Comments on S&T Item SCL-8
(Also Related to Block 3 Items SCL-3 and OTH-1)
Submitted by Henry Oppermann
Weights and Measures Consulting

Position: I am opposed to this item. If the axle weights are in 20-lb divisions and summed, then the rounding errors are unacceptable. The more axles that are weighed, the larger the rounding errors. When the net weight of a truck is calculated from weighing the gross and tare weights, the rounding error doubles. The proposed test procedure is based upon the net weight calculation. It will be extremely difficult for the scale to pass repeated tests because of the round off error associated with the calculated net weights. The tests would have to be conducted using vehicles of different axle configurations. Different test loads over the weighing range would have to be tested, including test loads near the minimum net loads. If a smaller scale division is used for axle weights, this would reduce the rounding error. However, this creates conflicts with the accuracy class parameters and causes a lack of mathematical agreement.
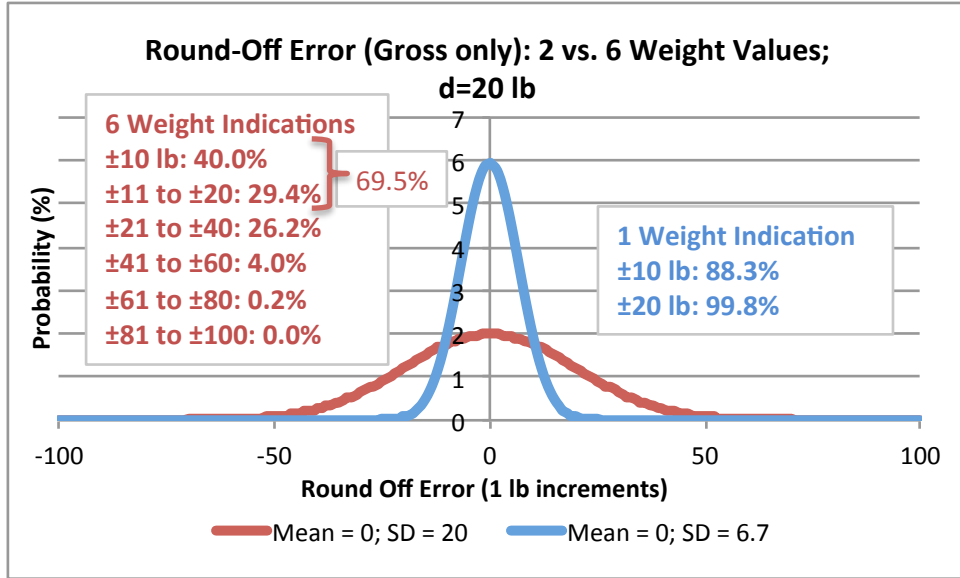
Discussion:
- The round off error varies depending upon the number of axles weighed and the size of the scale division for the axle weights.
- The round off error doubles if both gross and tare weights are weighed to get the net weight.
- The large rounding error for d=20 lb raises the suitability of equipment issue.
- Is mathematical agreement required for axle weights and total weights? Claims that only the total weight is the weight value of interest. Claims that axle weights are not subject to accuracy requirements.
    - Would W&M receive complaints if there is a lack of mathematical agreement and different scale divisions used for axle weights and the total weight?
    - If the axle weights have 5-lb divisions and the gross weight is in 20-lb divisions, then there are different division values for the "same scale," and there will be a lack of mathematical agreement.
    - Are different scale divisions allowed for axle weights and total weights? If so, then why not allow the axle weights in 1-lb divisions? Then different scale divisions would have to be allowed on multiple platform scales that weigh statically (Block 3 items).
- If the total weight is the sum of the internal resolution weight values for the axle weights, then there will be a lack of mathematical agreement for the axle weights and the total weight.
- Do the Class III L criteria apply to the total weight and/or the axle weights?
    - What are the scale capacities for axle weight and for the total weight scales? Does the total weight capacity depend upon the number of axles on the trucks? Can the total weight value have an unlimited number of divisions?
    - If Block 3 items are accepted, then there is no limit on the scale capacity for the total weight.
    - Does the tolerance apply to the results of the individual tests or to just the average?
- The requirement for recording weight values is under the wrong section (S.1.8.). The WIM scale is not a computing scale.

