVERTING U.S. CUSTOMARY UNITS TO SI UNITS FOR QUANTITY DECLARATIONS ON PACKAGES	50
APPENDIX C: REFERENCE INFORMATION FOR PACKAGED COMMODITIES WITH LABELING REQUIREMENTS SPECIFIED IN FEDERAL LAW AND REGULATION.....	53

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

Chapter 10. Quantity Control
Article 1. General §§ 4500. through 4512.

§ 4500. Standards for Fresh Berries.

Fresh berries shall be sold by net weight; or by volume in measure containers in specified capacities as follows:

- (a) Strawberries -Dry pint (33.6 cubic inches; net weight 12 oz.), or dry quart (67.2 cubic inches; net weight 1 lb. 6 oz.).
- (b) All other berries -Dry pint (33.6 cubic inches; net weight 12 oz.), or half dry pint (16.8 cubic inches; net weight 8 oz.). Half dry pints, dry pints, and dry quarts, when sold by volume, shall not be deemed to be packages for labeling purposes.

Berry containers (boxes, baskets or packaging in any manner), whether opened or covered shall not have a false bottom or be constructed as to facilitate deception or fraud.

Note: Authority cited: Sections 12027 and 12107.1, Business and Professions Code.
Reference: Sections 12107.1 and 12601, Business and Professions Code.

§ 4501. Fish Sales by Weight.

The provisions of Section 12024.5, Chapter 1, Division 5 of the California Business and Professions Code shall apply to the sale or advertisement for sale of fin fish and crustaceans, when sold for human consumption, and when not alive.

Note: Authority cited: Sections 12027 and 12609, Business and Professions Code. Reference: Sections 12024.5 and 12024.8, Business and Professions Code.

§ 4502. Wood for Fuel Purposes. (REPEALED 4-01-2020) See [NIST Handbook 133: Checking the Net Contents of Packaged Goods - Current Edition](#)

§ 4503. Gravimetric Testing of Fluid Products and Products Sold by Count.

Products sold by fluid measure or by count may be tested gravimetrically, by weights and measures officials, using procedures established by the Director. These procedures shall incorporate a statistical sampling plan established by Title 4, Chapter 8, Subchapter 2, Article 5, Sections 2930 through 2933.3.20 inclusive.

Note: Authority cited: Sections 12027, 12608 and 12609, Business and Professions Code.
Reference: Sections 12608 and 12609, Business and Professions Code.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

Article 2. Uniform Packaging and Labeling Regulation

§ 4510. Application

The packaging and labeling regulations as set forth in the most recent publication of the National Institute of Standards and Technology's Handbook 130, Uniform Laws and Regulations are herein adopted by reference as the packaging and labeling requirements for packaged commodities with the following exceptions and additional requirements.

Note: Authority cited: Sections 12027 and 12609, Business and Professions Code. Reference: Sections 12601 and 12609, Business and Professions Code.

§ 4511. Exceptions

The following sections in the Uniform Packaging and Labeling Regulation in the National Institute of Standards and Technology Handbook 130 are not adopted or incorporated by reference.

- (a) Section 2.11. Petroleum Products.
- (b) Section 6.13. Character of Declaration: Average.
- (c) Section 7.6. Character of Declaration: Average.
- (d) Section 12. Variation to be Allowed.
- (e) Section 13. Retail Sale Price Representations.
- (f) Section 14. Revocation of Conflicting Regulations.
- (g) Section 15. Effective Date.

(Editor's Note: The requirements that are not adopted from Handbook 130 UPLR are annotated [NOT ADOPTED] CCR § 4511. Exceptions.)

Note: Authority cited: Sections 12027 and 12609, Business and Professions Code. Reference: Sections 12601 and 12609, Business and Professions Code.

§ 4512. Requirements different than Handbook 130 UPLR

The following requirements apply in addition to those contained within the Uniform Packaging and Labeling Regulation in the National Institute of Standards and Technology Handbook 130.

§ 4512.1. Polyethylene Products. The declaration of quantity of contents for polyethylene products shall be as follows:

- (a) Consumer and nonconsumer packages of sheeting and film.
 - Length and width.
 - Area in square meters or square feet.
 - Thickness in micrometers and mils.
 - (1 mil = 0.001 in = 25.4 micrometers)
 - Weight.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

(b) The following consumer products sold at retail shall be labeled in the following terms:

(1) Food wrap.

- Length and width.
- Area in square meters or square feet.

(2) Lawn and trash bags.

- Count.
- Dimensions.
- Thickness in micrometers and mils.
- Capacity.

(3) Food and sandwich bags.

- Count.
- Dimensions.
- Capacity (except for fold-over sandwich bags).

(c) Bags not intended for the retail consumer shall be labeled in terms of:

- Count.
- Dimensions.
- Thickness in micrometers or mils.
- Weight.
- Capacity.

NOTE: Authority cited: Sections 12027, 12603, 12609 and 12610, Business and Professions Code. Reference: Sections 12601, 12602, 12603 and 12610, Business and Professions Code.

§ 4512.2. Animal Bedding.

Packaged animal bedding of all kinds, except for baled straw, shall be labeled by volume, that is by cubic meter, liter, or milliliter, and by the cubic yard, cubic foot, or cubic inch. If the commodity is packaged in a compressed state, the quantity declaration shall include both the quantity in the compressed state and the usable quantity that can be recovered. Example: “250 ml - expands to 500 ml (500 cu in expands to 1000 cu in).”

NOTE: Authority cited: Sections 12027, 12603, 12609 and 12610, Business and Professions Code. Reference: Sections 12601, 12602, 12603 and 12610, Business and Professions Code.

§ 4512.3. Enforcement.

A sealer may by written order forbid the display for sale, sale, or transport of any package which does not bear the labeling required by Chapter 6, of Division 5 of the

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

Business and Professions Code.

NOTE: Authority cited: Sections 12027 and 12609, Business and Professions Code.
Reference: Sections 12601, 12607, 12609 and 12611, Business and Professions Code.

(Editor's Note: The requirements that are different than Handbook 130 UPLR are printed in shaded, bordered, and numbered in the 4512 series to differentiate them from the Handbook 130 requirements.)

Note: Authority cited: Sections 12027, 12603, 12609 and 12610, Business and Professions Code. Reference: Sections 12601, 12602, 12603 and 12610, Business and Professions Code.

Article 3. Fireplace and Stove Wood

§ 4530. Method of Sale.

The method of sale of fireplace and stove wood shall conform to the requirements published in the 2019 edition of National Institute of Standards and Technology (NIST) Handbook 130, *Uniform Laws and Regulations in the Areas of Legal Metrology and Fuel Quality*, "IV. Uniform Regulations, Section B. Uniform Regulation for the Method of Sale of Commodities, Section 2. Non-Food Products, Section 2.4. Fireplace and Stove Wood.," inclusive, and are herein adopted and incorporated by reference with the additional requirements in this article.

Note: Authority cited: Sections 12024.11, 12027 and 12107.1, Business and Professions Code. Reference: Sections 12024.11 and 12107.1, Business and Professions Code.

§ 4531. Additional Requirements for Kindling.

Whenever kindling is included as part of the represented quantity of packaged or non-packaged fireplace or stove wood and is ten percent or more by volume of the represented quantity, the percentage of kindling, within five percent by volume, shall be stated on the label or delivery ticket or sales invoice.

Note: Authority cited: Sections 12024.11, 12027 and 12107.1, Business and Professions Code. Reference: Sections 12024.11, 12107.1 and 12609, Business and Professions Code.

§ 4532. Volumetric Sampling and Test Procedures.

In accordance with section 4600 of this division, the Department establishes the volumetric sampling and test procedures for determining net contents of packaged and stacked firewood to be those published in the current edition of National Institute of Standards and Technology (NIST) [Handbook 133, *Checking the Net Contents of Packaged Goods*, "Chapter 3. Test Procedures](#) - For Packages Labeled by Volume, Section 3.14. Firewood - Volumetric Test Procedure for Packaged Firewood with a Labeled Volume of 113 L (Liters) [4 ft³ (Cubic Feet)]

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

or Less and Stacked Firewood Sold by the Cord or Fractions of a Cord.” inclusive, and are therein adopted and incorporated by reference.

Note: Authority cited: Sections 12024.11, 12027, 12107.1 and 12211, Business and Professions Code. Reference: Sections 12107.1 12211 and 12609, Business and Professions Code.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

A. Uniform Packaging and Labeling Regulation

As adopted in NIST Handbook 130 by
The National Conference on Weights and Measures¹

1. Background

The Uniform Packaging and Labeling Regulation was first adopted during the 37th Annual Meeting of the National Conference on Weights and Measures (NCWM) in 1952. Reporting to the Conference, the Committee on Legislation stated:

The National Conference should adopt a model package regulation for the guidance of those states authorized to adopt such a regulation under provisions of their weights and measures laws. Since so much of the work of weights and measures officials in the package field concerns food products, the importance of uniformity between the Federal (FDA) regulations and any model regulations to be adopted by this Conference cannot be overemphasized.

Since its inception, the Uniform Packaging and Labeling Regulation has been continually revised to meet the complexities of an enormous expansion in the packaging industry – an expansion that, in late 1966, brought about the passage of the Fair Packaging and Labeling Act (FPLA). Recognizing the need for compatibility with the Federal Act, in 1968 the Committee on Laws and Regulations of the 53rd Annual Meeting of the National Conference amended the “Model Packaging and Labeling Regulation” (renamed in 1983) to parallel regulations adopted by federal agencies under FPLA. The process of amending and revising this Regulation is a continuing one in order to keep it current with practices in the packaging field and make it compatible with appropriate federal regulations. Amendments and additions since 1971 are noted at the end of each section.

The revision of 1978 provided for the use of the metric system (SI) on labels as well as allowing SI-only labels for those commodities not covered by federal laws or regulations. “SI” means the International System of Units as established in 1960 by the General Conference on Weights and Measures and interpreted or modified for the United States by the Secretary of Commerce. [See the “Interpretation of the International System of Units for the United States” in the “Federal Register” (Volume 73, No. 96, pages 28432 to 28433) for May 16, 2008, and 15 United States Code, Section 205a - 205l “Metric Conversion.” See also NIST Special Publication 330 “The International System of Units (SI)” 2019 edition and NIST Special Publication 811 “Guide for the Use of the International System of Units (SI)” 2008 edition that are available at <https://www.nist.gov/pml/owm/publications/metric-publications> or by contacting TheSI@nist.gov.] In 1988, Congress amended the Metric Conversion Law to declare that it is the policy of the United States to designate the International System of Units of measurement as the preferred system of weights and measures for U.S. trade and

¹ *The National Conference on Weights and Measures (NCWM) is supported by the National Institute of Standards and Technology (NIST) in partial implementation of its statutory responsibility for “cooperation with the states in securing uniformity in weights and measures laws and methods of inspection.”*

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

commerce. In 1992, Congress amended the federal FPLA to require the most appropriate units of the SI and the U.S. customary systems of measurement on certain consumer commodities. The 1993 amendments to NIST Handbook 130 require SI and U.S. customary units on certain consumer commodities in accordance with federal laws or regulations. Requirements for labeling in both units of measure were effective February 14, 1994, under FPLA and as specified in Section 15. Effective Date; except as specified in Section 11.32. SI Units, Exemptions for Consumer Commodities.

In 2015, the Federal Trade Commission (FTC) conducted a periodic review of its regulations issued under the FPLA and recently published several revisions which go into effect on December 17, 2015. [See the “Rules, Regulations, Statements of General Policy or Interpretation and Exemptions Under the Fair Packaging and Labeling Act] Final

2. Status of Promulgation

The table beginning on page 10, Section II. Uniformity of Laws and Regulations of Handbook 130 shows the status of adoption of the Uniform Packaging and Labeling Regulation.

Preamble

The purpose of this regulation is to provide accurate and adequate information on packages as to the identity and quantity of contents so that purchasers can make price and quantity comparisons.

(Added 1989)

Section 1. Application

This regulation shall apply to packages, but shall not apply to:

- (a) inner wrappings not intended to be individually sold to the customer;
- (b) shipping containers or wrapping used solely for the transportation of any commodities in bulk or in quantity to manufacturers, packers, or processors, or to wholesale or retail distributors, but in no event shall this exclusion apply to packages of consumer or non-consumer commodities as defined herein;
(Added 1971)
- (c) auxiliary containers or outer wrappings used to deliver packages of such commodities to retail customers if such containers or wrappings bear no printed matter pertaining to any particular commodity;
- (d) containers used for retail tray pack displays when the container itself is not intended to be sold (e.g., the tray that is used to display individual envelopes of seasonings, gravies, etc., and the tray itself is not intended to be sold);
- (e) open carriers and transparent wrappers or carriers for containers when the wrappers or carriers do not bear any written, printed, or graphic matter obscuring the label information required by this regulation; or

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

- (f) packages intended for export to foreign countries. (Amended 1994 and 1998)

Section 2. Definitions

2.1. Package.

Except as modified by Section 1. Application, the term “package,” whether standard package or random package, means any commodity:

- (a) enclosed in a container or wrapped in any manner in advance of wholesale or retail sale; or
- (b) whose weight ^[NOTE 1] or measure has been determined in advance of wholesale or retail sale. An individual item or lot of any commodity on which there is marked a selling price based on an established price per unit of weight or of measure shall be considered a package or packages.

(Amended 1988 and 1991)

NOTE 1: *When used in this regulation, the term “weight” means “mass.” (See paragraphs L. “Mass” and “Weight” in Section I. Introduction of NIST Handbook 130 for an explanation of these terms.)*

2.2. Consumer Package of Consumer Commodity.

A package that is customarily produced or distributed for sale through retail sales agencies or instrumentalities for consumption or use by individuals for the purposes of personal care or in the performance of services ordinarily rendered in or about the household or in connection with personal possessions.

(Amended 1988 and 1991)

2.3. Non-consumer Package: Package of Non-consumer Commodity.

Any package other than a consumer package, and particularly a package intended solely for industrial or institutional use or for wholesale distribution.

(Amended 1988 and 1991)

2.4. Random Package.

A package that is one of a lot, shipment, or delivery of packages of the same consumer commodity with no fixed pattern of net contents.

(Amended 1988 and 1990)

2.5. Label.

Any written, printed, or graphic matter affixed to, applied to, attached to, blown into, formed, molded into, embossed on, or appearing upon or adjacent to a consumer commodity, or a package containing any consumer commodity, for purposes of branding, identifying, or giving any information with respect to the commodity or to the contents of the package, except that

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

an inspector's tag or other non-promotional matter affixed to or appearing upon a consumer commodity shall not be considered a label requiring the repetition of label information required by this regulation.

(Amended 1988)

2.6. Person.

The term "person" means either singular or plural and shall include any individual, partnership, company, corporation, association, or society.

(Amended 1988)

2.7. Principal Display Panel or Panels.

That part, or those parts, of a label that is, or are, so designed as to most likely be displayed, presented, shown, or examined under normal and customary conditions of display and purchase. Wherever a principal display panel appears more than once on a package, all requirements pertaining to the "principal display panel" shall pertain to all such "principal display panels."

(Amended 1988)

2.8. Multi-unit Package.

A package containing two or more individual packages of the same commodity, in the same quantity, intended to be sold as a multiunit package.

(Amended 1988 and 2022)

2.9. Combination Package.

A package intended for retail sale, containing two or more individual packages or units of dissimilar commodities.

Examples:

Antiquing or housecleaning kit
Sponge and cleaner
Lighter fluid and flints

(Added 1989)

2.10. Variety Package.

A package intended for retail sale, containing two or more individual packages or units of similar, but not identical, commodities. Commodities that are generically the same, but that differ in weight, measure, volume, appearance, or quality, are considered similar, but not identical.

Examples:

Two sponges of different sizes
Plastic tableware,
Consisting of 4 spoons,
4 knives, and 4 forks

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS
Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

(Added 1989)

2.11. Petroleum Products. – [NOT ADOPTED - § 4511. Exceptions]

2.12. Spot Label.

A spot label is a label clearly defined by means of a border, indentation, or other means that covers only a small portion of the surface of a principal display panel of a package; the entire portion of the principal display panel outside the area of the label contains no printed or graphic matter of any kind. A spot label may contain all required labeling information (identity, responsibility, and net contents), but it must at least indicate the identity and net contents. See Section 11.29. Spot Label for net contents placement exemption for a spot label. (Added 1990) (Amended 1991)

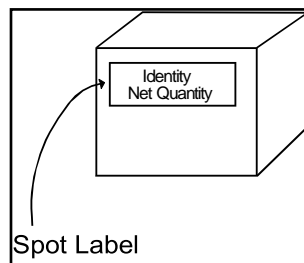


Figure 1 - Image of a Spot Label.

2.13. Header Strip.

A header label or header strip is a label that is attached across the top of a transparent or opaque bag or other container that bears no other printed or graphic material. See Section 11.30. Header Strip for net contents placement exemptions. (Added 1990)

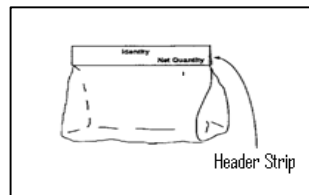


Figure 2 - Image of a Header Strip

2.14. Standard Package.

A package that is one of a lot, shipment, or delivery of packages of the same commodity with identical net contents declarations.

Examples:

- 1 L bottles or 12 fl oz cans of carbonated soda
- 500 g or 5 lb bags of sugar

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

100 m packages of rope

(Added 1991)

2.15. SI or SI Units.

SI or SI Units means the International System of Units as established in 1960 by the General Conference on Weights and Measures and interpreted or modified for the United States by the Secretary of Commerce. See the “Interpretation of the International System of Units for the United States” in the “Federal Register” (Volume 73, No. 96, pages 28432 to 28433) for May 16, 2008, and 15 United States Code, Section 205a – 2051 “Metric Conversion.” See also NIST Special Publication 330, *The International System of Units (SI)*, 2019 edition and NIST Special Publication 811, *Guide for the Use of the International System of Units (SI)*, 2008 edition that are available at www.nist.gov/pml/wmd/ or by contacting thesi@nist.gov.

(Added 1993)

Section 3. Declaration of Identity: Consumer Package

3.1. Declaration of Identity: Consumer Package.

A separate declaration of identity ^[NOTE 2] on a consumer package shall appear on the principal display panel and shall not be misleading or deceptive. The identity shall be in terms of:

- (a) the name specified in or required by any applicable federal or state law or regulation or, in the absence of this;
- (b) the common or usual name or, in the absence of this;
- (c) the generic name or other appropriate description, including a statement of function (such as “cleaning powder”).

(Amended 1990) (Note added 1986)

NOTE 2: *Section 19.(a) of the Uniform Weights and Measures Law (and 21 CFR 101.100 (b) (3) for non-meat and non-poultry foods) specifically exempts food packages from identity statements if the commodity is a food, other than meat or poultry, that was repackaged in a retail establishment and the food is displayed to the purchaser under either of the following circumstances: “(1) its interstate labeling is clearly in view or with a counter card, sign, or other appropriate device bearing prominently and conspicuously the common or usual name of the food, or (2) the common or usual name of the food is clearly revealed by its appearance.”*

(Added 1986) (Amended 2001)

3.1.1. Parallel Identity Declaration: Consumer Package.

A declaration of the identity on a consumer package shall appear generally parallel to the base on which the package rests as it is designed to be displayed.

