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SECTION 1 – Organisation and structure for metrology

1. LAWS OF METROLOGY

In the United States, both national (Federal) and State laws on weights and measures apply. The Federal commercial weights and measures laws concern particular products (for example, only meat and poultry) or groups of products (for example, only consumer packaged goods) and supersede State laws. Laws and regulations of the 50 U.S. states govern the vast bulk of commercial trade measurements.

The Federal laws on commercial trade, public and worker health and safety, and protection of the environment are contained in the U.S. Code and the regulations are contained in the U.S. Code of Federal Regulations. State laws and regulations are independent of each other. Often, local ordinances and regulations add additional complexity to trade measurement regulations.

At the State level, each State enacts its own laws and regulations that cover all commercial weights and measures transactions, including those matters covered by Federal law. This permits the States to enforce legal requirements on all weights and measures matters.

This decentralized structure and application of commercial weights and measures led to the establishment of the National Conference on Weights and Measures (NCWM) in 1905 by the National Bureau of Standards; the NCWM is still supported by the National Institute of Standards and Technology (NIST), formerly the National Bureau of Standards. NCWM, Inc. is an independent national professional organization that produces model laws and regulations and encourages their adoption by State and local agencies. All 50 States have adopted the NIST Handbook 44 “*Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices*” as have several agencies of the U.S. Department of Agriculture. These model laws are compatible with all Federal laws and thus a high degree of uniformity prevails.

2. LEGAL UNITS OF MEASUREMENT

The United States is signatory of the Treaty of the Meter (1875). The international meter and kilogram are the fundamental standards of the nation. The U.S. customary (inch-pound) system of weights and measures is defined in terms of the meter and kilogram as follows:

Length: 1 yard = 0.9144 m exactly,

Mass: 1 pound (avoirdupois) = 0.45359237 kg exactly.

The use of the U.S. customary system is provided for in Federal and State law; the use of the metric system is authorized by Federal and State law.

Information on units, systems, and tables of weights and measures is included in NIST Handbook 44 “*Specifications, Tolerances, and Other Technical Requirements for Commercial Weighing and Measuring Device*”. To assist in the U.S. conversion to SI units, the Federal Government now specifies its purchases in SI units. The Federal Fair Packaging and Labeling Act was revised to require metric (SI) units on consumer packages.

3. STRUCTURE OF METROLOGICAL CONTROL AUTHORITIES

3.1 National Organization for Legal Metrology

On the Federal level, the main authority in matters of commercial weights and measures is:

Office of Weights and Measures (OWM)
100 Bureau Drive, MS 2600
National Institute of Standards and Technology
Gaithersburg, MD 20899-2600 U.S.A
Telephone: 1-301-975-4004
Web: www.nist.gov/pml/wmd

The Office of Weights and Measures (OWM) at NIST is responsible for the distribution and calibration of the physical reference standards used by each State (State standards). Also, the NIST OWM provides the secretariat for the National Conference on Weights and Measures (NCWM), and therefore provides the technical and administrative assistance to the National Conference in the drafting of model laws and regulations. NIST publishes annual editions of NIST Handbooks 44 and 130 and periodically publishes other handbooks on laboratory and field procedures.

A separate office within the NIST OWM, the International Legal Metrology Program has responsibility for all OIML activities and manages U.S. representation and participation under the terms of the Convention of the Treaty. The manager of the program is the U.S. member of the International Committee of Legal Metrology (CIML).

In the U.S.A., the responsible authorities for non-traditional metrology services such as occupational health and safety, medical applications and pollution measurement and control exist in various Federal and State departments and agencies.

3.2 National Organization Responsible for Maintaining Primary Standards

The United States Primary Standards are held and maintained by the National Institute of Standards and Technology (NIST).

3.3 Regional and Local Verification Organization

Each State has one or more regulatory bodies in the field of weights and measures. These bodies are often in each State's Department of Agriculture. Some States also have local enforcement bodies at the county and city levels. A directory of these bodies is available from the NIST OWM (see clause 4.1). The OWM accredits State Weights and Measures Laboratories in mass, volume, length, and temperature.

