FAIRMOUNT
Minerals

11833 Ravenna Road
Chardon, OH 44024

RECEIVED
JAN 24 2013
NORTH DAKOTA
PUBLIC SERVICE COMMISSION

January 24, 2013

Public Services Commission
North Dakota Weights and Measures
600 E Boulevard
Bismarck, ND 58505-0480

RE: Blaisdell Industrial Sand Terminal Project
6350 67th Ave NW
Blaisdell, ND 58718
SCALE VARIANCE REQUEST DATED 12/17/2012

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11833 Ravenna Road
Chardon, OH 44024

December 17, 2012

Public Services Commission
North Dakota Weights and Measures
600 E Boulevard, Dept. 408
Bismarck, ND 58505-0480

RE: Blaisdell Industrial Sand Terminal Project
6350 67th Ave NW
Blaisdell, ND 58718

SUBJECT: SCALE VARIANCE

To whom it may concern:

Fairmount Minerals is in the process of constructing an industrial sand terminal project at the reference address in Blaisdell, North Dakota. The terminal will receive sand from railcars, convey the sand into storage silos, and discharge the sand into trucks. Elevated truck weigh scales will be used at the discharge point to weigh the amount of material loaded and are intended to produce a certified for commerce material weight.

During the course of the ongoing construction, it has been brought to our attention that the weigh scale installation does not meet all of the North Dakota standards for weighing devices. The purpose of this letter is to outline the areas where this installation does not meet the standards, provide explanation on how this installation will provide acceptable service, and seek a permanent variance permit under 64-02-02 for the two installed scales.

The terminal has been engineered to produce a fully functional sand handling and storage facility. The design is based upon both company and industry standards used at multiple facilities across the United States. In particular, the functionality of the weigh scales have been reviewed by multiple scale installation companies and found to be able to produce reliable and accurate weighing, with accommodating truck traffic flow.

The truck scales are manufactured by Cardinal Scale Mfg. Co. headquartered in Webb City, Missouri.

North scale: Model 135130-EPR 130' long, steel deck with side rails, 135 ton nominal capacity, Serial Number S0242965
South scale: Model 135120-EPR, 120' long, steel deck with side rails, 135 ton nominal capacity, Serial Number S0242957

The specific standard variance items are identified as follows, with an explanation on each:

69-10-02-05.1 Fixed pitless scales. A fixed pitless scale must have at least twelve inches [304.80 millimeters] of clearance between the "I" beam and the slab and the piers must extend down below the frostline and must be installed to manufacturer's specifications to support the device, prevent shifting, and provide protection from the environment.

The installed truck scales have an overall height to the top of the deck of 15 ½" above the foundation. Under the steel deck is 15 1/8" clear, and at the perimeter of the sections there is 5 1/8" clear under the framing channels. The scales are supported by scale and silo/scale matte concrete foundations, designed by a licensed professional engineer based upon the site specific geotechnical report. The matte foundation is 4'-6" thick, and engineered for the loads from the scale and silos, as well as the local conditions. Each scale passes through a drive-thru opening in two silos, and the portions of the scale outside the silo footprint are covered with metal buildings—the scales are covered for their entire lengths.

The scales have less clearance than the standards specify. However, measures are taken to prevent the buildup or accumulation of material under the scales. As noted above, the scales are protected from the environment by being completely under the silos or metal buildings for their entire lengths. Potential material spillage is also prevented by the use of silo unloading equipment consisting of a retractable spout and spout position, allowing precise delivery of material into the trucks with little to no spillage. In addition, Fairmount Minerals' operating procedures require daily review and cleanup of material on, below or around the truck scales.

69-10-02-09. Deck lengths
2. A motor truck or motor truck dump scale installed on or after January 1,1995, must have at least twelve feet [3.66 meters] or a distance equal to one-third of deck length, whichever is greater, of straight approaches beginning in a level plane with the surface of the scale deck. The slope of the approaches away from the scale deck may not exceed one-third inch [8.47 millimeters] per foot [30.48 centimeters]. The first twelve feet [3.66 meters] of approach from the scale must be of metal or concrete. An inside scale must measure a minimum of five feet [1.52 meters] of reinforced concrete between the scale deck and the inside of the doorsill at both ends of the scale. However, grating of sufficient strength to withstand all loads equal to the concentrated load capacity of the scale may be installed on either end of that inside scale.

The installed truck scales have concrete approaches that are 12' wide and are level from the edge of the scale out 10'-0", then slope down the 15 ½" to grade over an additional 10' length. The area outside each approach is compacted earth with gravel fill cover. Truck flow enters the site from the east, heads west, passes the south side of the silos, then makes a U-turn to enter the silos from the west and exit on the east. The truck path was laid out to allow the trucks to get aligned with the straight path through the silos both on the entrance and exit, with a straight area over 40' long. The scales lengths were oversized to allow the trucks to be fully on the scale during loading in any inlet port.

The concrete approaches used in this installation vary slightly from the standard. However, the overall constraints of the site required that the terminal footprint be minimized. The site has been engineered to allow trucks to have a clear, straight path both entering and exiting the scale, and at a slope that, while working with the site elevations, is also low enough to not impede trucks.

The scales are covered with silos and metal building for their entire lengths. The west end of the scales will have a rollup doors installed on the metal building framing. Those doors, when closed, will be 2'-6" from the edge of the scale.

The rollup doors are closer than the standard. The doors are being installed to protect the length of the metal building and silo interior from the westerly winds. These doors would be open during normal facility operating hours, and closed after operating hours. As such, the doors impose no practical impact at the west end of the scales.

P.O. Box 736, 4115 Progress Drive, Ottawa, IL 61350
815/433-2449 Ext: 8607
www.fairmountminerals.com

Although not identified as a necessary variance item, it should be noted that the scales are operated from the Control/Maintenance building with is approximately 200' from the east end of the scales. Multiple video cameras and radios are used to ensure proper remote operation, and a "scoreboard" weight readout is visible to the truck drivers at the east end of each scale.

Fairmount Minerals believes the weigh scales meet service requirements within accepted tolerances, and seeks a permanent variance. Included with this letter are system layout and scale drawings for your information. We are available to answer any questions that develop from your review, discuss this matter in person or by conference, and submit additional plans, equipment data, or other information you require to complete your review.

Regards,

Josh Turigliatti
Project Manager
Fairmount Minerals

Cc: File

Enc. System drawings GA02753001, GA02753101, GA02753102, S02753101, S02753102.
Scale drawings MD242957-SHT3A, MD242965-SHT3A.

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FAIRMOUNT
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11833 Ravenna Road
Chardon, OH 44024

January 11, 2013

Public Services Commission
North Dakota Weights and Measures
600 E Boulevard, Dept. 408
Bismarck, ND 58505-0480

ATTN: Ms. Shelly Bauske
sbauske@nd.gov

RE: Blaisdell Industrial Sand Terminal Project
6350 67th Ave NW
Blaisdell, ND 58718
SCALE VARIANCE REQUEST DATED 12/17/2012

SUBJECT: ADDITIONAL INFORMATION and ECONOMIC FACTORS

Ms. Bauske:

Thank you for taking the time to discuss the weigh scales and project with Patrick Fahn (ND Weights and Measures), Ryan Butler (Tank Connection) and me on January 7, 2013. The variance request will be presented to the commission on January 16, 2013, and, during the meeting, we were requested to provide additional information on the following items.

1. Pictures of facility, scale, approaches and foundations.
    a. The pictures with notes are attached to this letter.

2. Information on the scale company.
    a. The company that calibrated the scale to State specifications is:
        K-Scale
        1701 W Madison St
        Ste. 100
        Sioux Falls, SD 57104

3. Copy of the calibration paperwork.
    a. A copy of the paperwork is attached to this letter. Note that the Name of Business is not correct, and Kevin at K-Scale indicated he will be submitted a corrected report.

In addition to the previous letter and information provided above and attached, we should note that there were additional factors that drove the selection and use of this type of scale and the overall system design. To increase the scale clearance, and therefore overall height, would have had a severe economic impact on the project. The

increased height would have caused the drive thru openings in both the doghouses and silos to get taller, which would have increase the overall height of the silos, doghouses, and the entire silo loading system including the bucket elevator and stair tower around the bucket elevator. This overall system height increase would have been hundreds of thousands of pounds of steel, additional equipment requirements and had an economic impact on the project in the hundreds of thousands of dollars range.

The existing site, and developed site, also presented limitations to the overall footprint of the system. As it is designed now, the trucks have a straight path into and out of the silos, and are able to maneuver around the site. But, any more site development to accommodate longer approaches or approach slopes would have had severe economic impact on the project.

We ask that the economic factors noted above also be considered during the variance evaluation.

If you have any questions on this information, or other items to discuss, feel free to contact me.

Regards,

Josh Turigliatti
Project Manager
Fairmount Minerals

Cc: File
TC

Enc. Pictures with notes
Copy of ND certification documents

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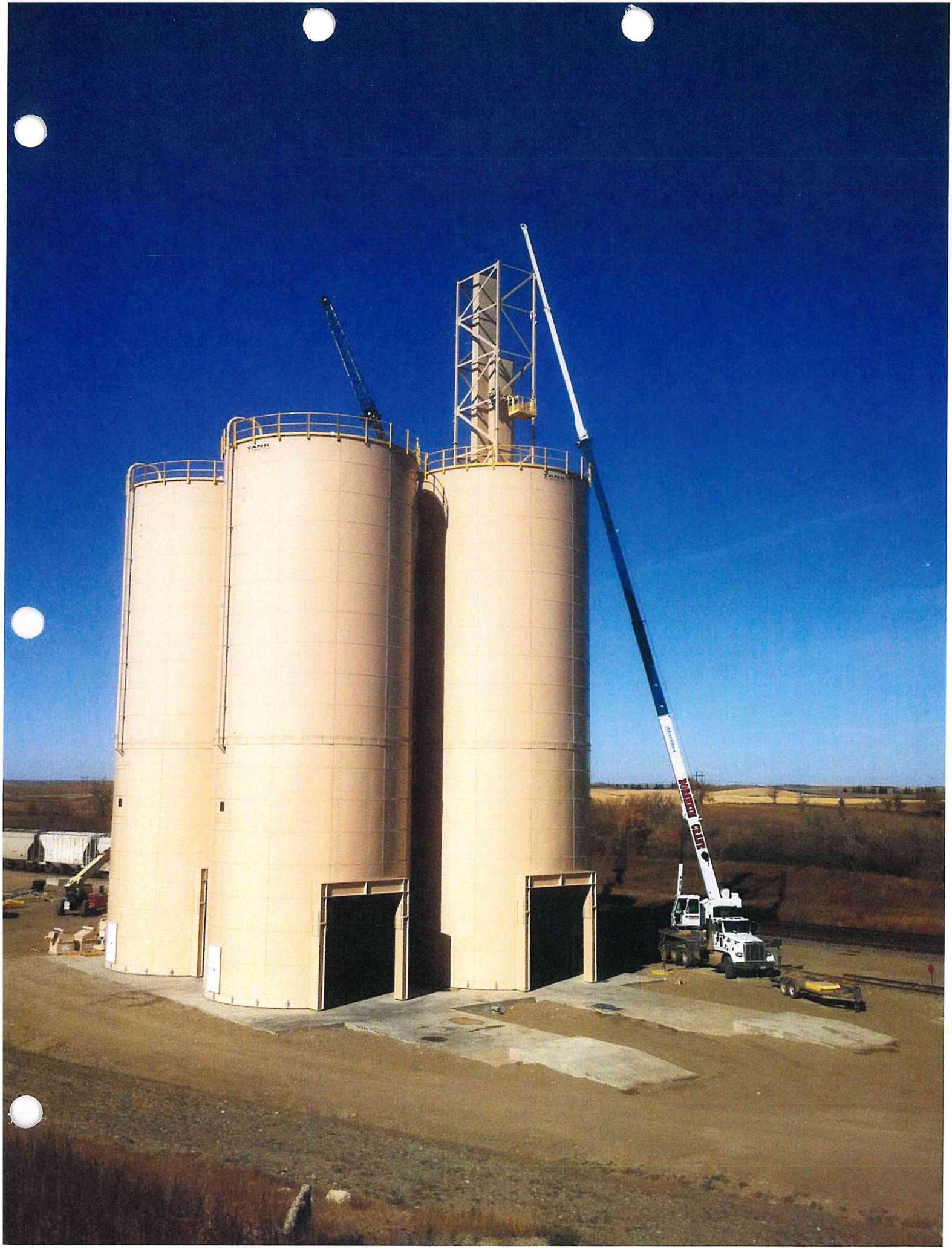
TANK
TANK
MANITOU CRANE


TANK
TANK
VALLEY MECHANICAL, INC


CAUTION


240


JLG 1930ES


Truck Loading Screen - SCALE #2
Truck Loading Screen - SCALE #1
Railcar Unload Screen
SILO #4
40% Full
SILO #3
-1% Full
SILO #2
0% Full
SILO #1
1% Full
SYSTEM IS IDLE
Start
Stop

TEST REPORT

K-Scale LLC
1701 W. Madison St., Ste. 100
Sioux Falls, SD 57104

Invoice Number

Operator No.	Date	Date Last Tested (P&S Only)
	12/13/12	

Name of Business: Fairmot Materials

Location of Device:

Mailing Address:

City: Stanley | State: ND | Zip Code:

County: | Telephone Number:

Check All That Apply

- ☐ Self-Certification ☐ Non-Commercial
- ☐ Equipment Repair ☐ New Installation
- ☐ Routine Service ☐ Annual ☐ Semi-Annual
- ☐ Rejected Equipment Tag #(Attach) _____
- ☐ Service Contract? Expires _____

Variance Posted: ☒ Yes ☐ No R. | Date of Variance: 2.

PSC Device Code: | Quantity (of like devices):

Make(s)	Regulating Element(s)	Serial Number(s)	Lever System
Cardinal	225 Indicator	E27512-0258 / Deck SN# 50242965.	