Section 4. Declaration of Identity: Non-consumer Package

A declaration of identity ^[NOTE 2] on a non-consumer package shall appear on the outside of a package and shall not be misleading or deceptive. The identity shall be in terms of:

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

- (a) the name specified in or required by any applicable federal or state law or regulation or, in the absence of this;
- (b) the common or usual name or, in the absence of this;
- (c) the generic name or other appropriate description, including a statement of function (such as “cleaning powder”).

(Amended 1990) (Note added 1986)

Section 5. Declaration of Responsibility: Consumer and Non-consumer Packages

Any package kept, offered, or exposed for sale, or sold at any place other than on the premises where packed shall specify conspicuously on the label of the package the name and address of the manufacturer, packer, or distributor. The name shall be the actual corporate name, or, when not incorporated, the name under which the business is conducted. The address shall include street address, city, state (or country if outside the United States), and ZIP Code (or the mailing code, if any, used in countries other than the United States); however, the street address may be omitted if it is listed in any readily accessible, well-known, widely published, and publicly available resource, including but not limited to a print directory, electronic database, or Web site.

(Amendment effective December 17, 2015)

If a person manufactures, packs, or distributes a commodity at a place other than his principal place of business, the label may state the principal place of business in lieu of the actual place where the commodity was manufactured or packed or is to be distributed, unless such statement would be misleading. Where the commodity is not manufactured by the person whose name appears on the label, the name shall be qualified by a phrase that reveals the connection such person has with such commodity, such as “Manufactured for and packed by _____,” “Distributed by _____,” or any other wording of similar import that expresses the facts.

(Amended 2016)

Section 6. Declaration of Quantity: Consumer Packages

6.1. General.

The International System of Units (SI) ^[NOTE 3] known as the metric system and the U.S. customary system of weights and measures are recognized as proper systems to be used in the declaration of quantity. Effective February 14, 1994, appropriate units of both systems shall be presented in a declaration of quantity except as specified in Section 11.32. SI Units, Exemptions for Consumer Commodities and Section 11.33 U.S. Customary Units, Exemptions - Consumer Commodities.

(Amended 1985, 1990, 1993, and 1999)

NOTE 3: Packages subject to this Section and/or the Federal Fair Packaging and Labeling Act shall be labeled in units of the International System of Units (SI) and the U.S. customary

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

system of measure effective February 14, 1994, [except for seed (see Section 10.10. Packaged Seed) and camera film and recording tape (see Section 11.22. Camera Film, Video Recording Tape, Audio Recording Tape and Other Image and Audio Recording Media Intended for Retail Sale and Consumer Use), and as specified in Section 11.32. SI Units, Exemptions - Consumer Commodities]. SI units may appear first.

(Added 1982) (Amended 1990 and 1993)

6.2. Largest Whole Unit.

Where this regulation requires that the quantity declaration be in terms of the largest whole unit, the declaration shall, with respect to a particular package, be in terms of the largest whole unit of weight or measure with any remainder expressed (following the requirements of Section 6.5.2. (a) Fractions and Section 6.11. Fractions):

(a) **SI Units.** – in decimal fractions of such largest whole unit.

(b) **U.S. Customary Units.**

(1) in common or decimal fractions of such largest whole unit; or

(2) in the next smaller whole unit or units with any further remainder in terms of common or decimal fractions of the smallest unit present in the quantity declaration.

6.3. Net Quantity.

A declaration of net quantity of the commodity in the package, exclusive of wrappers and any other material packed with such commodity (except as noted in Section 10.3. Aerosols and Other Pre-pressurized Containers Dispensing Product Under Pressure), shall appear on the principal display panel of a consumer package and, unless otherwise specified in this regulation (see Sections 6.6. Prescribed Units, SI, through 6.9. Bi-dimensional Commodities), shall be in terms of the largest whole unit.

6.3.1. Use of “Net Mass” or “Net Weight.”

A quantity declaration may stand alone [e.g., “200 g (7 oz)” or “1 lb (453 g)”] or may include the term “net mass” or “net weight” either preceding or following the declaration. The term “net” by itself may be used on food labels. However, the quantity of contents shall always declare the net quantity of contents even when such terms are not used.

(Amended 1993)

6.3.2. Lines of Print or Type.

Use of “Net Contents.” – When stating the net quantity of contents in terms of fluid measure or numerical count, a quantity declaration may stand alone [e.g., “177 mL (6 fl oz)”] or may include the term “net” or “net contents” either preceding or following the declaration.

(Amended 2019)

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

6.4. Terms: Weight, Measure, Volume, or Count.

The declaration of the quantity shall be expressed in terms of Table 6.4. Weight, Measure, Volume or Count:

Table 6.4. Weight, Measure, Volume, or Count

If the commodity is:	The declaration of the quantity of a particular commodity shall be expressed in terms of:
(a) solid, semisolid, viscous, or a mixture of solid and liquid	weight or mass
(b) liquid	fluid volume measure
(c) dry	dry measure
(d) or labeled by linear measure or area	linear measure or area
(e) or labeled by numerical units (count)	numerical count

However, if there exists a firmly established general consumer usage and trade custom with respect to the terms used in expressing a declaration of quantity of a particular commodity, such a declaration of quantity may be expressed in its traditional terms, provided such traditional declaration gives accurate and adequate information as to the quantity of the commodity. Any net content statement that does not permit price and quantity comparisons is forbidden.

(Amended 1989 and 2015)

6.4.1. Combination Declaration.

- (a) A declaration of quantity in terms of weight or volume shall be combined with appropriate declarations of the measure, count, and size of the individual units unless a declaration of weight alone is fully informative.
- (b) A declaration of quantity in terms of measure shall be combined with appropriate declarations of the weight, volume, count, and size of the individual units unless a declaration of measure alone is fully informative.
- (c) A declaration of quantity in terms of count shall be combined with appropriate declarations of the weight, volume, measure, and size of the individual units unless a declaration of count alone is fully informative.

(Added 1971)

6.5. SI Units: Mass, Measure.

[NOTE 3] – A declaration of quantity shall be expressed in terms of Table 6.5. SI Units: Mass, Measure, and the requirements in 6.5. (f), (g), and (h):

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS
 Title 4, Division 9, Chapter 9
 Quality Control §§ 4500. – 4532

Table 6.5. SI Units: Mass, Measure

If a declaration of quantity is in units of:	The units shall be in:
(a) mass	kilogram, gram, or milligram
(b) liquid measure	<p>liter or milliliter and shall express the volume at 20 °C*, except for:</p> <ol style="list-style-type: none"> (1) petroleum products or distilled spirits for which the declaration shall express the volume at 15.6 °C; (2) a commodity that is normally sold and consumed while frozen for which the declaration shall express the volume at the frozen temperature; and (3) malt beer beverages or a commodity that must be maintained in the refrigerated state for which the declaration shall express the volume at 4 °C. (4) refrigerated food (e.g., milk, dairy products labeled “keep refrigerated”) for which the declaration shall express the volume at 4 °C. <p>*Other liquids and wine (e.g., for immediate consumption that do not require, but may be refrigerated [shelf stable] such as soft drinks, bottled water) at 20 °C.</p>
(c) linear measure	meter, centimeter, or millimeter
(d) area measure	square meter, square decimeter, square centimeter, or square millimeter
(e) volume other than liquid measure	liter or milliliter, except that units cubic meter and cubic centimeter shall be used only when specifically designated as a method of sale.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

If a declaration of quantity is in units of:	The units shall be in:
(f) Rule of 1000.	<p>The selected multiple or submultiple prefixes for SI units shall result in numerical values between 1 and 1000. This rule allows centimeters or millimeters to be used where a length declaration is less than 100 centimeters.</p> <p>Examples: 500 g, not 0.5 kg 1.96 kg, not 1960 g 750 ml, not 0.75 L 750 mm or 75 cm, not 0.75 m (Added 1993)</p>
(g) SI declarations should be shown in three digits	<p>Except where the quantity is below 100 grams, milliliters, centimeters, square centimeters, or cubic centimeters, where it may be shown in two digits. In either case, any final zero appearing to the right of the decimal point need not be shown; and (Added 1993)</p>
(h) the declaration of net quantity of contents shall not be expressed in mixed units.	<p>Example: 1.5 kg, not 1 kg 500 g (Added 1993)</p>

(Amended 2015)

6.5.1. Symbols.

Any of the following symbols for SI units, and none other, may be employed in the quantity statement on a package of commodity:

Unit	Symbol	Unit	Symbol
centimeter	cm	cubic meter	m ³
meter	m	gram	g
liter	L or l	square meter	m ²
square centimeter	cm ²	square decimeter	dm ²

(a) Symbols ^[NOTE 4], except for liter, are not capitalized unless the unit is derived from a proper name. Periods shall not be used after the symbol. Symbols shall always be written in the singular form. Adding “s” to an SI symbol to express the plural of the

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

symbol is prohibited.

- (b) The “L” symbol and the “ml” symbol are preferred; however, the “l” symbol for liter and “ml” symbol for milliliter are permitted.
(Amended 1980 and 1993)

NOTE 4: *The “e” mark shall not be considered to be a qualifying word or phrase and may be used as part of the statement of the net quantity of contents where warranted. When used, the “e” mark shall be at least 3 mm (approximately 1/8 in) in height. The term “e” mark refers to the symbol “e” used in connection with the quantity declarations on labels of some consumer commodities marketed primarily in the European Union (EU) and South Africa. The “e” mark constitutes a representation by the packer or importer that the package to which it is applied has been filled in accordance with the average system of quantity specified by the EU. The average system is a method of declaring package fill in the EU and other countries of the world, including the United States.*
(Added 1993)

6.5.2. Fractions and Prefixes.

- (a) **Fractions:** An SI statement in a declaration of net quantity of contents of any consumer commodity may contain only decimal fractions.
- (b) **Prefixes:** The **following** chart indicates SI prefixes that may be used on a broad range of consumer commodity labels to form multiples and submultiples of SI units:

Prefix	Symbol	Multiplying Factor*
kilo-	k	$\times 10^3$
deka- ^{**}	da	$\times 10$
deci- ^{**}	d	$\times 10^{-1}$
centi- ^{***}	c	$\times 10^{-2}$
milli-	m	$\times 10^{-3}$
Micro- ^{****}	μ	$\times 10^{-6}$

* $10^2 = 100$; $10^3 = 1000$; $10^{-1} = 0.1$; $10^{-2} = 0.01$
Thus, 2 kg = 2 \times 1000 g = 2000 g and 3 cm = 3 \times 0.01 m = 0.03 m
**Not permitted on food labels.
***Should only be used with “meter.”
****Shall only be used for measurements less than 1 mm.

(Amended 1993)

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

6.6. Prescribed Units, SI. ^[NOTE 3]

6.6.1. Less than 1 Meter, 1 Square Meter, 1 Kilogram, 1 Cubic Meter, or 1 Liter.

The declaration of quantity shall be expressed as follows:

- (a) length measure of less than 1 meter: in centimeters or millimeters;
(Amended 1979)
- (b) area measure of less than 1 m²: in square decimeters and decimal fractions of a square decimeter or in square centimeters and decimal fractions of a square centimeter;
- (c) mass of less than 1 kg: in grams and decimal fractions of a gram, but if less than 1 g, then in milligrams;
- (d) liquid or dry measure of less than 1 L: in milliliters; and
- (e) cubic measure less than 1 m³: in cubic centimeters or cubic decimeters (liters);
(Added 1993)

Provided the quantity declaration appearing on a random mass package may be expressed in units of decimal fractions of the largest appropriate unit, the fraction being carried out to not more than three decimal places.

(Amended 1980 and 1993)

6.6.2. One Meter, 1 Square Meter, 1 Kilogram, 1 Liter, 1 Cubic Meter, or More.

In the case of:

- (a) length measure of 1 m or more: in meters and decimal fractions to not more than three places;
- (b) area measure of 1 m² or more: in square meters and decimal fractions to not more than three places;
- (c) mass of 1 kg or more: in kilograms and decimal fractions to not more than three places;
- (d) liquid or dry measure of 1 L or more: in liters and decimal fractions to not more than three places; and (Added 1986) (Amended 1993)
- (e) cubic measure of 1 m³ or more: in cubic meters and decimal fractions to not more than three places.

(Added 1993)

6.7. U.S. Customary Units: Weight, Measure.

A declaration of quantity shall be expressed in terms of Table 6.7. U.S. Customary Units: Weight, Measure:

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS
 Title 4, Division 9, Chapter 9
 Quality Control §§ 4500. – 4532

Table 6.7. U.S. Customary Units: Weight, Measure	
If a declaration of quantity is in units of:	The unit shall be in:
(a) weight	Avoirdupois pound or ounce
(b) liquid measure	US Gallon of 231 in ³ or liquid quart, liquid pint, or fluid-ounce subdivisions of the gallon and shall express the volume at 68 °F, except in case of: <ol style="list-style-type: none"> (1) petroleum products or distilled spirits for which the declaration shall express the volume at 60 °F; (2) a commodity that is normally sold and consumed while frozen for which the declaration shall express the volume at the frozen temperature; (3) a commodity that must be maintained in the refrigerated state for which the declaration shall express the volume at 40 °F; and (4) malt beverages for which the declaration shall express the volume at 39.1 °F.
(c) linear measure	Yard, foot, or inch
(d) area measure	Square yard, square foot, or cubic inch
(e) volume measure	Square yard, cubic foot, or cubic inch
(f) dry measure	U.S. bushel of 2150.42 in ³ , or peck, dry quart, and dry pint subdivisions of the bushel

(Amended 2015)

6.7.1. Symbols and Abbreviations.

Any of the following symbols and abbreviations, and none other, shall be employed in the quantity statement on a package of commodity:

Symbol	Abbreviation	Symbol	Abbreviation
avoirdupois	avdp	ounce	oz
piece	pc	count	ct
pint	pt	cubic	cu
pound	lb	each	ea
feet or foot	ft	quart	qt
fluid	fl	square	sq
gallon	gal	weight	wt

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

inch	in	yard	yd
liquid	liq	drained	dr
diameter	dia		

A period should not be used after the abbreviation. Abbreviations should be written in singular form; and “s” should not be added to express the plural. (For example, “oz” is the symbol for both “ounce” and “ounces.”) Both upper and lower case letters and exponents are acceptable.

(Amendment effective 12/17/2015.)

(Added 1974) (Amended 1980, 1990, 1993, and 2016)

6.7.2. Units of Two or More Meanings.

When the term “ounce” is employed in a declaration of liquid quantity, the declaration shall identify the particular meaning of the term by the use of the term “fluid;” however, such distinction may be omitted when, by association of terms (for example, as in “1 pint 4 ounces”), the proper meaning is obvious. Whenever the declaration of quantity is in terms of the dry pint or dry quart, the declaration shall include the word “dry.”

(Amended 1982)

6.8. Prescribed Units, U.S. Customary System.

6.8.1. Less than 1 foot, 1 square foot, 1 pound, or 1 pint.

The declaration of quantity shall be expressed in the following terms:

- (a) in the case of length measure of less than 1 ft, in inches and fractions of inches;
- (b) in the case of area measure of less than 1 ft², in square inches and fractions of square inches;
- (c) in the case of weight of less than 1 lb, in ounces and fractions of ounces; and
- (d) in the case of liquid measure of less than 1 pt, in fluid ounces and fractions of fluid ounces, provided, the quantity declaration appearing on a random package may be expressed in terms of decimal fractions of the largest appropriate unit, the fraction being carried out to not more than three decimal places.

(Amended 1984)

6.8.2. One Foot, 1 Square Foot, 1 Pound, 1 Pint, 1 Gallon, or More.

The declaration of quantity shall be expressed in the following terms (see Section 6.2. Largest Whole Unit and Section 6.11. Fractions):

- (a) **Linear Measure.** – If 1 ft or more, expressed in terms of the largest whole unit (a yard or a foot) with any remainder expressed in inches and fractions of the inch or in fractions of the foot or yard, except that it shall be optional to include a statement of length in terms of inches.

- (b) **Area Measure.**

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

(1) If 1 ft² or more, but less than 4 ft², expressed in square feet with any remainder expressed in square inches and fractions of a square inch or in fractions of a square foot; and

(2) If 4 ft² or more, expressed in terms of the largest whole unit (e.g., square yards or square feet) with any remainder expressed in square inches and fractions of a square inch or in fractions of the square foot or square yard.

(c) **Weight.** – If 1 lb or more, expressed in terms of the largest whole unit with any remainder expressed in ounces and fractions of an ounce or in fractions of the pound.

(d) **Liquid Volume.**

(1) If 1 pt or more, but less than 1 gal, expressed in the largest whole unit (quarts, quarts and pints, or pints, as appropriate) with any remainder expressed in fluid ounces or fractions of the pint or quart, except that 2 qt may be declared as ½ gal, and it shall be optional to include an additional expression of net quantity in fluid ounces; or

(2) If 1 gal or more, expressed in terms of the largest whole unit (gallons followed by fractions of a gallon or by the next smaller whole unit or units [for example, quarts and pints]) with any remainder expressed in fluid ounces or fractions of the pint or quart, except that it shall be optional to include an additional expression of net quantity in fluid ounces.

(e) **Dry Measure.** – If 1 dry pt or more, expressed in terms of the largest whole unit with the remainder expressed in fractions of a dry pint, dry quart, peck, or bushel, provided the quantity declaration on a random package may be expressed in decimal fractions of the largest appropriate unit carried out to not more than three decimal places.

(Amended 1993)

6.9. Bi-dimensional Commodities.

For bi-dimensional commodities (including roll-type commodities) the quantity declaration shall be expressed in both SI and U. S. Customary units of measurement as follows:

(a) if the area is less than 929 cm² (1 ft²), in terms of length and width (expressed in the largest whole unit for SI and in linear inches and fractions of linear inches for U.S. customary);

Example:

20.3 cm × 25.4 cm (8 in × 10 in)

(b) if the area is at least 929 cm² (1 ft²), but less than 37.1 dm² (4 ft²), in terms of area (expressed in the largest whole unit for SI and in square inches for U.S. customary), followed by a declaration of the length and width in terms of the largest whole unit:

Example:

31 dm² (49 cm × 64 cm) 3.36 ft² (1.6 ft × 2.1 ft), provided:

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

- (1) bi-dimensional commodities having a width of 10 cm (4 in) or less, the declaration of net quantity shall be expressed in terms of width and length in linear measure; no declaration of area is required;
- (2) an U.S. customary dimension of less than 2 ft may be stated in inches;
- (3) commodities consisting of usable individual units (e.g., paper napkins) require a declaration of unit area but not a declaration of total area of all such units (except roll-type commodities with individual usable units created by perforations, for which see Section 6.10. Count: Ply); and
- (4) U.S. customary declarations may include after the statement of the linear dimensions in the largest whole unit a parenthetical declaration of the same dimensions in inches.