3.4 Instrument Calibration and Evaluation Systems

The NCWM sponsors the National Type Evaluation Program (NTEP) for evaluating commercial measuring devices. Application forms, criteria, and test procedures for type evaluation are available from:

NTEP Administrator
The National Conference on Weights and Measures, Inc.
1135 M Street
Suite 110
Lincoln, NE 68508 U.S.A.
Telephone: 402-434-4880
E-mail: info@ncwm.net
Web: www.ncwm.net/committees/ntep

Measuring devices which are not commercial trade devices can be calibrated by NIST, by laboratories traceable to NIST, or by service companies using other standards calibrated by NIST or by secondary laboratories.

A great number of metrology laboratories (about 500) are members of an Association called the National Conference of Standards Laboratories (NCSL). It aims to solve problems common to calibration laboratories, in particular, by organizing symposia and training courses. NIST is a member of NCSL.

3.5 Accreditation Systems for Legal Metrology, Calibration and Testing Laboratories. Traceability to National, Regional, International or Foreign Measurement Standards

Within the U.S.A., many sectors of the economy look to laboratory accreditation and related efforts to provide some assurance of the technical proficiency and competence of an entity to assess a product's or service's conformance to a set of prescribed standards. Requirements and assessment criteria vary by program and according to the product, system, or service being assessed. Federal, State and local governments have various laboratory accreditation programs as well as private-sector professionals and trade organizations.

One such Federal program, the National Voluntary Laboratory Accreditation Program (NVLAP) at NIST, is applicable to calibration and testing laboratories seeking accreditation based on compatibility with international standards. The program activities are operated in conformance with ISO/IEC Guides 58 and ISO/IEC 7025. Accreditation is available to commercial labs, manufacturer's in-house labs, university labs, and Federal, State and local government facilities.

Ordering information on the following NIST publications on U.S. accreditation activities may be obtained from the NCSCI (see clause 4.1 for address):

- Laboratory Accreditation in the United States (NIST IR 4576);
- Directory of Federal Government Laboratory Accreditation/Designation Programs (NIST SP 808);
- Directory of State and Local Government Laboratory Accreditation/Designation Programs (NIST SP 815); and
- Directory of Professional Trade Organization Laboratory Accreditation/Designation Programs (NIST SP 831).

3.6 Legal and Applied Metrological Activities in Products Certification

In the United States, the Trade Agreements Act of 1979 implemented U.S. acceptance of the Standards Code of the General Agreement on Tariffs and Trade (GATT). Title IV of the Act specifies obligations for the Federal government, including responsibilities with regard to certification. Moreover, the Federal government is required to take reasonable measures to assure compliance with the requirements of the Act by State governments and the private sector.

There are many private sector organizations that engage in product certification activities. The U.S. Department of Commerce maintains at NIST, the National Center for Standards and Certification Information (NCSCI) which serves as a center for information on standards, specifications and related materials as well as serving as a resource for information on certification programs and activities. Information on this subject as well as on the following publications is available from NCSCI (see clause 4.1):

- The ABC's of Certification Activities in the United States (NBS IR 88-3821);
- Directory of Federal Government Certification Programs (NBS SP 739); and
- Directory of Private Sector Product Certification Programs (NIST SP 774).

3.7 Legal and Applied Metrological Activities in ISO Quality Management System

The ISO 9000 Standard Series was implemented in the United States through development of ANSI/ASQC (American National Standards Institute/American Society for Quality Control) Q90 Series and later changed to the ANSI/ASQC Q9000 Series when the 1994 editions of the series were adopted. ANSI is the U.S. member organization in ISO, and through its National Committee, is the U.S. member organization in IEC. Interest in quality improvement has become the focus in many Federal, States and local governmental agencies as well as a key business strategy among companies. Hence, some Federal agencies, such as the U.S. Food and Drug Administration's Center for Medical Devices and Radiological Health is in the process of harmonizing its Good Manufacturing Practices guidelines with a supplemented version of ISO 9001 and the Department of Defense has adopted the ANSI / ASQC Q90 Standard Series for use as appropriate. The interest these standards have generated throughout the public and private sector has resulted in an increase in the number of U.S.-based organizations offering quality system registration. In 1989 the Registrar Accreditation Board (RAB) was established as an affiliate of ASQC to develop a program to evaluate the quality of services offered by registrars. RAB was later incorporated within the American National Standards Institute (ANSI).

