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Marking Requirements and Proper Testing Procedures for Vehicle Scales Equipped with Multiple Independent Platforms Interfaced with a Totalizing Indicating Element

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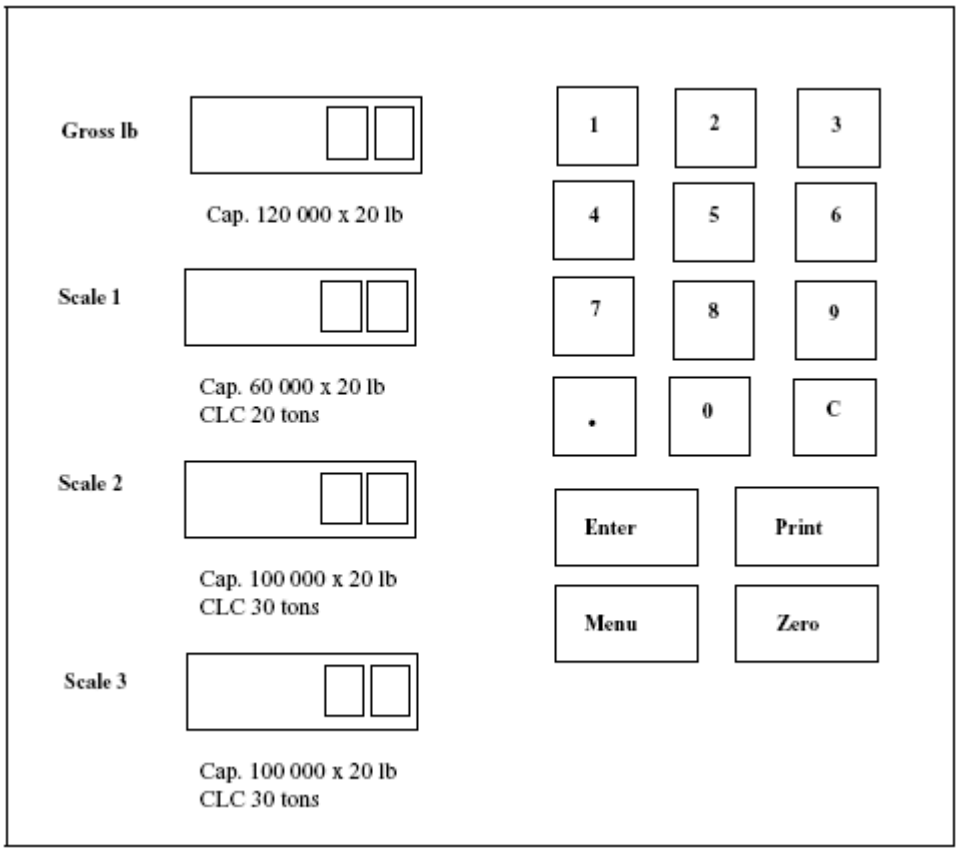
How is the total number of scale divisions "n" properly determined on a vehicle scale equipped with multiple independent weighing elements used simultaneously to perform single draft weighing of vehicles? What capacity markings are required on the indicator of these weighing systems considering each load-receiving element may be used independently or in combination with others? What testing is needed to verify compliance with NIST Handbook 44 (HB-44) performance requirements? Since WMD frequently receives inquiries regarding the proper test procedures and marking requirements for these scale systems, this article addresses those requirements.

The operational features that exist on indicating elements designed for use on weighing systems equipped with multiple, independent weighing elements vary greatly depending upon the specific application. Thus, testing procedures and applicable requirements may differ significantly based upon the capabilities of a system and how that system is used.

For example, some of the test procedures necessary to perform an adequate test on a system that provides a summed result of all the independent weighing elements may not be needed or may differ from those necessary on a system that does not have summing capability. For this reason, it is important to note that not all of the procedures and requirements mentioned in this article are intended to be applicable to all the various systems equipped with multiple independent weighing elements. Rather, the requirements and test procedures explained in this article are intended to apply to a system believed to be one of the most common; that is, to a vehicle scale system equipped with multiple independent weighing elements used simultaneously to perform single-draft weighing of vehicles. Systems that typically perform this function are comprised of two or more independent weighing elements connected to a single indicator that provides a separate weight display for each independent weighing element and a summed total. An example of an indicator equipped with these features is illustrated below.



Required Indicator Markings

As with all indicating elements not permanently attached to a weighing and load-receiving element, the indicators used with multiple weighing element systems must be marked with the appropriate information listed in HB-44 Scales Code, Table S.6.3.a. However, there are some significant differences in the markings required on an indicator connected to multiple weighing elements versus an indicator connected to a single weighing element. Since it is the capacity of the weighing/load-receiving element that most often determines the nominal capacity of a vehicle scale, it is this value that is typically marked on a vehicle scale's indicator. It would not be appropriate to include only a single capacity statement on an indicator connected to multiple independent weighing elements, especially in light of the fact that oftentimes weighing elements with different manufacturer's capacity ratings are used within the same scale system. Nor would it be appropriate to include only a single concentrated load capacity (CLC) or section capacity statement (whichever is applicable) if the CLC or section capacity ratings of the various independent weighing/load-receiving elements were different.