Example: 25 ft² (12 in × 8.33 yd) (12 in × 300 in)

(c) if the area is 37.1 dm² (4 ft²) or more, in terms of area (expressed in the largest whole unit for SI and in square feet for U.S. customary), followed by a declaration of the length and width, in terms of the largest whole unit, provided:

- (1) no declaration of area is required for a bi-dimensional commodity with a width of 10 cm (4 in) or less;
- (2) bi-dimensional commodities with a width of 10 cm (4 in) or less, the U.S. customary statement of width shall be expressed in terms of linear inches and fractions thereof, and length shall be expressed in the largest whole unit (yard or foot) with any remainder in terms of fractions of the yard or foot, except that it shall be optional to express the length in the largest whole unit followed by a statement of length in inches or to express the length in inches followed by a statement of length in the largest whole unit;

Examples:

5 cm × 9.14 m (2 in × 10 yd)
5 cm × 9.14 m (2 in × 10 yd) (360 in)
5 cm × 9.14 m (2 in × 360 in) (10 yd)

- (3) an U.S. customary dimension of less than 2 ft may be stated in inches; and

(d) no declaration of area is required for commodities for which the length and width measurements are critical in terms of end use (such as wallpaper border) if such commodities clearly present the length and width measurements on the label.

6.10. Count: Ply.

If the commodity is in individually usable units of one or more components or plies, the quantity declaration shall, in addition to complying with other applicable quantity declaration requirements of this regulation, include the number of plies and total number of usable units.

Roll type commodities, when perforated so as to identify individual usable units, shall not be deemed to be made up of usable units; however, such roll type commodities shall be labeled in terms of:

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

- (a) total area measurement;
- (b) number of plies;
- (c) count of usable units; and
- (d) dimensions of a single usable unit.

(Amended 1988)

6.11. Fractions.

- (a) **U.S. Customary:** An U.S. customary unit statement of net quantity of contents of any consumer commodity may contain common or decimal fractions. A common fraction shall be in terms of halves, quarters, eighths, sixteenths, or thirty-seconds, except that:
 - (1) if there exists a firmly established general consumer usage and trade custom of employing different common fractions in the net quantity declaration of a particular commodity, they may be employed; and
 - (2) if linear measurements are required in terms of yards or feet, common fractions may be in terms of thirds.
- (b) **Common fractions:** A common fraction shall be reduced to its lowest term.

Example:

$\frac{2}{4}$ becomes $\frac{1}{2}$

- (c) **Decimal fractions:** A decimal fraction shall not be carried out to more than three places.

(Amended 1986 and 1993)

6.12. Supplementary Quantity Declarations.

The required quantity declaration may be supplemented by one or more declarations of weight, measure, or count, such declaration appearing other than on a principal display panel. Such supplemental statement of quantity of contents shall not include any term qualifying a unit of weight, measure, or count that tends to exaggerate the amount of commodity contained in the package (e.g., “giant” quart, “larger” liter, “full” gallon, “when packed,” “minimum,” [NOTE 5, page HB 130 pg. 71] or words of similar import).

(Amended 2018)

[Note 5 CCR pg. QC-15] / [Note 5 HB 130 pg. 71]: *Packages of products subject to the labeling requirements under the EPA, Federal Insecticide, Fungicide, and Rodenticide Act (FIRFA) under 40 CFR 156.10 are permitted to display the term “minimum” in conjunction with the net quantity of contents declaration. The packer may choose to fill the packages under the minimum or average systems of fill. However, if the minimum system is declared, variations above minimum quantity is permissible only to the extent that it represents deviation unavoidable in good manufacturing practice and no variation below the stated minimum quantity is permitted.*

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

(Added 2018)

(Note added 2018)

6.13. Rounding.

6.14. Qualification of Declaration Prohibited.

In no case shall any declaration of quantity be qualified by the addition of the words “when packed,” “minimum,” or “not less than” or any words of similar import (e.g., “approximately”), nor shall any unit of weight, measure, or count be qualified by any term (such as “jumbo,” “giant,” “full,” or the like) that tends to exaggerate the amount of commodity.

(Amended 1998 and 2018)

[NOTE 5 HB 130 pg. 71]: Packages of products subject to the labeling requirements under the EPA, Federal Insecticide, Fungicide, and Rodenticide Act (FIRFA) under 40 CFR 156.10 are permitted to display the term “minimum” in conjunction with the net quantity of contents declaration. The packer may choose to fill the packages under the minimum or average systems of fill. However, if the minimum system is declared, variations above minimum quantity is permissible only to the extent that it represents deviation unavoidable in good manufacturing practice and no variation below the stated minimum quantity is permitted.

(Added 2018)

(Note added 2018)

6.15. Character of Declaration: Average.

The average quantity of contents in the packages of a particular lot, shipment, or delivery shall at least equal the declared quantity, and no unreasonable shortage in any package shall be permitted even though overages in other packages in the same shipment, delivery, or lot compensate for such shortage.

(Added 1981)

6.16. Random Packages.

A random weight package must bear a label conspicuously declaring:

- (a) the net weight;
- (b) unit price; and
- (c) the total price.

In the case of a random package packed at one place for subsequent sale at another, neither the price per unit of weight nor the total selling price need appear on the package, provided the package label includes both such prices at the time it is offered or exposed for sale at retail.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

(Added 1999)

Section 7. Declaration of Quantity: Non-consumer Packages

7.1. General.

The SI and U.S. customary systems of weights and measures are recognized as proper systems to be used in the declaration of quantity. Units of both systems may be combined in a dual declaration of quantity ^[NOTE 7 HB 130 pg. 72]: (See Section 6.3. Net Quantity, and Section 6.3.1. Use of “Net Mass” or “Net Weight.”)

[NOTE 7 HB 130 pg. 72] Although non-consumer packages under this Regulation may bear SI declarations only, this Regulation should not be construed to supersede any labeling requirement specified in federal law.

7.2. Location.

A non-consumer package shall bear on the outside a declaration of the net quantity of contents. Such declaration shall be in terms of the largest whole unit (see Section 6.2. Largest Whole Unit; for small packages, see Section 11.16. Small Packages).

7.3. Terms: Weight, Liquid Measure, Dry Measure, or Count.

The declaration of the quantity of a particular commodity shall be expressed in terms of liquid measure if the commodity is liquid, in terms of dry measure if the commodity is dry, in terms of weight if the commodity is solid, semisolid, viscous, or a mixture of solid and liquid, or in terms of numerical count. However, if there exists a firmly established general consumer usage and trade custom with respect to the terms used in expressing a declaration of quantity of a particular commodity, such declaration of quantity may be expressed in its traditional terms if such traditional declaration gives accurate and adequate information as to the quantity of the commodity.

7.4. SI Units: Mass, Measure. – A declaration of quantity:

- (a) in units of mass shall be in terms of the kilogram, gram, or milligram;
- (b) in units of liquid measure shall be in terms of the liter or milliliter, and shall express the volume at 20 °C, except in the case of petroleum products or distilled spirits, for which the declaration shall express the volume at 15.6 °C, and except also in the case of a commodity that is normally sold and consumed while frozen, for which the declaration shall express the volume at the frozen temperature, and except also in the case of malt beverages or a commodity that is normally sold in the refrigerated state, for which the declaration shall express the volume at 4 °C;

(Amended 1985)

- (c) in units of linear measure shall be in terms of the meter, centimeter, or millimeter;
- (d) in units of area measure shall be in terms of the square meter, square decimeter, square centimeter or square millimeter;

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

- (e) in units of volume other than liquid measure shall be in terms of the liter and milliliter, except that the terms cubic meter, cubic decimeter, and cubic centimeter will be used only when specifically designated as a method of sale;
- (f) Rule of 1000. – The selected multiple or submultiple prefixes for SI units shall result in numerical values between 1 and 1000. This rule allows centimeters or millimeters to be used where a length declaration is less than 100 centimeters;

Examples:

500 g, not 0.5 kg
1.96 kg, not 1960 g 750 ml, not 0.75 L
750 mm or 75 cm, not 0.75 m

(Added 1993)

- (g) SI declarations should be shown in three digits except where the quantity is below 100 grams, milliliters, centimeters, square centimeters, or cubic centimeters where it can be shown in two digits. In either case, any final zero appearing to the right of the decimal point need not be shown; and

(Added 1993)

- (h) the declaration of net quantity of contents shall not be expressed in mixed units.

Example: 1.5 kg, not 1 kg 500 g

7.4.1. Symbols.

Only those symbols as detailed in Section 6.5.1. Symbols, and none other, may be employed in the quantity statement on a package of commodity.

7.5. U.S. Customary Units: Weight, Measure.

A declaration of quantity:

- (a) in units of weight shall be in terms of the avoirdupois pound or ounce;
- (b) in units of liquid measure shall be in terms of the United States gallon of 231 cubic inches or liquid quart, liquid pint, or fluid ounce subdivisions of the gallon and shall express the volume at 68 °F, except in the case of petroleum products or distilled spirits, for which the declaration shall express the volume at 60 °F, and except also in the case of a commodity that is normally sold and consumed while frozen, for which the declaration shall express the volume at the frozen temperature, and except also in the case of a commodity that is normally sold in the refrigerated state, for which the declaration shall express the volume at 40 °F, and except also in the case of malt beverages, for which the declaration shall express the volume at 39.1 °F;

(Amended 1985)

- (c) in units of linear measure shall be in terms of the yard, foot, or inch;
- (d) in units of area measure shall be in terms of the square yard, square foot, or square inch;

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

- (e) in units of volume measure shall be in terms of the cubic yard, cubic foot, or cubic inch; and
- (f) in units of dry measure, shall be in terms of the United States bushel of 2150.42 in³, or peck, dry quart, and dry pint subdivisions of the bushel.

7.5.1. Symbols and Abbreviations.

Any generally accepted symbol and abbreviation of a unit name may be employed in the quantity statement on a package of commodity. (For commonly accepted symbols and abbreviations, see Section 6.7.1. Symbols and Abbreviations.)

7.6. Character of Declaration: Average. –

Section 8. Prominence and Placement: Consumer Packages

8.1. General.

All information required to appear on a consumer package shall appear thereon in the English language and shall be prominent, definite, plain, and conspicuous as to size and style of letters and numbers and as to color of letters and numbers in contrast to color of background. Any required information that is either in hand lettering or hand script shall be entirely clear and equal to printing in legibility.

8.1.1. Location.

The declaration or declarations of quantity of the contents of a package shall appear in the bottom 30 % of the principal display panel or panels. For cylindrical containers, see also Section 10.7. Cylindrical Containers for additional requirements. For small packages, see Section 11.16. Small Packages.

(Amended 1975)

8.1.2. Style of Type or Lettering.

The declaration or declarations of quantity shall be in such a style of type or lettering as to be boldly, clearly, and conspicuously presented with respect to other type, lettering, or graphic material on the package, except that a declaration of net quantity blown, formed, or molded on a glass or plastic surface is permissible when all label information is blown, formed, or molded on the surface.

8.1.3. Color Contrast.

The declaration or declarations of quantity shall be in a color that contrasts conspicuously with its background, except that a declaration of net quantity blown, formed, or molded on a glass or plastic surface shall not be required to be presented in a contrasting color if no required label information is on the surface in a contrasting color.

8.1.4. Free Area.

The area surrounding the quantity declaration shall be free of printed information:

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

- (a) above and below, by a space equal to at least the height of the lettering in the declaration; and
- (b) to the left and right, by a space equal to twice the width of the letter “N” of the style and size of type used in the declaration.

8.1.5. Parallel Quantity Declaration.

The quantity declaration shall be presented in such a manner as to be generally parallel to the declaration of identity and to the base on which the package rests as it is designed to be displayed.

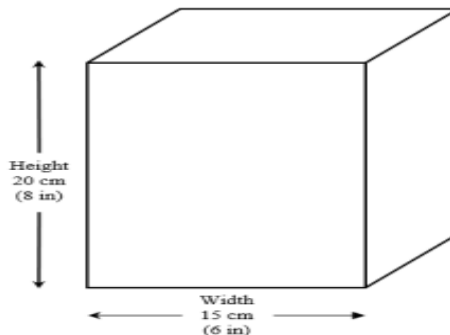
8.2. Calculation of Area of Principal Display Panel for Purposes of Type Size.

The area of the principal display panel shall be:

- (a) in the case of a rectangular container, one entire side that properly can be considered to be the principal display panel, the product of the height times the width of that side;

For Figure 3. Calculation of the Area of the Principal Display Area of a Rectangular Container, the area of the principal display panel is 20 cm (8 in) × 15 cm (6 in) = 300 cm² (48 in²).

Figure 3 - Calculation of the Area of the Principal Display Area of a Rectangular Container



- (b) in the case of a cylindrical or nearly cylindrical container, the product of the height of the container times the circumference times 40 %;

For Figure 4. Calculation of the Area of the Principal Display Area of a Cylindrical Container, the area of the principal display panel is: 5 cm (2 in) × 25 cm (10 in) = 125 cm (20 in²) × 0.40 = 50 cm² (8 in²) (see also Section 10.7. Cylindrical Containers).

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS
 Title 4, Division 9, Chapter 9
 Quality Control §§ 4500. – 4532

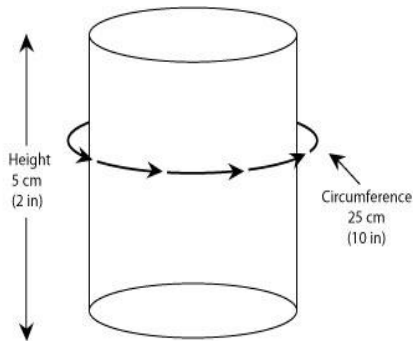


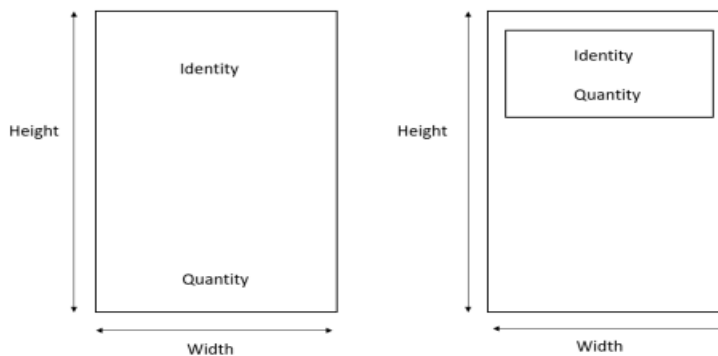
Figure 4 - Calculation of the Area of the Principal Display Area of a Cylindrical Container

(c) in the case of any other shaped container, 40 % of the total surface of the container, unless such container presents an obvious principal display panel (e.g., the top of a triangular or circular package of cheese, or the top of a can of shoe polish), in which event the area shall consist of the entire such surface. Determination of the principal display panel shall exclude tops, bottoms, flanges at tops and bottoms of cans, and shoulders and necks of bottles or jars. (see Figure 5. Other Shaped Containers.)



Figure 5 - Other Shaped Containers

(d) in the case of a spot label, it is not the size of the label that is used to determine the minimum type size of the quantity statement, but the size of the surface of the package exposed (panel) viewable to the customer. The declaration of net quantity of contents must be of the same height in both cases. In Figure 6. Spot Labels, the package on the right side of the figure has a spot label. The area of the principal display panel is the same in both examples. (see Section 2.12. Spot Label and Section 11.29. Spot Label.)



EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

Figure 6 – Spot Labels

8.2.1. Minimum Height of Numbers and Letters.

The height of any letter or number in the required quantity declaration shall be not less than that shown in Table 1 with respect to the area of the panel, and the height of each number of a common fraction shall meet one-half the minimum height standards. When upper and lowercase or all lowercase letters are used, it is the lowercase “o” or its equivalent that shall meet the minimum height requirement. When upper and lowercase or all lowercase letters are used in SI symbols, it is the uppercase “L,” lowercase “d,” or their equivalent in the print or type that shall meet the minimum height requirement. However, no letter shall be less than 1.6 mm (1/16 in) in height. Other letters and exponents must be presented in the same type style and in proportion to the type size used.

(Amended 1993)

8.2.3. Numbers and Letters: Proportion.

No number or letter shall be more than three times as high as it is wide.

Table 1. Minimum Height of Numbers and Letters

Area of Principal Display Panel	Minimum Height of Numbers and Letters	Minimum Height; Label Information Blown, Formed, or Molded on Surface of Container
$\leq 32 \text{ cm}^2$ (5 in ²)	1.6 mm (1/16 in)	3.2 mm (1/8 in)
$> 32 \text{ cm}^2$ (5 in ²) $\leq 161 \text{ cm}^2$ (25 in ²)	3.2 mm (1/8 in)	4.8 mm (3/16 in)
$> 161 \text{ cm}^2$ (25 in ²) $\leq 645 \text{ cm}^2$ (100 in ²)	4.8 mm (3/16 in)	6.4 mm (1/4 in)
$> 645 \text{ cm}^2$ (100 in ²) $\leq 2581 \text{ cm}^2$ (400 in ²)	6.4 mm (1/4 in)	7.9 mm (5/16 in)
$> 2581 \text{ cm}^2$ (400 in ²)	12.7 mm (1/2 in)	14.3 mm (9/16 in)
<p>Symbols: \leq means less than or equal to; $<$ means less than; $>$ means greater than. NOTE: The type size requirements specified in this table do not apply to the “e” mark [NOTE 4].</p>		

Section 9. Prominence and Placement: Non-consumer Packages

9.1. General.

All information required to appear on a non-consumer package shall be definitely and clearly stated thereon in the English language. Any required information that is either in hand lettering or hand script shall be entirely clear and equal to printing in legibility.

Section 10. Requirements: Specific Consumer Commodities, Non-consumer Commodities, Packages, Containers

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

(Title amended 1979)

10.1. Display Card Package.

For an individual package affixed to a display card, or for a commodity and display card together comprising a package, the type size of the quantity declaration is governed by the dimensions of the display card.

10.2. Eggs.

When cartons containing 12 eggs have been designed so as to permit division in half by the retail purchaser, the required quantity declaration shall be so positioned as to have its context destroyed when the carton is divided.

10.3. Aerosols and Other Pre-pressurized Containers Dispensing Product Under Pressure.

The declaration of quantity on an aerosol and on other pre-pressurized containers dispensing products under pressure shall disclose the net quantity of the commodity (including propellant, where applicable) in terms of weight that will be expelled when the instructions for use as shown on the container are followed.

Note: Enforceable on packages using bag-on-valve (BOV) technology after January 1, 2018.

(Amended 2014)

10.4. Multi-unit Packages. [NOTE 8 CCR page QC-25] / [NOTE 8, HB 130 page 78]

Any package containing more than one individual “commodity in package form” [NOTE 7] (see Section 2.1. Package) of the same commodity shall bear on the outside of the package a declaration of:

- (a) the number of individual units;
- (b) the quantity of each individual unit; and
- (c) the total quantity of the contents of the multi-unit package.

Example:

Soap bars, 6 Bars, Net Wt 100 g (3.53 oz) each
Total Net Wt 600 g (1.32 lb).

(Amended 1993)

- (d) A multiunit package containing unlabeled individual packages which are not intended for retail sale separate from the multiunit package may contain, in lieu of the requirements of section (a), (b) and (c), a declaration of quantity of contents expressing the total quantity of the multiunit package without regard for inner packaging. For such multiunit packages, it shall be optional to include a statement of the number of individual packages when such a statement is not otherwise required by the regulations.