The NIST Standards Code and Information Program has been designated to serve as the clearing house for the dissemination of Federal agency activities related to the ISO 9000 Series.

4. RANGE OF EQUIPMENT SUBJECT TO LEGAL METROLOGY

In general, all instruments or measuring systems for weighing or measuring in commercial transactions are subject to legal control. Legal control over devices is largely exercised by the States. The types of devices are those covered in NIST Handbook 44.

Other instruments, such as utility meters (water, gas and electrical energy meters), as well as instruments used in health care and protection, etc., may also be subject to regulation by governmental agencies other than the weights and measures service.

5. NATIONAL TECHNICAL REGULATIONS

Legal Requirements of Traceability

State laws require State primary standards to maintain traceability to the national standards held by the National Institute of Standards and Technology.

6. TYPE APPROVAL (i.e. PATTERN APPROVAL)

6.1 Legal and Technical Requirements for Type Approval

The National Type Evaluation Program (NTEP) is operated by the National Conference on Weights and Measures, the States, and the private sector. The program determines the conformance of a "type" of device or system with the relevant provisions of NIST Handbook 44. Evaluations are conducted on a fully cost-reimbursable basis. If the device or system meets all of the requirements, NCWM issues a Certificate of Conformance, copies of which are sent to the manufacturer and to each State. The States, in turn, accept these certificates as evidence of compliance with State laws and regulations requiring type approval.

6.2 Authority Responsible for Issuing Type Approval

Under the National Type Evaluation Program, NCWM is the authority responsible for issuing type approval certificates.

6.3 Recognition/Acceptance of OIML Certificates

This subject is under development at the current time NCWM has been named the responsible authority for conducting OIML Certificate evaluations for the United States for R76 for non-automatic weighing devices and R60 for load cells.

6.4 Authority Responsible for Testing for Type Approval

That type evaluation testing process is conducted by NIST, in other NTEP authorized Federal and State laboratories, and for certain devices, by the Legal Metrology Branch, Industry Canada.

6.5 List of Major Test Facilities Available

NTEP-authorized U.S. test facilities are located at NIST, the U.S. Department of Agriculture's Federal Grain Inspection Service, and the States of California, Maryland, New York, North Carolina and Ohio.

7. VERIFICATION (CONFORMITY ASSESSMENT), INSPECTION AND REVERIFICATION

7.1 Legal and Technical Requirements for Verification

The type evaluation is the first step of the regulatory process. Further steps include initial and subsequent verification by the States or local weights and measures agencies of the production devices or systems manufactured in conformance with the "type" described in a Certificate of Conformance and installed in a commercial application.

7.2 Range of Equipment Verified and Re-verified and any Statistical Information Available

In general, all instruments or measuring systems for weighing or measuring in commercial transactions are subject to initial verification and periodic re-verification by the States. Some statistical information is currently gathered by the States.

8. LEGAL METROLOGY PRACTITIONERS

8.1 Numbers

Approximately 3,600 State and local weights and measures officials reporting to about 800 independent agencies enforce the Federal, State, and local regulations and Laws governing commercial transactions. Another 7,000 Federal officials enforce meat and poultry regulations under the U.S. Department of Agriculture Food Safety and Inspection Service. Federal agents at the Food and Drug Administration, U.S. Treasury's Customs Service, Bureau of Alcohol, Tobacco, and Firearms, the Federal Trade Commission, and the U.S. Department of Commerce's National Fisheries Service all provide some commercial trade enforcement and regulatory services. Approximately 70,000 private service and repair agents are licensed by the States to install and place repaired devices into service without government presence.

