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Understanding Shift Test Requirements

By Rick Harshman

WMD frequently receives questions regarding the correct application of shift test requirements for vehicle scales, axle-load scales, and combination vehicle/livestock scales. In recent years, the shift test requirements have become more defined, and additional precautions and calculations are often necessary to prevent the overloading of these types of scales. In some instances, it may be that some scales are being improperly loaded due to a lack of understanding or an insufficient knowledge of recent changes that have affected not only loading procedures, but also the amount of weight that can be safely loaded onto the platforms of these scales. If this is occurring, it is placing those individuals involved at an unnecessary risk of personal injury and/or creating the risk of damage to the scales. That's not to mention the resulting unfair disadvantages that such improper procedures impose on the performance of a device.

The shift test requirements for vehicle scales, axle-load scales, and combination vehicle/livestock scales are contained in the five subsections (a-e), of N.1.3.4.1., Scales Code, NIST Handbook 44. Below is a description of each, followed by an explanation of how the subsections are to be applied.

Section N.1.3.4.1. Vehicle Scales, Axle-Load Scales, and Combination Vehicle/Livestock Scales

- (a) **Minimum Shift Test.** This section specifies the number of shift tests required, minimum shift test load, and the location of the test load on the load-receiving element.

Interpretation: This paragraph requires at least one shift test be conducted with a minimum test load of 12.5% of scale capacity. It also allows the test to be performed anywhere on the load-receiving element providing prescribed test patterns are utilized and maximum loading isn't exceeded. Prescribed test patterns and maximum loading are defined below in the subsequent subsections of N.1.3.4.1. Note that this requirement does not mandate using test weights when performing shift tests, although their use is preferred.

- (b) **Prescribed Test Pattern and Loading for Vehicle Scales, Axle-Load Scales, and Combination Vehicle/Livestock Scales.** This section prescribes the dimensions of a normal test pattern and recognizes the use of multiple test patterns in loading.

Interpretation: The normal prescribed test pattern is 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. These dimensions were established in 1994 and are based upon a group of two vehicle axles with specific

spacing. The established dimensions were agreed upon in an effort to provide a consistent basis for manufacturers to rate their scales. This requirement also permits the use of multiple test patterns provided the scale is loaded in accordance with subsections (c), (d), and (e).

(c) Loading Precautions for Vehicle Scales, Axle-Load Scales, and Combination Vehicle/Livestock Scales. This section defines specific procedures for loading and provides instructions for determining maximum loading when the dimensions of the test pattern are less than or greater than a normal prescribed test pattern. This section also permits the substitution of the CLC with the section capacity rating when determining maximum loading on any scale manufactured before January 1, 1989.

Interpretation: The first part of Subsection (c) requires that when loading a scale for testing, one side of a test pattern is to be loaded to no more than half of the CLC or test load before loading the other side. Overloading may occur, for example, when test carts or trucks are driven onto or removed from a side of the platform rather than one of the approach ends. Concentrating a load weighing more than one half the CLC in a test pattern, which covers only one side of the platform, with no load on the other side, causes overloading and therefore must be avoided.

Subsection (c) also provides a formula which has the effect of reducing the maximum loading on a scale when a prescribed test pattern is less than 1.2 m (4 ft) in length by 3.0 m (10 ft) or the width of the platform, whichever is less.

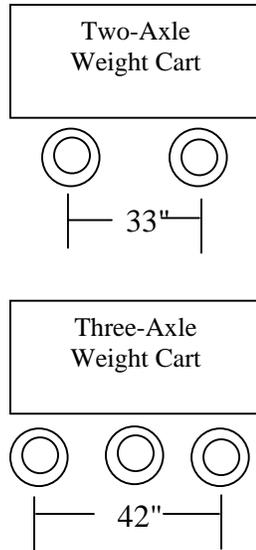
The formula is as follows:

$$[(\text{wheel base of test cart or length of test load divided by 48 in}) \times 0.9 \times \text{CLC}].$$

It should be applied to determine maximum loading whenever a load is placed on the load-receiving element of the scale in an area that contains less than 4 ft of platform length. That load can be comprised of any object or material, including but not limited to, test cart with weights, test weights, tandem truck axles, forklifts, etc.

To better illustrate the application of this formula, consider the diagram below.

When loaded or driven onto a scale, both of the weight carts shown would apply a force to the platform in an area containing less than 4 ft of platform length. Therefore, when using either of these carts, it would be necessary to determine maximum loading by applying this formula. Notice that when the formula is applied, reducing the length of the load on the platform has the affect of reducing the maximum loading. For example, if you are performing a shift test on a two-section vehicle scale with a CLC rating of 40,000 lb using the three-wheel cart as shown, the maximum loading is 31,500 lb. However, if you are using the two-wheel cart with the shorter wheelbase, maximum loading is reduced to 24,750 lb. The risk of overloading these types of scales is most evident when this formula is not applied properly.



One must also be aware that such loading precautions not only apply to loads placed over a single section of scale. They also apply to loads that are distributed over more than one section, up to and including the entire platform. Consider for example, a strain-load test being conducted on a vehicle scale using a dump truck to place the scale under load and a test cart used as the known weight. The weight of the test cart must not exceed maximum loading (calculated by formula) even though the combined loads of the truck and cart are distributed over the entire platform and the total weight is less than the scale's nominal capacity.

It is not just in the testing and repair of these scales that loading precautions must be employed. When a truck is weighed on a scale, the force of the load of that truck is not evenly applied to the different sections of the scale. The weights of the axles and groups of axles will vary greatly. For example, a steering axle on a loaded dump truck will typically weigh far less than the combined weight of the rear tandem axles. The NCWM, recognizing that trucks utilize many different axle configurations, adopted Table UR.3.2.1. in 1996. This table specifies the maximum loading of a vehicle scale for a given vehicle, based upon the axle configuration and the scale's concentrated load capacity. Use of this table has the effect of increasing maximum loading as spacing between axles and groups of axles is increased.

- (c) **Multiple Pattern Loading** addresses the use of multiple test patterns in the testing to capacity.

Interpretation: To test to nominal capacity, the device should be loaded consistent with normal use; multiple patterns are loaded simultaneously.

- (d) **Other Designs** addresses the testing of special design scales and those that are wider than 3.7 m (12ft).

Interpretation: Scales having special designs and those that are wider than 3.7m (12 ft) must be tested consistent with their use and following principles described above.

For questions about the requirements for shift tests on vehicle scales, axle-load scales, or combination vehicle/livestock scales, contact Rick Harshman telephone at 301-975-8107 or by e-mail at richard.harshman@nist.gov.