Examples:

Deodorant Cakes –

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

5 cakes, Net Wt 113 g (4 oz) each, Total Net Wt 566 g (1.25 lb); or

5 cakes, Total Net Wt 566 g (1 lb 4 oz)

Soap Packets –

10 packets, Net Wt 56.6 g (2 oz) each, Total Net Wt 566 g (1.25 lb); or Net Wt 566 g (1 lb 4 oz); or 10 packets, Total Net Wt 566 g (1 lb 4 oz)

The term “total” or the phrase “total contents” may precede the quantity declaration.

(Amended 1993)

[NOTE 8, HB 130 page 78] For foods, a “multi-unit” package means a package containing two or more individually packaged units of the identical commodity in the same quantity, intended to be sold as part of the multi-unit package but labeled to be individually sold in full compliance with this regulation. Open multi-unit retail food packages under the authority of the FDA or the USDA that do not obscure the number of units or prevent examination of the labeling on each of the individual units are not required to declare the number of individual units or the total quantity of contents of the multi-unit package if the labeling of each individual unit complies with requirements so that it is capable of being sold individually. (See also Section 11.11. Soft Drink Bottles and Section 11.12. Multi-Unit Soft-Drink Bottles.)

(Added 1984)

10.5. Combination Packages.

A combination package is a package intended for retail sale, containing two or more individual packages or units of dissimilar commodities. The declaration of net quantity for a combination package shall contain an expression of weight, volume, measure, or count or a combination thereof, as appropriate, for each individual package or unit, provided the quantity statements for identical packages or units shall be combined. This section does not apply to food or other commodities subject to the Federal Food, Drug, and Cosmetic Act (21 USC).

Examples:

Lighter Fluid and Flints –

2 cans lighter fluid – each 236 ml (8 fl oz) 1 package – 8 flints

Sponges and Cleaner –

2 sponges – each 10 cm x 15 cm x 2.5 cm (4 in x 6 in x 1 in) 1 box cleaner – Net Mass 170 g (6 oz)

Picnic Pack –

20 spoons, 10 knives, and 10 forks

10 2-ply napkins 25 cm x 25 cm (10 in x 10 in)

10 cups – 177 ml (6 fl oz)

(Amended 1993)

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

10.6. Variety Packages.

A variety package is a package intended for retail sale, containing two or more individual packages or units of similar but not identical commodities. Commodities that are generically the same but that differ in weight, measure, volume, appearance, or quality are considered similar but not identical. This section does not apply to foods or other commodities subject to the Federal Food, Drug, and Cosmetic Act (21 USC). The declaration of net quantity for a variety package will be expressed as follows:

- (a) The number of units for each identical commodity followed by the weight, volume, or measure of that commodity;
- (b) The total quantity by weight, volume, measure, and count, as appropriate, of the variety package. The statement of total quantity shall appear as the last item in the declaration of net quantity and shall not be of greater prominence than other terms used.

Examples:

Sponges –

11 sponges 11 cm x 20.3 cm x 1.9 cm (4 in x 8 in x $\frac{3}{4}$ in) 14 sponges 5.7 cm x 10 cm x 1.2 cm ($2\frac{1}{4}$ in x 4 in x $\frac{1}{2}$ in) Total: 25 sponges

Soap –

2 soap bars 85 g (3 oz) ea

1 soap bar 142 g (5 oz)

Total: 3 soap bars 312 g (11 oz)

Examples Cont.

Liquid Shoe Polish –

1 brown 89 ml (3 fl oz)

1 black 89 ml (3 fl oz)

1 white 148 ml (5 fl oz)

Total: 326 ml (11 fl oz)

Picnic Ware – 34 spoons

33 forks

33 knives

Total: 100 pieces

(Amended 1993)

When individual units in a variety package are either packaged or labeled and are intended for retail sale as individual units, each unit shall be labeled in compliance with the applicable sections of this regulation.

10.7. Cylindrical Containers.

In the case of cylindrical or nearly cylindrical containers, information required to appear on the principal display panel shall appear within that 40 % of the circumference which is most likely to be displayed, presented, shown, or examined under customary conditions of display for retail

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

sale.

10.8. Measurement of Container-Type Commodities, How Expressed.

10.8.1. General.

Commodities designated and sold at retail to be used as containers for other materials or objects, such as bags, cups, boxes, and pans, shall be labeled with the declaration of net quantity as follows:

- (a) For bag-type commodities, in terms of count followed by linear dimensions of the bag (whether packaged in a perforated roll or otherwise). The linear dimensions shall be expressed:
 - (1) in SI units: in millimeters or centimeters, except that a dimension of 1 meter or more will be expressed in meters with the remainder in terms of decimal fractions of the meter; and
 - (2) in U.S. customary units: in inches, except that a dimension of 2 ft or more will be expressed in feet with any remainder in terms of inches or common or decimal fractions of the foot.
- (b) When the unit bag is characterized by two dimensions because of the absence of a gusset, the width and length will be stated.

Examples:

25 bags, 12.7 cm × 10 cm (5 in × 4 in) or
50 bags, 75 cm × 1.2 m (2.5 ft × 3.9 ft)

- (c) When the unit bag is gusseted, the dimensions will be expressed as width, depth, and length.

Examples:

25 bags, 43 cm × 10 cm × 50 cm (17 in × 4 in × 20 in) or
100 bags, 50.8 cm × 30.4 cm × 76.2 cm (20 in × 12 in × 2½ ft)

- (d) For other square, oblong, rectangular, or similarly shaped containers, in terms of count followed by length, width, and depth, except depth need not be listed when less than 5 cm or 2 in. The linear dimensions shall be expressed as specified in Section 10.8.1.(a).

Example:

Bag-type commodities: 2 Pans, 20 cm × 20 cm (8 in × 8 in)

- (e) For circular or other generally round-shaped containers, except cups and the like, in terms of count followed by diameter and depth, except depth need not be listed when less than 5 cm or 2 in.

Example:

4 pans, 20 cm (8 in) diameter × 10 cm (4 in)

- (f) Cups – Notwithstanding the above requirements, the net quantity statement for containers such as cups will be listed in terms of count and liquid capacity

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

per unit.

Example:

24 cups, 177 ml (6 fl oz) capacity

10.8.2. Capacity.

When the functional use of the container is related by label references in standard terms of measure to the capability of holding a specific quantity of substance or class of substances such references shall be a part of the net quantity statement and shall specify capacity as follows:

- (a) in SI units: in terms of volume for all containers and liners. The expressed capacity will be stated in terms of milliliters, except that a quantity of 1 liter or more shall be expressed in liters with the remainder in terms of decimal fractions of the liter; and
- (b) in U.S. customary units:
 - (1) In terms of liquid measure for containers that are intended to be used for liquids, semisolids, viscous materials, or mixtures of solids and liquids. The expressed capacity will be stated in terms of the largest whole unit (gallon, quart, pint, fluid ounce) with any remainder in terms of common or decimal fractions of that unit.

Example:

Freezer Boxes –

4 Boxes, 946 ml capacity, 15 cm × 15 cm × 10 cm (1 qt capacity, 6 in × 6 in × 4 in)

- (2) In terms of dry measure for containers that are intended to be used for solids. The expressed capacity will be stated in terms of the largest whole unit (bushel, peck) with any remainder in terms of common or decimal fractions of that unit.

Example:

Leaf Bags –

8 bags, 211 L capacity, 1.21 m × 1.52 m (6 bu capacity, 4 ft × 5 ft)

- (3) Where containers are used as liners for other more permanent containers, in the same terms as are normally used to express the capacity of the more permanent containers.

Example:

Garbage Can Liners –

10 liners, 76.2 cm × 93.9 cm, fits up to 113 L cans (2 ft 6 in × 3 ft 1 in, fits up to 30 gal cans)

10.8.3. Terms.

For purposes of this section, the use of the terms “capacity,” “diameter,” and “fluid” is optional.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

10.9. Textile Products, Threads, and Yarns.

10.9.1. Wearing Apparel.

Wearing apparel (including non-textile apparel and accessories such as leather goods and footwear) sold as single unit items, or if normally sold in pairs (such as hosiery, gloves, and shoes) sold as single unit pairs, shall be exempt from the requirements for net quantity statement by count, as required by Section 6.4. Terms: Weight, Liquid Measure, Dry Measure, or Count of this regulation.

10.9.3. Textiles.

Bed sheets, blankets, pillowcases, comforters, quilts, bedspreads, mattress covers and pads, afghans, throws, dresser and other furniture scarves, tablecloths and napkins, flags, curtains, drapes, dishtowels, dishcloths, towels, facecloths, utility cloths, bathmats, carpets and rugs, potholders, fixture and appliance covers, nonrectangular diapers, slipcovers, etc., shall be exempt from the requirements of Section 6.9. Bi-dimensional Commodities of this regulation, provided:

- (a) The quantity statement for fitted sheets and mattress covers shall state, in centimeters and inches, the length and width of the mattress for which the item is designed and the size designation of the mattress if the item is intended to fit a mattress identified as “twin,” “double,” “queen,” “king,” “California king,” etc.

Example:

Double sheet for 137 cm x 190 cm (54 in x 75 in) mattress

(Amended 1987)

- (b) The quantity statement for flat sheets shall state, in centimeters and inches, the length and width of the mattress for which the sheet is designed, followed in parentheses by a statement, in centimeters and inches, of the length and width of the finished sheet. The quantity statement shall also state the size designation of the mattress for which the sheet is designed, such as “twin,” “double,” “queen,” “king,” “California king,” if the item is intended to fit such a mattress.

Example:

Twin flat sheet for 99 cm x 190 cm (39 in x 75 in) mattress 167 cm x 244 cm (66 in x 96 in) finished size

(Amended 1987)

- (c) The quantity statement for pillowcases shall state, in centimeters and inches, the length and width of the pillow for which the pillowcase is designed, followed in parentheses by a statement, in centimeters and inches of the length and width of the finished pillowcase. The quantity statement for pillowcases shall also state the size designation of the pillow for which the pillowcase is designed, for example, “youth,” “standard,” “queen,” etc., if the item is intended to fit such pillows.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

Example:

Standard pillowcase for 51 cm x 66 cm (20 in x 26 in) pillow, 51 cm x 76 cm (20 in x 30 in) in finished size

(Amended 1977 and 1987)

- (d) The quantity statement for blankets, comforters, quilts, bedspreads, mattress pads, afghans, and throws shall state, in centimeters and inches, the length and width of the finished item. The quantity statement shall also state the length of any ornamentation and the size designation of the mattress for which the item is designed, if it is intended to fit, for example, a “twin,” “double,” “queen,” “king,” “California king,” etc., mattress.

(Amended 1988)

- (e) The quantity statement for tablecloths and napkins shall state, in centimeters and inches, the length and width of the finished item. The quantity statement also may state parenthetically, in centimeters and inches, the length and width of the item before hemming and be properly identified as such.
- (f) The quantity statement for curtains, drapes, flags, furniture scarves, etc., shall state, in centimeters and inches, the length and width of the finished item. The quantity statement also may state parenthetically, in centimeters and inches, the length of any ornamentation.
- (g) The quantity statement for carpets and rugs shall state, in meters and feet, with any remainder in decimal fractions of the meter for SI sizes or common or decimal fractions of the foot or in inches for U.S. customary sizes, the length and width of the item. The quantity statement also may state parenthetically, in centimeters and inches, the length of any ornamentation.
- (h) The quantity statement for woven dishtowels, dishcloths, towels, facecloths, utility cloths, bathmats, etc., shall state, in centimeters and inches, the length and width of the item. The quantity statement for such items, when knitted, need not state the dimensions.
- (i) The quantity statement for textile products such as potholders, fixture and appliance covers, slipcovers, non-rectangular diapers, etc., shall be stated in terms of count and may include size designations and dimensions.
- (j) The quantity statement for other than rectangular textile products identified in Sections (a) through (h) shall state the geometric shape of the product and the dimensions that are customarily used in describing such geometric shape.

Examples:

Round scarf , 190 cm (74 in) in diameter;

Oval tablecloth, 177 cm x 254 cm (70 in x 100 in) representing the maximum length and width in this case.

- (k) The quantity statement for packages of remnants of textile products of assorted sizes, when sold by count, shall be accompanied by the term

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

“irregular dimensions” and the minimum size of such remnants.

(Added 1971)

10.9.3. Sewing Threads, Handicraft Threads, and Yarns.

Sewing and handicraft threads shall be labeled as follows:

- (a) The net quantity for sewing and handicraft threads shall be expressed in terms of meters and yards.
- (b) The net quantity statement for yarns shall be expressed in terms of mass or weight.
- (c) Thread products may, in lieu of name and address, bear a trademark, symbol, brand, or other mark that positively identifies the manufacturer, packer, or distributor provided such marks are filed with the Director.
- (d) Each unit of industrial thread shall be marked to show its net length in terms of meters and yards or its net weight in terms of kilograms or grams and avoirdupois pounds or ounces, except that ready-wound bobbins that are not sold separately shall not be required to be individually marked to show the number of bobbins contained therein and the net meters and yards of thread on each bobbin.

10.10. Packaged Seed.

Packages of seeds intended for planting with net contents of less than 225 g or 8 oz shall be labeled in full accord with this regulation except as follows:

- (a) The quantity statement shall appear in the upper 30 % of the principal display panel.
- (b) The quantity statement shall be in terms of:
 - (1) the largest whole SI unit for all packages with weights up to 7 g; and
 - (2) in grams and ounces for all other packages with weights less than 225 g or 8 oz.
- (c) The quantity statement for coated seed, encapsulated seed, pelletized seed, pre-planters, seed tapes, etc., shall be in terms of count.

(Added 1972) (Amended 1975 and 1993)

Section 11. Exemptions [NOTE 9, CCR page 31] [NOTE 9, HB 130 page 83]

[NOTE 9, CCR page 31] [NOTE 9, HB 130 page 83]: Section 11. Exemptions include several requirements that refer only to the historic use of U.S. customary units or are direct restatements of exemptions contained in federal laws or regulations which do not include SI units. SI equivalents are omitted in most of these requirements because the SI units would not be meaningful or useful.

(Added 1993) (Amended 1995)

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

11.1. Random Packages.

A random package bearing a label conspicuously declaring:

- (a) the net weight;
- (b) unit price; and
- (c) the total price

Shall be exempt from the SI units, type size, location, and free area requirements of this regulation. In the case of a random package packed at one place for subsequent sale at another, neither the price per unit of weight nor the total selling price need appear on the package, provided the package label includes both such prices at the time it is offered or exposed for sale at retail.

This section shall also apply to uniform weight packages of fresh fruit or vegetables labeled by count, in the same manner and by the same type of equipment as random packages exempted by this section, and cheese and cheese products labeled in the same manner and by the same type of equipment as random packages exempted by this section.

(Amended 1989)

11.1.1. Indirect Sale of Random Packages.

A random package manufactured or produced and offered for indirect sale (e.g., e-commerce, online, phone, fax, catalog, and similar methods) shall be exempt from the labeling requirements of:

- (a) unit price
- (b) total price

When the following requirements are met:

At the time of the delivery, each package need only bear a statement of net weight, provided that:

- (a) the unit price is set forth and established in the initial product offering;
- (b) the maximum possible net weight, unit price, and maximum possible price are provided to the customer by order confirmation when the product is ordered; and
- (c) when the product is delivered, the customer receives a receipt bearing the following information: identity, declared net weight, unit price, and the total price.

Indirect Sales: For the purpose of Section 11.1.1. Indirect Sale of Random Packages, indirect sales are sales where the customer makes a selection and places an order, but cannot be present when the determination of the net quantity is made. Examples of such indirect methods include, without limitation, Internet or online sales, sales conducted by telephone or facsimile, and catalog sales.

(Added 2001) (Amended 2002)

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

11.2. Small Confections.

Individually wrapped pieces of “penny candy” and other confectionery of less than 15 g or ½ oz net weight per individual piece shall be exempt from the labeling requirements of this regulation when the container in which such confectionery is shipped is in conformance with the labeling requirements of this regulation. Similarly, when such confectionery items are sold in bags or boxes, such items shall be exempt from the labeling requirements of this regulation, including the required declaration of net quantity of contents, when the declaration of the bag or box meets the requirements of this regulation.

11.3. Small Packages of Meat or Meat Products.

Individually wrapped and labeled packages of meat or meat products of less than 15 g or ½ oz net weight, which are in a shipping container, need not bear a statement of the net quantity of contents when the statement of the net quantity of contents on the shipping container is in conformance with the labeling requirements of this regulation.

(Added 1987)

11.4. Individual Servings.

Individual serving size packages of foods containing less than 15 g or ½ oz or less than 15 ml or ½ fl oz for use in restaurants, institutions, and passenger carriers, and not intended for sale at retail, shall be exempt from the required declaration of net quantity of contents specified in this regulation.

11.5. Cuts, Plugs, and Twists of Tobacco and Cigars.

When individual cuts, plugs, and twists of tobacco and individual cigars are shipped or delivered in containers that conform to the labeling requirements of this regulation, such individual cuts, plugs, and twists of tobacco and cigars shall be exempt from such labeling requirements.

11.6. Reusable (Returnable) Glass Containers.

Nothing in this Regulation shall be deemed to preclude the continued use of reusable (returnable) glass containers, provided such glass containers ordered after the effective date of this regulation shall conform to all requirements of this regulation.

11.7. Cigarettes and Small Cigars.

Cartons of cigarettes and small cigars, containing ten individual packages of twenty, labeled in accordance with the requirements of this regulation shall be exempt from the requirements set forth in Section 8.1.1. Location, Section 8.2.1. Minimum Height of Numbers and Letters, and Section 10.4. Multi-unit Packages, provided such cartons bear a declaration of the net quantity of commodity in the package.

11.8. Packaged Commodities with Labeling Requirements Specified in Federal Laws and Regulations.

Packages of alcoholic beverages (i.e., beer, distilled spirits, and wine), cosmetics, catfish (Siluriformes), meat and meat products, medical devices, over-the-counter drugs, poultry products, tobacco and tobacco products, and pesticides shall be exempt from those portions of

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

these regulations specifying location, and minimum type size of the net quantity declaration, provided net quantity of contents and other required labeling requirements (i.e., identity, responsibility) for such products are specified in federal law or regulation so as to follow reasonably sound principles of providing consumer information. (Refer to Section 11.32. SI Units, Exemptions - Consumer Commodities and Appendix C. Reference Information for Packaged Commodities and Labeling Requirements Specified in Federal Laws and Regulations.)

(Amended 2018)

11.9. Fluid Dairy Products, Ice Cream, and Similar Frozen Desserts.

- (a) When packaged in ½ liq pt and ½ gal containers, are exempt from the requirements for stating net contents of 8 fl oz and 64 fl oz, which may be expressed as ½ pt and ½ gal, respectively.
- (b) When measured by and packaged in measure containers as defined in “Measure Container Code” of the NIST Handbook 44, “Specifications, Tolerances, and Other Technical Requirements for Weighing Measuring Devices” are exempt from the requirements of Section 8.1.1. Location that the declaration of net contents be located within the bottom 30 % of the principal display panel.
- (c) Milk and milk products when measured by and packaged in glass or plastic containers of ½ pt, 1 pt, 1 qt, ½ gal, and 1 gal capacities are exempt from the placement requirement of Section 8.1.1. Location that the declaration of net contents be located within the bottom 30 % of the principal display panel, provided other required label information is conspicuously displayed on the cap or outside closure and the required net quantity of contents declaration is conspicuously blown, formed, or molded on, or permanently applied to that part of the glass or plastic container that is at or above the shoulder of the container.