No. of Sections: 6

☐ Monorail/Track ☐ MTD ☐ Hopper ☐ Livestock ☐ Platform ☐ Axle Load ☐ Multiple ☐ Pit Depth
☐ Aux. Beam ☒ MT ☐ Hanging ☐ Counter Scale ☐ Dormant/Deck ☐ Other

Capacity & Min. Grad.	Class	Size of Platform	Approaches (Length/Condition)
160,000 X 20 LB	III L	11 X 130	10' New

Printer Model	Printer Serial Number	Wind	Temperature	Device Location
Epson TM U590		Inside	0° +/-	East Building

SR (Sensitivity Response) OR Discrimination Test
ZERO LOAD = _____ lb. LOADED = _____ lb.

Motion Detection Range = 3 lb.

AZSM (auto zero) Range = 3 lb.

Device/ Load Position	Amount of Test Equipment Used	Actual Readings As Found	Actual Readings As Left
Cell #1	12,000		0
2	"		0
3	"		+20
4	"		0
5	"		+20
6	"		+20
7	"		0 +20
8	"		0
9	"		+20/0
10	"		0
11	"		0
12	"		0
13			0
14			0

Device/ Load Position	Amount of Test Equipment Used	Actual Readings As Found	Actual Readings As Left
Sec 1	12K	0	0
2		0	0
3		0	0
4		0	0
5		0	0
6		0	0
7			0
Sec 1	20K		0
2			0
3			0/+20
4			+20.
5			+20
6			0
7			0

STRAIN LOAD TEST

	Section #	Section #	Section #	Section #
Empty Truck Weight	32,640			
Total Test Weight Added	20,000			
Truck Plus Weights	52,640/660			
Error on Added Test Weights				

I hereby declare the statements made here are correct:

Are there any other jurisdictional devices at this location that require testing? ☒ Yes ☐ No

HAS SECURITY SEAL AND STICKER BEEN APPLIED? ☐ YES ☒ NO
NO STICKER

☐ Approved ☐ Rejected | Service Agency (Print): K-SCALE LLC

Inspector/Permit Holder Signature | Permit No. 1622

Owner - Operator Signature

REMARKS & ADJUSTMENTS MADE

Temp was +20/6°
Winds Not a Factor. Scale is under a roof.

This Scale is Not being placed in service. Variances pending.

Results are on the day Tested.
This Scale is difficult to hold Tolerance because of so many cells.

1 Copy to Public Service Commission, 600 E. Boulevard Avenue, Bismarck, ND 58505 / 1 Copy to Owner/Operator

TEST REPORT

K-Scale LLC
1701 W. Madison St., Ste. 100
Sioux Falls, SD 57104

Invoice Number

Operator No.	Date	Date Last Tested (P&S Only)
	12/13/12	

Name of Business: Fairmont Materials
Location of Device:
Mailing Address:
City: Stanley | State: ND | Zip Code:
County: | Telephone Number:

Check All That Apply

- ☐ Self-Certification ☐ Non-Commercial
- ☐ Equipment Repair ☐ New Installation
- ☐ Routine Service ☐ Annual ☐ Semi-Annual
- ☐ Rejected Equipment Tag #(Attach) _____
- ☐ Service Contract? Expires _____

Variance Posted: ☒ Yes ☐ No ?
Date of Variance: ?
PSC Device Code:
Quantity (of like devices):

Make(s): Cardinal
Regulating Element(s): 225 Indicator
Serial Number(s): 5024295 / E27512-0054
Lever System:
No. of Sections: 6
☐ Monorail/Track ☐ MTD ☐ Hopper ☐ Livestock ☐ Platform ☐ Axle Load ☐ Aux. Beam ☒ MT ☐ Hanging ☐ Counter Scale ☐ Dormant/Deck ☐ Other
Multiple:
Pit Depth:
Capacity & Min. Grad.: 160,000 X 20 LB
Class: III L
Size of Platform: 11 X 120
Approaches (Length/Condition): 10'
Printer Model: Epson TM U590
Printer Serial Number:
Wind: inside
Temperature: 0°
Device Location: East Building
SR (Sensitivity Response) OR Discrimination Test
ZERO LOAD = _____ lb. LOADED = _____ lb.
Motion Detection Range = 3 lb.
AZSM (auto zero) Range = 3 lb.

Device/ Load Position	Amount of Test Equipment Used	Actual Readings As Found	Actual Readings As Left
Cell #1	12,000		0
2	"		0
3	"		0
4	"		0
5	"		+20
6	"		0
7	"		0
8	"		0
9	"		+20/0
10	"		0
11	"		0
12	"		0

Device/ Load Position	Amount of Test Equipment Used	Actual Readings As Found	Actual Readings As Left
Sec 1	12K	0	0
2		0	0
3		0	0
4		0	0
5		0	0
6		0	0
Sec 1	20K		0
2			0
3			0/+20
4			0/+20
5			0
6			0

STRAIN LOAD TEST

	Section #	Section #	Section #	Section #
Empty Truck Weight: 32,640				
Total Test Weight Added: 20,000				
Truck Plus Weights: 52,640/660				
Error on Added Test Weights				

I hereby declare the statements made here are correct:

Are there any other jurisdictional devices at this location that require testing? ☒ Yes ☐ No
HAS SECURITY SEAL AND STICKER BEEN APPLIED? ☐ YES ☒ NO
NO STICKER
☐ Approved ☐ Rejected
Service Agency (Print): K-SCALE LLC
Inspector/Permit Holder Signature:
Permit No.:
Owner - Operator Signature:

REMARKS & ADJUSTMENTS MADE

TEMP was +2°
WINDS NOT a Factor. SCALE is under a roof.
This SCALE is NOT being placed IN service. Variances pending
Results are on the day Tested.

1 Copy to Public Service Commission, 600 E. Boulevard Avenue, Bismarck, ND 58505 / 1 Copy to Owner/Operator

ARTICLE 69-10

TESTING AND SAFETY

CHAPTER 69-10-01
WEIGHTS AND MEASURES - GENERAL

69-10-01-01. Definitions. As used in article 69-10:

1. "Automatic bulk weighing system" means a weighing system which weighs grain in successive drafts, automatically records the no-load and loaded weight values, and accumulates the net weight of each draft.

2. "Batching scale" means a noncommercial weighing or measuring device used to determine, in part, the amount of an ingredient in a finished, manufactured commodity.

3. "Certify" means to seal, if upon testing and inspection, a weighing or measuring device is within the permitted tolerance and properly installed.

4. "Commerce" means the distribution or consumption of quantities, things, produce, commodities, or articles which may be offered or submitted by any person for sale or hire.

5. "Equipment repair notice tag" means a tag that allows a device to be operated for sixty days from its inspection date pending correction of cited defects relating to the device or any of its required peripheral equipment. The tag defaults to a rejection tag if the device is not in compliance within sixty days.

6. "Liquid or LPG computing pump" means a device that provides fuel or LPG to a consumer.

7. "NIST" means the United States department of commerce, national institute of standards and technology.

8. "Not sealed" means a sticker or seal applied to a device which has not been inspected and tested, does not meet applicable design or tolerance requirements, or is no longer being used commercially. A device that is not sealed shall not be used in commerce.

9. "Random testing" means the random retesting and recertification by a weights and measures inspector of any weighing or measuring device being tested under the self-certification rules.

10. "Registered service person" means a person or agency authorized by the commission to remove an official rejection seal placed on a weighing or measuring device or to repair and certify weighing and measuring devices described in North Dakota Century Code section 64-02-13.

11. "Rejected for repair" means a sticker or seal applied to a device which has been inspected and tested and does not meet applicable design or tolerance requirements. A device that is rejected for repair shall be modified or repaired by a registered service person within thirty days of

the date it was rejected and may not be used in commerce until placed into service.

12. "Retail fuel device" means a commercial, indicating fuel pump used to deliver fuel to individual highway vehicles in quantities of one hundred gallons [378.54 liters] or less per transaction.

13. "Seal" means marking a weighing or measuring device to show certification or rejection.

14. "Security seal" means either a lead and wire pressure-sensitive seal, a plastic and wire pressure-sensitive seal, or a sealing sticker, permanently attached to a weighing or measuring device to prevent unauthorized access to the tolerance-adjusting mechanisms of that device.

15. "Single draft weighing" means simultaneously weighing each end of a vehicle or individual elements of coupled combination vehicles.

16. "Split-weighing" means determining the weight of a vehicle, combination vehicle, or a commodity by adding together the results obtained by separately and not simultaneously weighing each end of such vehicle or individual elements of such coupled combinations.

17. "Standard" means test equipment used for certifying weighing or measuring devices.

18. "Variance permit" means a temporary or permanent suspension of a particular rule granted to an owner or operator of a commercial weighing or measuring device because of an economic hardship, a site restriction requiring modification to the design or installation of a device, or a special installation or operational condition, to be determined by the commission on a case-by-case basis.

19. "Weights and measures inspector" means a commission employee in the testing and safety division performing duties set by the commission.

History: Amended effective April 1, 1992; August 1, 1993; September 1, 1994; February 1, 1996; July 1, 1997; July 1, 1998; August 1, 2000; January 1, 2002; March 1, 2003; November 1, 2003; July 1, 2008.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-03

69-10-01-02. Installation by other than a registered service person. A person, other than a registered service person, who installs a commercial weighing or measuring device must report the installation to the commission within seven working days from the day the installation was completed. The device must then

be certified by a weights and measures inspector or a registered service person, as allowed by section 69-10-04-02.1, before the device can be used in commerce.

History: Amended effective April 1, 1992; August 1, 1993; July 1, 1997; July 1, 1998.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

69-10-01-02.1. Certification. A weighing and measuring device may only be certified for commercial use by the commission or a registered service person. Certification must take place at the location of intended use unless the device is otherwise designed, in which case the device must be tested by the commission at the location of intended use within fifteen months of its installation. The commission may certify a weighing or measuring device by actual testing of the device, or by witnessing the test.

History: Effective April 1, 1992; amended effective August 1, 1993; September 1, 1994; February 1, 1996; July 1, 1997; July 1, 1998.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

69-10-01-02.2. Repair and calibration. A commercial weighing and measuring device may only be repaired, tested, calibrated, and placed into commercial service by a registered service person, or tested and adjusted, as allowed by law, and certified for commercial service by the commission, whichever is applicable.

History: Effective July 1, 1997.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

69-10-01-02.3. Recertification. The commission or a registered service person may inspect, test, and calibrate a commercial weighing or measuring device annually. The owner of any commercial weighing or measuring device is responsible for its accuracy and must have it tested once every fifteen months. Commission staff shall issue a written compliance order to the owner or operator of any commercial device that has not been tested within the fifteen-month time limit. The compliance order must allow thirty days for the owner of the device to have it recertified by a registered service person. Failure to comply with a compliance order within the thirty-day time limit will cause the device to be removed from commercial service.

History: Effective July 1, 2008.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

69-10-01-03. Sealing. A weighing or measuring device used in commerce must be certified and sealed. A security seal must be installed where applicable, to prevent adjustments to the calibration of the device. An adhesive sticker that is of

sufficient quality that it remains readable and unaffected by the elements must be installed externally to show visual proof of certification. It is unlawful to remove, or allow to be removed, an official tag or seal without commission approval. Effective January 1, 1995, an adhesive sticker must contain the following information: name and telephone number of the commission or registered service company certifying the device, the words "tested and approved", and the month and year of certification.

History: Amended effective April 1, 1992; August 1, 1993; September 1, 1994; July 1, 1997; July 1, 1998; January 1, 2002; July 1, 2008.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

69-10-01-03.1. Registration of a new or moved commercial device. A written report must be filed with the commission by the owner or operator of any new commercial weighing or measuring device and any commercial weighing or measuring device that has been moved from its original location of certification within seven working days of installation or relocation.

History: Effective July 1, 1997; amended effective July 1, 1998; January 1, 2002.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

69-10-01-03.2. Equipment repair notice - Applicable usage. An equipment repair notice tag may be used in the following circumstances:

1. During the period any one of the following is pending:

    a. Response to a variance permit request;

    b. Completion of design requirements; or

    c. Repair of required peripheral equipment;

2. When a point of sale liquid-measuring device:

    a. Is a retail liquid-measuring device that is no more than two cubic inches [32.77 milliliters] outside of the applicable tolerance for over-registration or ten cubic inches [163.87 milliliters] outside the applicable tolerance for under-registration, using a five gallon [18.93 liter] test measure;

    b. Is a vehicle tank or wholesale liquid-measuring device that is no more than twenty-two cubic inches [360.52 milliliters] outside of the applicable tolerance for over-registration or one hundred cubic inches [1638.71 milliliters] outside the applicable tolerance for under-registration, using a one hundred gallon [378.54 liter] prover;

c. Is an LPG liquid-measuring device that is no more than five-tenths of one percent outside of the applicable tolerance for over-registration or five percent outside the applicable tolerance for under-registration, using a one hundred gallon [378.54 liter] test with a one hundred gallon [378.54 liter] prover;

d. Is an LPG or anhydrous ammonia liquid-measuring device equipped with an automatic temperature compensating system, the allowable error difference between an activated and not activated mechanical or electronic automatic temperature compensating system is no more than one-half of one percent outside of the applicable tolerance for over-registration or under-registration; or

e. Is a liquid hydrocarbon or agri-chemical measuring device that has an automatic temperature compensating system, the difference between the meter error (expressed as a percentage) for results determined with and without the mechanical or electronic automatic temperature compensating system activated may be no more than one-tenth of one percent outside of the applicable tolerance for over-registration or under-registration;

3. When a point of sale weighing device is no more than one scale division outside of applicable tolerance for over-registration or two scale divisions outside the applicable tolerance for under-registration; or

4. When a point of purchase or point of sale weighing device is no more than one scale division outside of applicable tolerance for over-registration or under-registration.

History: Effective March 1, 2003; amended effective November 1, 2003; May 1, 2005; July 1, 2008.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

69-10-01-04. Registration of new devices - Moving existing devices. Repealed effective April 1, 1992.

