April 16, 2018

Comments on S&T Item SCL-8:
Sections Throughout the Code to Include Provisions for
Commercial Weigh-in-Motion Vehicle Scale Systems

Submitted by Henry Oppermann
Weights and Measures Consulting

Position: I am opposed to this item and it should be made developing. The proposed test procedure of three passes with one load (suggested to be 20 000 lb of test weights) on one type of truck (probably a state test truck with three axles) is insufficient to determine the in-motion accuracy of the scale for all types of trucks and loads that may be weighed over these scales. Additionally, it is unlikely that these scales can accurately weigh tank trucks or tank trailers loaded with liquids due to the movement of liquids during the dynamic, split-weighing process. If weights and measures regulatory officials adopt a test procedure that is inadequate and insufficient to reasonably ensure accurate weighing, then this a disservice to the people who will buy the scales and those who buy and sell over the scales. There are many unanswered questions that are raised in the discussion section below.

Discussion: The manufacturer has agreed that the tolerances to be applied to this in-motion scale should be the same as for static weighing scales. This is good and appropriate, since any new scale technology to weigh highway vehicles commercially should be at least as good as what is in use today. This means that for test loads of 0 to 500d to which acceptance tolerances apply, there cannot be any indicated error in the weight indication, since the tolerance is ±0.5d. The minimum load for vehicle scales is 10d. The proposed test procedure does not even specify which test loads should be used to test the scale. The test procedure does not address testing trucks loaded with liquids. Scales should be tested over their weighing range to the extent practical and for the types of loads to be weighed (solids and liquids). No test loads are specified for the strain load test. The scales should be tested at test loads at or just above the minimum load, at or below a test load of 500d, and with loads near the top of each tolerance step thereafter to the limit of the weights that are available, with a minimum amount of test weights of 25% of the scale capacity. Do the tolerances apply to each individual test result or to the average of the test results?

This raises the following questions:

1. What is the capacity of the scale?
2. Is the capacity of the scale the maximum weight that can be weighed in-motion on each axle?
3. Is it the static weighing capacity of the scale?
4. Is it the maximum sum of the axle weights that can be weighed on the scale?
5. Does the number of scale divisions comply with Class III L parameters?
6. Does the capacity of the scale depend upon the number of axles for the trucks being weighed?
7. Is there a CLC for the scale? How does the CLC relate to the scale capacity (S.6.1)?
8. Does the repeatability tolerance (T.N.5.) apply to the individual test results for the gross, tare and net weights? If not, why not?

Since the probable truck to use for the single test load in the proposed test notes is a state test truck, the truck probably has three axles and carries around 20 000 lb of test weights. A three-

axle truck does not even represent the most common type of truck on the highways. A 20 000-lb test load does not test the largest net loads that trucks carry. Furthermore, the minimum net load is not tested.

The following table is taken from the Federal Highway Administration, Chapter III, "Scenario Descriptions," 2000[1]. It shows that the most common highway truck (at 43%) is the 5-axle tractor-semitrailer. The 3-axle single unit truck is the second most common vehicle configuration and represents about 25% of the trucks on the highway in the year 2000.

Table 1. Base Year and Forecast Commercial Vehicle Fleet and Travel

Vehicle Class	Number of Vehicles			Vehicle Miles Traveled (in millions)		
	1994	2000	Percent Share of Truck Fleet	1994	2000	Percent Share of Truck Fleet
3-axle single unit truck	594,197	693,130	24.9	8,322	9,707	7.6
4-axle or more single unit truck	106,162	123,838	4.4	2,480	2,893	2.2
3-axle tractor-semitrailer	101,217	118,069	4.2	2,733	3,188	2.5
4-axle tractor-semitrailer	227,306	265,152	9.5	9,311	10,861	8.5
5-axle tractor-semitrailer	1,027,760	1,198,880	43.0	71,920	83,895	65.4
6-axle tractor-semitrailer	95,740	111,681	4.0	5,186	6,049	4.7
7-axle tractor-semitrailer	8,972	10,466	0.3	468	546	0.4
3- or 4- axle truck-trailer	87,384	101,934	3.6	1,098	1,280	1.0
5-axle truck-trailer	51,933	60,579	2.2	1,590	1,855	1.4
6-axle or more truck-trailer	11,635	13,572	0.5	432	503	0.4
5-axle double	51,710	60,319	2.2	4,512	5,263	4.1
6-axle double	7,609	8,876	0.3	627	731	0.6
7-axle double	7,887	9,201	0.3	542	632	0.5
8-axle or more double	9,319	10,871	0.4	650	759	0.6
Triples	1,203	1,404	0.0	108	126	0.1

In-motion weighing process introduces many more variables into the weighing process than apply to static weighing. The dynamics of each vehicle configuration may have significant effect of the weighing results. One cannot assume or conclude that testing with one truck of a single axle configuration at one test load will ensure that the in-motion scale will weigh all truck configurations and all gross and net load combinations accurately. Hence, the proposed test procedure is not adequate and should not be adopted by the NCWM. A more comprehensive test method is needed.

[1] https://www.fhwa.dot.gov/reports/tswstudy/Vol3-Chapter3.pdf