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Proposed NIST Handbook 44 Requirements for Tare – Part 2, Terminology and Definitions

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This article is the second in a series of three articles on the discussion of the proposals to amend and add tare requirements in Handbook 44, *Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices* (HB 44). This article will address the revised definition of tare mechanism and many of the new definitions that may not be familiar to the reader including "tare-balancing," "tare-weighing," and "preset tare" including "percentage" and "proportional" tare. The Tare Work Group (WG), established in 2006 by the NTETC Weighing Sector, believes that the definitions are necessary to facilitate an understanding of the terms and promote consistent and uniform interpretation of the amended and proposed tare requirements.

The WG has recommended amending the following definition for "tare mechanism" by introducing the terms tare-balancing and tare-weighing, and providing additional notes describing how tare may or may not increase the weighing range of a device as follows:

tare mechanism. A tare-balancing or tare-weighing 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 and for setting the net indication to zero when the tare object is on the load-receiving element (See also "preset tare," "tare-weighing mechanism," and "tare-balancing mechanism").

Notes:
1. Reducing the weighing range for net loads is known as subtractive tare (e.g., Net Weight +≤ Gross Weight Capacity).

2. Increasing the weighing range for gross loads without altering the weighing range for net loads on mechanical scales is known as additive tare (e.g., a tare bar on a mechanical scale with a beam indicator where Net Weight + Tare Weight ≥ Gross Weight Capacity).

Also included in the proposed amendment to the definition for "tare mechanism" are the following descriptions of the various ways a "tare mechanism" can operates as follows:

- A manual adjustment of a physical balancing mechanism or electronic adjustment of an electronic scale is defined as a "non-automatic tare mechanism." For example, sliding a poise on a beam scale, adding a counterbalance weight on a balance, or turning a potentiometer on an electronic scale with the purpose to set the scale indication or balance position of a pointer to zero.

- A single operation to initiate the setting or balancing the tare to achieve a zero net indication is defined as a semi-automatic tare mechanism which is also know as a pushbutton tare. For example, pressing a "TARE" button on an electronic scale will change the indication of weight value in the gross indicating mode to a zero indication in the net indicating mode and if equipped with a separate tare weight display, display the weight of the tare object.

- A programmed sequence of operations that set the tare to achieve a zero net indication without intervention by the operator is defined as an "automatic tare mechanism." Note that the proposed definition for automatic tare is limited to indirect sales to the customer. For example, a prepackaging scale with automatic tare enabled can be programmed to automatically balance or tare off the first weight placed on the load-receiving element (LRE). Net weight is determined by either a change in weight (product added to

the container) or the second weight placed on the LRE (tare container removed from the scale, then filled with the product and placed back on to the LRE).

You will note that the proposed amendment includes a description of the terms subtractive and additive tare. The intent of the amendments is to clarify that the effect of a tare bar or poise on a mechanical scale can increase the gross nominal capacity of some mechanical scales since the net capacity is not reduced. The WG reviewed the existing HB 44 definition of "nominal capacity" to confirm that the amended language did not conflict with the existing definition. There are very few examples for this type of additive tare; examples include scales with un-graduated tare bars in which the tare capacity of mechanical scales with un-graduated (fractional) tare bars are limited to 2 ½ % of the sum of the capacities of the remaining reading elements.

The WG also agreed that the definition for "net weight" from NIST Handbook 130, *Uniform Laws and Regulations in the area of legal metrology and engine fuel quality* (HB 130) should be repeated in HB 44. The WG also developed a proposed definition for "tare" based on language included in the definition of "net weight" in HB 130. The proposed new definitions for the terms "net weight value," "tare weight value," and "gross weight value" are fairly straightforward and are consistent with similar terms in OIML 76 and R 51 international recommendations. The new proposed definitions for "tare-balancing mechanism," "tare weighing-mechanism," "preset tare," and "preset tare mechanism" described in the following paragraphs are based on NCWM Publication 3 guidelines and interpretations, OIML R 76, and OIML R 51 and are consistent with NCWM Publication 14, *Weighing Devices, Measuring Devices, Grain Analyzers, and NTEP Administrative Policy*, performance requirements for tare.

The "tare-*balancing*" and "tare-*weighing*" definitions have been recommended to help define these tare mechanisms as a metrological or weighing function of the scale. In using a "tare-*balancing* mechanism," the tare material has been actually placed on a scale and its weight is balanced-off to the internal resolution of an electronic scale. This is similar to a semiautomatic zero-setting mechanism found in most electronic scales. In a mechanical scale, the tare adjustment would be like adjusting the balance condition of the scale using only the zero-balancing mechanism (e.g., moving a poise on an un-graduated tare bar on a beam indicator or screw adjustment on a dial scale). In the case of a "tare-*weighing* mechanism," the tare material is actually weighed and its value is indicated as a separate tare weight indication on a digital display or by reading the scale graduation marks on a graduated tare bar on a beam indicator or dial indication. The main difference between these two types of tare is that the quantity of tare material becomes a known value with a "tare-*weighing* mechanism." The similarities with these mechanisms are that tare is determined at the time of the transaction and only used once. As a result, accurate net weights are consistently achieved since there is little or no chance for the tare to change during the transaction. "Tare-*balancing*" and "tare-*weighing*" mechanisms are also considered as metrological or the "property of the result of a measurement" (defined by the International Bureau of Weights and Measures - BIPM). Additionally, a (metrological) tare from a "tare-*weighing*" mechanism becomes a "preset tare" value when the tare value is stored in memory or is documented on a ticket, label, etc. and is used in the determination of net weight in subsequent or for multiple weighments. The following paragraphs provide examples for the types of preset tares.