In 1990, the NCWM adopted a statement supporting the interpretation that multiple weighing devices used together are to be considered a single system and that HB-44 requirements must be met by each scale separately and by the system as a whole. For this reason, to comply with marking requirements specified in Table S.6.3.a., the nominal capacity shown together with the value of the scale division for each independent

weighing element—and for the system as a whole—must be clearly and conspicuously marked on the reading face of the indicator. The CLC or section capacity (whichever is applicable) of each independent weighing element must also be marked on the indicator. This required marking information must be positioned on the indicator to correspond with the weight display for which it is associated or be otherwise identified using suitable text. An example of this required marking information correctly positioned on an indicator is shown in the above illustration. To enable users to differentiate between the various independent weighing/load-receiving elements, they, too, must be marked to correspond to the display indications.

Determining the Number of Scale Divisions (n)

Determining the number of scale divisions (n) for any given scale is usually a simple process of dividing the nominal capacity by the minimum division size (d). However, a problem arises when determining the value of "n" on a scale system in which a number of independent weighing elements are interfaced to a totalizing indicating element and used in combination to perform single-draft weighing.

For example, if "n" were determined from the capacity markings of Scale 1, Scale 2, and Scale 3 shown in the example illustration at the left, its value would total 13 000 divisions, i.e., [(60 000 + 100 000 + 100 000) ÷ 20] = 13 000. This value exceeds the maximum number of allowable divisions for a Class IIIL scale as specified in HB-44 Scales Code paragraph S.5.2. and Table 3.

However, when considering the interpretation adopted by the NCWM in 1990, the marking on the indicator illustrated above conforms to Table 3 because the value of "n" for each individual weighing element (i.e., n = 3 000, n = 5 000, and n = 5 000) and the system as a whole, (i.e., n = 6 000) are all within the parameters set forth in Table 3.

Minimum Test Requirements

Testing vehicle scales equipped with multiple independent weighing elements used to weigh vehicles as a single draft is not much different than testing a vehicle scale equipped with a single weighing element. The important thing to remember is that when testing a vehicle scale equipped with multiple independent weighing elements, each independent weighing element and the system as a whole are to be tested as if each were an independent scale. This means that a complete performance test must be conducted on each independent weighing element and on the system as a whole; the minimum test of each being the procedures referenced in the test section of Examination Procedure Outline 13E of NIST Handbook 112, Examination Procedure Outlines for Commercial Weighing and Measuring Devices.

During testing, it is necessary to verify that values indicated on the summing weight display are equal to the sum of the values indicated on the displays for the various independent weighing elements.

If one weighing element is overloaded and causes the display to blank out, then the summing weight display must also blank out if the indicator is equipped with a ticket printer, a ticket should be printed at each test load and the values recorded compared to those indicated to ensure they agree. Recorded values must also be appropriately identified to indicate which weighing element was used or if the recorded value was summed.

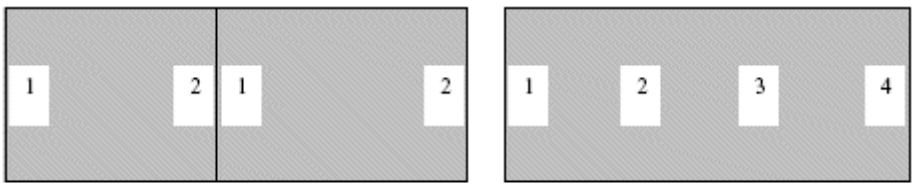
Verifying Shift Test Agreement

The results of the section test must comply with the provisions of HB-44 Scales Code T.N.4.4. Shift or Section Tests. That is, all scale sections in the multiple weighing elements used simultaneously must agree within the absolute value of the maintenance tolerances as if the scale had a single weighing element. This provision applies even if dead spaces exist between those weighing elements.

The illustration and the tables shown below are used to explain the correct application of T.N.4.4. The illustration shows 3 independent weighing elements with a dead space between platforms 2 and platform 3. The three tables below this illustration depict the results of a shift test performed on these platforms using a 20 000 lb test load. Section numbers are shown in the numbered boxes. Assuming the value of the scale division is 20 lb, HB-44 Scales Code Table 6 Maintenance Tolerance for a 20 000 lb test load is +/- 40 lb. Therefore, to comply with T.N.4.4. requirements the range of errors in the shift test results cannot exceed the absolute value of +/- 40 lb, which is 40 lb. The shaded portions of the tables shown below portray the errors that cause the permissible range to be exceeded. The range of error in the results of this example that are shaded is 60 lb and is shown in shaded text.

Note that each individual result complies with Table 6 maintenance tolerance and that the shift test results for each individual platform complies with T.N.4.4. However, it is when the shift test results of all platforms are compared that the scale fails the provisions of T.N.4.4.

Example of a Vehicle Scale with 3 Independent Weighing Elements



Shift Test Results

Platform 1			
Load Position	**Test Load**	**Scale Indication**	**Error**
Section 1	20 000 lb	20 000 lb	0
Section 2	20 000 lb	19 980 lb	- 20 lb

Platform 2			
Load Position	**Test Load**	**Scale Indication**	**Error**
Section 1	20 000 lb	19 980 lb	- 20 lb
Section 2	20 000 lb	19 960 lb	- 40 lb

Platform 3			
Load Position	**Test Load**	**Scale Indication**	**Error**
Section 1	20 000 lb	20 000 lb	0
Section 2	20 000 lb	20 020 lb	+ 20 lb
Section 3	20 000 lb	20 020 lb	+ 20 lb
Section 4	20 000 lb	20 000 lb	0

For additional information on testing scales equipped with multiple load-receiving elements with independent weighing systems, contact Rick Harshman by telephone at (301) 975-8107 or by e-mail at richard.harshman@nist.gov.