69-10-01-04.1. Variance permit requests. The operator of any commercial weighing or measuring device, other than an operator seeking a split-weigh variance permit under section 69-10-01-04.2, may make written request for a variance permit from the commission under North Dakota Century Code section 64-02-02. The request for a variance permit must contain:

1. The name, address, and telephone number of the business making the request along with the name of its contact person and the reason for the request;

2. A plan for compliance over a period not to exceed one hundred eighty days if the variance permit request results from a rejection; or, a plan for compliance over a period not to exceed five years if the variance request results from economic hardship. Through reapplication, the economic hardship variance may be a permanent variance permit provided the applicant can show that compliance will continue to cause economic hardship;

3. The manufacturer's name, type, location, serial number, deck length, and capacity of the device;

4. The maximum amount that will be weighed on the device, along with a certified letter from an engineer or competent scale engineering authority certifying that operating the device at that weight will not constitute a safety hazard (if applying for a variance permit that will allow a device to be used beyond its rated sectional or concentrated load capacity);

5. Detailed information showing that compliance with specific regulations will cause economic hardship (if applicable to the variance permit request); and

6. Any other information the operator believes may expedite the variance permit request.

A variance permit granted by the commission is a temporary variance permit and does not become permanent until sufficient time to conclude inspection and testing (usually two years) has elapsed. A notice of the variance permit must be conspicuously posted on the device during the time the temporary variance permit is in effect.

History: Effective August 1, 1993; amended effective September 1, 1994; February 1, 1996; July 1, 1997; July 1, 2008.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

69-10-01-04.2. Split-weigh variance permit requests. The operator of any motor truck or motor truck dump scale installed after April 1, 1965, may make written request for a permanent split-weigh variance permit from the commission under North Dakota Century Code section 64-02-02. The request for a variance permit must contain:

1. The name, address, and telephone number of the business making the request along with the name of its contact person and the reason for the request;

2. The manufacturer's name, type, location, deck length, serial number, and capacity of the device;

3. The maximum amount of weight that will be placed upon the device at any time during the split-weighing operation. If that maximum weight exceeds the rated sectional capacity or concentrated load capacity of the device, the applicant must also include a letter from an engineer or competent scale engineering authority certifying that operating the device at that weight will not constitute a safety hazard;

4. The maximum distance between the front and rear outer axles of the vehicle or coupled-combination vehicle that will be split-weighed;

5. A statement in the variance permit request certifying that each axle of the vehicle or each axle of the coupled-combination vehicle will rest on a straight surface, in the same plane with, and not to exceed one-third inch [8.47 millimeters] per foot [30.48 centimeters] out of level with, the scale deck during the split-weighing operation;

6. A statement in the variance permit request agreeing to the following procedures to be observed during the split-weighing operation:

   a. Use of the vehicle brakes is prohibited;

   b. The vehicle transmission must be in neutral; and

   c. Chocking of the vehicle's wheels should be discouraged.

7. For an operator of a motor truck or motor truck dump scale installed after April 1, 1995, a temporary variance permit will be issued only if the operator has substantiated that it is unable to install a scale of sufficient length to allow single-draft weighing due to economic hardship. If the operator chooses to pursue the plea of economic hardship, then the operator's split-weigh variance permit request must also include a plan for compliance over a period not to exceed five years. Through reapplication, at the end of the five-year period, the economic hardship temporary variance permit may be made a permanent variance permit provided the operator can show that compliance will continue to cause economic hardship.

History: Effective February 1, 1996; amended effective July 1, 1997; July 1, 2008.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-04

69-10-01-05. Rejected devices. Once a weighing or measuring device has been rejected, the device may not be used in commerce. The commission may install a security seal on the device to prevent its use until the device has been retested and certified or a variance permit has been granted.

History: Amended effective April 1, 1992; September 1, 1994; July 1, 2008.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

69-10-01-05.1. Inactive weighing or measuring devices. An inactive commercial weighing or measuring device unused or tagged "not sealed" for longer than one year, must meet all current state laws and rules before it may be retested and certified, unless the operator receives a variance permit allowing for the use of the device.

History: Effective September 1, 1994; amended effective July 1, 1997; July 1, 2008.
General Authority: NDCC 28-32-02, 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-04

69-10-01-06. Liquefied petroleum gas meters. Repealed effective April 1, 1992.

69-10-01-06.1. Liquefied petroleum gas meters - Temperature compensation. All sales of liquefied petroleum gas in a liquid state shall be made through a meter having an automatic temperature conpensator. The compensator shall be connected, operable, and in use at all times.

History: Effective February 1, 1996.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-03

69-10-01-07. Sale of liquid fuels on other than gross volume basis prohibited. Repealed effective July 1, 2008.

69-10-01-08. Assisting inspector. When requested, the owner or operator of any commercial weighing or measuring device shall supply access and assistance to the division inspector in movement of the test weights to and from and on and off the scale for testing purposes, or for returning liquids to aboveground or belowground storage tanks. Failure to provide inspector access and assistance in a timely manner may be grounds for tagging the device "not sealed".

History: Effective August 1, 1993; amended effective September 1, 1994; February 1, 1996.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

69-10-01-09. Bulk liquid fuel meters. Repealed effective August 1, 2000.

69-10-01-09.1. Bulk liquid fuel meters - Retail sales. Meters designed for bulk loading use may not be used for retail fuel sales without first obtaining a variance from the commission, which may be granted for no longer than six months.

History: Effective September 1, 1994.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

69-10-01-09.2. Bulk liquid fuel meters - Marking. A bulk liquid fuel meter used in commerce and not marked from the manufacturer with the liquid to be measured must be sealed with a tag indicating the product for which the meter is designed to deliver, or the liquid used to certify the meter if other than the design liquid.

History: Effective September 1, 1994.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

69-10-01-09.3. Bulk liquid fuel meters - Design use. A bulk liquid fuel meter may not be used for the commercial delivery of any liquid fuel that is not substantially similar in physical properties to the liquid fuel for which it was designed, tested, and certified.

History: Effective September 1, 1994.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

69-10-01-10. Examination of records. The commission may obtain copies of, and examine any weigh ticket, weigh receipt, meter printer ticket, or any other record of sale resulting from the operation of any commercial weighing or measuring device.

History: Effective August 1, 1993.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

69-10-01-10.1. Retention of records. A record of a sale such as a weigh ticket, weigh receipt, meter printer ticket, or any other record resulting from the operation of any commercial weighing or measuring device must be maintained on file at the place of sale for a period of not less than two years from the date of sale.

History: Effective July 1, 1998.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

69-10-01-11. Device adjustments. State weights and measures inspectors may not make adjustments to a commercial weighing or measuring device other than to zero a device or adjust the level on certain counter, dormant, and platform scales.

History: Effective September 1, 1994; amended effective July 1, 1997; November 1, 2003.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

69-10-01-12. Sale of anhydrous ammonia. The sale of anhydrous ammonia after January 1, 1999, on any basis other than by certified scale or

certified meter by any new or newly expanded anhydrous ammonia dealer is prohibited.

History: Effective July 1, 1997.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

69-10-01-13. Enforcement. An operator of a commercial weighing and measuring device shall ensure that the device is designed, constructed, operated, and maintained to meet applicable standards in state and national institute of standards and technology handbook no. 44 requirements (1999 edition). The commission may require proof of compliance. The commission may file a complaint for noncompliance, and, in addition to other appropriate sanctions, assess civil penalties under North Dakota Century Code chapter 49-07 after notice and opportunity for hearing on the complaint.

History: Effective May 1, 2005; amended effective July 1, 2008.
General Authority: NDCC 49-07, 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

69-10-01-14. Inspection and testing accessibility. A commercial weighing or measuring device must be installed so that it is easily accessible for inspection and testing.

History: Effective May 1, 2005.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

69-10-01-15. Devices taken out of service. When a state weights and measures inspector or a registered service person removes a commercial weighing or measuring device from service, the inspector or registered service person shall notify the commission in writing within seven working days of the removal.

History: Effective May 1, 2005.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

69-10-01-16. Service contracts. Registered service companies shall notify the commission of any service contract that provides for annual certification of a commercial device. Notification must be given no later than thirty days from the date of the verbal or written contract. Commercial devices under service contract that have not been tested within twelve months may be scheduled for testing by the commission.

History: Effective May 1, 2005; amended effective July 1, 2008.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

69-10-01-17. Manufacturer design deviations and limitations. Deviations from the manufacturer's design, installation specifications, intended application, or established limits applicable to any commercial weighing or measuring device are not permitted without approval from the manufacturer's engineering authority and a variance permit granted by the commission.

History: Effective July 1, 2008.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

CHAPTER 69-10-02
SCALES

69-10-02-01. Livestock scales - Specifications. A commercial livestock scale must be equipped with a type registering print device, and the value of the minimum graduated interval must not be greater than five pounds [2.27 kilograms], provided, however, that for scale capacities in excess of fifty thousand pounds [22679.6 kilograms] the scale may indicate and record in ten-pound [4.54-kilogram] divisions. A scale rack on a livestock scale must be securely mounted on the scale platform, with adequate clearance between the outside of the rack and other obstructions. The steel yard or beam rod must be connected directly to the transverse lever.

History: Amended effective July 1, 1997.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

69-10-02-02. Livestock scales - Installation. All livestock scales must be installed so as to permit ready access for large capacity testing equipment. At the one end of a livestock scale there must be a straight concrete approach the full width of the scale platform, in the same plane as the scale platform and equal in length to the width of the scale platform in order to provide a clean and level area for the purpose of unloading test weights used in testing the scale. Provisions must be made to allow the test truck to back up to the approach by providing an entrance of adequate height and width to enable the test truck to be reasonably level when weights are unloaded. A livestock scale newly constructed after July 1, 1993, must have a minimum entrance and approach width and height of twelve feet [3.66 meters].

A livestock ring scale constructed after January 1, 1998, must have an approach that is level with the scale platform and at least twenty-eight feet [8.53 meters] in length and ten feet [3.05 meters] in width.

History: Amended effective August 1, 1993; July 1, 1997.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

69-10-02-02.1. Livestock scales - Certification. All livestock scales under the jurisdiction of the federal packers and stockyards administration must be certified once every six months. The scales may be certified by either a weights and measures inspector or a registered service person.

History: Effective August 1, 1993.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

69-10-02-03. Twister head extensions. The twister head extensions cannot be used under any conditions in the installation of motor truck, motor truck dump, or livestock scales. Extension levers used on motor truck, livestock, or motor dump truck scales must be securely anchored to or suspended from concrete of the neck or walls of the scale pit.

History: Amended effective August 1, 1993.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

69-10-02-04. Steel yard rod. The steel yard rod connecting the weighbeam to the transverse lever on all scales must be installed or shielded to prevent interference.

General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

69-10-02-05. Portable pitless scales and portable hopper scales. A self-contained portable pitless scale and a self-contained portable hopper scale used solely to weigh materials used for government highway construction

are exempt from the provisions of this article. Installation and operation of a self-contained portable pitless scale and a self-contained portable hopper scale for commercial use without a variance permit from the commission is prohibited.

History: Amended effective April 1, 1984; August 1, 1993; September 1, 1994; February 1, 1996; July 1, 1997; July 1, 2008.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

69-10-02-05.1. Fixed pitless scales. A fixed pitless scale must have at least twelve inches [304.80 millimeters] of clearance between the "I" beam and the slab and the piers must extend down below the frostline and must be installed to manufacturer's specifications to support the device, prevent shifting, and provide protection from the environment.

History: Effective August 1, 1993; amended effective September 1, 1994; February 1, 1996.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

69-10-02-06. Clearances - Drainage - Pit entrances. Motor truck, motor truck dump, and livestock scales, other than fixed pitless scales, regardless of capacity, must have a clearance of not less than four feet [12.19 decimeters] from the finished floorline of the scale pit to the bottom of the "I" beam of the scale bridge. A five-eighths-inch [15.88-millimeter] clearance must be provided between the live deck and the pit coping. A "crushing strip" or "rock guard" must be installed in the event a concrete deck is installed on a scale; wood decks must be undercut around deck to prevent foreign material from lodging between deck and coping. Scale pits must be kept reasonably clean and dry at all times, and adequate drainage must be provided. Convenient entrances to the scale pit must be provided for the purpose of inspecting and cleaning.

History: Amended effective August 1, 1993; September 1, 1994.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

69-10-02-07. Foundation and supports. The foundation and supports of any scale installed in a fixed position shall consist of reinforced concrete of sufficient strength to ensure rigidity and permanence. The fulcrum stands for the levers or the load cells of large capacity scales must be installed on level piers with a minimum of grouting. All footings must be of adequate depth to extend below the frostline.

History: Amended effective August 1, 1993.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

69-10-02-08. Deviations from manufacturer's design. Repealed effective July 1, 2008.

69-10-02-09. Deck lengths.

1. A motor truck or motor truck dump scale installed and operational before January 1, 1995, must have at least twelve feet [3.66 meters] or a distance equal to one-third of deck length, whichever is greater, of straight driveway on either end of the scale deck not over one-third inch [8.47 millimeters] per foot [30.48 centimeters] out of level with the platform. The first twelve feet [3.66 meters] from the scale must be of a hard surface (concrete or asphalt). An inside scale must measure a minimum of four feet [1.22 meters] of metal, wood, asphalt, or reinforced concrete between the scale deck and the inside of the doorsill at both ends of the scale.

2. A motor truck or motor truck dump scale installed on or after January 1, 1995, must have at least twelve feet [3.66 meters] or a distance equal to one-third of deck length, whichever is greater, of straight approaches beginning in a level plane with the surface of the scale deck. The slope of the approaches away from the scale deck may not exceed one-third inch [8.47 millimeters] per foot [30.48 centimeters]. The first twelve feet [3.66 meters] of approach from the scale must be of metal or concrete. An inside scale must measure a minimum of five feet [1.52 meters] of reinforced concrete between the scale deck and the inside of the doorsill at both ends of the scale. However, grating of sufficient strength to withstand all loads equal to the concentrated load capacity of the scale may be installed on either end of that inside scale.