8.2 Qualification/Training

Qualifications and minimum training varies depending upon the government agency or private company that employs the inspector. Minimum requirements for some State and Federal jurisdictions are a bachelor's degree with approximately 9-12 weeks formal training, 6 months on-the-job training, and final examinations in specific core capabilities leading to formal licenses. In other jurisdictions, minimum requirements may only be a high-school diploma with several months of on-the-job partnership with more experienced personnel, requiring no formal course work or examination.

8.3 Training Organizations and Courses Organized

The NIST Office of Weights and Measures has managed (for the NCWM) the development of weights and measures short courses culminating in the publication of “modules” of trainer and student manuals for 3 to 5 day courses. NIST Office of Weights and Measures also provides training in weights and measures laboratory metrology and specialized training such as liquid propane gas meter testing and packaged commodity training. State weights and measures agencies provide their own training staff, and contact for training from their sister agencies, local colleges, and management training providers. The U.S. Department of Agriculture operates a meat and poultry inspector school in Denton, TX.

8.4 Range of Functions Weights and Measures organizations in the U.S.A:

- Regulate commercial weighing and measuring devices;
- Inspect and test the accuracy of the devices;
- License commercial weighers who provide weighing services for hire (called “weighmasters”), license installers and repairers of commercial measuring devices;
- Regulate and inspect commercial trade practices including advertising, labeling, and other disclosure information; and
- Check packaged commodities for general labeling and net contents accuracy.

9. PACKAGING

9.1 Legislative Control for Packaging

The NCWM Uniform Packaging and Labeling Regulation serve as the basis for individual State legislation and has been adopted in most States. It is updated annually and has been made fully compatible with the Federal Fair Packaging and Labeling Act and all other Federal laws having to do with the subject. The text is included in NIST Handbook 130 “*Uniform Laws and Regulations*”. NIST Handbook 133 “*Checking the Net Content of Packaged Goods*” has been adopted by Federal and State agencies.

9.2 Organization Responsible

Several Federal agencies as well as the various States are responsible for administering the packaging and labeling laws and regulations.

10. SANCTIONS

Sanctions vary from State to State as well as at the Federal level and may include administrative, criminal or civil penalties.

SECTION 2 – Some key activities of 2015 - 2016

1. Revisions to the U.S. Taximeters Code

A USNWG on Taximeters continues its work to revise the current Taximeters Code in NIST Handbook 44 (HB 44), “*Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices.*” The purpose of this USNWG is to adequately address emerging technologies used to assess charges based on time and/or distance measurements in taxi applications and to ensure that the prescribed methodologies and standards facilitate measurements that are traceable to the International System of Units (SI).

Many changes to the existing Taximeters Code have already been approved during the July 2015 NCWM Conference in Philadelphia.

Two new proposals were submitted to the regional Weights and Measures Associations in August & September 2016. Both proposals have been supported by at least two of the regional associations and were forwarded as voting items for the NCWM’s agenda.

First proposal is for the creation of a new NIST HB44 device code for Transportation Network Measurement Systems (TNMS). This is a documentary standard intended to provide requirements, performance tolerances, and test procedures for those transportation for-hire services that operate using software applications (apps) as an interface between users and service provider.

These TNMS typically determine distance traveled by the vehicle using the input from location services such as GPS and cellular networks. The driver’s device (cellular telephone, tablet, etc.) serves as a receiver of the location service data as well as performing the functions of an indicating element in the system.

Another typical characteristic of the TNMS is that the passenger enters into an agreement with the service provider (Transportation Network Company or TNC) including the acceptance of the terms of service. The passenger will normally request transportation service via their personally-owned device (e.g., mobile telephone or tablet) and is able to receive an up-front estimate of fare charges based on the pick-up location and destination. Once the trip has been completed, the passenger receives a detailed receipt itemizing the charges incurred.

