

September 2006

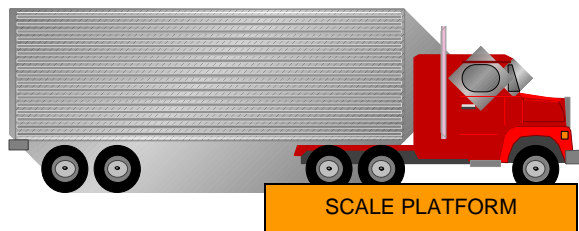
Split-draft Weighing

By Juana Williams

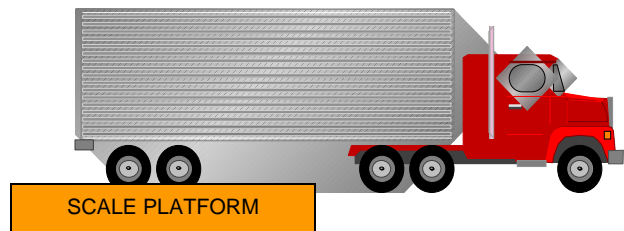
Since the 1930s the weights and measures community has raised questions about the practice of "split-draft weighing" a vehicle when the length of the vehicle exceeds the length of the scale platform. This article examines this practice and the related NIST Handbook 44 requirement that applies when determining the weight of a vehicle used in commercial applications.

The practice of split-draft weighing occurs when the front tractor or truck of the vehicle or vehicle combination (that is coupled or attached by connectors for the purpose of towing) are weighed, then the uncoupled trailer unit(s) or rear portion of the vehicle is weighed and the two weights are totaled for the vehicle weight (see the example in Figure 1 below). The practice is also referred to as "two-draft weighing," "two spotting," "double weighing," or "double-draft weighing."

Step 1: Determine Weight 1



Step 2: Determine Weight 2



Step 3: Weight 1 + Weight 2 = Vehicle Weight

Figure 1: Split-draft Weighing

Note that this practice is different from the acceptable practice of single-draft weighing in which the entire vehicle does not exceed the scale platform length (see Figure 2) or the case of single-draft weighing on a scale with multiple platforms in which the length of each vehicle combination does not exceed the platform where it rests (see Figure 4 below).

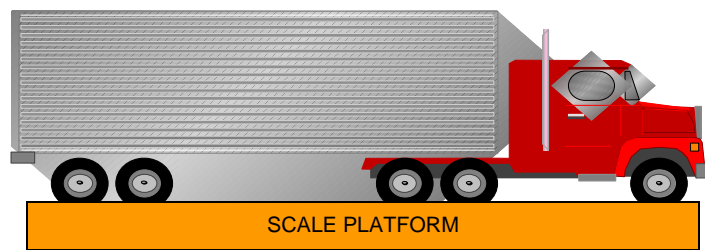


Figure 2: Single-draft Weighing of a Vehicle

In the 1930s rapid changes in the trucking industry resulted in new models of trucks with wheelbases longer than existing scale platforms. The practice of split-draft weighing began as a time-saving method (to eliminate the time spent uncoupling, moving, and recoupling the vehicle components, e.g., tractor and trailer) for determining truck weights on scales of insufficient length.

In 1938, in response to concerns about the appropriateness of split-draft weighing, NIST conducted a study that examined the errors associated with this practice. The study demonstrated that certain factors beyond the scale's performance contribute to the uncertainty in the weighing process:

- The grade and level of the approach below that of the scale result in a lower weight for a vehicle component.
- A vehicle or a vehicle combination of like design results in less external forces during each weighing.
- The nature and distribution of the load on the vehicle axles (e.g., liquids shift to a greater degree) affect the level of these external forces.
- The amount of shift in the load, which is more likely to occur the steeper the approach grade or with a quick stop on the platform, has an influence on the vehicle weight.
- The center of gravity for each vehicle unit as it relates to the shift of the load and type of commodity impacts the magnitude of these forces.
- Braking when pulling on the scale can cause the scale to bind resulting in a lighter weight.
- The proximity of the vehicle to the scale; the closer the vehicle is to the scale, the less external influence is on the vehicle's weight.

Given most transactions involve processes for determining both gross and tare weight (two weighings), when these external factors are introduced during both steps of the weighing process, the errors they contribute were found to total as high as 5.5 %. Additional studies were conducted in 1954 with similar results.

In 1955, the National Conference on Weights and Measures adopted an earlier version of current paragraph UR.3.3. Single-Draft Vehicle Weighing (a requirement that became effective in 1957) to address its concern about the practice of split draft weighing. This paragraph appears in the current edition of NIST Handbook 44 as follows:

UR.3.3. Single-Draft Vehicle Weighing. - A vehicle or a coupled vehicle combination shall be commercially weighed on a vehicle scale only as a single draft. That is, the total weight of such a vehicle or combination shall not be determined by adding together the results obtained by separately and not simultaneously weighing each end of such vehicle or individual elements of such coupled combination. However:

- (a) the weight of a coupled combination may be determined by uncoupling the various elements (tractor, semitrailer, trailer), weighing each unit separately as a single draft, and adding together the results, or
- (b) the weight of a vehicle or coupled-vehicle combination may be determined by adding together the weights obtained while all individual elements are resting simultaneously on more than one scale platform.

Note: This paragraph does not apply to highway-law-enforcement scales and scales used for the collection of statistical data.
(Note Added 1992)

Paragraph UR.3.3. requires that only single- draft weighing be used for commercial vehicle weighing applications. That is, the entire vehicle must be weighed on a scale of sufficient length. Commercial applications are those in which the weight indications are the basis for custody transfer, buying or selling, or determining transportation charges.