History: Amended effective September 1, 1994; February 1, 1996.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

69-10-02-10. Indicating and printing elements. A beam-type or dial-type indicating element must be installed in a level and plumb position, mounted on concrete piers, or on a concrete slab, and fastened securely to the concrete walls or neck of the scale pit. These mechanical indicating element foundations must be independent of the scalehouse floor, weighing room, or other similar structures. The installation of a dial must allow for adequate clearance for service between the cabinet of the dial and the wall. Motor truck, motor truck dump, railroad track, and livestock scales installed after July 1, 1973, and used in commerce, must be equipped with a ticket printing device with a copy of the printed receipt issued to the customer at the time of the delivery. Notwithstanding the above, for a scale installed prior to July 1, 1973, equipped with any type of ticket printing capability, its operator must use that ticket printing capability for all sales, with a copy of the printed ticket to be issued to the customer at the time of the delivery. A shoulder or stop must be provided on each weighbeam bar to prevent the poise from traveling

and remaining behind the zero graduation. An indicating or printing element must be adequately protected against environmental damage.

History: Amended effective August 1, 1993; September 1, 1994; February 1, 1996; July 1, 1997.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

69-10-02-11. Limits established by factory-rated scale capacity. Repealed effective July 1, 2008.

69-10-02-12. Observation windows or video cameras. Windows must be provided and must be located in such a position and manner so that the scale operator has full view of the scale platform and weighing operation from the scale operator's working position, and that the weighman and indicating elements are clearly visible to interested parties. Video cameras may be substituted for windows if the substitution does not diminish the view for either the scale operator or other interested parties. However, installations that exceed two hundred feet [61 meters] from the main indicating element must be equipped with two-way audio communication and remote or video display of weight indication.

History: Amended effective August 1, 1993; September 1, 1994; July 1, 2008.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

69-10-02-13. Inspection and testing accessibility. Repealed effective May 1, 2005.

69-10-02-14. Assisting inspector. Repealed effective August 1, 1993.

69-10-02-15. Counter computing scales. Repealed effective August 1, 2000.

69-10-02-16. Automatic bulk-loading systems - Receiving. A commercial automatic bulk-loading system used for receiving grain may not be commercially operated without first receiving a variance permit from the commission. Before receiving any grain through an automatic bulk-weighing system, a certified commercial truck scale must be made available to the seller for optional check weighing.

History: Effective September 1, 1994; amended effective July 1, 2008.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

69-10-02-17. Coal belt conveyor scales jurisdictional - Exemption. Coal belt conveyor scales not used for coal sales to the general public, or not used for

the sale of coal on behalf of leasehold interests, are exempt from the provisions of this article.

History: Effective September 1, 1994; amended effective January 1, 2002.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-03-07

69-10-02-18. Concrete hopper scales - Jurisdiction. A concrete hopper scale that is used for measuring a finished concrete product that is sold by a measurement other than weight, even though the quality of its composition (cement, sand, aggregate, and water) is determined by weight, shall be defined as a "batching scale" and is exempt from the provisions of this article.

History: Effective September 1, 1994.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

69-10-02-18.1. Exemptions from testing. Grain moisture testing meters, jewelers' scales, prescription scales, and postal scales used by the United States postal service are exempt from the provisions of this article.

History: Effective January 1, 2002.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

69-10-02-19. Single-draft weighing - Exceptions. It shall be unlawful to weigh a vehicle or a combination vehicle in any method other than the single-draft method, as outlined in the NIST Handbook No. 44, section 2.20. scales, UR.3.3., Single-draft Vehicle Weighing, except for the following:

1. When the sale of the commodity being weighed is determined by destination weight;

2. For a motor truck or motor truck dump scale installed prior to April 1, 1965; or

3. For a motor truck or motor truck dump scale installed after April 1, 1965, provided a split-weigh variance permit has first been granted by the commission under section 69-10-01-04.2, and the parties involved have complied with section 69-10-02-20 prior to split-weighing.

History: Effective February 1, 1996; amended effective August 1, 2000; July 1, 2008.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-03, 64-02-04

69-10-02-20. Split-weigh agreements. Upon approval by the commission of a variance permit allowing split-weighing, and before an individual customer is split-weighed, an approved split-weigh agreement form must be signed by both the

business and that customer, and kept on file at the place where the split-weighing occurs.

History: Effective February 1, 1996; amended effective July 1, 2008.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-03, 64-02-04

69-10-02-21. Shift test - Load-bearing and section testing. After January 1, 1996, all motor truck, motor truck dump, and railroad track/truck combination scales shall be load-bearing and section tested. The load-bearing test must be conducted with a minimum standard of the lesser value of either ten thousand pounds [4535.9 kilograms] or one-quarter the device capacity in test weights, with the test weights centered, as nearly as possible, successively over each main load support. Section testing shall be conducted with a minimum standard of either twenty thousand pounds [9071.8 kilograms] or one-half the device capacity in test weights, with the test weights centered, as nearly as possible, successively at the center of each quarter of the load receiving element. Applicable tolerances from NIST Handbook No. 44, scale section, T.N.3.1. and T.N.3.2., shall be applied to the amount of test load used.

History: Effective February 1, 1996.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-03, 64-02-04

69-10-02-22. Sensitivity response. The sensitivity response of a motor truck or motor truck dump scale designed with a division size of five pounds [2.27 kilograms] and without a balance indicator may not exceed four scale divisions.

History: Effective October 1, 1999.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-03, 64-02-04

69-10-02-23. Stored tare weight. A stored tare weight across a motor truck or motor truck dump scale may not be used for more than one commercial transaction.

History: Effective January 1, 2002.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02

69-10-02-24. Electronic scale data storage and retrieval. Computer programming installed on commercial scales after January 1, 2002, enabling the electronic recording or storage of scale weight must conform to the following:

1. If more than one scale is interfaced, the system must store the identity of the scale which originated the weight and all printed data must identify the scale which originated the weight;

2. Any weight which is manually entered must be identified as manually entered on all recorded weights;

3. All recorded weights must match actual scale-weight indications;

4. All recalled weights must match stored weights;

5. Stored weight must have a recorded audit trail on a dedicated line printer in a continuous format which includes an "S" indicating that it is a stored weight; a sequential reference number; a scale identifier number; a unique reference number to enable the recall of that stored weight; and the stored weight;

6. Any stored weight which is recalled must be immediately printed on a scale ticket with the following information: an "R" indicating that it is a recalled weight; the unique reference number identified in subsection 5; and the recalled weight;

7. After the transaction is completed, the recalled weight must be automatically deleted from the recalled weights data file;

8. Computer computations such as rounding off and truncation must be programmed so that the computations do not result in the degradation of the accuracy of the scale tolerance by more than one-half of one scale division; and

9. Programming must ensure all essential data is properly entered and stored before issuing a weight ticket.

History: Effective January 1, 2002; amended effective May 1, 2005; July 1, 2008.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02

69-10-02-25. Law enforcement scales. Axle load scales or portable wheel load scales used to enforce load limit restrictions by the North Dakota highway patrol may be tested annually, but must be tested at least once every fifteen months.

History: Effective May 1, 2005; amended effective July 1, 2008.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02

69-10-02-26. Hoppers scale design requirements. The owner of a commercial hopper scale shall provide a bracket or lifting arms able to utilize a hand-operated chain hoist that will facilitate testing with five hundred pounds [226.80 kilograms] or larger test weights. The brackets or lifting arms must be of sufficient strength for the intended load and permanently and legibly marked with a maximum load rating.

All commercial hopper scales, newly constructed and placed into service after the effective date of this rule, must have a minimum of three feet [.91 meter] of unobstructed clearance on all four sides to facilitate testing with large weights.

Notwithstanding the provisions of this section, automatic bulk-weighing systems with integral standards, overhead hopper scales accessible underneath, and hopper scales with capacities of five thousand pounds [2267.96 kilograms] or less are exempt from this requirement.

History: Effective July 1, 2008.
General Authority: NDCC 64-02-03
Law Implemented: NDCC 64-02-02, 64-02-13

NIST
National Institute of
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as adopted by the 96th
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Weights and Measures 2011

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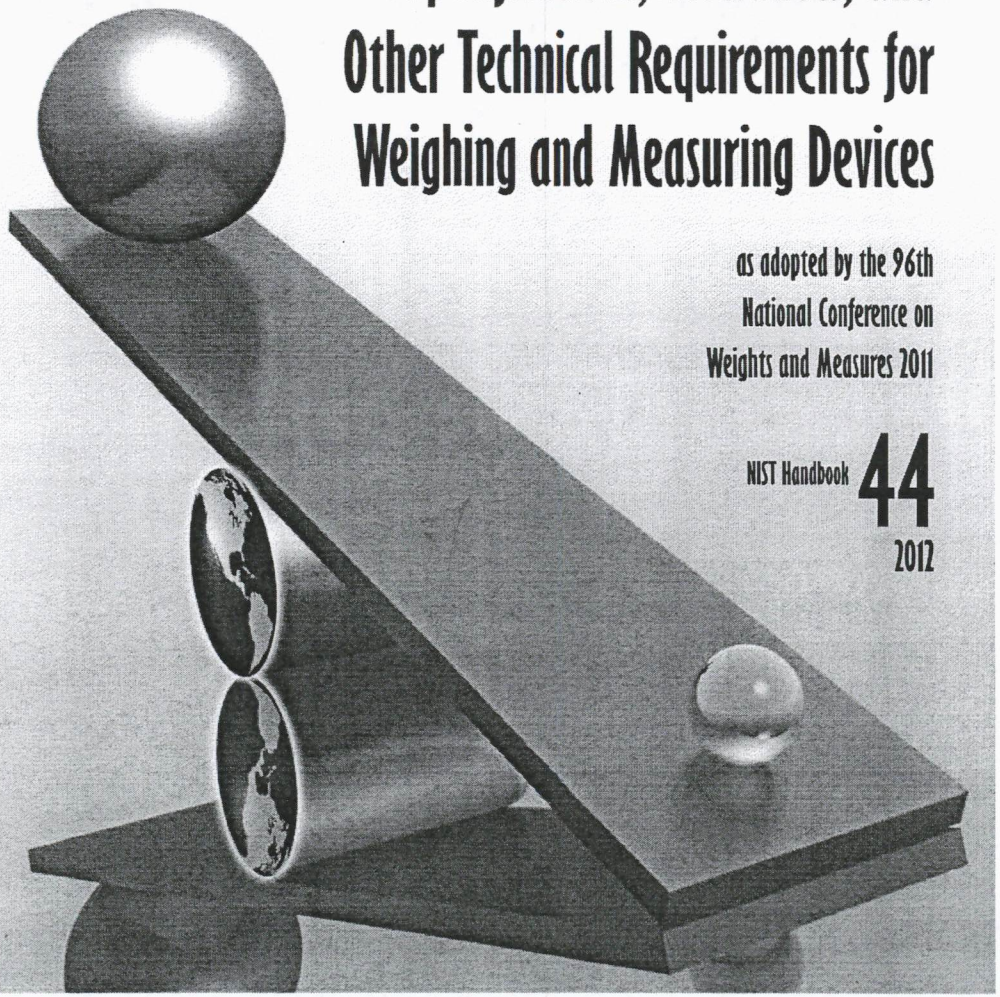

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G-UR. User Requirements

G-UR.1. Selection Requirements.

G-UR.1.1. Suitability of Equipment. – Commercial equipment shall be suitable for the service in which it is used with respect to elements of its design, including but not limited to its weighing capacity (for weighing devices), its computing capability (for computing devices), its rate of flow (for liquid-measuring devices), the character, number, size, and location of its indicating or recording elements, and the value of its smallest unit and unit prices.

(Amended 1974)

G-UR.1.2. Environment. – Equipment shall be suitable for the environment in which it is used including, but not limited to, the effects of wind, weather, and RFI.

(Added 1976)

G-UR.1.3. Liquid-Measuring Devices. – To be suitable for its application, the minimum delivery for liquid-measuring devices shall be no less than 100 divisions, except that the minimum delivery for retail analog devices shall be no less than 10 divisions. Maximum division values and tolerances are stated in the specific codes.

(Added 1995)

G-UR.2. Installation Requirements.

G-UR.2.1. Installation. – A device shall be installed in accordance with the manufacturer's instructions, including any instructions marked on the device. A device installed in a fixed location shall be installed so that neither its operation nor its performance will be adversely affected by any characteristic of the foundation, supports, or any other detail of the installation.

G-UR.2.1.1. Visibility of Identification. – Equipment shall be installed in such a manner that all required markings are readily observable.

(Added 1978)

G-UR.2.2. Installation of Indicating or Recording Element. – A device shall be so installed that there is no obstruction between a primary indicating or recording element and the weighing or measuring element; otherwise there shall be convenient and permanently installed means for direct communication, oral or visual, between an individual located at a primary indicating or recording element and an individual located at the weighing or measuring element. [See also G-UR.3.3.]

G-UR.2.3. Accessibility for Inspection, Testing, and Sealing Purposes. – A device shall be located, or such facilities for normal access thereto shall be provided, to permit:

(a) inspecting and testing the device;

(b) inspecting and applying security seals to the device; and

(c) readily bringing the testing equipment of the weights and measures official to the device by customary means and in the amount and size deemed necessary by such official for the proper conduct of the test.

Otherwise, it shall be the responsibility of the device owner or operator to supply such special facilities, including such labor as may be needed to inspect, test, and seal the device, and to transport the testing equipment to and from the device, as required by the weights and measures official.

(Amended 1991)

G-UR.3. Use Requirements.

G-UR.3.1. Method of Operation. – Equipment shall be operated only in the manner that is obviously indicated by its construction or that is indicated by instructions on the equipment.

G-UR.3.2. Associated and Nonassociated Equipment. – A device shall meet all performance requirements when associated or nonassociated equipment is operated in its usual and customary manner and location.

(Added 1976)

G-UR.3.3. Position of Equipment. – A device or system equipped with a primary indicating element and used in direct sales, except for prescription scales, shall be positioned so that its indications may be accurately read and the weighing or measuring operation may be observed from some reasonable "customer" and "operator" position. The permissible distance between the equipment and a reasonable customer and operator position shall be determined in each case upon the basis of the individual circumstances, particularly the size and character of the indicating element.

(Amended 1974 and 1998)

G-UR.3.4. Responsibility, Money-Operated Devices. – Money-operated devices, other than parking meters, shall have clearly and conspicuously displayed thereon, or immediately adjacent thereto, adequate information detailing the method for the return of monies paid when the product or service cannot be obtained. This information shall include the name, address, and phone number of the local responsible party for the device. This requirement does not apply to devices at locations where employees are present and responsible for resolving any monetary discrepancies for the customer.