(Amended 1993)

11.10. Single Strength and Less than Single-Strength Fruit Juice Beverages, Imitations thereof, and Drinking Water.

- (a) When packaged in glass, plastic, or fluid milk type paper containers of 8 fl oz and 64 fl oz capacity, are exempt from the requirements of Section 6.2. Largest Whole Unit to the extent that net contents of 8 fl oz and 64 fl oz (or 2 qt) may be expressed as ½ pt (or half pint) and ½ gal (or half gallon), respectively.
- (b) When packaged in glass or plastic containers of ½ pt, 1 pt, 1 qt, ½ gal, and 1 gal capacities, are exempt from the placement requirements of Section 8.1.1. Location that the declaration of net contents be located within the bottom 30 % of the principal display panel, provided other label information is conspicuously displayed on the cap or outside closure and the required net quantity of contents declaration is conspicuously blown, formed, or molded into or permanently applied to that part of the glass or plastic container that is at or above the shoulder of the container.

(Amended 1993)

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

11.11. Soft Drink Bottles.

Bottles of soft drinks shall be exempt from the placement requirements for the declaration of:

- (a) identity when such declaration appears on the bottle closure; and
- (b) quantity when such declaration is blown, formed, or molded on or above the shoulder of the container and when all other information required by this regulation appears only on the bottle closure.

11.12. Multi-unit Soft Drink Packages.

Multi-unit packages of soft drinks are exempt from the requirement for a declaration of:

- (a) responsibility when such declaration appears on the individual units and is not obscured by the multi-unit packaging or when the outside container bears a statement to the effect that such declaration will be found on the individual units inside; and
- (b) identity when such declaration appears on the individual units and is not obscured by the multi-unit packaging.

11.13. Butter.

When packaged in 4 oz, 8 oz, and 1 lb packages with continuous label copy wrapping, butter is exempt from the requirements that the statement of identity (Section 3.1.1. Parallel Identity Declaration: Consumer Package) and the net quantity declaration (Section 8.1.5. Parallel Quantity Declaration) be generally parallel to the base of the package. When packaged in 8 oz and 1 lb units, butter is exempt from the requirement for location (Section 8.1.1. Location) of net quantity declaration.

(Amended 1980 and 1993)

11.14. Eggs.

Cartons containing 12 eggs shall be exempt from the requirement for location (Section 8.1.1. Location) of net quantity declaration. When such cartons are designed to permit division in half, each half shall be exempt from the labeling requirements of this regulation if the undivided carton conforms to all such requirements.

11.15. Flour.

Packages of wheat flour in conventional 2, 5, 10, 25, 50, and 100 lb packages shall be exempt from the requirement in this regulation for location (Section 8.1.1. Location) of the net quantity declaration.

(Amended 1980 and 1993)

11.16. Small Packages.

On a principal display panel of 32 cm² (5 in²) or less, the declaration of quantity need not appear in the bottom 30 % of the principal display panel if that declaration satisfies the other requirements of this regulation.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

(Amended 1980)

11.17. Decorative Containers.

The principal display panel of a cosmetic marketed in a “boudoir-type” container, including decorative cosmetic containers of the “cartridge,” “pill box,” “compact,” or “pencil” variety, and those with a capacity of 7.4 ml (¼ oz) or less, may be a tear-away tag or tape affixed to the decorative container and bearing the mandatory label information as required by this regulation.

(Amended 1980)

11.18. Combination and Variety Packages.

Combination and variety packages are exempt from the requirements in this regulation for:

- (a) location (see Section 8.1.1. Location);
- (b) free area (see Section 8.1.4. Free Area); and
- (c) minimum height of numbers and letters (see Section 8.2.1. Minimum Height of Numbers and Letters).

(Amended 1989)

11.19. Margarine.

Margarine in 1 lb rectangular packages, except for packages containing whipped or soft margarine or packages containing more than four sticks, shall be exempt from the requirement in this regulation for location (see Section 8.1.1. Location) of the net quantity declaration. The statement of net quantity shall appear in a clear and conspicuous manner on the principal display panel. (see 9 CFR 317.2)

(Amended 1980, 1993, and 2021)

11.20. Corn Flour and Corn Meal.

Corn flour and corn meal packaged in conventional 5, 10, 25, 50, and 100 lb bags shall be exempt from the requirement in this regulation for location (see Section 8.1.1. Location) of the net quantity declaration.

(Amended 1978 and 1980)

11.21. Prescription and Insulin Containing Drugs.

Prescription and insulin containing drugs subject to the provisions of Section 503(b) (1) or 506 of the Federal Food, Drug, and Cosmetic Act shall be exempt from the provisions of this regulation.

11.22. Camera Film, Video Recording Tape, Audio Recording Tape, and Other Image and Audio Recording Media Intended for Retail Sale and Consumer Use.

Image and audio media packaged and labeled for retail sale are exempt from the net quantity statement requirements of this regulation that specify how measurement of commodities should be expressed, provided:

- (a) Unexposed or Unrecorded Media. – The net quantity of contents of unexposed or

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

unrecorded image and audio media is expressed:

- (1) For still film, tape, or other still image media, in terms of the usable or guaranteed number of available still image exposures. The length and width measurements of the individual exposures, expressed in millimeters or inches, are authorized as an optional statement.

Examples:

36 exposures, 36 mm × 24 mm, or
12 exposures, 2¼ in × 2¼ in

- (2) For bulk or movie film, in terms of length (in meters or feet) of film available for exposure.
- (3) For all other image and/or audio media, in terms of length of time of electronic media available for recording, together with recording and/or playing speed or other machine settings as necessary. Supplemental information concerning the length of the media [NOTE 9] may be provided.

Supplemental information may be provided on other than the principal display panel.

[NOTE 10, CCR pg. 35] / [NOTE 10, HB 14- pg 87]: *Size, length of media, and format details to ensure interchangeability and other characteristics of audio and imaging media are available in the applicable American National Standards.*

- (b) Exposed, Recorded, or Processed Media. – The net quantity of contents of exposed or processed film or prerecorded electronic media shall be expressed in terms of the length of time that is of entertainment value.

“Entertainment value” is defined as that portion of a film, tape, or other media that commences with the first frame of sound or picture, whichever comes first after the countdown sequence (if any), and ends with either: (a) the last frame of credits; (b) the last frame of the phrase “The End”; or (c) the end of sound, whichever is last.

(Amended 1990)

11.23. Tint Base Paint.

Tint base paint may be labeled on the principal display panel in terms of a liter, quart, or a gallon, including the addition of colorant selected by the purchaser, provided the system employed ensures that the purchaser always obtains a liter, quart, or a gallon; and further provided, in conjunction with the required quantity statement on the principal display panel, a statement indicating that the tint base paint is not to be sold without the addition of colorant is presented; and further provided the contents of the container, before the addition of colorant, is stated in fluid ounces elsewhere on the label.

Wherever the above conditions cannot be met, containers of tint base paint must be labeled with a statement of the actual net contents prior to the addition of colorant in full accord with all the requirements of this regulation.

(Added 1972) (Amended 1980 and 1993)

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

11.24. Motor Oil in Cans.

Motor oils when packed in cans bearing the principal display panel on the body of the container are exempt from the requirements of Section 3. Declaration of Identity: Consumer Package to the extent that the Society of Automotive Engineers (SAE) viscosity number is required to appear on the principal display panel, provided the SAE viscosity number appears on the can lid and is expressed in letters and numerals in type size of at least 6 mm or ¼ in.

(Amended 1974, 1980, and 1993)

11.25. Pillows, Cushions, Comforters, Mattress Pads, Sleeping Bags, and Similar Products.

Those products including pillows, cushions, comforters, mattress pads, and sleeping bags that bear a permanent label as designated by the International Association of Bedding and Furniture Law Officials (iabflo.org) or the Department of Consumer Affairs, Bureau of Household Goods and Services (BHGS) (bhgs.dca.ca.gov) shall be exempt from the requirements for location (Section 8.1.1. Location), size of letters or numbers (Sections 8.2.1. Minimum Height of Numbers and Letters and 8.2.2. Numbers and Letters: Proportion), free area (Section 8.1.4. Free Area), and the declarations of identity and responsibility (Sections 3.1. Declaration of Identity and 5. Declaration of Responsibility: Consumer and Nonconsumer Packages), provided declarations of identity, quantity, and responsibility are presented on a permanently attached label and satisfy the other requirements of this Regulation, and further provided the information on such permanently attached label be fully observable to the purchaser.

(Added 1973)

11.26. Commodities' Variable Weights and Sizes.

Individual packaged commodities put up in variable weights and sizes for sale intact and intended to be weighed and marked with the correct quantity statement prior to or at the point of retail sale are exempt from the requirements of Section 6. Declaration of Quantity: Consumer Packages while moving in commerce and while held for sale prior to weighing and marking, provided the outside container bears a label declaration of the total net weight.

(Added 1973)

11.27. Packaged Commodities Sold by Count.

[NOTE 11, HB 10, pg. 88] – When a packaged consumer commodity is properly measured in terms of count only, or in terms of count and some other appropriate unit, and the individual units are fully visible to the purchaser, such packages shall be labeled in full accord with this Regulation, except that those containing six or less items need not include a statement of count.

(Added 1973)

[NOTE 11, HB 130 pg. page 88]: *When the net contents declaration of a package that may enter interstate commerce includes count, federal regulations under the Federal Fair Packaging and Labeling Act provide no exemption from declaring the count unless the count is one (1).*

(Added 1990)

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

11.28. Textile Packages.

Packages of textiles that are required by Section 6.4.1. Combination Declaration to provide a combination declaration stating the quantity of each individual unit and the count shall be exempt from the requirements in this regulation for:

- (a) Location (see Section 8.1.1. Location);
- (b) Free area (see Section 8.1.4. Free Area); and
- (c) Minimum height of numbers and letters (see Section 8.2.1. Minimum Height of Numbers and Letters).

(Added 1971) (Amended 1989)

11.29. Spot Label.

The declaration of quantity of the contents of a package is exempt from Section 8.1.1. Location requiring the quantity declaration to appear in the bottom 30 % of the principal display panel, as long as the declaration of quantity appears in the lower 30 % of the spot label. In no case may the size of the spot label be used to determine the minimum type size; see Section 8.2.

Calculation of Area of Principal Display Panel for Purposes of Type Size for this determination.

(Added 1990)

11.30. Header Strip.

The declaration of quantity of the contents of a package is exempt from Section 8.1.1. Location requiring the quantity declaration to appear in the bottom 30 % of the principal display panel, as long as the declaration of quantity appears in the lower 30 % of the header strip or header label. In no case may the size of the header strip be used to determine the minimum type size; see Section 8.2. Calculation of Area of Principal Display Panel for Purposes of Type Size for this determination.

(Added 1990)

11.31. Decorative Wallcovering Borders.

Decorative wallcovering borders when packaged and labeled for retail sale shall be exempt from the requirements of Sections 6.6.2. One Meter, 1 Square Meter, 1 Kilogram, 1 Liter, 1 Cubic Meter, or More; 6.8.2. One Foot, 1 Square Foot, 1 Pound, 1 Pint, 1 Gallon or More; and 6.9. Bi-dimensional Commodities provided the length and width of the border are presented in terms of the largest whole unit in full accord with the other requirements of the regulation.

(Added 1992) (Amended 1993)

11.32. SI Units, Exemptions - Consumer Commodities.

The requirements for statements of quantity in SI units (except for those in Section 10.10. Packaged Seed and Section 11.22. Camera Film, Video Recording Tape, Audio Recording Tape and Other Image and Audio Recording Media Intended for Retail Sale and Consumer Use) in Section 6. Declaration of Quantity: Consumer Packages shall not apply to:

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

- (a) foods packaged at the retail store level;
- (b) random weight packages (see Sections 2.4. Random Package and 11.1. Random Packages);
- (c) package labels printed before February 14, 1994;
- (d) meat and poultry products subject to the Federal Meat or Poultry Products Inspection Acts;
- (e) tobacco or tobacco products;
- (f) any beverage subject to the Federal Alcohol Administration Act;
- (g) any product subject to the Federal Insecticide, Fungicide, and Rodenticide Act;
- (h) drugs and cosmetics subject to the Federal Food, Drug and Cosmetic Act;
- (i) nutrition labeling information.

11.33. U.S. Customary Units, Exemptions - Consumer Commodities.

The requirements for statements of quantity in U.S. customary units shall not apply to packages that bear appropriate SI units. This exemption does not apply to foods, drugs, or cosmetics or to packages subject to regulation by the FTC, meat and poultry products subject to the Federal Meat or Poultry Products Inspection Acts, and tobacco or tobacco products.

(Added 1999)

11.34. Bacon

Bacon packages as sliced shingles in rectangular packages shall be exempt from the requirement in this regulation for location (see Section 8.1.1. Location) of the net quantity declaration. The statement of net quantity shall appear in a clear and conspicuous manner on the principal display panel. (see 9 CFR 317.2)

(Added 2021)

Section 12. Variations to be Allowed [NOT ADOPTED – CCR § 4511. Exceptions]

Section 13. Retail Sale Price Representations [NOT ADOPTED – CCR § 4511. Exceptions]

Section 14. Revocation of Conflicting Regulations [NOT ADOPTED – CCR § 4511. Exceptions]

Section 15. Effective Date [NOT ADOPTED – CCR § 4511. Exceptions]

§ 4512. Additional Requirements.

The following requirements apply in addition to those contained within the Uniform Packaging and Labeling Regulation in the National Institute of Standards and Technology Handbook 130.

Note: Authority cited: Sections 12027, 12603, 12609 and 12610, Business and Professions

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

Code. Reference: Sections 12601, 12602, 12603 and 12610, Business and Professions Code.

CCR § 4512.1. Polyethylene Products.

The declaration of quantity of contents for polyethylene products shall be as follows:

(a) Consumer and nonconsumer packages of sheeting and film.

- Length and width.
- Area in square meters or square feet.
- Thickness in micrometers and mils. (1 mil = 0.001 in = 25.4 micrometers)
- Weight.

(b) The following consumer products sold at retail shall be labeled in the following terms:

(1) Food wrap.

- Length and width.
- Area in square meters or square feet.

(2) Lawn and trash bags.

- Count.
- Dimensions.
- Thickness in micrometers and mils.
- Capacity.

(3) Food and sandwich bags.

- Count.
- Dimensions.
- Capacity (except for fold-over sandwich bags).

(c) Bags not intended for the retail consumer shall be labeled in terms of:

- Count.
- Dimensions.
- Thickness in micrometers or mils.
- Weight.
- Capacity.

Note: Authority cited: Sections 12027, 12603, 12609 and 12610, Business and Professions Code. Reference: Sections 12601, 12602, 12603 and 12610, Business and Professions Code.

CCR § 4512.2. Animal Bedding.

Packaged animal bedding of all kinds, except for baled straw, shall be labeled by volume, that is by cubic meter, liter, or milliliter, and by the cubic yard, cubic foot, or cubic inch. If the commodity is packaged in a compressed state, the quantity declaration shall include both the quantity in the compressed state and the usable quantity that can be recovered. Example: “250 ml - expands to 500 ml (500 cu in expands to 1000 cu in).”

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

Note: Authority cited: Sections 12027, 12603, 12609 and 12610, Business and Professions Code. Reference: Sections 12601, 12602, 12603 and 12610, Business and Professions Code.

CCR § 4512.3. Enforcement.

A sealer may by written order forbid the display for sale, sale, or transport of any package which does not bear the labeling required by Chapter 6, of Division 5 of the Business and Professions Code.

Note: Authority cited: Sections 12027 and 12609, Business and Professions Code. Reference: Sections 12601, 12607, 12609 and 12611, Business and Professions Code.

UPLR Appendix A: SI/U.S. Customary Conversion Factors **

* Exactly

** These conversion factors are given to six or more significant digits in the event such accuracy is necessary. To convert to U.S. customary units divide the factor rather than multiplying.

(Amended 1998)

LENGTH

1 mil (0.001 in)	=	25.4	µm*	1 micrometer	=	0.039 370	mil
1 inch	=	2.54	cm*	1 millimeter	=	0.039 370 1	in
1 foot	=	30.48	cm*	1 centimeter	=	0.393 701	in
1 yard	=	0.914 4	m*	1 meter	=	3.280 84	ft
1 rod	=	5.029 2	m*				

AREA

1 square inch	=	6.451 6	cm ^{2*}	1 square centimeter	=	0.155 000	in ²
1 square foot	=	929.030	cm ²	1 square decimeter	=	0.107 639	ft ²
1 square yard	=	0.836 127	m ²	1 square meter	=	10.763 9	ft ²

VOLUME or CAPACITY

1 cubic inch	=	16.387 1	cm ³	1 cubic centimeter	=	0.061 023 74	in ³
1 cubic foot	=	0.028 316 8	m ³	1 cubic decimeter	=	0.035 314 7	ft ³
		28.316 8	L	1 cubic meter	=	35.314 7	ft ³
1 cubic yard	m ³ =	0.764 555			=	1.307 95	yd ³
1 fluid ounce	=	29.573 5	ml	1 milliliter (cm ³)	=	0.033 814	fl oz

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

1 liquid pint	=	473.177	ml	1 liter	=	1.056 69	liq qt
		0.473 177	L			0.264 172	gal
1 liquid quart	=	946.353	ml	1 dry pint	=	550.610 5	ml
		0.946 353	L	1 dry quart	=	1.101 221	L
1 gallon	=	3.785 41	L	1 peck	=	8.809 768	L
1 bushel	=	35.239 1	L	1 gill	=	118.294 1	ml

MASS (weight)

1 ounce	=	28.349 5	g	1 milligram	=	0.000 035 2	7oz
						0.015 432 4	grain
1 pound	=	453.592 37	g*	1 gram	=	0.035 274	oz
		0.453 592	kg				
1 grain	=	64.798 91	mg	1 kilogram	=	2.204 62	lb

TEMPERATURE

$t^{\circ}\text{F} - 1.8 t^{\circ}\text{P} + 32^*$	$t^{\circ}\text{C} = 5/p (t^{\circ}\text{F} - 32)^*$
* Exactly	
** These conversion factors are given to six or more significant digits in the event such accuracy is necessary. To convert to U.S. customary units, divide the factor rather than multiplying. (Amended 1998)	

UPLR Appendix B: Converting U.S. Customary Units to SI Units for Quantity Declarations on Packages

1. Conversion.

To convert an U.S. customary quantity to an SI quantity, multiply the appropriate conversion factor in Table 1 in Appendix A by the U.S. customary unit and round according to the following rules.

