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Defining a "Test Load"

By Rick Harshman

How much certified test weight is required to adequately perform a shift test on a vehicle, axle-load, or combination vehicle/livestock scale? NIST WMD was recently asked this question when officials from two State weights and measures programs discovered they had different interpretations of the requirement pertaining to the minimum shift test load, which is outlined in NIST Handbook 44, Scales Code, Paragraph N.1.3.4.1. (a) Minimum Shift Test. The requirement reads as follows:

> **N.1.3.4.1. Vehicle Scales, Axle-Load Scales, and Combination Vehicle/Livestock Scales. -**
>
> (a) **Minimum Shift Test.** At least one shift test shall be conducted with a minimum test load of 12.5 % of scale capacity, which may be performed anywhere on the load-receiving element using the prescribed test patterns and maximum test loads specified below. (Combination Vehicle/Livestock Scales shall also be tested consistent with N.1.3.4.2.)

Officials from one State concluded that the 12.5 % test load required by N.1.3.4.1. must be comprised entirely of field standards while officials from the other State concluded that the test load could be comprised of a combination of field standards and other known test loads determined using substitution test methods. Why had officials reached different conclusions on how much certified test weight was required by the regulation? Officials within each State simply interpreted the definition of the term "test load" differently.

No definition for the term "test load" exists within the Definition section of Handbook 44. However, a definition for the term appears as a footnote within Table 4 of the Scales Code. Is the Table 4 definition of the term "test load" intended to apply to N.1.3.4.1.(a) Minimum Shift Test?

WMD researched past editions of Handbook 44, National Conference on Weights and Measures (NCWM) Annual Reports, and other documents. The proposal to require a minimum test load amount of 12.5 % for shift tests was discussed by the 85th NCWM Specifications and Tolerances Committee (S&T) in 2000 (Item 320-4). The S&T Committee agreed that the 12.5 % minimum test load for the shift test could consist of a combination of test weights and other applied load using the substitution test method. Since the Table 4 definition of test load applies to the shift test, the minimum shift test load on a vehicle, axle-load, and combination vehicle/livestock scale must be comprised of either (1) all certified test weights or (2) a combination of certified test weights and substituted test loads of known value using substituted test methods. Note that although substituted test loads combined with certified test weight are permissible for use when performing shift tests, in most instances it is advisable to use certified test weight entirely.

Accurate adjustment of an unknown load to enable substitution for test weight requires strict adherence to proper loading procedures. Even slight differences in the position of the same load can result in different weight indications. Thus, the test weight and the unknown load selected for substitution must be applied to the load-receiving element in the same precise location to minimize any potential error that could be caused by differences in the load positions. Some unknown loads may not be suitable for substitution due to their design dimensions in relation to the design dimensions of the test weights that are used. Failure to strictly follow proper substitution procedures can cause questionable results.

Table 4.
Minimum Test Weights and Test Loads[1]

Device capacity	**Minimums (in terms of device capacity)**		**(where practicable)**
	Test weights (greater of)	**Test loads[2]**	
0 to 150 kg (0 to 300 lb)	100 %		
151 to 1 500 kg (301 to 3 000 lb)	25 % or 150 kg (300 lb)	75 %	Test weights to dial face capacity, 1 000 d, or test load to used capacity, if greater than minimums specified During initial verification, a scale should be tested to capacity.
1 501 to 20 000 kg (3 001 to 40 000 lb)	12.5 % or 500 kg (1 000 lb)	50 %	
20 001 kg+ (40 001 lb+)	12.5 % or 5 000 kg (10 000 lb)	25 %[3]	

[1]If the amount of test weight in Table 4 combined with the load on the scale would result in an unsafe condition, then the appropriate load will be determined by the official with statutory authority.

[2]The term "test load" means the sum of the combination of field standard test weights and any other applied load used in the conduct of a test using substitution test methods. Not more than three substitutions shall be used during substitution testing, after which the tolerances for strain load tests shall be applied to each set of test loads.

[3]The scale shall be tested from zero to at least 12.5 % of scale capacity using known test weights, and then to at least 25 % of scale capacity using either a substitution or strain load test that utilizes known test weights of at least 12.5 % of scale capacity. Whenever practical, a strain load test should be conducted to the used capacity of the scale. When a strain load test is conducted, the tolerances apply only to the test weights or substitution test loads.
(Amended 1988, 1989, 1994, and 2003)

This leads to the question of why Table 4 requires a test load of 25 % of device capacity for scales rated at 40 001 lb or greater whereas N.1.3.4.1.(a) requires a test load of only 12.5 % of device capacity. In 2000 the S&T Committee discussed whether or not the proposed language for N.1.3.4., (the numbering has changed and is currently N.1.3.4.1.(a)), varied from Table 4, noting

that in Table 4, the test load is in terms of 25 % of device capacity for scales rated at 40 001 lb or greater, whereas the N.1.3.4. proposal specified a 12.5 % test load. It is important to note a significant difference in the applications of Table 4 and N.1.3.4.1.(a). Table 4 specifies the minimum test weights and test loads for overall in-service tests, whereas Paragraph N.1.3.4.1.(a) specifies the minimum test load required for only the shift test. Thus, for the overall test of scales with capacities of 40 001 lb or greater, 25 % of device capacity is needed. However, the S&T Committee recommended that for the shift test, only 12.5 % of device capacity is needed. Hence, the Committee intended that the requirements for the minimum shift test load be different than Table 4.

If you have any questions regarding the minimum amount of test weight or test loads required for official tests, contact Rick Harshman by telephone at 301-975-8107 or by e-mail at richard.harshman@nist.gov.