(Amended 1977 and 1993)

G-UR.4. Maintenance Requirements.

G-UR.4.1. Maintenance of Equipment. – All equipment in service and all mechanisms and devices attached thereto or used in connection therewith shall be continuously maintained in proper operating condition throughout the period of such service. Equipment in service at a single place of business found to be in error predominantly in a direction favorable to the device user (see also Introduction, Section Q) shall not be considered "maintained in a proper operating condition."

(Amended 1973 and 1991)

G-UR.4.2. Abnormal Performance. – Unstable indications or other abnormal equipment performance observed during operation shall be corrected and, if necessary, brought to the attention of competent service personnel.

(Added 1976)

G-UR.4.3. Use of Adjustments. – Weighing elements and measuring elements that are adjustable shall be adjusted only to correct those conditions that such elements are designed to control, and shall not be adjusted to compensate for defective or abnormal installation or accessories or for badly worn or otherwise defective parts of the assembly. Any faulty installation conditions shall be corrected, and any defective parts shall be renewed or suitably repaired, before adjustments are undertaken. Whenever equipment is adjusted, the adjustments shall be so made as to bring performance errors as close as practicable to zero value.

G-UR.4.4. Assistance in Testing Operations. – If the design, construction, or location of any device is such as to require a testing procedure involving special equipment or accessories or an abnormal amount of labor, such equipment, accessories, and labor shall be supplied by the owner or operator of the device as required by the weights and measures official.

G-UR.4.5. Security Seal. – A security seal shall be appropriately affixed to any adjustment mechanism designed to be sealed.

G-UR.4.6. Testing Devices at a Central Location.

(a) When devices in commercial service require special test facilities, or must be removed from service for testing, or are routinely transported for the purpose of use (e.g., vehicle-mounted devices and devices used in multiple locations), the official with statutory authority may require that the devices be brought to a central location for testing. The dealer or owner of these devices shall provide transportation of the devices to and from the test location.

(b) When the request for removal and delivery to a central test location involves devices used in submetering (e.g., electric, hydrocarbon vapor, or water meters), the owner or operator shall not interrupt the utility service to the customer or tenant except for the removal and replacement of the device. Provisions shall be made by the owner or operator to minimize inconvenience to the customer or tenant. All replacement or temporary meters shall be tested and sealed by a weights and measures official or bear a current, valid approval seal prior to use.

(Added 1994)

Section 2

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Section 2.20. Scales

A. Application

A.1. General. – This code applies to all types of weighing devices other than automatic bulk-weighing systems, belt-conveyor scales, and automatic weighing systems. The code comprises requirements that generally apply to all weighing devices, and specific requirements that are applicable only to certain types of weighing devices.
(Amended 1972 and 1983)

A.2. Wheel-Load Weighers, Portable Axle-Load Weighers, and Axle-Load Scales. – The requirements for wheel-load weighers, portable axle-load weighers, and axle-load scales apply only to such scales in official use for the enforcement of traffic and highway laws or for the collection of statistical information by government agencies.

A.3. Additional Code Requirements. – In addition to the requirements of this code, devices covered by the Scales code shall meet the requirements of Section 1.10. General Code.

S. Specifications

S.1. Design of Indicating and Recording Elements and of Recorded Representations.

S.1.1. Zero Indication.

(a) On a scale equipped with indicating or recording elements, provision shall be made to either indicate or record a zero-balance condition.

(b) On an automatic-indicating scale or balance indicator, provision shall be made to indicate or record an out-of-balance condition on both sides of zero.

(c) A zero-balance condition may be indicated by other than a continuous digital zero indication, provided that an effective automatic means is provided to inhibit a weighing operation or to return to a continuous digital indication when the scale is in an out-of-balance condition.
(Added 1987) (Amended 1993)
(Amended 1987)

S.1.1.1. Digital Indicating Elements.

(a) A digital zero indication shall represent a balance condition that is within ± ½ the value of the scale division.

(b) A digital indicating device shall either automatically maintain a "center-of-zero" condition to ± ¼ scale division or less, or have an auxiliary or supplemental "center-of-zero" indicator that defines a zero-balance condition to ± ¼ of a scale division or less. A "center-of-zero" indication may operate when zero is indicated for gross and/or net mode(s).
[Nonretroactive as of January 1, 1993]
(Amended 1992 and 2008)

S.1.1.2. No-Load Reference Value. – On a single draft manually operated receiving hopper scale installed below grade, used to receive grain, and utilizing a no-load reference value, provision shall be made to indicate and record the no-load reference value prior to the gross load value.
(Added 1983)

S.1.2. Value of Scale Division Units. *– Except for batching scales and weighing systems used exclusively for weighing in predetermined amounts, the value of a scale division "d" expressed in a unit of weight shall be equal to:*

(a) 1, 2, or 5; or

(b) a decimal multiple or submultiple of 1, 2, or 5; or

Examples: scale divisions may be 10, 20, 50, 100; or 0.01, 0.02, 0.05; or 0.1, 0.2, 0.5, etc.

(c) a binary submultiple of a specific unit of weight.

Examples: scale divisions may be ½, ¼, 1/8, 1/16, etc.
[Nonretroactive as of January 1, 1986]

S.1.2.1. Digital Indicating Scales, Units. *– Except for postal scales, a digital-indicating scale shall indicate weight values using only a single unit of measure. Weight values shall be presented in a decimal format with the value of the scale division expressed as 1, 2, or 5, or a decimal multiple or submultiple of 1, 2, or 5.*

The requirement that the value of the scale division be expressed only as 1, 2, or 5, or a decimal multiple or submultiple of only 1, 2, or 5 does not apply to net weight indications and recorded representations that are calculated from gross and tare weight indications where the scale division of the gross weight is different from the scale division of the tare weight(s) on multi-interval or multiple range scales. For example, a multiple range or multi-interval scale may indicate and record tare weights in a lower weighing range (WR) or weighing segment (WS), gross weights in the higher weighing range or weighing segment, and net weights as follows:

55 kg	*Gross Weight (WR2 d = 5 kg)*		*10.05 lb*	*Gross Weight (WS2 d = 0.05 lb)*	
– 4 kg	*Tare Weight*	*(WR1 d = 2 kg)*	*– 0.06 lb*	*Tare Weight*	*(WS1 d = 0.02 lb)*
= 51 kg	*Net Weight*	*(Mathematically Correct)*	*= 9.99 lb*	*Net Weight*	*(Mathematically Correct)*

[Nonretroactive as of January 1, 1989]
(Added 1987) (Amended 2008)

S.1.2.2. Verification Scale Interval.

S.1.2.2.1. Class I and II Scales and Dynamic Monorail Scales. If $e \neq d$, the verification scale interval "e" shall be determined by the expression:

$$d < e \leq 10\,d$$

If the displayed division (d) is less than the verification division (e), then the verification division shall be less than or equal to 10 times the displayed division.

The value of e must satisfy the relationship, $e = 10^k$ of the unit of measure, where k is a positive or negative whole number or zero. This requirement does not apply to a Class I device with $d < 1$ mg where $e = 1$ mg. If $e \neq d$, the value of "d" shall be a decimal submultiple of "e," and the ratio shall not be more than 10:1. If $e \neq d$, and both "e" and "d" are continuously displayed during normal operation, then "d" shall be differentiated from "e" by size, shape, color, etc. throughout the range of weights displayed as "d."
(Added 1999)

S.1.2.2.2. Class III and IIII Scales. The value of "e" is specified by the manufacturer as marked on the device. Except for dynamic monorail scales, "e" must be less than or equal to "d."
(Added 1999)

S.1.2.3. Prescription Scale with a Counting Feature. – A Class I or Class II prescription scale with an operational counting feature shall not calculate a piece weight or total count unless the sample used to determine the individual piece weight meets the following conditions:

(a) minimum individual piece weight is greater than or equal to 3 e; and

(b) minimum sample piece count is greater than or equal to 10 pieces.
(Added 2003)

S.1.3. Graduations.

S.1.3.1. Length. – Graduations shall be so varied in length that they may be conveniently read.

S.1.3.2. Width. – In any series of graduations, the width of a graduation shall in no case be greater than the width of the clear space between graduations. The width of main graduations shall be not more than 50 % greater than the width of subordinate graduations. Graduations shall be not less than 0.2 mm (0.008 in) wide.

S.1.3.3. Clear Space Between Graduations. – The clear space between graduations shall be not less than 0.5 mm (0.02 in) for graduations representing money-values, and not less than 0.75 mm (0.03 in) for other graduations. If the graduations are not parallel, the measurement shall be made:

(a) along the line of relative movement between the graduations at the end of the indicator; or

(b) if the indicator is continuous, at the point of widest separation of the graduations.

S.1.4. Indicators.

S.1.4.1. Symmetry. – The index of an indicator shall be of the same shape as the graduations, at least throughout that portion of its length associated with the graduations.

S.1.4.2. Length. – The index of an indicator shall reach to the finest graduations with which it is used, unless the indicator and the graduations are in the same plane, in which case, the distance between the end of the indicator and the ends of the graduations, measured along the line of the graduations, shall be not more than 1.0 mm (0.04 in).

S.1.4.3. Width. – The width of the index of an indicator in relation to the series of graduations with which it is used shall be not greater than:

(a) the width of the narrowest graduation;
[Nonretroactive as of January 1, 2002]

(b) the width of the clear space between weight graduations; and

(c) three-fourths of the width of the clear space between money-value graduations.

When the index of an indicator extends along the entire length of a graduation, that portion of the index of the indicator that may be brought into coincidence with the graduation shall be of the same width throughout the length of the index that coincides with the graduation.

S.1.4.4. Clearance. – The clearance between the index of an indicator and the graduations shall in no case be more than 1.5 mm (0.06 in).

S.1.4.5. Parallax. – Parallax effects shall be reduced to the practicable minimum.

S.1.5. Weighbeams.

S.1.5.1. Normal Balance Position. – The normal balance position of the weighbeam of a beam scale shall be horizontal.

S.1.5.2. Travel. – The weighbeam of a beam scale shall have equal travel above and below the horizontal. The total travel of the weighbeam of a beam scale in a trig loop or between other limiting stops near the weighbeam tip shall be not less than the minimum travel shown in Tables 1M and 1. When such limiting stops are not provided, the total travel at the weighbeam tip shall be not less than 8 % of the distance from the weighbeam fulcrum to the weighbeam tip.

Table 1M.
Minimum Travel of Weighbeam of Beam Scale Between Limiting Stops

Distance From Weighbeam Fulcrum to Limiting Stops (centimeters)	Minimum Travel Between Limiting Stops (millimeter)
30 or less	10
30+ to 50, inclusive	13
50+ to 100, inclusive	18
Over 100	23

Table 1.
Minimum Travel of Weighbeam of Beam Scale Between Limiting Stops

Distance From Weighbeam Fulcrum to Limiting Stops (inches)	Minimum Travel Between Limiting Stops (inch)
12 or less	0.4
12+ to 20, inclusive	0.5
20+ to 40, inclusive	0.7
Over 40	0.9

S.1.5.3. Subdivision. – A subdivided weighbeam bar shall be subdivided by scale division graduations, notches, or a combination of both. Graduations on a particular bar shall be of uniform width and perpendicular to the top edge of the bar. Notches on a particular bar shall be uniform in shape and dimensions and perpendicular to the face of the bar. When a combination of graduations and notches is employed, the graduations shall be positioned in relation to the notches to indicate notch values clearly and accurately.

S.1.5.4. Readability. – A subdivided weighbeam bar shall be so subdivided and marked, and a weighbeam poise shall be so constructed, that the weight corresponding to any normal poise position can easily and accurately be read directly from the beam, whether or not provision is made for the optional recording of representations of weight.

S.1.5.5. Capacity. – On an automatic-indicating scale having a nominal capacity of 15 kg (30 lb) or less and used for direct sales to retail customers:

(a) the capacity of any weighbeam bar shall be a multiple of the reading-face capacity;

(b) each bar shall be subdivided throughout or shall be subdivided into notched intervals, each equal to the reading-face capacity; and

(c) the value of any turnover poise shall be equal to the reading-face capacity.

S.1.5.6. Poise Stop. – Except on a steelyard with no zero graduation, a shoulder or stop shall be provided on each weighbeam bar to prevent a poise from traveling and remaining back of the zero graduation.

S.1.6. Poises.

S.1.6.1. General. – No part of a poise shall be readily detachable. A locking screw shall be perpendicular to the longitudinal axis of the weighbeam and shall not be removable. Except on a steelyard

with no zero graduation, the poise shall not be readily removable from a weighbeam. The knife-edge of a hanging poise shall be hard and sharp and so constructed as to allow the poise to swing freely on the bearing surfaces in the weighbeam notches.

S.1.6.2. Adjusting Material. – The adjusting material in a poise shall be securely enclosed and firmly fixed in position; if softer than brass, it shall not be in contact with the weighbeam.

S.1.6.3. Pawl. – A poise, other than a hanging poise, on a notched weighbeam bar shall have a pawl that will seat the poise in a definite and correct position in any notch, wherever in the notch the pawl is placed, and hold it there firmly and without appreciable movement. The dimension of the tip of the pawl that is transverse to the longitudinal axis of the weighbeam shall be at least equal to the corresponding dimension of the notches.

S.1.6.4. Reading Edge or Indicator. – The reading edge or indicator of a poise shall be sharply defined, and a reading edge shall be parallel to the graduations on the weighbeam.

S.1.7. Capacity Indication, Weight Ranges, and Unit Weights.

(a) Gross Capacity. An indicating or recording element shall not display nor record any values when the gross load (not counting the initial dead load that has been canceled by an initial zero-setting mechanism) is in excess of 105 % of scale capacity.

(b) *Capacity Indication. Electronic computing scales (excluding postal scales and weight classifiers) shall neither display nor record a gross or net weight in excess of scale capacity plus 9 d. [Nonretroactive as of January 1, 1993]*

The total value of weight ranges and of unit weights in effect or in place at any time shall automatically be accounted for on the reading face and on any recorded representation.