2. Rounding and Significant Digits.

It is the packager's responsibility to round converted values appropriately and select the appropriate number of significant digits to use in quantity declaration. [These rounding rules are for converting quantity determinations on packages and do not apply to digital scales that automatically round indications to the nearest indicated value.] Conversions, the proper use of significant digits, and rounding must be based on the packer's knowledge of the accuracy of the original measurement that is being converted. For example, if a package is labeled 453.59 g (1 lb), the packer is implying that the package declaration is accurate within ± 0.005 g (or ± 5 mg). For liquid volume measure, a label declaration of 473 ml (16 fl oz) implies that the package declaration is accurate to within ± 0.5 ml (0.01 fl oz). The requirements of 6.13. Rounding apply to all quantity declarations that are derived from converted values:

6.13. Rounding. – In all conversions for the purpose of showing an equivalent SI or

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

U.S. customary quantity to a rounded U.S. customary or SI quantity, or in calculated values to be declared in the net quantity statement, the number of significant digits retained must be such that accuracy is neither sacrificed nor exaggerated. Conversions, the proper use of significant digits, and rounding must be based on the packer’s knowledge of the accuracy of the original measurement that is being converted. In no case shall rounded net contents declarations overstate a quantity; the packer may round converted values down to avoid overstating the net contents.

NOTE: *When as a result of rounding SI or U.S. customary declarations calculated based on the conversion factors in Appendix A, the resulting declarations are not exact, the largest declaration, whether metric or U.S. customary, will be used for enforcement purposes to determine whether a package contains at least the declared amount of the product.*

Do not round conversion factors or any other quantity used or determined in the calculation; only round the final quantity to the number of significant digits needed to maintain the accuracy of the original quantity. Use the rounding rules presented below in Table 1 as guidance to round the final result. In general, quantity declarations on consumer commodities should only be shown to two or three significant digits (for example, 453 g or 85 g). Any final zeros to the right of the decimal point need not be expressed. The U.S. customary and SI declarations of quantity must be accurate and equivalent to each other. For example, a package bearing a net weight declaration of 2 lb (32 oz) must also include an SI declaration of 907 g.

Table 1. Rounding Rules

When The First Digit Dropped is:	The Last Digit Retained is:	Examples
less than 5	Unchanged	2.44 to 2.4 2.429 to 2.4
more than 5, or 5 followed by at least 1 digit other than 0	Increased by 1	2.46 to 2.5 2.451 to 2.5
5 followed by zeros	Unchanged if Even, or Increased by 1 if Odd	2.450 to 2.4 2.550 to 2.6

- (a) When the first digit discarded is less than 5, the last digit retained should not be changed. For example, if the quantity 984.3 is to be declared to 3 significant digits, the number 3 to the right of the decimal point must be discarded since it is less than 5 and the last digit to be retained (the number 4) will remain unchanged. The rounded number will read 984. The same rationale applies to numbers declared to two significant digits (for example 68.4 and 7.34); again, the final digit is dropped and the last digit retained remains unchanged so that the “rounded-off” numbers become 68 and 7.3 respectively.
- (b) When the first digit to be discarded is greater than 5, or it is a 5 followed by at least one digit other than zero, the last digit to be retained should be increased by one unit.

Examples:

984.7 becomes 985
984.51 becomes 985

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

6.86 becomes 6.9

6.88 becomes 6.9

- (c) When the first digit to be discarded is exactly 5, followed only by zeros, the final digit to be retained should be rounded up if it is an odd number (1, 3, 5, 7, or 9), but no adjustment should be made if it is an even number (2, 4, 6, or 8).

Examples:

984.50 becomes 984

985.50 becomes 986

68.50 becomes 68

7.450 becomes 7.4

7.550 becomes 7.6

***NOTE:** See additional examples in Table 2.

3. Additional Advice on Rounding and Significant Digits

- (a) These rules require the packer to use good judgment in making decisions on how to round and the number of significant digits to use in quantity declarations. Rounding should always be done in one step; for example, if 16.946 47 g has to be rounded to three significant digits, it should be rounded to 16.9 g, not 16.946 5, then to 16.946, then to 16.95 which would then round to 17.0 g (see rounding rules above).
- (b) Do not use rounded SI values to calculate quantities. For example, using 1 in = 25.4 mm, rounded to 25 mm, should not be multiplied by 2 to determine the SI equivalent for 2 in. The SI equivalent for 2 in is determined by multiplying 2 in \times 25.4 mm = 50.8 mm, then rounding to 51 mm.
- (c) If a dimension given as 8 ft is valid to the nearest 1/10 in, consider it to mean 96.0 in and treat it as having 3 significant digits. The rounded dimension would then be 2.44 m instead of 2.4 m.
- (d) Conversions using a multiple digit conversion factor usually give a product with more digits than the original quantity. The final product should contain no more significant digits than are contained in the number with the fewest significant digits used in the conversion. For example, the area of a sheet of paper is determined on a calculator by multiplying 1.25 cm (length) \times 1.5 cm (width) = 1.875 cm². The product given to 4 significant digits on the calculator cannot be any more accurate than two significant digits (the number of significant digits in 1.5 cm), so the area should be declared as 1.9 cm².
- (e) Packagers of consumer commodities should be aware that when a converted value is rounded up, there may be a need to (1) increase the package contents and/or, (2) select a converted value that does not exaggerate the precision of the quantity or overstate the net contents. For example, under the rules above, a net weight declaration of 16 oz (453.592 37 g) may be rounded up to 454 g for three significant digits. Inspections by weights and measures officials are typically conducted using devices with a resolution of 0.5 g or less. If the packer does not address this possibility, some lots of commodities may pass when the U.S. customary declaration is tested, but fail when the SI declaration is verified.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS

Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

Table 2. Examples

Weight: To convert ounces to grams, multiply ounces by 28.349 5 grams		
U.S. Customary	Calculated SI	Rounded SI
1.0 oz	28.349 5 g	28 g
5.0 oz	141.747 6 g	142 g
10¼ oz	290.582 38 g	291 g*
16.0 oz	453.592 4 g	454 g*
32.0 oz	907.184 g	907 g
48.0 oz	1360.776 g	1.36 kg
5 lb	2.267 962 kg	2.27 kg*
10 lb	4.535 924 kg	4.54 kg*
25 lb	11.339 81 kg	11.3 kg
Liquid Volume: To convert fluid ounces to milliliters, multiply fluid ounces by 29.573 5 milliliters		
U.S. Customary	Calculated SI	Rounded SI
1.0 fl oz	29.573 5 ml	30 ml*
8.0 fl oz	236.588 ml	237 ml*
16.0 fl oz	473.176 ml	473 ml
32.0 fl oz	946.353 ml	946 ml
1 gal	3.785 41 L	3.79 L*
2½ gal	9.463 525 L	9.46 L
5 gal	18.927 05 L	18.9 L
Dry Measure: To convert dry pints to milliliters, multiply dry pints by 550.610 5 milliliters		
U.S. Customary	Calculated SI	Rounded SI
1 dry pt	550.610 5 ml	551 ml*
1 dry qt	1.101 221 L	1.1 L
Length: To convert inches to millimeters, multiply inches by 25.4 millimeters		
U.S. Customary	Calculated SI	Rounded SI
10.5 in	266.7 mm	267 mm* or 26.7 cm*
1 ft	30.48 cm	305 mm* or 30.5 cm*
5 ft	152.4 cm	152 cm or 1.5 m
50 ft	15.240 03 m	15.2 m
100 ft	30.480 06 m	30.5 m*
* See 6.13. Rounding located under UPLR Appendix B		

Appendix C: Reference Information for Packaged Commodities with Labeling Requirements Specified in Federal Law and Regulation

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS
 Title 4, Division 9, Chapter 9
 Quality Control §§ 4500. – 4532

Product Agency	Code of Federal Regulations (CFR)	Net Quantity of Contents Requirements, Guides, or Other Information
Alcoholic Beverages, Wine, and Beer Treasury Department – Alcohol and Tobacco Tax and Trade Bureau www.ttb.gov	27 CFR, Chapter I, Subchapter A. “Alcohol”	Refer to Part 4 “Labeling and Advertising of Wine.” Refer Part 5 “Labeling and Advertising of Distilled Spirits.” See also: The Beverage Alcohol Manual (BAM) A Practical Guide – “Basic Mandatory Labeling Information for Distilled Spirits - Volume 2” at www.ttb.gov/spirits/bam.shtml . Refer to Part 7 “Labeling and Advertising of Malt Beverages.” See also: “The Beverage Alcohol Manual (BAM) A Practical Guide” at www.ttb.gov/beer/bam.shtml .
Animal Food Food and Drug Administration (FDA) www.fda.gov	21 CFR 501, Chapter I, Subchapter E – Animal Drugs, Feeds and Related Products. “Animal Food Labeling. Subpart F – Exemptions, Animal Food Labeling Requirements	Refer to § 501.105 – “Declaration of net quantity of contents when exempt.”
Catfish* (Siluriformes) U.S. Department of Agriculture (USDA) – Food Safety and Inspection Service www.fsis.usda.gov	9 CFR 541, Chapter III, Subchapter F, “Marks, Marking and Labeling of Products and Containers”	Refer to § 541.7 which incorporates the requirements in Section 9 CFR 317.2 “Labels: definitions; required features.” *Fish of the order Siluriformes include, but are not limited to, “catfish” (fish of the family Ictaluridae) and “basa” and “swai” (fish of the family Pangasiidae).
Alcoholic Beverages, Wine, and Beer Treasury Department – Alcohol and Tobacco Tax and Trade Bureau www.ttb.gov	27 CFR, Chapter I, Subchapter A. “Alcohol”	Refer to Part 4 “Labeling and Advertising of Wine.” Refer Part 5 “Labeling and Advertising of Distilled Spirits.” See also: The Beverage Alcohol Manual (BAM) A Practical Guide – “Basic Mandatory Labeling Information for Distilled Spirits - Volume 2” at www.ttb.gov/spirits/bam.shtml . Refer to Part 7 “Labeling and Advertising of Malt Beverages.” See also: “The Beverage Alcohol Manual (BAM) A Practical Guide” at www.ttb.gov/beer/bam.shtml

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS
 Title 4, Division 9, Chapter 9
 Quality Control §§ 4500. – 4532

Product Agency	Code of Federal Regulations (CFR)	Net Quantity of Contents Requirements, Guides, or Other Information
Animal Food Food and Drug Administration (FDA) www.fda.gov	21 CFR 501, Chapter I, Subchapter E – Animal Drugs, Feeds and Related Products. “Animal Food Labeling. Subpart F – Exemptions, Animal Food Labeling Requirements	Refer to § 501.105 – “Declaration of net quantity of contents when exempt.”
Catfish* (Siluriformes) U.S. Department of Agriculture (USDA) – Food Safety and Inspection Service www.fsis.usda.gov	9 CFR 541, Chapter III, Subchapter F, “Marks, Marking and Labeling of Products and Containers”	Refer to § 541.7 which incorporates the requirements in Section 9 CFR 317.2 “Labels: definitions; required features.” *Fish of the order Siluriformes include, but are not limited to, “catfish” (fish of the family Ictaluridae) and “basa” and “swai” (fish of the family Pangasiidae).
Cosmetics Food and Drug Administration (FDA) www.fda.gov	21 CFR 701, Chapter I Subchapter G, “Cosmetic Labeling”	Refer to § 701.13 – “Declaration of net quantity of contents.” See also: www.fda.gov/Cosmetics/Labeling/default.htm
Meat & Poultry Products U.S. Department of Agriculture (USDA) – Food Safety and Inspection Service www.fsis.usda.gov	Meat and Meat Products: 9 CFR 317, Chapter III, Subchapter A, “Labeling, Marking Devices and Containers”	Refer to § 317.2 “Labels: definitions; required features.”

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS
 Title 4, Division 9, Chapter 9
 Quality Control §§ 4500. – 4532

Product Agency	Code of Federal Regulations (CFR)	Net Quantity of Contents Requirements, Guides, or Other Information
Meat & Poultry Products U.S. Department of Agriculture (USDA) – Food Safety and Inspection Service www.fsis.usda.gov	Poultry: 9 CFR 442, Chapter III, Subchapter E, “Quantity of Contents Labeling and Procedures and Requirements for Accurate Weights”	Refer to 442.1 – “Quantity of contents labeling.”
Over-the-Counter Medical Devices Food and Drug Administration (FDA) www.fda.gov	21 CFR 801, Chapter I, Subchapter H “Labeling Requirements for Over-the-Counter Medical Devices”	Refer to § 801.62 – “Declaration of net quantity of contents.”
Over-the-Counter Drugs Food and Drug Administration (FDA) www.fda.gov	21 CFR 201, Chapter I, Subchapter C Drugs, “Labeling”	Refer to § 201.62 “Declaration of Net Quantity of Contents.”
Pesticides Environmental Protection Agency (EPA) www.epa.gov	40 CFR 156, Chapter I, Subchapter E, “Labeling Requirements for Pesticides and Devices,” Subpart A, “General Provisions”	Refer to § 156.10 “Labeling requirements.” See also: “Pesticide Registration – Label Review Manual” at www.epa.gov/pesticide-registration/label-review-manual .
Tobacco and Tobacco Products Food and Drug Administration (FDA) www.fda.gov	Section 903 of the Federal Food, Drug, and Cosmetic Act – “Misbranded Tobacco Products”	Since 2009 FDA has regulated all tobacco products including e-cigarettes, hookah tobacco, and cigars. The exceptions to the UPLR Sections 11.5. “Cuts, Plugs, and Twists of Tobacco and Cigars” and Section 11.7. “Cigarettes and Small Cigars” remain in effect as they were based on U.S. Treasury Department labeling requirements for smokeless tobacco (chewing tobacco and snuff) and recognize traditional methods of sale of tobacco in cuts, plugs, and twists as well as cigars.

EXTRACT FROM CALIFORNIA CODE OF REGULATIONS
Title 4, Division 9, Chapter 9
Quality Control §§ 4500. – 4532

Regulations are codified annually in the U.S. Code of Federal Regulations (CFR) online at: www.ecfr.gov and <https://www.govinfo.gov/app/collection/cfr>.

(Added 2018)



CALIFORNIA DEPARTMENT OF
FOOD & AGRICULTURE

Extracts from the
CALIFORNIA CODE OF REGULATIONS
TITLE 4, DIVISION 9

WEIGHTS AND MEASURES FIELD REFERENCE MANUAL (2023)

Chapter 11

**Sampling and Testing Procedures for Determining the Net Contents of
Packaged Commodities**

Section 4600.

Amendments to NIST HB 133 – 2023

Editorial Changes to NIST HB 133 – 2023

Table of Acronyms to NIST HB 133 – 2023

Introduction to NIST HB 133 – 2023

NIST Website Links to NIST Handbook 133 – 2023



CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE
DIVISION OF MEASUREMENT STANDARDS

DISCLAIMER

This document represents the Division of Measurement Standards' field manual for enforcing regulations pertaining to weights and measures in California. This field manual is not to be considered as the official Code of Regulations, as published by Barclays Law Publishers.

To find the latest online version of the California Code of Regulations (CCR) Title 4, Division 9, visit the California Office of Administration Law (OAL) at:

<http://ccr.oal.ca.gov/linkedslice/default.asp?SP=CCR-1000&Action=Welcome>

The CCR may also be accessed at <http://oal.ca.gov/> by clicking the "Publications" tab at the top of the OAL home page.

For information concerning the contents of this document, please contact the Division of Measurement Standards by e-mail at dms@cdfa.ca.gov.

NIST Handbook 133 (2023 Edition) - Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices as adopted by the 107th National Conference on Weights and Measures in July 2023 is available at:

www.nist.gov/pml/wmd/pubs/hb133.cfm

EXTRACTS FROM THE CALIFORNIA CODE OF REGULATIONS
CCR Title 4, Division 9, Chapter 11
2023 Handbook 133 - Sampling and Testing Procedures for Determining the Net Contents
of Packaged Commodities §§ 4600.

**Chapter 11. Sampling and Testing Procedures for Determining the Net
Contents of Packaged Commodities**

Article 1. Definitions

§ 4600. National Uniformity. Sampling and testing procedures for determining the net contents of packaged commodities shall conform to the latest requirements set forth in the National Institute of Standards and Technology Handbook 133, "Checking the Net Contents of Packaged Goods," which is herein incorporated by reference. Copies of Handbook 133 may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

Note: Authority cited: Sections 12027, 12211 and 12609, Business and Professions Code.
Reference: Section 12211, Business and Professions Code.

(NOTE 1: Sections 4601 through 4626 have been REPEALED)

(NOTE 2: NIST Handbook 133 – Checking the Net Contents of Packaged Goods can be downloaded at:

<https://www.nist.gov/system/files/documents/2023/02/10/2023%20NIST%20Handbook%20133.pdf>

**Article 2. Sampling and Testing Procedures for
Determining the Net Contents of Packaged Commodities**

(Sections 4650 through 4657 have been REPEALED)

EXTRACTS FROM THE CALIFORNIA CODE OF REGULATIONS
CCR Title 4, Division 9, Chapter 11
2023 Handbook 133 - Sampling and Testing Procedures for Determining the Net Contents
of Packaged Commodities §§ 4600.

Handbook 133 Table of Contents [DOCX](#) | [PDF](#)

Amendments and Editorial Changes [DOCX](#) | [PDF](#)

Introduction [DOCX](#) | [PDF](#)

Chapter 1. General Information [DOCX](#) | [PDF](#)

Chapter 2. Test Procedures for Packages Labeled by Weight – Gravimetric
Testing [DOCX](#) | [PDF](#)

Chapter 3. Test Procedures - For Packages Labeled by Volume [DOCX](#) | [PDF](#)

Chapter 4. Test Procedures – Packages Labeled by Count, Linear Measure, Area, Thickness,
and Combinations of Quantities [DOCX](#) | [PDF](#)

Chapter 5. Specialized Test Procedures [DOCX](#) | [PDF](#)

Appendix A. Tables [PDF](#)

Appendix B. Random Number Tables [PDF](#)

Appendix C. Model Inspection Report Forms [PDF](#)

Appendix D. AOSA Rules for Testing Seeds [PDF](#)

Appendix E. General Tables of Units of Measurement [PDF](#)

Appendix F. Glossary [PDF](#)

Appendix G. Table of Acronyms [PDF](#)

Index [PDF](#)

References [PDF](#)

EXTRACTS FROM THE CALIFORNIA CODE OF REGULATIONS
 CCR Title 4, Division 9, Chapter 11
 2023 Handbook 133 - Sampling and Testing Procedures for Determining the Net Contents
 of Packaged Commodities §§ 4600.

2022 Amendments to the 2023 Edition of NIST Handbook-133

The following table indicates the items amended by the 107th (2022) National Conference on Weights and Measures (NCWM). As appropriate, the text on the cited pages indicates the changes to a Handbook 133 section, or paragraph as “Added 2022” or “Amended 2022.” Unless otherwise noted, the effective date of the regulations added or amended in 2022 is January 1, 2023.