Challenges in the development of this proposed new HB44 Code included:

- drafting requirements that addressed specific requirements for indicating elements (since they are “not built for purpose” devices and normally not owned or controlled by the service provider);
- the loss of location services signals; and
- providing a means for sealing the metrological components of the system.

The proposed draft has been submitted as a tentative code which is not intended to immediately be used as an enforcement tool but is rather intended to be used on a trial basis. Field officials would be encouraged to apply the requirements contained in this code and to identify any existing gaps and portions of the proposed code that are in need of further development.

The proposal may be found on NCWM’s website using the following link:

<https://www.ncwm.net/resources/dyn/files/75646902zc2d62391/fn/4-ST-Agenda-Master.pdf>

The other proposal that has been submitted by the USNWG on Taximeters is a draft of multiple changes being recommended to the existing HB44 Taximeters Code. These changes were developed primarily with the intent of modifying requirements for traditional-type taximeters that would align

those requirements with corresponding requirements for TNMS so that these regulatory controls do not create any advantage/disadvantage for either type of transportation-for-hire service over the other type.

2. Truck Scales -- Weigh-in-Motion Systems

- A. The US recently adopted a new NIST Handbook 44 tentative code for Weigh-in-Motion (WIM) Systems used for vehicle enforcement screening. The tentative status of the code provides for a trial period of the requirements for study prior to the development and adoption of a final code. The code applies to systems used to weigh vehicles while in motion for the purpose of screening and sorting vehicles based on the vehicle weight to determine if a static weighing is necessary.
- B. The National Conference on Weights and Measures (NCWM) recently formed a Task Group comprised of WIM equipment manufacturers, weights and measures and truck weight enforcement officials, and others to assist in the further development of a draft proposal to amend NIST Handbook 44 that it recognize the use of slow speed WIM systems to weigh vehicles for commercial purposes. The current draft being considered by the Task Group proposes a tolerance of plus or minus (+/-) 0.2 percent of the total weight of a vehicle for these systems.

3. Draft Code for Electricity Meters:

In February 2016, a draft NIST Handbook 44 Code for Electric Watthour Meters was distributed by the U.S. National Work Group on Electric Vehicle Fueling and Sub-metering (USNWG). This code was derived from a draft code that included proposed requirements for both electric vehicle refueling equipment and electric watthour meters used in sub-metering; the USWNG elected to address the two types of devices in separate codes and extracted the requirements applicable to the electric watthour meters from the code that was ultimately adopted for electric vehicle refueling equipment. The test procedures (field official's inspection and test based on HB 44-Section 3.40) and test equipment portion of the project still must be completed.

4. Legal Metrology Issues related to Compressed Natural Gas (CNG) and Liquefied Natural Gas (LNG) Vehicles

With the current situation of an abundant and inexpensive U.S. domestic natural gas supply, the U.S. is significantly increasing its use of natural gas as a vehicle fuel. A natural gas vehicle (NGV) uses compressed natural gas (CNG) or liquefied natural gas (LNG) as a cleaner alternative to other fossil fuels.

For the past several years, the most prevalent NGVs in the US are fleets of mass-transit local busses which are fueled with CNG at a (non-retail) central location for the fleet.

Because of the inexpensive natural gas fuel costs, the owners/operators of many heavy-use engines that traditionally have used diesel fuel (including long-haul trucks and boats) have been buying or converting their engines to run on natural gas, especially LNG. NIST and NCWM are working to establish new requirements and test procedures for the new retail LNG fuel dispensers that will be installed to service these industries.

5. Volumetric Test Procedures for Firewood

NIST Office of Weights and Measures developed Volumetric Test Procedures for Firewood (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. These 20 pages of new procedures replaced ambiguous test procedures with new procedures that will provide improved national uniformity in test results.

Unless otherwise indicated, take all measurements without rearranging the wood or removing it from the package. However, if the layers of wood are crosshatched or not ranked in discrete sections in the package, remove the wood from the package, re-stack, and measure according to the procedures described in this section. For boxed firewood, it is the volume of the wood in the box that is determined not the volume of the box. Note: The implementation date for this is effective July 2017.