This requirement does not apply to: (1) single-revolution dial scales, (2) multi-revolution dial scales not equipped with unit weights, (3) scales equipped with two or more weighbeams, nor (4) devices that indicate mathematically derived totalized values.

(Amended 1990, 1992, and 1995)

S.1.8. Computing Scales.

S.1.8.1. Money-Value Graduations, Metric Unit Prices. – The value of the graduated intervals representing money-values on a computing scale with analog indications shall not exceed:

(a) 1 cent at all unit prices of 55 cents per kilogram and less;

(b) 2 cents at unit prices of 56 cents per kilogram through $2.75 per kilogram (special graduations defining 5-cent intervals may be employed but not in the spaces between regular graduations);

(c) 5 cents at unit prices of $2.76 per kilogram through $7.50 per kilogram; or

(d) 10 cents at unit prices above $7.50 per kilogram.

Value figures and graduations shall not be duplicated in any column or row on the graduated chart. (See also S.1.8.2. Money-Value Computation)

S.1.8.2. Money-Value Graduations, Inch-Pound Unit Prices. – The value of the graduated intervals representing money-values on a computing scale with analog indications shall not exceed:

(a) 1 cent at all unit prices of 25 cents per pound and less;

(b) 2 cents at unit prices of 26 cents per pound through $1.25 per pound (special graduations defining 5-cent intervals may be employed but not in the spaces between regular graduations);

(c) 5 cents at unit prices of $1.26 per pound through $3.40 per pound; or

(d) 10 cents at unit prices above $3.40 per pound.

Value figures and graduations shall not be duplicated in any column or row on the graduated chart. (See also S.1.8.2. Money-Value Computation)

S.1.8.3. Money-Value Computation. – A computing scale with analog quantity indications used in retail trade may compute and present digital money-values to the nearest quantity graduation when the value of the minimum graduated interval is 0.005 kg (0.01 lb) or less. (See also Sec. 1.10. General Code G-S.5.5. Money-Values, Mathematical Agreement)

S.1.8.4. Customer's Indications. – Weight indications shall be shown on the customer's side of computing scales when these are used for direct sales to retail customers. Computing scales equipped on the operator's side with digital indications, such as the net weight, unit price, or total price, shall be similarly equipped on the customer's side. Unit price displays visible to the customer shall be in terms of single whole units of weight and not in common or decimal fractions of the unit. Scales indicating in metric units may indicate price per 100 g.

(Amended 1985 and 1995)

S.1.8.4.1. *Scales that will function as either a normal round off scale or as a weight classifier shall be provided with a sealable means for selecting the mode of operation and shall have a clear indication (annunciator), adjacent to the weight display on both the operator's and customer's side whenever the scale is operating as a weight classifier.*
[Nonretroactive as of January 1, 2001]

(Added 1999)

S.1.8.5. Recorded Representations, Point-of-Sale Systems. – The sales information recorded by cash registers when interfaced with a weighing element shall contain the following information for items weighed at the checkout stand:

(a) the net weight;[1]

(b) the unit price;[1]

(c) the total price; and

(d) the product class or, in a system equipped with price look-up capability, the product name or code number.

[1] For devices interfaced with scales indicating in metric units, the unit price may be expressed in price per 100 grams. Weight values shall be identified by kilograms, kg, grams, g, ounces, oz, pounds, or lb. *The "#" symbol is not acceptable.*
[Nonretroactive as of January 1, 2006]
(Amended 1995 and 2005)

S.1.9. Prepackaging Scales.

S.1.9.1. Value of the Scale Division. – On a prepackaging scale, the value of the intervals representing weight values shall be uniform throughout the entire reading face. The recorded weight values shall be identical with those on the indicator.

S.1.9.2. Label Printer. – A prepackaging scale or a device that produces a printed ticket to be used as the label for a package shall print all values digitally and of such size, style of type, and color as to be clear and conspicuous on the label.

S.1.10. Adjustable Components. – An adjustable component such as a pendulum, spring, or potentiometer shall be held securely in adjustment and, except for a zero-load balance mechanism, shall be located within the housing of the element.

(Added 1986)

S.1.11. Provision for Sealing.

(a) Except on Class I scales, provision shall be made for applying a security seal in a manner that requires the security seal to be broken before an adjustment can be made to any component affecting the performance of an electronic device.
[Nonretroactive as of January 1, 1979]

(b) Except on Class I scales, a device shall be designed with provision(s) for applying a security seal that must be broken, or for using other approved means of providing security (e.g., data change audit trail available at the time of inspection), before any change that detrimentally affects the metrological integrity of the device can be made to any electronic mechanism.
[Nonretroactive as of January 1, 1990]

(c) Except on Class I scales, audit trails shall use the format set forth in Table S.1.11.
[Nonretroactive as of January 1, 1995]

A device may be fitted with an automatic or a semi-automatic calibration mechanism. This mechanism shall be incorporated inside the device. After sealing, neither the mechanism nor the calibration process shall facilitate fraud.

(Amended 1989, 1991, and 1993)

Table S.1.11. Categories of Device and Methods of Sealing	
Categories of Device	***Methods of Sealing***
Category 1: *No remote configuration capability.*	*Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.*
Category 2: *Remote configuration capability, but access is controlled by physical hardware.* *The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode.*	*The hardware enabling access for remote communication must be at the device and sealed using a physical seal or two event counters: one for calibration parameters and one for configuration parameters.*
Category 3: *Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password).*	*An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. A printed copy of the information must be available through the device or through another on-site device. The event logger shall have a capacity to retain records equal to 10 times the number of sealable parameters in the device, but not more than 1000 records are required. (Note: Does not require 1000 changes to be stored for each parameter.)*

[Nonretroactive as of January 1, 1995]

(Table added 1993)

S.1.12. Manual Weight Entries. *– A device when being used for direct sale shall accept an entry of a manual gross or net weight value only when the scale gross or net* weight indication is at zero. Recorded manual weight entries, except those on labels generated for packages of standard weights, shall identify the weight value as a manual weight entry by one of the following terms: "Manual Weight," "Manual Wt," or "MAN WT." The use of a symbol to identify multiple manual weight entries on a single document is permitted, provided that the symbol is defined on the same page on which the manual weight entries appear and the definition of the symbol is automatically printed by the recording element as part of the document.*
*[Nonretroactive as of January 1, 1993] [*Nonretroactive as of January 1, 2005]*

(Added 1992) (Amended 2004)

S.1.13. Vehicle On-Board Weighing Systems: Vehicle in Motion. – When the vehicle is in motion, a vehicle on-board weighing system shall either:

(a) be accurate; or

(b) inhibit the weighing operation.

(Added 1993)

S.2. Design of Balance, Tare, Level, Damping, and Arresting Mechanisms.

S.2.1. Zero-Load Adjustment.

S.2.1.1. General. – A scale shall be equipped with means by which the zero-load balance may be adjusted. Any loose material used for this purpose shall be enclosed so that it cannot shift in position and alter the balance condition of the scale.

Except for an initial zero-setting mechanism, an automatic zero adjustment outside the limits specified in S.2.1.3. Scales Equipped with an Automatic Zero-Tracking Mechanism is prohibited.
(Amended 2010)

S.2.1.2. Scales used in Direct Sales. – A manual zero-setting mechanism (except on a digital scale with an analog zero-adjustment mechanism with a range of not greater than one scale division) shall be operable or accessible only by a tool outside of and entirely separate from this mechanism, or it shall be enclosed in a cabinet. Except on Class I or II scales, a balance ball shall either meet this requirement or not itself be rotatable.

A semiautomatic zero-setting mechanism shall be operable or accessible only by a tool outside of and separate from this mechanism or it shall be enclosed in a cabinet, or it shall be operable only when the indication is stable within plus or minus:

(a) 3.0 scale divisions for scales of more than 2000 kg (5000 lb) capacity in service prior to January 1, 1981, and for all axle load, railway track, and vehicle scales; or

(b) 1.0 scale division for all other scales.

S.2.1.3. Scales Equipped with an Automatic Zero-Tracking Mechanism.

S.2.1.3.1. Automatic Zero-Tracking Mechanism for Scales Manufactured Between January 1, 1981, and January 1, 2007. – The maximum load that can be "rezeroed," when either placed on or removed from the platform all at once under normal operating conditions, shall be for:

(a) bench, counter, and livestock scales: 0.6 scale division;

(b) vehicle, axle load, and railway track scales: 3.0 scale divisions; and

(c) all other scales: 1.0 scale division.

(Amended 2005)

S.2.1.3.2. Automatic Zero-Tracking Mechanism for Scales Manufactured on or after January 1, 2007. – The maximum load that can be "rezeroed," when either placed on or removed from the platform all at once under normal operating conditions, shall be:

(a) for vehicle, axle load, and railway track scales: 3.0 scale divisions; and

(b) for all other scales: 0.5 scale division.

(Added 2005)

S.2.1.3.3. Means to Disable Automatic Zero-Tracking Mechanism on Class III L Devices. *– Class III L devices equipped with an automatic zero-tracking mechanism shall be designed with a sealable means that would allow zero tracking to be disabled during the inspection and test of the device.*
[Nonretroactive as of January 1, 2001]

(Added 1999) (Amended 2005)

S.2.1.4. Monorail Scales. – On a static monorail scale equipped with digital indications, means shall be provided for setting the zero-load balance to within 0.02 % of scale capacity. On a dynamic monorail weighing system, means shall be provided to automatically maintain these conditions.

(Amended 1999)

S.2.1.5. Initial Zero-Setting Mechanism. – Scales of accuracy Classes I, II, and III may be equipped with an initial zero-setting device.

(a) For weighing, load-receiving, and indicating elements in the same housing or covered on the same CC, an initial zero-setting mechanism shall not zero a load in excess of 20 % of the maximum capacity of the scale unless tests show that the scale meets all applicable tolerances for any amount of initial load compensated by this device within the specified range.

(b) For indicating elements not permanently attached to weighing and load-receiving elements covered on a separate CC, the maximum initial zero-setting mechanism range of electronic indicators shall not exceed 20 % of the configured capacity.
[Nonretroactive as of January 1, 2009]

(Added 2008)

(Added 1990) (Amended 2008)

S.2.1.6. Combined Zero-Tare ("0/T") Key. – Scales not intended to be used in direct sales applications may be equipped with a combined zero and tare function key, provided that the device is clearly marked as to how the key functions. The device must also be clearly marked on or adjacent to the weight display with the statement "Not for Direct Sales."

(Added 1998)

S.2.2. Balance Indicator. – On a balance indicator consisting of two indicating edges, lines, or points, the ends of the indicators shall be sharply defined. When the scale is in balance, the ends shall be separated by not more than 1.0 mm (0.04 in).

S.2.2.1. Dairy-Product Test, Grain-Test, Prescription, and Class I and II Scales. – Except on digital indicating devices, a dairy-product test, grain-test, prescription, or Class I or II scale shall be equipped with a balance indicator. If an indicator and a graduated scale are not in the same plane, the clearance between the indicator and the graduations shall be not more than 1.0 mm (0.04 in).

S.2.2.2. Equal-Arm Scale. *– An equal-arm scale shall be equipped with a balance indicator. If the indicator and balance graduation are not in the same plane, the clearance between the indicator and the balance graduation shall be not more than 1.0 mm (0.04 in).*
[Nonretroactive as of January 1, 1989]

(Added 1988)

S.2.3. Tare. – *On any scale (except a monorail scale equipped with digital indications and multi-interval scales or multiple range scales when the value of tare is determined in a lower weighing range or weighing segment), the value of the tare division shall be equal to the value of the scale division.** The tare mechanism shall operate only in a backward direction (that is, in a direction of underregistration) with respect to the zero-load balance condition of the scale. *A device designed to automatically clear any tare value shall also be designed to prevent the automatic clearing of tare until a complete transaction has been indicated.**
*[*Nonretroactive as of January 1, 1983]*

(Amended 1985 and 2008)

*Note: On a computing scale, this requires the input of a unit price, the display of the unit price, and a computed positive total price at a readable equilibrium. Other devices require a complete weighing operation, including tare, net, and gross weight determination**
*[*Nonretroactive as of January 1, 1983]*

S.2.3.1. Monorail Scales Equipped with Digital Indications. – On a static monorail weighing system equipped with digital indications, means shall be provided for setting any tare value of less than 5 % of the scale capacity to within 0.02 % of scale capacity. On a dynamic monorail weighing system, means shall be provided to automatically maintain this condition.

(Amended 1999)

S.2.4. Level-Indicating Means. – Except for portable wheel-load weighers and portable axle load scales, a portable scale shall be equipped with level-indicating means if its weighing performance is changed by an amount greater than the appropriate acceptance tolerance when it is tilted up to and including 5 % rise over run in any direction from a level position and rebalanced. The level-indicating means shall be readable without removing any scale parts requiring a tool.

[This requirement is nonretroactive as of January 1, 1986, for prescription, jewelers', and dairy-product test scales and scales marked Class I and II.]

Note: Portable wheel-load weighers and portable axle-load scales shall be accurate when tilted up to and including 5 % rise over run in any direction from a level position and rebalanced.

(Amended 1991 and 2008)

S.2.4.1. Vehicle On-Board Weighing Systems. – A vehicle on-board weighing system shall operate within tolerance when the weighing system is tilted up to and including 5 % rise over run in any direction from a level position and rebalanced. If the accuracy of the system is affected by out-of-level conditions normal to the use of the device, the system shall be equipped with an out-of-level sensor that inhibits the weighing operation when the system is out of level to the extent that the accuracy limits are exceeded.

(Added 1992) (Amended 2008)

S.2.5. Damping Means. – An automatic-indicating scale and a balance indicator shall be equipped with effective means to damp oscillations and to bring the indicating elements quickly to rest.

S.2.5.1. Digital Indicating Elements. – Digital indicating elements equipped with recording elements shall be equipped with effective means to permit the recording of weight values only when the indication is stable within plus or minus:

(a) 3.0 scale divisions for scales of more than 2000 kg (5000 lb) capacity in service prior to January 1, 1981, hopper (other than grain hopper) scales with a capacity exceeding 22 000 kg (50 000 lb), and for all vehicle, axle load, livestock, and railway track scales;

(b) 1.0 scale division for all other scales.