Chapter	L&R Committee Item No.	Section	Action	HB 133 Page
Chapter 1. General Information	NET-19.1	Section 1.2.4. Maximum Allowable Variation	Amended	7
Chapter 1. General Information	NET-19.1	1.2.4.1. Total Quantity MAV for Multiunit and Variety Packages	Added	8
Chapter 2. Test Procedures for Packages Labeled by Weight – Gravimetric Testing	NET-19.2	Section 2.1. Scope	Note added	13
Chapter 2. Test Procedures for Packages Labeled by Weight – Gravimetric Testing	NET-19.2	Section 2.3.7.1 Maximum Allowable Variation (MAV) Requirement	Note added	25
Chapter 2. Test Procedures for Packages Labeled by Weight – Gravimetric Testing	NET-19.2	Section 2.7.3. Evaluation of Results – Compliance Determinations	Note added	41
Chapter 3. Test Procedures – For Packages Labeled by Volume	NET-19.2	Section 3.1. Scope	Note added	45
Chapter 4. Test Procedures – Packages Labeled by Count, Linear Measure, Area, Thickness, and Combinations of Quantities	NET-19.2	Section 4.1. Scope	Note added	113
Chapter 5. Specialized Test Procedures	NET-19.3	Chapter 5	Added	149-154
Appendix F. Glossary	NET-19.4	Multiunit package	Added	249
Appendix F. Glossary	NET-19.4	Total quantity MAV	Added	253
Appendix F. Glossary	NET-19.4	Variety package	Added	233

EXTRACTS FROM THE CALIFORNIA CODE OF REGULATIONS
 CCR Title 4, Division 9, Chapter 11
 2023 Handbook 133 - Sampling and Testing Procedures for Determining the Net Contents
 of Packaged Commodities §§ 4600.

2022 Editorial Changes to the 2023 Edition of NIST Handbook-133

The following items were deemed editorial in nature based on the following criteria: 1) the modified text did not change the meaning or procedure outlined, 2) modified text corrected an omission or clarified how the text was written, or 3) the item itself was reformatted and relocated in the text to make the organization of the content more meaningful.

Note: For the purposes of this table, the **bold**, underscored text indicates new language added and **bold**, ~~strikeout~~ text indicates deleted text.

Chapter	Section	Action	HB-133 Page
Chapter 2. Test Procedures – Packages Labeled by Weight - Gravimetric Testing	Table 2-3 Notes	The notes were included within the content of the table as opposed to after the table.	27
Chapter 3. Test Procedures – For Packages Labeled by Volume	3.2. Gravimetric Test Procedure for Non-Viscous Liquids	Example content updated and format switched to a table layout.	47
Chapter 3. Test Procedures – For Packages Labeled by Volume	3.2. Gravimetric Test Procedure for Non-Viscous Liquids	A p <u>P</u> artial immersion thermometer (or equivalent) with a range of – 35 °C to + 50 °C (30 °F to 120 °F), at least 1 °C (42 °F) graduations, and with a tolerance of – 35 °C to + 50 °C (– 30 °F to + 120 °F) accurate to ± 1 °C (± 2 °F).	47
Chapter 3. Test Procedures – For Packages Labeled by Volume	Example for Determining Scale Suitability	Formatted and clarified example content in a table	49
Chapter 3. Test Procedures – For Packages Labeled by Volume	3.3. Volumetric Test Procedure for Non-Viscous Liquids	A p <u>P</u> artial immersion thermometer (or equivalent) with a range of – 35 °C to + 50 °C (30 °F to 120 °F), at least 1 °C (42 °F) graduations, and with a tolerance of – 35 °C to + 50 °C (– 30 °F to + 120 °F) accurate to ± 1 °C (± 2 °F).	52
Chapter 3. Test Procedures – For Packages Labeled by Volume	3.11.1. Test Equipment	A p <u>P</u> artial immersion thermometer (or equivalent) with a range of – 35 °C to + 50 °C (30 °F to 120 °F), at least 1 °C (42 °F) graduations, and with a tolerance of – 35 °C to + 50 °C (– 30 °F to + 120 °F) accurate to ± 1 °C (± 2 °F).	74
Chapter 3. Test Procedures – For	3.14.2.b. Stacked Firewood	Clarified calculation	92

EXTRACTS FROM THE CALIFORNIA CODE OF REGULATIONS
 CCR Title 4, Division 9, Chapter 11
 2023 Handbook 133 - Sampling and Testing Procedures for Determining the Net Contents
 of Packaged Commodities §§ 4600.

Chapter	Section	Action	HB-133 Page
Packages Labeled by Volume		<p>Width of Stack. This dimension is calculated by averaging the length of individual pieces of wood in the stack <u>and multiplying it by the number of rows.</u></p> <p><u>Width of Stack = Average Piece Length (APL) × Number of Rows</u></p>	
Chapter 3. Test Procedures – For Packages Labeled by Volume	3.14.3. Field Audit Procedure – Bundled and Bagged Firewood	<p>After the bundle or bag is secured, use a flexible measuring tape to measure the circumference near each end of the bundle or bag of firewood <u>as shown in (see Figure 3-13a. “Strapping the Ends of a Bundle”).</u> Using one movement, extend the measuring tape around the end of the bundle or bag to obtain its circumference <u>(see Figure 3-13b. “Measuring the Circumference of the Bundle”).</u></p>	94
Chapter 3. Test Procedures – For Packages Labeled by Volume	4.8.1.2. Audit Test Procedure	<p>Note: Graph paper of an appropriate size that allows for tracing of the entire chamois shall be used. However, if a single sheet of appropriate-sized graph paper is not available, it may be necessary to tape sheets of graph paper together to create an area sufficient in size to measure the area for a chamois (e.g., chamois greater than 23.22 dm² [2.5 ft²]).</p>	134
Chapter 3. Test Procedures – For Packages Labeled by Volume	4.8.2.2. Test Procedure	<p>6. Calculate the area of the rectangle cut from the pattern by multiplying the length by width and record as Area (A) in <u>square</u> centimeters or square inches.</p>	134
Appendix E. General Tables of Units of Measurement	Units of Capacity or Volume – Dry Volume Measure	<p>Correct the equivalent for dry pint <u>4.12 33.600 312 5</u> cubic inches”</p>	224
Appendix E. General Tables of Units of Measurement	General Tables of Units	<ul style="list-style-type: none"> Information was expanded to fully describe the retirement of the U.S. survey foot, including three new tables that present U.S. survey unit conversion factors in terms of the International foot. Section 2 surveying 	197–225

EXTRACTS FROM THE CALIFORNIA CODE OF REGULATIONS
 CCR Title 4, Division 9, Chapter 11
 2023 Handbook 133 - Sampling and Testing Procedures for Determining the Net Contents
 of Packaged Commodities §§ 4600.

Chapter	Section	Action	HB-133 Page
		<p>length and area tables were reformatted to align with the U.S. survey foot retirement FRN.</p> <ul style="list-style-type: none"> • Several NIST publications, Federal Register Notices, and federal statutes and code of regulations references were updated in the footnotes. Website URLs were verified and updated. • Unit symbols and abbreviations were added to the “starting units” column to improve usability. • Removed the ångström unit to align with the latest edition of the BIPM SI Brochure and NIST SP 330, as it was eliminated in 2019. • Added footnote guidance for users to consult federal/state laws and regulations and industry documentary standards to confirm the barrel quantity used for a specific application. 	
Appendix G. Table of Acronyms		Added	251

EXTRACTS FROM THE CALIFORNIA CODE OF REGULATIONS
CCR Title 4, Division 9, Chapter 11
2023 Handbook 133 - Sampling and Testing Procedures for Determining the Net Contents
of Packaged Commodities §§ 4600.

Introduction

A. Source.

The information and procedures in this handbook comprise all of those adopted by the National Conference on Weights and Measures, Inc. (NCWM). Contact NCWM at:

135 M Street, Suite 100
Lincoln, NE 68508
Phone: (402) 434-4880
E-mail: info@ncwm.com
Fax: (402) 434-4878
URL: www.ncwm.com

The NCWM is supported by the National Institute of Standards and Technology (NIST), which provides its Executive Secretary and publishes its documents. NIST also develops technical publications for use by weights and measures agencies; these publications may subsequently be endorsed or adopted by the NCWM or its members.

This handbook is recommended by NCWM for adoption by states when reviewing or amending their official laws and regulations on testing the net contents of packaged goods. A similar recommendation is made with regard to the local jurisdictions within a state in the absence of the promulgation of such laws and regulations at the state level.
(Amended 2019)

B. Purpose.

This handbook has been prepared as a procedural guide for the compliance testing of net content statements on packaged goods. Compliance testing of packaged goods is the determination of the conformance of the results of the packaging, distribution, and retailing process (the packages) to specific legal requirements for net content declarations. This handbook has been developed primarily for the use of government officials. However, commercial and industrial establishments packaging, distributing, and selling commodities will find this handbook useful.

In conducting compliance testing, the conversion of quantity values from one measurement system to another (e.g., from the metric system to the U.S. customary system) should be handled with careful regard to the implied correspondence between the accuracy of the data and the number of digits displayed. In all conversions, the number of significant digits retained should ensure that accuracy is neither sacrificed nor exaggerated. For this 2020 edition of NIST Handbook 133, "Checking the Net Content of Packaged Goods" all dimensions for test procedures, devices, or environments have been rounded to two significant digits (e.g., 2.5 cm to 1.0 in) or to a precision level applicable to the test equipment (e.g., 200 kPa for 25 psi and 35 MPa for 5000 psi).

EXTRACTS FROM THE CALIFORNIA CODE OF REGULATIONS
CCR Title 4, Division 9, Chapter 11
2023 Handbook 133 - Sampling and Testing Procedures for Determining the Net Contents
of Packaged Commodities §§ 4600.

C. Amendments

Amendments to NIST Handbook 133 are deliberated and developed by NCWM's Committee on Laws and Regulations before presentation to the general membership for a vote. In some instances, amendments that significantly affect other NIST Handbooks may be processed jointly by two or more committees.

Amendments to the handbooks are made in accordance with NCWM procedures and policies. The process begins at the regional weights and measures association meetings in the fall of each year and is culminated at the NCWM Annual Meeting in July. After passing through one or more of the regional associations, the proposed amendment is placed on the agenda of the appropriate NCWM committee for consideration at the NCWM's Interim Meeting in January. After final deliberation and development by the committee, the amendment may be presented to the membership for a vote at the NCWM Annual Meeting in July. The NCWM policy provides for exceptions to the process to accommodate urgent or priority items. NIST staff provides technical assistance and advice throughout the process.

The policy is available on the NCWM website at www.ncwm.com. For information on the regional weights and measures associations, visit www.ncwm.com/other-links.

D. Revisions to the Handbook

NIST publishes a new edition of this handbook after significant changes are made. If NIST determines that amendments made by NCWM were minor or editorial in nature an annual publication will not be published. Instead, NIST will issue a notice that the current edition is still valid and will publish a list of the changes on the NIST website.

E. Annotation

Beginning in 1971, amendments or additions to sections in the handbook are annotated at the end of each section (e.g., "Amended 1982") as a service to those states that are planning to update their own laws or regulations. The references to each revision and the year will enable government officials and industry members to trace the rationale for the changes by referring to the "Report of the XXX National Conference on Weights and Measures (also known as the NCWM Annual Report) for the year indicated and make decisions regarding adoptions and amendments to their laws and regulations.

F. Effective Enforcement Dates of Regulations

Unless otherwise specified, new or amended sections are intended to become effective and subject to enforcement on January 1 of the year following adoption by NCWM.

EXTRACTS FROM THE CALIFORNIA CODE OF REGULATIONS
CCR Title 4, Division 9, Chapter 11
2023 Handbook 133 - Sampling and Testing Procedures for Determining the Net Contents
of Packaged Commodities §§ 4600.

G. Section References

In most references made to specific sections or subsections in this handbook, the word “Section” followed by the section number is used.

H. The International System of Units

The “International System of Units,” “SI,” or “SI Units” means the modernized metric system as established in 1960 by the General Conference on Weights and Measures (CGPM). In 1988, Congress amended the Metric Conversion Act of 1975 (see Section 5164 of Public Law 100-418) to declare that it is the policy of the United States to designate the metric system of measurement as the preferred measurement system for U.S. trade and commerce, and it further defined “the metric system of measurement” to be the International System as established by the CGPM and as interpreted or modified for the United States by the Secretary of Commerce. (see Metric Conversion Law 15 U.S.C. 205; NIST Special Publication (SP) 330, “The International System of Units (SI); NIST SP 814, “Guide for the Use of the International System of Units (SI); Interpretation of the International System of Units [the Metric System of Measurement] for the United States in the “Federal Register” of May 16, 2008, [“Federal Register” Vol. 73, No. 96] or subsequent revisions). In 1992, Congress amended the Federal Fair Packaging and Labeling Act (FPLA) to require certain consumer commodities to include the appropriate SI units along with the customary inch-pound units in their quantity statements.

(Amended 2019)

I. “Mass” and “Weight.” [NOTE 1, page 9]

The mass of an object is a measure of the object’s inertial property or the amount of matter it contains. The weight of an object is a measure of the force exerted on the object by gravity or the force needed to support it. The pull of gravity on the earth gives an object a downward acceleration of about 9.8 m/s^2 . In trade and commerce and everyday use, the term “weight” is often used as a synonym for “mass.” The “net mass” or “net weight” declared on a label indicates that the package contains a specific amount of commodity exclusive of wrapping materials. The use of the term “mass” is predominant throughout the world and is becoming increasingly common in the United States.

J. Use of the Terms “Mass” and “Weight.” [NOTE 1, page 9]

When used in this handbook, the term “weight” means “mass.” The term “weight” appears when U.S. customary units are cited or when both inch-pound and SI units are included in a requirement. The terms “mass” or “masses” are used when only SI units are cited in a requirement. The following note appears where the term “weight” is first used in a law or regulation.

EXTRACTS FROM THE CALIFORNIA CODE OF REGULATIONS
CCR Title 4, Division 9, Chapter 11
2023 Handbook 133 - Sampling and Testing Procedures for Determining the Net Contents
of Packaged Commodities §§ 4600.

NOTE 1: *When used in this law (or regulation), the term “weight” means “mass.” (see paragraphs I. “Mass” and Weight and J. Use of the Terms “Mass” and “Weight” in the Introduction section of NIST Handbook 133 for an explanation of these terms.)*
(Introduction added 2015)



Extracts from the
CALIFORNIA CODE OF REGULATIONS
TITLE 4, DIVISION 9

WEIGHTS AND MEASURES FIELD REFERENCE MANUAL (2023)

Chapter 12

Administration

Sections 4700. through 4802.

Article 1. Permit Reform Act

Article 2. Weights and Measures Penalty Guidelines



CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE
DIVISION OF MEASUREMENT STANDARDS

EXTRACT FROM THE CALIFORNIA CODE OF REGULATIONS
2023 CCR Title 4, Division 9, Chapter 12.
Administration. §§ 4700.-4801.

DISCLAIMER

This document represents the Division of Measurement Standards' field manual for enforcing regulations pertaining to weights and measures in California. This field manual is not to be considered as the official Code of Regulations, as published by Barclays Law Publishers.

To find the latest online version of the California Code of Regulations (CCR) Title 4, Division 9, visit the California Office of Administration Law at:

<http://ccr.oal.ca.gov/linkedslice/default.asp?SP=CCR-1000&Action=Welcome>

The CCR may also be accessed at <http://oal.ca.gov> by clicking the "Publications" tab at the top of the OAL home page.

For information concerning the contents of this document, please contact the Division of Measurement Standards by e-mail at dms@cdfa.ca.gov.

EXTRACT FROM THE CALIFORNIA CODE OF REGULATIONS
2023 CCR Title 4, Division 9, Chapter 12.
Administration. §§ 4700.-4801.

Chapter 12. Administration §§ 4700-4801

ARTICLE 1. Permit Reform Act..... 1

 § 4700. Permit Processing Times (Including Licenses, Permits, Registrations
 and Certificates)..... 1

 § 4701. Appeal Procedure..... 2

ARTICLE 2. Weights and Measures Penalty Guidelines..... 3

 § 4800. Notice of Proposed Action and Disposition. 3

 § 4801. Administration. 3

 § 4802. Penalty Guidelines. 4

EXTRACT FROM THE CALIFORNIA CODE OF REGULATIONS
2023 CCR Title 4, Division 9, Chapter 12.
Administration. §§ 4700.-4801.

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Chapter 12. Administration §§ 4700-4802

ARTICLE 1. Permit Reform Act.

§ 4700. Permit Processing Times (Including Licenses, Permits, Registrations and Certificates).

(a) Within the number of calendar days of receipt of an application for a permit shown in column A of subsection (c), the Division shall inform the applicant in writing that the application is either complete and accepted for filing, or that it is deficient, and what specific information or documentation is required to complete the application. An application is considered complete if all necessary fees and information required by the application form have been submitted.

(b) Within the number of calendar days after receipt of a complete application, as shown in column B of subsection (c), the Department shall approve or disapprove the application.

(c) The Division's minimum, median, and maximum time periods, in calendar days, for processing an application from the receipt of the initial application to the final decision, based on the Department's actual performance during the two years immediately preceding the proposal of this section, are shown in columns C, D, and E of the chart which follows.

Permit Type	Maximum time for notifying that application is complete or deficient (Days)	Maximum time after receipt of a complete application to issue or deny permit (Days)	ACTUAL DAYS TO PROCESS BASED ON PRIOR TWO YEARS (Days) Minimum	ACTUAL DAYS TO PROCESS BASED ON PRIOR TWO YEARS (Days) Median	ACTUAL DAYS TO PROCESS BASED ON PRIOR TWO YEARS (Days) Maximum
Device Repairman Registration	30	35	1	6	52
- Renewal	7	60	1	17	66
Weighmaster License	15	45	1	12	84
- Renewal	45	45	1	12	84

NOTE: Authority cited: Section 15376, Government Code; and Section 12027, Business and Professions Code. Reference: Section 15376, Government Code.

§ 4701. Appeal Procedure.

(a) The following information shall be included on application forms for all Department permits subject to Government Code Sections 15374-15378:

“The Department of Food and Agriculture has established time periods for the processing of permit applications, in compliance with Government Code Sections 15374-15378. Failure to comply with these time periods may be appealed to the Secretary of Food and Agriculture, 1220 N Street, P.O. Box 942871, Sacramento, CA 94271-0001, pursuant to regulations set forth in Title 4, California Code of Regulations, Section 4701. Under certain circumstances, the Secretary may order that the applicant receive a reimbursement of filing fees.”

(b) An applicant whose application for a permit has not been processed by the Department within the time periods established by Section 4700 may appeal in writing to the Secretary of the Department of Food and Agriculture. The appeal shall set forth a concise statement of facts and chronology of events regarding the application. An appeal concerning a permit application on which a final decision has been made must be filed within 30 days of the date the applicant was notified of the decision.

(c) The Secretary shall promptly review an appeal filed under this section and, shall issue a decision within 30 days after conducting any investigation of the matter which the Secretary deems appropriate.

(d) If the Secretary finds that a program exceeded the time limit for informing the permit applicant that an application is complete or is deficient and requires additional information to be processed, the Secretary shall direct the program to make its determination by a specified date and so inform the applicant.

(e) The time period within which the Department must make a decision to issue or deny the permit commences with the date the complete application is received. If the Secretary finds that the Department exceeded the time period for acting on a completed application without the good cause defined by Government Code Section 15376(h), all filing fees paid by the permit applicant will be refunded.