Paragraph UR.3.3. also specifies other acceptable methods for commercial weighing operations where the vehicle's wheelbase is longer than the scale platform. These methods are prescribed in sections (a) and (b) and illustrated in Figures 3 and 4, respectively, on page 4. In section (a) the vehicle or vehicle combination can be uncoupled then weighed as single drafts. In section (b) the vehicle combination is weighed in single drafts on multiple weighing elements interfaced with a totalizing indicating element, where the weights are totalized. In either case the important point is that the vehicle or component should rest completely on a platform.

In 1992, paragraph UR.3.3. was modified to include a note to clarify that the requirement (for only single-draft weighing of commercial vehicles) does not apply to highway law enforcement scales and scales used to collect statistical data. While split- draft weighing is not ideal, the results prove to be accurate and practical enough to permit the practice in law enforcement and data collecting applications. Even though the sources for errors in split-draft weighing remain the same and deserve consideration, the weights and measures community has not changed its position to accept the practice as a necessary method of use in law enforcement and statistical weighing applications. Yet periodically over the past 60 years, the community has made changes to the Handbook because more stringent performance tolerances were warranted as improvements were made to scale technology used in these applications. The same limitation to only single-draft weighing does not apply to railway track scales.

It has been over 50 years since a formal study was conducted indicating that split- draft weighing is not appropriate; however, some suggest that it is time for a new study. While weighing technology continues to advance, no evidence has yet been presented to indicate that split-draft weighing consistently provides a sufficient level of accuracy for commercial vehicle weighing. In fact, some jurisdictions that have conducted informal

studies on the practice continue to support the Handbook requirement for only single draft weighing of commercial vehicles.

If you have any questions about this information, please contact Juana Williams at 301-975-3989 or at juana.williams@nist.gov.

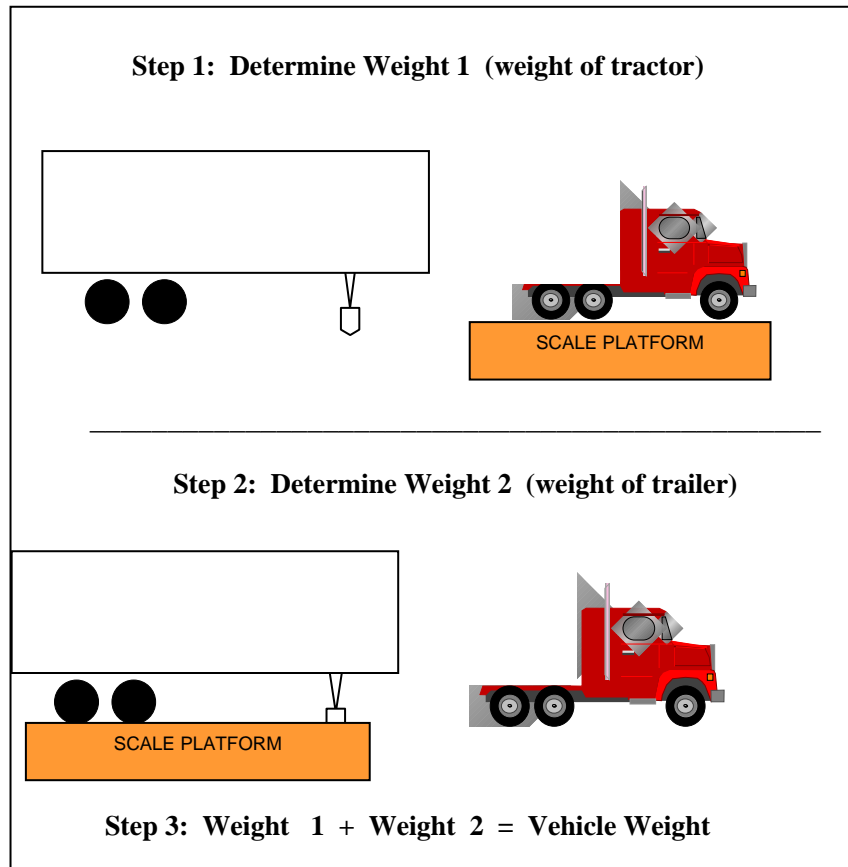


Figure 3: Single-draft Weighing of Uncoupled Vehicle Units (tractor and trailer)

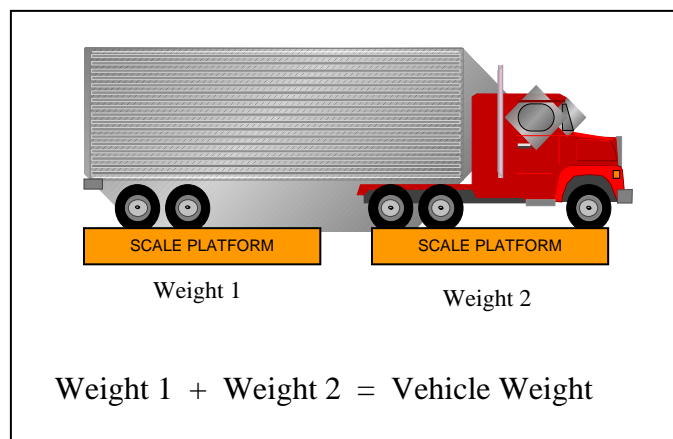


Figure 4: Simultaneous Single-draft Weighing of Coupled Vehicle Units Resting on More than One Scale Platform