The values recorded shall be within applicable tolerances.

(Amended 1995)

S.2.5.2. Jewelers', Prescription, and Class I, and Class II Scales. – A jewelers', prescription, Class I, or Class II scales shall be equipped with appropriate means for arresting the oscillation of the mechanism.

S.2.5.3. Class I and Class II Prescription Scales with a Counting Feature. – A Class I or Class II prescription scale shall indicate to the operator when the piece weight computation is complete by a stable display of the quantity placed on the load-receiving element.

(Added 2003)

S.3. Design of Load-Receiving Elements.

S.3.1. Travel of Pans of Equal-Arm Scale. – The travel between limiting stops of the pans of a nonautomatic-indicating equal-arm scale not equipped with a balance indicator shall be not less than the minimum travel shown in Table 2M and Table 2.

Table 2M. Minimum Travel of Pans of Nonautomatic Indicating Equal-Arm Scale Without Balance Indicator	
Nominal Capacity (kilograms)	**Minimum Travel of Pans (millimeters)**
2 or less	9
2+ to 5, inclusive	13
5+ to 12, inclusive	19
Over 12	25

Table 2. Minimum Travel of Pans of Nonautomatic Indicating Equal-Arm Scale Without Balance Indicator	
Nominal Capacity (pounds)	**Minimum Travel of Pans (inch)**
4 or less	0.35
4+ to 12, inclusive	0.5
12+ to 26, inclusive	0.75
Over 26	1.0

S.3.2. Drainage. – A load-receiving element intended to receive wet commodities shall be so constructed as to drain effectively.

S.3.3. Scoop Counterbalance. – A scoop on a scale used for direct sales to retail customers shall not be counterbalanced by a removable weight. A permanently attached scoop-counterbalance shall indicate clearly on both the operator's and customer's sides of the scale whether it is positioned for the scoop to be on or off the scale.

S.4. Design of Weighing Elements.

S.4.1. Antifriction Means. – Frictional effects shall be reduced to a minimum by suitable antifriction elements. Opposing surfaces and points shall be properly shaped, finished, and hardened. A platform scale having a frame around the platform shall be equipped with means to prevent interference between platform and frame.

S.4.2. Adjustable Components. – An adjustable component such as a nose-iron or potentiometer shall be held securely in adjustment. The position of a nose-iron on a scale of more than 1000 kg (2000 lb) capacity, as determined by the factory adjustment, shall be accurately, clearly, and permanently defined.

(Amended 1986)

S.4.3. Multiple Load-Receiving Elements. – Except for mechanical bench and counter scales, a scale with a single indicating or recording element, or a combination indicating-recording element, that is coupled to two or more load-receiving elements with independent weighing systems, shall be provided with means to prohibit the activation of any load-receiving element (or elements) not in use, and shall be provided with automatic means to indicate clearly and definitely which load-receiving element (or elements) is in use.

S.5. Design of Weighing Devices, Accuracy Class.

S.5.1. Designation of Accuracy Class. *– Weighing devices are divided into accuracy classes and shall be designated as I, II, III, III L, or IIII.*
[Nonretroactive as of January 1, 1986]

S.5.2. Parameters for Accuracy Class. *– The accuracy class of a weighing device is designated by the manufacturer and shall comply with parameters shown in Table 3.*
[Nonretroactive as of January 1, 1986]

S.5.3. Multi-Interval and Multiple Range Scales, Division Value. – On a multi-interval scale and multiple range scale, the value of "e" shall be equal to the value of "d."[2]

(Added 1986) (Amended 1995)

S.5.4. Relationship of Load Cell Verification Interval Value to the Scale Division. *– The relationship of the value for the load cell verification scale interval, v_{min}, to the scale division, d, for a specific scale installation using National Type Evaluation Program (NTEP) load cells shall comply with the following formulae where N is the number of load cells in the scale (such as hopper or vehicle scale weighing/load-receiving elements):*

(a) $v_{min} \leq \frac{d^*}{\sqrt{N}}$ *for scales without lever systems; and*

(b) $v_{min} \leq \frac{d^*}{\sqrt{N} \times (scale\ multiple)}$ *for scales with lever systems.*

*[*When the value of the scale division, d, is different from the verification scale division, e, for the scale, the value of e must be used in the formulae above.]*

This requirement does not apply to complete weighing/load-receiving elements or scales, which satisfy all the following criteria:

- *the complete weighing/load-receiving element or scale has been evaluated for compliance with T.N.8.1. Temperature under the NTEP;*
- *the complete weighing/load-receiving element or scale has received an NTEP Certificate of Conformance; and*
- *the complete weighing/load-receiving element or scale is equipped with an automatic zero-tracking mechanism which cannot be made inoperative in the normal weighing mode. (A test mode which permits the disabling of the automatic zero-tracking mechanism is permissible, provided the scale cannot function normally while in this mode.*

[Nonretroactive as of January 1, 1994]

(Added 1993) (Amended 1996)

[2] See Footnote 1 to Table 3 Parameters for Accuracy Classes.

Table 3.
Parameters for Accuracy Classes

Class	*Value of the Verification Scale Division (d or e[1])*	*Number of Scale[4] Divisions (n)*	
		Minimum	*Maximum*
	SI Units		
I	*equal to or greater than 1 mg*	*50 000*	--
II	*1 to 50 mg, inclusive*	*100*	*100 000*
	equal to or greater than 100 mg	*5 000*	*100 000*
III[2,5]	*0.1 to 2 g, inclusive*	*100*	*10 000*
	equal to or greater than 5 g	*500*	*10 000*
III L[3]	*equal to or greater than 2 kg*	*2 000*	*10 000*
IIII	*equal to or greater than 5 g*	*100*	*1 200*
	Inch-Pound Units		
III[5]	*0.0002 lb to 0.005 lb, inclusive*	*100*	*10 000*
	0.005 oz to 0.125 oz, inclusive	*100*	*10 000*
	equal to or greater than 0.01 lb	*500*	*10 000*
	equal to or greater than 0.25 oz	*500*	*10 000*
III L[3]	*equal to or greater than 5 lb*	*2 000*	*10 000*
IIII	*greater than 0.01 lb*	*100*	*1 200*
	greater than 0.25 oz	*100*	*1 200*

[1] For Class I and II devices equipped with auxiliary reading means (i.e., a rider, a vernier, or a least significant decimal differentiated by size, shape, or color), the value of the verification scale division "e" is the value of the scale division immediately preceding the auxiliary means.

[2] A Class III scale marked "For prescription weighing only" may have a verification scale division (e) not less than 0.01 g.

(Added 1986) (Amended 2003)

[3] The value of a scale division for crane and hopper (other than grain hopper) scales shall be not less than 0.2 kg (0.5 lb). The minimum number of scale divisions shall be not less than 1000.

[4] On a multiple range or multi-interval scale, the number of divisions for each range independently shall not exceed the maximum specified for the accuracy class. The number of scale divisions, n, for each weighing range is determined by dividing the scale capacity for each range by the verification scale division, e, for each range. On a scale system with multiple load-receiving elements and multiple indications, each element considered shall not independently exceed the maximum specified for the accuracy class. If the system has a summing indicator, the n_{max} for the summed indication shall not exceed the maximum specified for the accuracy class.

(Added 1997)

[5] The minimum number of scale divisions for a Class III Hopper Scale used for weighing grain shall be 2000.)

[Nonretroactive as of January 1, 1986]

(Added 2004) (Amended 1986, 1987, 1997, 1998, 1999, 2003, and 2004)

S.6. Marking Requirements. [See also G-S.1. Identification, G-S.4. Interchange or Reversal of Parts, G-S.6. Marking Operational Controls, Indications, and Features, G-S.7. Lettering, G-UR.2.1.1. Visibility of Identification, and UR.3.4.1. Use in Pairs]

S.6.1. Nominal Capacity; Vehicle and Axle-Load Scales. *– For all vehicle and axle-load scales, the marked nominal capacity shall not exceed the concentrated load capacity (CLC) times the quantity of the number of sections in the scale minus 0.5.*

As a formula, this is stated as: $\text{nominal capacity} \leq CLC \times (N - 0.5)$
where N = the number of sections in the scale.
(See N.1.3.3. Vehicle Scales, Axle-Load Scales, and Livestock Scales and T.N.3.1. Maintenance Tolerance Values)
[Nonretroactive as of January 1, 1989]

Note: When the device is used in a combination railway track and vehicle weighing application, the above formula shall apply only to the vehicle scale application.

(Added 1988) (Amended 1999 and 2002)

S.6.2. Location of Marking Information. – Scales that are not permanently attached to an indicating element, and for which the load-receiving element is the only part of the weighing/load-receiving element visible after installation, may have the marking information required in G-S.1. of the General Code and S.6. of the Scales Code located in an area that is accessible only through the use of a tool; provided that the information is easily accessible (e.g., the information may appear on the junction box under an access plate). The identification information for these scales shall be located on the weighbridge (load-receiving element) near the point where the signal leaves the weighing element or beneath the nearest access cover.

(Added 1989)

S.6.3. Scales, Main Elements, and Components of Scales or Weighing Systems. – Scales, main elements of scales when not contained in a single enclosure for the entire scale, load cells for which Certificates of Conformance (CC) have been issued under the National Type Evaluation Program (NTEP), and other equipment necessary to a weighing system, but having no metrological effect on the weighing system, shall be marked as specified in Table S.6.3.a. Marking Requirements and explained in the accompanying notes in Table S.6.3.b. Notes for Table S.6.3.a.

(Added 1990)

S.6.4. Railway Track Scales. – A railway track scale shall be marked with the maximum capacity of each section of the load-receiving element of the scale. Such marking shall be accurately and conspicuously presented on, or adjacent to, the identification or nomenclature plate that is attached to the indicating element of the scale. *The nominal capacity of a scale with more than two sections shall not exceed twice its rated section capacity. The nominal capacity of a two-section scale shall not exceed its rated section capacity.**
*[*Nonretroactive as of January 1, 2002]*

(Amended 1988, 2001, and 2002)

S.6.5. Livestock Scales. – A livestock scale manufactured prior to January 1, 1989, or after January 1, 2003, shall be marked with the maximum capacity of each section of the load-receiving element of the scale. Livestock scales manufactured between January 1, 1989, and January 1, 2003, shall be marked with either the Concentrated Load Capacity (CLC) or the Section Capacity. Such marking shall be accurately and conspicuously presented on, or adjacent to the identification or nomenclature plate that is attached to the indicating element of the scale. *The nominal capacity of a scale with more than two sections shall not exceed twice its rated section capacity. The nominal capacity of a two-section scale shall not exceed its rated section capacity.**
*[*Nonretroactive as of January 1, 2003]*

(Added 2002)

See also Note 14 in Table S.6.3.b. Notes for Table S.6.3.a.

S.6.6. Counting Feature, Minimum Individual Piece Weight, and Minimum Sample Piece Count. – A Class I or Class II prescription scale with an operational counting feature shall be marked with the minimum individual piece weight and minimum number of pieces used in the sample to establish an individual piece weight.

(Added 2003)

Table S.6.3.a.
Marking Requirements

To Be Marked With ⇓	Weighing Equipment				
	Weighing, Load-Receiving, and Indicating Element in Same Housing or Covered on the Same CC[1]	**Indicating Element not Permanently Attached to Weighing and Load-Receiving Element or Covered by a Separate CC**	**Weighing and Load-Receiving Element Not Permanently Attached to Indicating Element or Covered by a Separate CC**	**Load Cell with CC (11)**	**Other Equipment or Device (10)**
Manufacturer's ID (1)	x	x	x	x	x
Model Designation and Prefix (1)	x	x	x	x	x
Serial Number and Prefix (2)	x	x	x	x	x (16)
Certificate of Conformance Number (CC) (23)	x	x	x	x	x (23)
Accuracy Class (17)	x	x (8)	x (19)	x	
Nominal Capacity (3)(18)(20)	x	x	x		
Value of Scale Division, "d" (3)	x	x			
Value of "e" (4)	x	x			
Temperature Limits (5)	x	x	x	x	
Concentrated Load Capacity (CLC) (12)(20)(22)		x	x (9)		
Special Application (13)	x	x	x		
Maximum Number of Scale Divisions (n_{max}) (6)		x (8)	x (19)	x	
Minimum Verification Scale Division (e_{min})			x (19)		
"S" or "M" (7)				x	
Direction of Loading (15)				x	
Minimum Dead Load				x	
Maximum Capacity				x	
Safe Load Limit				x	
Load Cell Verification Interval (v_{min}) (21)				x	
Section Capacity and Prefix (14)(20)(22)(24)		x	x		

Table S.6.3.a.
Marking Requirements

Note: For applicable notes, see Table S.6.3.b.

[1] Weighing/load-receiving elements and indicators which are in the same housing or which are permanently attached will generally appear on the same CC. If not in the same housing, elements shall be hard-wired together or sealed with a physical seal or an electronic link. This requirement does not apply to peripheral equipment that has no input or effect on device calibrations or configurations.