NOTE: Authority cited: Sections 15376 and 15378, Government Code; and Section 12027, Business and Professions Code. Reference: Sections 15376 and 15378, Business and Professions Code.

ARTICLE 2. Weights and Measures Penalty Guidelines

§ 4800. Notice of Proposed Action and Disposition.

- (a) When a county sealer takes administrative action, the person charged with a violation (s) shall be notified of the proposed penalty(s) and the right to request a hearing. The notification shall also include the right to appeal to the Secretary pursuant to the procedures provided in Section 12015.3(c) or Section 13302 as appropriate of the Business and Professions Code.
- (b) When the State Sealer takes administrative action, the person charged with the violation(s) shall be notified of the proposed penalty(s), and the right to request a hearing. The notification shall also include the right to have the decision reviewed, within 30 days of receiving the sealer's decision, pursuant to Section 12015.3(c) of the Business and Professions Code.
- (c) When a respondent in an administrative action agrees to stipulate to the notice of proposed action, a signed stipulation with the payment of the proposed administrative penalty shall be returned to the county/State Sealer within 45 days of the postmark of the notice of proposed action. If the stipulation and payment of the proposed administrative penalty are not received within 45 days, the county/State Sealer may file a certified copy of a final decision that directs the payment of a civil penalty with the clerk of the superior court of any county pursuant to Section 12015.3(d) of Business and Professions Code.
- (d) If an administrative hearing is requested, a proposed decision and order shall be made by a hearing officer within 60 days of the conclusion of the hearing. The final decision and order shall be made by the sealer. This order will be mailed to the respondent. Any penalty imposed shall be due and payable within 45 days of the postmark of such order. If a respondent fails to pay the penalty and fails to timely file a written appeal pursuant to Business and Professions Code Section 12015.3(c) or 13302(c), the sealer may take action as provided in Business and Professions Code Sections 12015.3(d) or 13302(d). Action may be taken to collect the penalty and the collection costs actually incurred.
- (e) In the event that a respondent fails to comply with the provisions of Business and Professions Code Sections 12015.3 or 13302, the sealer may take the action proposed without a hearing. This action may include collection of the penalty and the collection costs actually incurred.

NOTE: Authority cited: Sections 12015.3(b) and 13302(b), Business and Professions Code.
Reference: Sections 12015.3(b) and 13302(b), Business and Professions Code.

§ 4801. Administration.

- (a) When a county sealer initiates an action, the sealer shall send a copy of the notice of proposed action to the State Sealer at the time of notice to the person charged with the violation(s). Additionally, the county sealer shall inform the State Sealer of violations for which penalties have been assessed. On at least an annual basis, the State Sealer shall inform county sealers throughout the State of violations for which penalties have been assessed.
- (b) When the State initiates the action, the State Sealer shall send a copy of the notice of proposed action to the county sealer involved. This notice shall also be sent, at the time of

Extract from California Code of Regulations
2023 CCR Title 4, Division 9, Chapter 12.

notice, to the person charged with the violation(s). The State Sealer shall also inform the county sealer in which the action has been initiated of violations for which penalties have been assessed.

NOTE: Authority cited: Section 12027, Business and Professions Code. Reference: Section 12027, Business and Professions Code.

§ 4802. Penalty Guidelines.

In applying Sections 12015.3 or 13302 of the Business and Professions Code, the sealer shall use the provisions of this section to determine the types of violations for which penalties may be assessed and the amounts of the penalties. Nothing in this article prohibits a sealer from seeking other relief through the criminal or civil court process in lieu of administrative action.

(a) For the purposes of this article, violation types are designated as “Category A”, “Category B”, and “Category C”.

- (1) “Category A” violations are violations in which there are actual, or there is the potential for actual false, deceptive, or misleading business practices, or significant monetary loss to consumers; or repeated violations of subparagraph (2) that occurred within a two-year period at the same location and which resulted in an action and subsequent penalty. Included in this category are certain violations subject to prior legislated fine levels pursuant to Business and Professions Code Section 12729. The appropriate penalty range for these violations is \$400-\$1,000; however, such penalty shall not exceed the maximum criminal fine specified in the charging section.
- (2) “Category B” violations are violations in which there is a reasonable potential for intermediate level of consumer or competitive harm; or repeated violations of subparagraph (3) that occurred within a two-year period at the same location and which resulted in an action and subsequent penalty. The appropriate penalty range for these violations is \$150-\$600; however, such penalty shall not exceed the maximum criminal fine specified in the charging section.
- (3) “Category C” violations are primarily violations that would typically have a less egregious effect on consumers or equitable competition in the marketplace. Included in this category are other violations included in Business and Professions Code, Division 5 that are not included in Table A. The appropriate penalty range for these violations is \$50-\$250; however, such penalty shall not exceed the maximum criminal fine specified in the charging section.

(b) Table A shall be used to establish the level of severity of a particular violation and its corresponding penalty range. Except where specific violation parameters are provided, the violation column in Table A is an abbreviated description of the corresponding section in the California Business and Professions Code, Division 5, Weights and Measures.

Extract from California Code of Regulations
2023 CCR Title 4, Division 9, Chapter 12.

1 = Category A		2 = Category B		3 = Category C	
(\$400 to \$1,000)		(\$150 to \$600)		(\$50 to \$250)	
B&P §	TABLE A VIOLATIONS	TYPE			
		1	2	3	
12016	Hindering or obstructing sealer.	1			
12018	Neglect or Refusal to exhibit weighing or measuring device for inspection	1			
12021	Marking or stamping false or short weight or measure on containers: Taking false tare (knowingly).	1			
12022.5	Fresh meats or roasts: Advertising/selling on basis of net weight, not including added fat.		2		
12023	Selling according to gross weight or measure.		2		
12024 <i>(Prepacked product – Labeled and sold, but not packed on the same premises)</i>	Selling in less quantity than represented: Prepackaged – Labeled and sold, but not packed on the same premises.				
	- Single Lot:				
	Overcharge less than 50¢.			3	
	Overcharge 50¢ to \$2.00.		2		
	Overcharge more than \$2.00.	1			
	- Total of All Lots:				
	Overcharge less than \$2.00.			3	
	Overcharge \$2.00 to \$10.00.		2		
	Overcharge more than \$10.00.	1			
Short measure bulk wood deliveries.	1				
12024 <i>(Prepacked product – Packed, labeled, and sold on the same premises)</i>	Selling in less quantity than represented (per BPC §12024.3 criteria) Prepackaged – Packed, labeled, and sold on the same premises				
	- Single Lot (unknowingly):				
	Overcharge of \$2.00 or less			3	
	Overcharge more than \$2.00	1			
	- Total of Multiple Lots (unknowingly):				
	Overcharge of less than \$2.00			3	
	Overcharge \$2.00 to \$10.00		2		
Overcharge more than \$10.00	1				

Extract from California Code of Regulations
2023 CCR Title 4, Division 9, Chapter 12.

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B&P §	TABLE A VIOLATIONS	TYPE		
		1	2	3
12024 <i>(Wholesale or retail lots – not packed or labeled by retailer)</i>	Selling in less quantity than represented: Prepackaged – Wholesale or retail lots – Not packed or labeled by retailer			
	Overcharge not more than \$50.00		2	
	Overcharge more than \$50.00	1		
12024.1	Misrepresenting charge for service rendered (willfully).	1		
12024.2	Unlawful computation of value.			
	(A) Test Purchase of Commodities by Weight, Measure, or Count, Determined at Time of Sale: (Applies to any number of items purchased or inspected for pricing integrity)			
	- Overcharged on One Item: Overcharge equals 15¢ or more and is 5% or more of correct value for that item.		2	
	- Overcharged on Two or More Items: Total Overcharge equals 15¢ or more and is 3% or more of correct total value for those items.	1		
	(B) Scanning/Automated and Other Check stand Inspections.			
	- Overcharged on fewer than 10% of items purchased or inspected for pricing integrity or total overcharge is less than 2% of correct total price of all items purchased or inspected.			3
	- Overcharged on 10% or more but on fewer than 12% of items purchased or inspected for pricing integrity.		2	
	- Total overcharge 2% or more but less than 4% of correct total price of all items purchased or inspected.		2	
	- Overcharged on 12% or more of items purchased or inspected for pricing integrity.	1		
	- Total overcharge 4% or more of the correct total price of all items purchased or inspected.	1		
	Test Sample Size of 10 or Fewer Items (“Initial Standard Inspections” as defined by BPC §13350 or “Special Inspections” as defined by BPC §13356):			

Extract from California Code of Regulations
2023 CCR Title 4, Division 9, Chapter 12.

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B&P §	TABLE A VIOLATIONS	TYPE			
		1	2	3	
	- Overcharge on any item does not exceed 8% of the correct price of that item			3	
	- Overcharge on any item is greater than 8% but does not exceed 15% of the correct price of that item		2		
	- Overcharge on any item is greater than 15% of the correct price of that item	1			
12024.5	Sale of fowl, meat, or fish other than by weight: ready-to-eat items.		2		
12024.55	Door-to-door salespersons; failure to provide price per pound statements on packages.		2		
12024.6	Prohibition of advertising intended to entice customer into transaction other than represented.	1			
12024.7	Failure to provide: A statement of weight and type of cuts of meat sold; itemized statement showing quantity of fruits, vegetables, and other food products delivered in connection with meat sale.		2		
12024.9	Failure to provide a statement of weights supplied to consumer upon direct sale of meat on basis of primal cuts or carcass weight.		2		
12024.10	Failure to retain a document stating weight and cut of meat sold.		2		
12025	Refusal to exhibit commodity being sold at given weight or quantity.	1			
12025.5	Identification of commodity or container ordered "off sale" under §§ 12211 or 12607.	1			
12107	Violation of tolerances and specifications for commercial weighing and measuring apparatus.			3	
12107.1	Establishment of commodity standards, weights, measures, and counts: Procedure: Unlawful sales.			3	
12500.5	Approval and certification of commercial instruments: Sale or use for commercial purposes of nonapproved instruments.		2		
12507	Repair of "out of order" instruments: Time: Disuse: Effect of refusal or neglect to repair: Disposition of seized instruments.	1			
12508	Removal or obliteration of sealer's tag or device.	1			

Extract from California Code of Regulations
2023 CCR Title 4, Division 9, Chapter 12.

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B&P §	TABLE A VIOLATIONS	TYPE			
		1	2	3	
12510(a)	Presumption of intent to violate law:				
	(1) Using an incorrect device.		2		
	(2) Sells commercial device not sealed within last year.			3	
	(3) Using a condemned device contrary to law.	1			
	(4) Uses for commercial purposes an unsealed, incorrect device not kept at fixed location.		2		
	(5) Used to falsify.	1			
	(6) Location of retail scale.		2		
	(7) False computation of price.		2		
	(8) Return to zero (knowingly).	1			
	(9) Deliver for test.		2		
	(10) Sells, uses, rents, loans incorrect device.		2		
12512	Purchase of less than true quantity.	1			
12515	(a) Repair, sale, or installation of instrument: Failure to notify county sealer.		2		
12516	Location of scale when auctioning livestock		2		
12532	(a) Engaging in business as a service agency when not registered with the Secretary of Food and Agriculture		2		
12533	(a) (1) Not possessing or having available necessary standards and testing equipment			3	
	(a) (2) Standards and testing equipment shall meet specifications and tolerances in NIST 105 Series Handbooks			3	
	(b) Ensure every service agent has a current service agent license		2		
	(c) Possess a current copy of Title 4 of the California Code of Regulations, Field Reference Manual			3	
12534	Use suitable and sufficient standards, permanently and uniquely identified and have a current certificate of accuracy			3	
12540	Service agent examination and licensing		2		

Extract from California Code of Regulations
2023 CCR Title 4, Division 9, Chapter 12.

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B&P §	TABLE A VIOLATIONS	TYPE			
		1	2	3	
12602	Distributing commodity contained in nonconforming package: Exception for wholesale or retail distributors not engaged in packaging or labeling.		2		
	Regulations to be established by Secretary: Required provisions of regulations.				
12603	- Identity of commodity and/or name and place of business of packer/distributor/manufacturer.		2		
	- Net quantity of contents not on container or label.		2		
12605	Prohibition of distribution of packaged commodity containing qualifying words in separate statement of net quantity of contents: Supplemental statements: Prohibited qualifications.		2		
12606	Containers not to be constructed or filled as to facilitate fraud		2		
12606.2	Misleading food containers, prohibited		2		
12602	Distributing commodity contained in nonconforming package: Exception for wholesale or retail distributors not engaged in packaging or labeling.		2		
12603	Regulations to be established by Secretary: Required provisions of regulations.				
	- Identity of commodity and/or name and place of business of packer/distributor/manufacturer.		2		
	- Net quantity of contents not on container or label.		2		
12605	Prohibition of distribution of packaged commodity containing qualifying words in separate statement of net quantity of contents: Supplemental statements: Prohibited qualifications.		2		
12606	Containers not to be constructed or filled as to facilitate fraud		2		
12606.2	Misleading food containers, prohibited		2		
12611	Selling commodity in nonconforming container or with nonconforming label: Required information not prominently displayed.		2		
12703	Weighmaster License, fee and/or penalty required.		2		
12704	Weighmaster License fee.		2		
12705	Change in legal entity of weighmaster licensee.		2		

Extract from California Code of Regulations
2023 CCR Title 4, Division 9, Chapter 12.

1 = Category A		2 = Category B		3 = Category C	
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B&P §	TABLE A VIOLATIONS	TYPE			
		1	2	3	
12707	Weighmaster License renewal; failure to pay fee when due.		2		
12710.5	(b) Failure to notify of replacement/deletion of deputy weighmaster.			3	
12711	When weighmaster certificate to be issued.		2		
12712	Issuance of certificate by one other than weighmaster making determination; transfer of weight or measure to other certificate.				
	(a) Weighmaster certificates issued based on information from another weighmaster.		2		
	(b) Transfer of weight from one certificate to another.		2		
12713	(a) Responsibility for completeness of weighmaster certificate.		2		
	(b) Omitted information on weighmaster certificate.		2		
12714	Weighmaster certificate legend/principal licensee name.			3	
12714.5	Information on certificate to be legible; consecutive numbering.			3	
12715	Contents of weighmaster certificate.			3	
12716	Weighmaster recordkeeping; inspection.		2		
12716.5	Correction of errors (weighmaster certificate).		2		
12717	Approval, testing, and sealing of weighing or measuring device.		2		
12718	Acts constituting misdemeanors				
	(a) Requests a person to weigh, measure, or count falsely.	1			
	(b) Requests a false or incorrect weighmaster certificate.	1			
	(c) Furnishes or gives false information to a weighmaster.	1			
	(d) Knowingly presents for payment a false weighmaster certificate.	1			
	(e) Knowingly issues a false weighmaster certificate.	1			
	(f) Alters a weighmaster certificate resulting in a false weight, measure, or count.	1			
	(g) Possesses blank weighmaster certificates if not licensed.	1			
	(h) Issues a weighmaster certificate with alterations or omissions of gross, net, tare weights, net only weights, or measurements.	1			

Extract from California Code of Regulations
2023 CCR Title 4, Division 9, Chapter 12.

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B&P §	TABLE A VIOLATIONS	TYPE			
		1	2	3	
12719	Change of net contents after recordation of weight.	1			
12720	Alteration of tare weight of vehicle prior to determining net weight of commodity.	1			
12721	Weighing for purposes of certification.	1			
12722	Use of predetermined tare weight; exemption for specified rock products.				
	(a) Violation of tare regulations.	1			
	(b) Rock, sand, and gravel predetermined tares.	1			
12724	Determination of gross and tare weights by a weighmaster; requirement that all persons be off scale and vehicle; exceptions.		2		
12725	Conditions under which gross weight not to be certified.		2		
12727	Verification of weight, measure, or count.	1			
12728	Requirement that entire vehicle rest on scale; exemption for seed cotton, multiple rail cars containing grain/grain products.		2		
12729 (c)	Tomato cab card tare weight. (See also B&P Section 12729)	1	2		
12730	Farm products.		2		
12731	Livestock.		2		
12732	Adjustments to load; commodity weights determined at other than site where vehicle was loaded.		2		
12733	Scrap metal and salvage materials.		2		
12734	Squid or anchovy.		2		
13300	Customer display and indicator requirements		2		
13411	Sale of petroleum products contingent upon additional purchase.		2		
13413	Deceptive, false, or misleading statements (Chapter 14) Petroleum Products.	1			
13420 13421 13422	Operators of petroleum dealerships required to make monthly update of advertising medium indicating hours of sale and turn off lights when not open for business.			3	
13441	Sale or delivery of nonstandard product.	1			

Extract from California Code of Regulations
2023 CCR Title 4, Division 9, Chapter 12.

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B&P §	TABLE A VIOLATIONS	TYPE			
		1	2	3	
13442	Sale or delivery of nonstandard product as motor fuel to be labeled "not gasoline".	1			
13451	Sale or delivery of nonstandard diesel, kerosene, or fuel oil.	1			
13460 13461	Sale of engine or gear oil which fails to meet specifications.	1			
13470	Display of price sign on dispensing apparatus: Contents of sign.		2		
13470.5	Gallon-to-liter conversion table.		2		
13472	Dual pricing.		2		
13480	Sale, etc., of petroleum products from unlabeled containers, etc: Viscosity rating: Containers with net content of gallon or less.			3	
13482	Sale of lubricant without SAE/API service classification.			3	
13486	Filling of tanks with product other than that identified on container label.	1			
13500	Labeling:				
	(a) No product and/or grade on delivery vehicle.			3	
13501	Commingling of products.	1			
13502, 13486	Deliveries into storage tanks.	1			
13520	Temperature-corrected gallonage.		2		
13530	Application of article; display of price per liter or per gallon.				
13531	(a) Advertising a price that is not identical with the dispenser.		2		
	Display requirements; exemption of specified geographic areas; violations.				
	(a) Failure to advertise motor fuel prices.		2		
13532	Motor fuel; contents of display:				
	(a) Advertising price signs.			3	
	(b) Violation of discount advertising.			3	
	(c) Advertising lower price only. (See also § 13413)		2		
	(d) Failure to advertise price in same form.		2		

Extract from California Code of Regulations
2023 CCR Title 4, Division 9, Chapter 12.

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B&P §	TABLE A VIOLATIONS	TYPE			
		1	2	3	
13534	Additional advertising matter.			3	
13562	Change of designation under which product purchased: Authorization.		2		
13568	Written authority; furnishing copies.		2		
13570	Percentage of alcohol to be stated on normal business records: Certification of antiknock index.		2		
13571	Not providing documentation when requested.		2		
13593	Refusal to permit sampling.	1			
13595	Selling product which does not meet specifications. (See also §§ 13413, 13441, 13451)	1			
	Selling from unlabeled or mislabeled containers. (See also §§ 13413, 13480)			3	
13600	Unauthorized breaking, etc., of seal.	1			
13740	Sale or distribution of adulterated or mislabeled product.	1			
13741	Deceptive, false, misleading statement (Chapter 15) Automotive Products	1			

Extract from California Code of Regulations
2023 CCR Title 4, Division 9, Chapter 12.

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