September 2008

Proposed NIST Handbook 44 Requirements for Tare – Part 1, Background

By Steven Cook

If you have been following the agendas and reports of the NCWM S&T Committee agenda over the past two years on the subject of "tare," you likely are aware that there are several proposals to amend existing requirements, and to add new requirements, terms, and definitions for tare. These recommendations are applicable to both the Scales Code and Automatic Weighing Systems Code.

This is the first in a series of three articles (the first two parts appear in this edition of *W&M Quarterly*) to assist readers in analyzing the proposals by reviewing the background information, proposed definitions, existing type evaluation checklist procedures and requirements, and international differences and similarities. This article will discuss the reasons the NTETC Weighing Sector developed the proposals.

As early as 1986, the NTETC Weighing Sector developed criteria used to evaluate tare features on weighing devices in NCWM Publication 14, *Weighing Devices, Measuring Devices, Grain Analyzers, and NTEP Administrative Policy*. The evaluation criteria were based on General Code paragraph G-S.2. Facilitation of Fraud and other requirements that apply to indicating and recording elements and recorded representations and the policies, interpretations, and guidelines on tare design and applications in NCWM Publication 3 (no longer published) SECTION 3 - 3.2.11., Jan. 87 Specifications, Tolerances, and Device Inspection.

NTEP laboratories have since stated that it has become increasingly difficult to base compliance decisions solely on paragraph G-S.2. because the general nature of the language results in multiple interpretations. To compound the problem of multiple interpretations of tare, Publication 14 is not widely available to the weights and measures community. In addition, only a limited number of weights and measures officials, device manufacturers, and device owners and operators are regular participants in Weighing Sector meetings where tare evaluation criteria are developed and discussed. It is difficult for parties responsible for the design, use, and test of the tare feature to interpret and apply technical requirements published in Publication 14. This results in differing interpretations of NIST Handbook 44, *Specifications Tolerances, and Other Technical Requirements for Weighing and Measuring Devices* (HB 44), requirements and Publication 14 evaluations.

One example of conflicting interpretations included disagreements among the NTEP laboratories about how to round indicated and recorded tare values on multi-interval and multiple range scales where the tare weight was in a different weighing range or segment than the net weight value. Some believed that the scale should always round tare to the nearest division since General Code paragraph G-S.5.2.2.(c) Digital Indication and Representation states that a digital value "rounds off" to the nearest minimum unit that can be indicated or recorded. Others stated that when tare is rounded down (to the lower division), the scale will subtract too little tare, and will indicate and print a net weight that is higher than the actual net weight, which is in violation of the Uniform Weights and Measures Law Section 15. Misrepresentation of Quantity in Handbook 130, *Uniform Laws and Regulations in the areas of legal metrology and engine fuel quality* (HB 130).

At the 2006 Weighing Sector meeting, a Tare Work Group (WG) was formed to review existing tare requirements and, among other things, develop recommendations for changes to HB 44. The WG was also asked to provide guidance to the Weighing Sector on type evaluation requirements relating to tare.
As a result of its deliberations, the WG developed proposals to amend HB 44 requirements to:

1. ensure that a tare feature operates in a manner that increases the accuracy of net weight determinations,
2. clearly state what information and values are permitted and required for indicated and recorded representations of net weight and tare weight, and

3. identify the types of tare weight values (e.g., semiautomatic and stored) determined at the time objects are weighed or when tare weight values are determined prior to the time objects are weighed.

The WG reviewed existing tare requirements and terminology (including dictionary definitions), previous discussions of tare in the NCWM Annual Reports, and other international recommendations for automatic and nonautomatic weighing devices that were under revision. This gave the WG and WMD an opportunity to offer suggested changes to the international recommendations on tare and to request clarifications, examples, and interpretations on other existing international tare requirements, rounding, and net weight calculations for multi-interval and multiple range scales. The WMD and the WG did receive several of the requests for clarifications and were successful in getting the U.S. recommendations adopted into the international standards.

It should be noted that most of the WG recommendations do not conflict with existing or revised recommendations on tare. However, the WG developed a proposal that was adopted at the 2008 NCWM Annual Meeting to allow an exception for multi-interval and multiple range scales regarding the calculation of net weight based on the indications and recorded representations. The new language in 2.20. Scales Code (HB 44) paragraph S.1.2.1. Weight Units allows multi-interval and multiple range scales to not round tare if the net weight value is in a different weighing range or segment. As a result, net weights (calculated as the difference between gross and tare weights) will be more accurate since tare is not rounded to a higher or lower division value. OIML R 76 allows a 1-division error in the calculation of net as on a multiple range scale as shown in the following example (PT is the proposed abbreviation for "Preset tare," which covers pushbutton, semiautomatic, keyboard and stored tare, and WR is the abbreviation for weighing range):

Capacity: WR1 = 0 - 4 kg x 2 g
WR2 = 4 - 10 kg x 5 g
WR3 = 10 - 20 kg x 10 g

	OIML R 76	Pub. 14 (08)	H44 (09)
	Displayed/Printed		
Gross	13.380 kg	13.380 kg	13.380 kg
PT	-3.814 kg	-3.810 kg*	-3.814 kg
Net	9.565 kg	9.570 kg	9.566 kg

**3.814 rounded to the nearest d for WR3*

As you can see in the OIML example, net does not equal gross minus tare (Net ≠ Gross – Tare) since the net weight value has been rounded to the nearest division in WR2. Prior to the adoption of this requirement, Publication 14 required that tare values be rounded to the division size of the WR for the gross weight so that the scale division was the same for gross, net, and tare weight values. In order for the net weight equation to be mathematically correct (Net = Gross – tare), both the tare and net weights must be rounded to a larger division size when tare was determined in a lower weighing range in order.

The proposals being considered by the S&T may, if adopted, be used to address some of the issues of the stored vehicle tare concerns raised in discussions on the accuracy and suitability of devices that store tare values in vehicle weighing applications. The proposal would require stored tare weights to be identified on a printed ticket thereby making it easier to determine whether the tare values are the result of a weighment at the time the gross weight was determined or that the tare has been electronically stored in memory or manually entered.

This is a brief summary of the background information for the item on tare in the S&T Committee agenda. You may review the 2005 to 2007 reports of the Weighing Sector for additional background information and reports from the Tare WG. The next article in the series will discuss the proposed revised definition of

tare mechanism and many of the new definitions that may not be familiar to the reader such as “calculated net weights,” “tare-balancing,” “tare-weighing,” and “preset tare” including “percentage” and “proportional” tare. 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.