The proposed definition for "preset tare" states the following:

preset tare. A numerical value, representing a weight that is entered into a weighing device (e.g., keyboard, recalled from stored data, or entered through an interface) and is intended to be applied to weighings without determining individual tares.

Types of preset tare mechanisms include:
- keyboard tare. . .
- digital tare. . .
- programmable tare. . .
- stored tare. . .
- percentage tare. . .
- proportional tare. . .

Because the previous definitions for "tare-*balancing*" and "tare-*weighing*" are directed to metrological values, the WG believed it necessary to include definitions for non-metrological (numerical) tare values that are used in net weight determinations. Examples on non-metrological tare include manually entering tare through a numeric keypad, which is frequently called "keyboard tare," or entering numerical values as a tare that is recalled from stored data on a scale, separable indicating element, or other software-based devices interfaced with a weighing system. The tares may be used for multiple net weight determinations. It has long been recognized that there are disadvantages to the use of this type of tare since the weight of the actual tare material may change or be different than the numerical value entered as tare; thus leading to errors in the tare values and uncertainties in the process. "Preset tare" inaccuracies and uncertainties are well documented in package checking programs and were highlighted in the conclusion of the 2005 - 2006 National Stored Tare Vehicle Study. The conclusion and additional background information on the study can be found on the NIST WMD web site (http://ts.nist.gov/WeightsAndMeasures/index.cfm) in the link to the National Stored Tare Vehicle Study and in two newsletter articles located in the Weights and Measures Quarterly Newsletter Archive (F19 and F20).

In the United States, "preset tares" are known under various names such as "keyboard tare," "digital tare," "programmable tare," "percentage tare," and "proportional tare" and depending on the term, indicative of the way the preset tare is entered into a net weight determination. Thumbwheel tare is also considered a preset tare but was not included in the proposed definition since the WG believed that there are very few, if any, devices using thumbwheel tare remaining in commercial field applications. The proposed definition for "preset tare" includes the descriptions of these "subtypes" of preset tare. Most of the "subtypes" of preset tare are fairly common in the marketplace. However, the terms "percentage tare" and "proportional tare" are fairly recent additions to the marketplace and are briefly described in the following paragraphs. It should also be noted that the terms "percentage tare" and "proportional tare" are not addressed in OIML recommendations. Therefore, WMD, NTEP, and Measurement Canada worked cooperatively to develop these terms, definitions, and applicable test procedures for type evaluation as part of the U.S./Canada Mutual Recognition Agreement.

A "percentage tare" is a type of "preset tare" where the tare for wrapped items for sale from bulk is a value, expressed as a percentage (i.e., 5.6 %), that represents the percentage of tare material compared to the gross or net weight of the commodity. The first example of percentage tare was an application where wrapped piece candy, such as salt water taffy, was weighed on a customer-operated computing scale. The customer would fill a bag with the candy and place the bag on the scale platform. The scale was preprogrammed with a unit price, a stored tare weight for the bag and a percentage factor related to the amount and type of wrapping material on the specific amount of candy. The program subtracted the preprogrammed weight of the empty bag and then multiplied the remaining weight of the candy, less the weight of the bag, by a percentage to obtain the net weight of the candy without the wrapping around each piece. Assuming the scale was programmed with the correct bag weigh and percentage value, the customer received the correct net weight of piece candy purchased. (Note: This is also an example of a consecutive tare transaction, which will be discussed in the next article in this series.).

"Proportional tare" is a value, automatically calculated by the scale, proportional to the gross weight indicated by the scale. A proportional tare can be a percentage tare or a fixed tare value proportional to a range of gross weights (i.e., a 10 g tare for gross weights between 0 and 2 kg, a 20 g tare for gross weights between 2 and 4 kg, etc.). A proportional tare is, therefore, not limited to being a percentage tare. Applications where a "proportional tare" might be used include automatic weighing systems where pre-wrapped poultry carcasses will have different percentage tare factors since larger carcasses will require more wrapping than smaller carcasses. Since the unwrapped carcasses have random weights, the packager will establish an appropriate "percentage tare" factor for a number of weight ranges to reduce the number of "percentage tare" factors that must be programmed into the weighing system. Hopefully, the operator should be aware that the "percentage tare" for the weight range should be adequate for the heaviest carcass in the weight range.

This has been a brief discussion of the proposed definitions for Tare Mechanism, Gross Weight Value, Net Weight, Net Weight Value, Tare, Tare Weight Value, and Preset Tare. As stated earlier, the intent of the proposed definitions is to promote a consistent understanding of tare terminology and the uniform application of tare requirements in HB 44. The final article in this series will discuss the proposed new and amended HB 44 language relating to the specifications for tare and preset tare. You may contact Steve Cook by phone at 301-975-4003 by phone or by e-mail at owm@nist.gov if you have additional questions about this article.