6. Aerosols and Similar Pressurized Containers

There are a number of products in the marketplace bearing quantity statements in terms of fluid measure that utilize the Bag on Valve (BOV) technology. Packages using BOV technology are generally pressurized containers but propellant is not dispensed with the product. Consumers are not able to do price and quantity comparisons between products packaged using BOV technology (which is being typically labeled by volume in the marketplace) and similar product in traditional aerosol packaging (required to be labeled by net weight) – because the aerosol packaged product includes the propellant in the net weight and the propellant is dispensed with the product.

In July 2014, the National Conference on Weights and Measures (NCWM) unanimously approved a revision to the requirements for these products. The revision supports and further strengthens states position that the method of sale for aerosols and other pre-pressurized containers dispensing product under pressure (including those using BOV technology) **must be sold by weight**. This has been the traditional method of sale in the marketplace for these type products for over 50 years.

Please note that industry who have been mislabeling BOV containers by volume, were granted a 3 year time period (2014-2017) to comply with the labeling requirements.

7. Animal Bedding

Animal Bedding, also called pet or stall bedding, litter or simply bedding, is generally sold by dry volume in compressed or uncompressed packages. Based on numerous failed inspections of packaged animal bedding, the NIST Office of Weights and Measures conducted a study in which compressed and uncompressed packages of animal bedding were measured using a variety of procedures and test equipment. The results from those tests indicated that the current procedures in the 2014 Edition of NIST Handbook 133 “Checking the Net Contents of Packaged Goods,” the dimensional inspection procedure for testing compressed packages (e.g., peat moss); and the volumetric inspection procedure (e.g., mulch); were inadequate for use in testing animal bedding.

Uncompressed volume measurements of animal bedding are dependent on a number of factors, including the size and shape of the measuring container, the method of filling the measuring container, and the means used to break up the bedding prior to measuring. Based on the findings of this study, a draft procedure has been developed for testing the uncompressed volume of animal bedding. NIST OWM also designed and constructed new test measures to be used with the

procedure, and then brought these measures to several animal bedding packaging plants for on-site verification of the test methods.

Preliminary findings indicate that the draft procedure provides more consistent measurement results. Further, the study shows that there is no correlation between compressed and uncompressed volumes of animal bedding, leading to the conclusion that the requirement for compressed volume statements on the package label is unnecessary.

NIST has developed proposals that includes recommended changes to the method of sale for Animal Bedding in NIST Handbook 130 “Uniform Laws and Regulations in the Areas of Legal Metrology and Engine Fuel Quality,” a revised test procedure for NIST Handbook 133 relating to the verification of the compressed volume of peat moss (which has been used with animal bedding), new test procedures for measuring the compressed and uncompressed volumes of animal bedding, suggested test equipment and a gravimetric auditing procedure that allows inspectors to avoid destroying all of the packages.

Previously, packaged animal bedding of all kinds, except for baled straw, should have been sold by volume (by the cubic meter, liter, or milliliter and by the cubic yard, cubic foot, or cubic inch). If the commodity was packaged in a compressed state, the quantity declaration should have included both the quantity in the compressed state and the usable quantity that could be recovered.

8. High Accuracy Weighing -- Retail Sales of Recreational and Medical Marijuana

Several U.S. States recently adopted regulations legalizing the use of recreational and/or medical marijuana. Retail sales of recreational marijuana, in particular, sometimes involve very small quantities of a particular variety of leaf marijuana as some consumers wish to sample several different varieties with a limit on the amount of money they’re able to spend. Consequently, the loads being weighed are sometimes very small, necessitating the use of a scale with a very high resolution to minimize the effect of digital rounding, applicable tolerance, and other error and uncertainties associated with the weighing of very small loads in a retail application. Some states report seeing scales that have a verification scale interval equal to 1 mg and scale division equal to 0.1 mg. States are having to deal with determining scale suitability for the different retail outlets that are opening and having to procure test weights of high enough accuracy to be able to test the scales.