Gross Weight Only

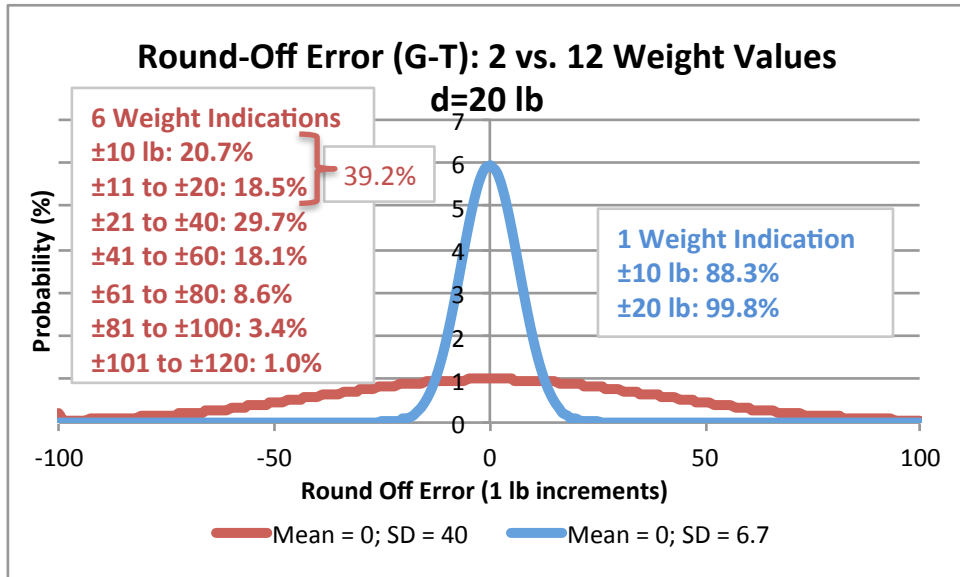**Truck with six axles: axle weight d = 20 lb, gross weight d = 20 lb**

Potential round off error on net weight: 6 axles x ±10 lb = ±60 lb

Round-Off Error (Gross only): 2 vs. 6 Weight Values; d=20 lb

6 Weight Indications
±10 lb: 40.0%
±11 to ±20: 29.4% } 69.5%
±21 to ±40: 26.2%
±41 to ±60: 4.0%
±61 to ±80: 0.2%
±81 to ±100: 0.0%

1 Weight Indication
±10 lb: 88.3%
±20 lb: 99.8%

Probability (%)

Round Off Error (1 lb increments)

Mean = 0; SD = 20   Mean = 0; SD = 6.7

Net Weight

Truck with six axles: axle weight d = 20 lb, gross weight d = 20 lb

Potential round off error on net weight: 12 axles x ±10 lb = ±120 lb

Round-Off Error (G-T): 2 vs. 12 Weight Values d=20 lb

6 Weight Indications
±10 lb: 20.7%
±11 to ±20: 18.5% } 39.2%
±21 to ±40: 29.7%
±41 to ±60: 18.1%
±61 to ±80: 8.6%
±81 to ±100: 3.4%
±101 to ±120: 1.0%

1 Weight Indication
±10 lb: 88.3%
±20 lb: 99.8%

Probability (%)

Round Off Error (1 lb increments)

Mean = 0; SD = 40   Mean = 0; SD = 6.7

2

Net Weight

Truck with **five axles: axle weight d = 20 lb, gross weight d = 20 lb**

Potential round off error on net weight: 10 axles x ±10 lb = ±100 lb
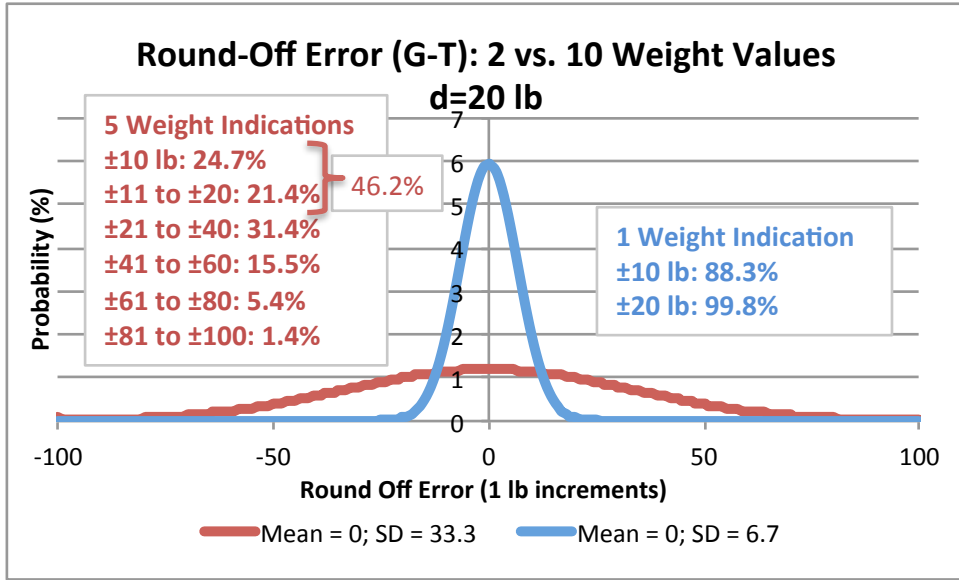
Round-Off Error (G-T): 2 vs. 10 Weight Values
d=20 lb

5 Weight Indications
±10 lb: 24.7%
±11 to ±20: 21.4% } 46.2%
±21 to ±40: 31.4%
±41 to ±60: 15.5%
±61 to ±80: 5.4%
±81 to ±100: 1.4%

1 Weight Indication
±10 lb: 88.3%
±20 lb: 99.8%

Probability (%)

Round Off Error (1 lb increments)

━━ Mean = 0; SD = 33.3   ━━ Mean = 0; SD = 6.7

Net Weight

Truck with **five axles: axle weight d = 5 lb, gross weight d = 20 lb**

Potential round off error on net weight: 10 axles x ±2.5 lb = ±25 lb

Round-Off Error (G-T): 2 vs. 10 Weight Values
d=5 d=20 lb

5 Weight Indications
±10 lb: 79.4%
±11 to ±20: 19.2% } 98.7%
±21 to ±40: 1.3%
±41 to ±60: 0.0%

1 Weight Indication
±10 lb: 88.3%
±20 lb: 99.8%

Probability (%)

Round Off Error (1 lb increments)

━━ Mean = 0; SD = 8.3   ━━ Mean = 0; SD = 6.7
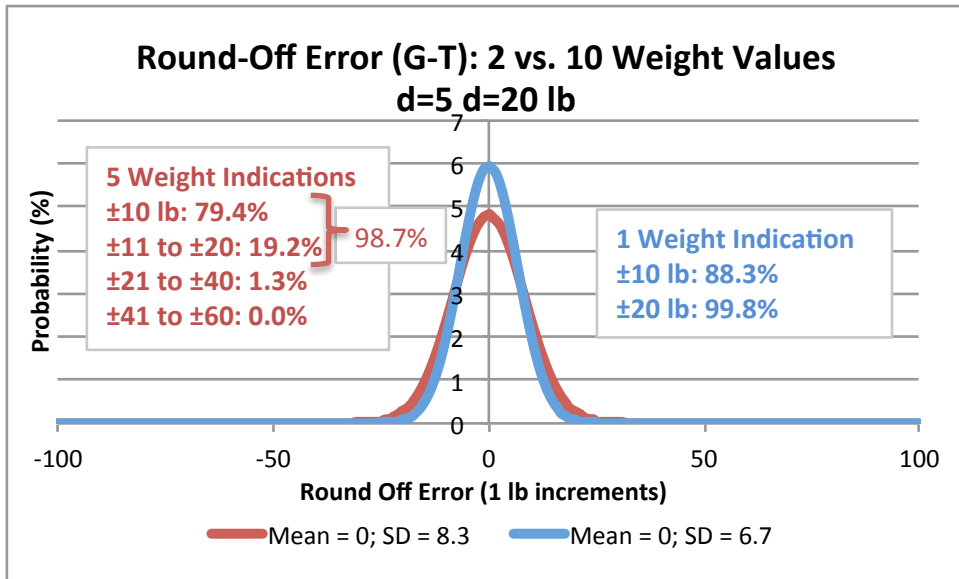
Net Weight
Truck with **three axles: axle weight d = 5 lb, gross weight d = 20 lb**
Potential round off error on net weight: 6 axles x ±2.5 lb = ±15 lb

Round-Off Error (G-T): 2 vs. 6 Weight Values d=5 d=20 lb

3 Weight Indications
±10 lb: 96.5%
±11 to ±20: 3.5%   100%
±21 to ±40: 0.0%
±41 to ±60: 0%

1 Weight Indication
±10 lb: 88.3%
±20 lb: 99.8%

Probability (%)

Round Off Error (1 lb increments)

Mean = 0; SD = 5   Mean = 0; SD = 6.7