(Added 2001)

(Added 1990) (Amended 1992, 1999, 2000, 2001, 2002, and 2004)

Table S.6.3.b.
Notes for Table S.6.3.a. Marking Requirements

1. Manufacturer's identification and model designation and *model designation prefix.**
   *[*Nonretroactive as of January 1, 2003]*
   (See also G-S.1. Identification) *[Prefix lettering may be initial capitals, all capitals or all lower case]*
   (Amended 2000)

2. *Serial number [Nonretroactive as of January 1, 1968] and prefix [Nonretroactive as of January 1, 1986].* (See also G-S.1. Identification)

3. The device shall be marked with the nominal capacity. *The nominal capacity shall be shown together with the value of the scale division (e.g., 15 x 0.005 kg, 30 x 0.01 lb, or capacity = 15 kg, d = 0.005 kg) in a clear and conspicuous manner and be readily apparent when viewing the reading face of the scale indicator unless already apparent by the design of the device. Each scale division value or weight unit shall be marked on multiple range or multi-interval scales. [Nonretroactive as of January 1, 1983]*
   (Amended 2005)

4. *Required only if different from "d." [Nonretroactive as of January 1, 1986]*

5. *Required only on Class III, III L, and IIII devices if the temperature range on the NTEP CC is narrower than and within -10 °C to 40 °C (14 °F to 104 °F). [Nonretroactive as of January 1, 1986]*
   (Amended 1999)

6. *This value may be stated on load cells in units of 1000; e.g., n: 10 is 10 000 divisions. [Nonretroactive as of January 1, 1988]*

7. *Denotes compliance for single or multiple load cell applications. It is acceptable to use a load cell with the "S" or Single Cell designation in multiple load cell applications as long as all other parameters meet applicable requirements. A load cell with the "M" or Multiple Cell designation can be used only in multiple load cell applications. [Nonretroactive as of January 1, 1988]*
   (Amended 1999)

8. *An indicating element not permanently attached to a weighing element shall be clearly and permanently marked with the accuracy Class of I, II, III, III L, or IIII, as appropriate, and the maximum number of scale divisions, n_{max}, for which the indicator complies with the applicable requirement. Indicating elements that qualify for use in both Class III and III L applications may be marked III/III L and shall be marked with the maximum number of scale divisions for which the device complies with the applicable requirements for each accuracy class. [Nonretroactive as of January 1, 1988]*

Table S.6.3.b.
Notes for Table S.6.3.a. Marking Requirements

9. *For vehicle and axle-load scales only. The CLC shall be added to the load-receiving element of any such scale not previously marked at the time of modification.*
[Nonretroactive as of January 1, 1989]
(Amended 2002)

10. Necessary to the weighing system but having no metrological effect, e.g., auxiliary remote display, keyboard, etc.

11. *The markings may be either on the load cell or in an accompanying document; except that, if an accompanying document is provided, the serial number shall appear both on the load cell and in the document. [Nonretroactive as of January 1, 1988] The manufacturer's name or trademark, the model designation, and identifying symbols for the model and serial numbers as required by paragraph G-S.1. Identification shall also be marked both on the load cell and in any accompanying document. [Nonretroactive as of January 1, 1991]*

12. Required on the indicating element *and the load-receiving element* of vehicle and axle-load scales. *Such marking shall be identified as "concentrated load capacity" or by the abbreviation "CLC."**
*[*Nonretroactive as of January 1, 1989]*
(Amended 2002)

13. *A scale designed for a special application rather than general use shall be conspicuously marked with suitable words, visible to the operator and to the customer, restricting its use to that application, e.g., scale, prepack scale, weight classifier, etc.** When a scale is installed with an operational counting feature, the scale shall be marked on both the operator and customer sides with the statement "The counting feature is not legal for trade," except when a Class I or Class II prescription scale complies with all Handbook 44 requirements applicable to counting features.
*[*Nonretroactive as of 1986]*
(Amended 1994 and 2003)

14. Required on *livestock** and railway track scales. When marked on vehicle and axle-load scales manufactured before January 1, 1989, it may be used as the CLC. For livestock scales manufactured between January 1, 1989, and January 1, 2003, required markings may be either CLC or section capacity.
*[*Nonretroactive as of January 1, 2003]*
(Amended 2002)

15. *Required if the direction of loading the load cell is not obvious.*
[Nonretroactive as of January 1, 1988]

16. *Serial number [Nonretroactive as of January 1, 1968] and prefix [Nonretroactive as of January 1, 1986].* (See also G-S.1. Identification) Modules without "intelligence" on a modular system (e.g., printer, keyboard module, cash drawer, and secondary display in a point-of-sale system) are not required to have serial numbers.

17. *The accuracy class of a device shall be marked on the device with the appropriate designation as I, II, III, III L, or IIII.*
[Nonretroactive as of January 1, 1986]

18. The nominal capacity shall be conspicuously marked as follows:
(a) on any scale equipped with unit weights or weight ranges;
(b) on any scale with which counterpoise or equal-arm weights are intended to be used;
(c) on any automatic-indicating or recording scale so constructed that the capacity of the indicating or recording element, or elements, is not immediately apparent;
(d) on any scale with a nominal capacity less than the sum of the reading elements; and
*(e) on the load-receiving element (weighbridge) of vehicle, axle-load, and livestock scales.**
*[*Nonretroactive as of January 1, 1989]*
(Amended 1992)

Table S.6.3.b.
Notes for Table S.6.3.a. Marking Requirements

19. *For weighing and load-receiving elements not permanently attached to indicating element or covered by a separate CC.*
[Nonretroactive as of January, 1, 1988]
(Amended 1992)

20. *Combination vehicle/railway track scales must be marked with both the nominal capacity and CLC for vehicle weighing and the nominal capacity and section capacity for railway weighing. All other requirements relating to these markings will apply.*
[Nonretroactive as of January 1, 2000]
(Added 1999)

21. *The value of the load cell verification interval (v_{min}) must be stated in mass units. In addition to this information, a device may be marked with supplemental representations of v_{min}.*
[Nonretroactive as of January 1, 2001]
(Added 1999)

22. *Combination vehicle/livestock scales must be marked with both the CLC for vehicle weighing and the section capacity for livestock weighing. All other requirements relative to these markings will apply.*
[Nonretroactive as of January 1, 2003]
(Added 2002) (Amended 2003)

***Note:** The marked section capacity for livestock weighing may be less than the marked CLC for vehicle weighing.*
(Amended 2003)

23. *Required only if a CC has been issued for the device or equipment. [Nonretroactive as of January 1, 2003]*
(G-S.1. Identification (e) Added 2001)

24. *The section capacity shall be prefaced by the words "Section Capacity" or an abbreviation of that term. Abbreviations shall be "Sec Cap" or "Sec C." All capital letters and periods may be used.*
[Nonretroactive as of January 1, 2005]
(Added 2004)

N. Notes

N.1. Test Procedures.

N.1.1. Increasing-Load Test. – The increasing-load test shall be conducted on all scales with the test loads approximately centered on the load-receiving element of the scale, except on a scale having a nominal capacity greater than the total available known test load. When the total test load is less than the nominal capacity, the test load is used to greatest advantage by concentrating it, within prescribed load limits, over the main load supports of the scale.

N.1.2. Decreasing-Load Test (Automatic Indicating Scales). – The decreasing-load test shall be conducted with the test load approximately centered on the load-receiving element of the scale.

N.1.2.1. Scales Marked I, II, III, or IIII. – Except for portable wheel load weighers, decreasing-load tests shall be conducted on scales marked I, II, III or IIII and with "n" equal to or greater than 1000 with test loads equal to the maximum test load at each tolerance value. For example, on a Class III scale, at test loads equal to 4000 d, 2000 d, and 500 d; for scales with n less than 1000, the test load shall be equal to one-half of the maximum load applied in the increasing-load test. (See Table 6. Maintenance Tolerances)
(Amended 1998)

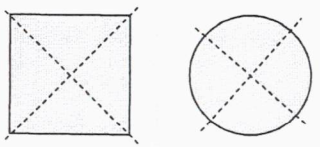
N.1.2.2. All Other Scales. – On all other scales, except for portable wheel load weighers, the decreasing-load test shall be conducted with a test load equal to one-half of the maximum load applied in the increasing-load test.

(Amended 1998)

N.1.3. Shift Test.

N.1.3.1. Dairy-Product Test Scales. – A shift test shall be conducted with a test load of 18 g successively positioned at all points on which a weight might reasonably be placed in the course of normal use of the scale.

N.1.3.2. Equal-Arm Scales. – A shift test shall be conducted with a half-capacity test load centered successively at four points positioned equidistance between the center and the front, left, back, and right edges of each pan as shown in the diagrams below. An equal test load shall be centered on the other pan.



N.1.3.3. Vehicle Scales, Axle-Load Scales, and Livestock Scales.

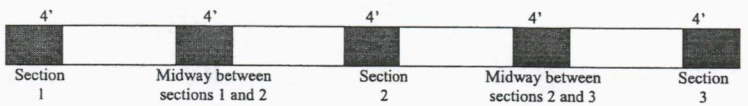
N.1.3.3.1. Vehicle Scales, Axle-Load Scales, and Combination Vehicle/Livestock Scales.

(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.1.3.3.2. Prescribed Test Pattern and Test Loads for Livestock Scales with More Than Two Sections and Combination Vehicle/Livestock Scales.)

(Amended 1991, 2000, and 2003)

(b) **Prescribed Test Pattern and Loading for Vehicle Scales, Axle-Load Scales, and Combination Vehicle/Livestock Scales.** – The normal prescribed test pattern shall be an area of 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. Multiple test patterns may be utilized when loaded in accordance with paragraph (c), (d), or (e) as applicable. An example of a possible test pattern is shown in the diagram below.

(Amended 1997, 2001, and 2003)



(c) **Loading Precautions for Vehicle Scales, Axle-Load Scales, and Combination Vehicle/Livestock Scales.** – When loading the scale for testing, one side of the test pattern shall be loaded to no more than half of the concentrated load capacity or test load before loading the other side. The area covered by the test load may be less than 1.2 m (4 ft) x 3.0 m (10 ft) or the width of the scale platform, whichever is less; for test patterns less than 1.2 m

(4 ft) in length the maximum loading shall meet the formula: [(wheel base of test cart or length of test load divided by 48 in) x 0.9 x CLC]. The maximum test load applied to each test pattern shall not exceed the concentrated load capacity of the scale. When the test pattern exceeds 1.2 m (4 ft), the maximum test load applied shall not exceed the concentrated load capacity times the largest "r" factor in Table UR.3.2.1. Span Maximum Load for the length of the area covered by the test load. For load-receiving elements installed prior to January 1, 1989, the rated section capacity may be substituted for concentrated load capacity to determine maximum loading. An example of a possible test pattern is shown above.

(Amended 1997 and 2003)

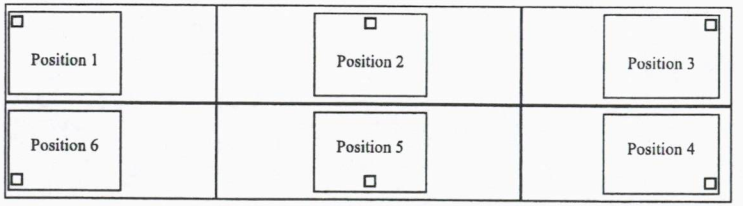
(d) **Multiple Pattern Loading.** – To test to the nominal capacity, multiple patterns may be simultaneously loaded in a manner consistent with the method of use.

(e) **Other Designs.** – Special design scales and those that are wider than 3.7 m (12 ft) shall be tested in a manner consistent with the method of use but following the principles described above.

(Amended 1988, 1991, 1997, 2000, 2001, and 2003)

(Amended 2003)

N.1.3.3.2. Prescribed Test Pattern and Test Loads for Livestock Scales with More Than Two Sections and Combination Vehicle/Livestock Scales. – A minimum test load of 5000 kg (10 000 lb) or one-half of the rated section capacity, whichever is less, shall be placed, as nearly as possible, successively over each main load support as shown in the diagram below. For livestock scales manufactured between January 1, 1989, and January 1, 2003, the required loading shall be no greater than one-half CLC. (Two-section livestock scales shall be tested consistent with N.1.3.7. All Other Scales Except Crane Scales, Hanging Scales, Hopper Scales, Wheel-Load Weighers, and Portable Axle-Load Weighers.)



□ = Load Bearing Point

(Added 2003)

N.1.3.3.3. Prescribed Test Patterns and Test Loads for Two-Section Livestock Scales. – A shift test shall be conducted using the following prescribed test loads and test patterns, provided the shift test load does not exceed one-half the rated section capacity or one-half the rated concentrated load capacity whichever is applicable, using either:

(a) A one-half nominal capacity test load centered as nearly as possible, successively at the center of each quarter of the load-receiving element as shown in N.1.3.7. All Other Scales Except Crane Scales, Hanging Scales, Hopper Scales, Wheel-Load Weighers, and Portable Axle-Load Weighers Figure 1; or

(b) A one-quarter nominal capacity test load centered as nearly as possible, successively over each main load support as shown in N.1.3.7. All Other Scales Except Crane Scales, Hanging Scales, Hopper Scales, Wheel-Load Weighers, and Portable Axle-Load Weighers Figure 2.

(Added 2007)

N.1.3.4. Railway Track Scales Weighing Individual Cars in Single Drafts. – A shift test shall be conducted with at least two different test loads, if available, distributed over, to the right and left of, each pair of main levers or other weighing elements supporting each section of the scale.

N.1.3.5. Monorail Scales, Static Test. – A shift test shall be conducted with a test load equal to the largest load that can be anticipated to be weighed in a given installation, but never less than one-half scale capacity. The load shall be placed successively on the right end, the left end, and the center of the live rail.

(Added 1985)

N.1.3.5.1. Dynamic Monorail Weighing Systems. – Dynamic tests with livestock carcasses or portions of carcasses shall be conducted during normal plant production. No less than 20 test loads using carcasses or portions of carcasses of the type normally weighed shall be used in the dynamic test. If the plant conveyor chain does not space or prevent the carcasses or portions of carcasses from touching one another, dynamic tests shall not be conducted until this condition has been corrected.

All carcasses or portions of carcasses shall be individually weighed statically on either the same scale being tested dynamically or another monorail scale with the same or smaller divisions and in close proximity. (The scale selected for static weighing of the carcasses or portions of carcasses shall first be tested statically with certified test weights that have been properly protected from the harsh environment of the packing plant to ensure they maintain accuracy.)

If the scale being tested is used for weighing freshly slaughtered animals (often referred to as a "hot scale"), care must be taken to get a static weighment as quickly as possible before or following the dynamic weighment to avoid loss due to shrink. If multiple dynamic tests are conducted using the same carcasses or portions of carcasses, static weights shall be obtained before and after multiple dynamic tests. If the carcass or portion of a carcass changes weight between static tests, the amount of weight change shall be taken into account, or the carcass or portion of a carcass shall be disregarded for tolerance purposes.

Note: For a dynamic monorail test, the reference scale shall comply with the principles in the Fundamental Considerations paragraph 3.2. Tolerances for Standards.

(Added 1996) (Amended 1999 and 2007)

N.1.3.6. Vehicle On-Board Weighing Systems. – The shift test for a vehicle on-board weighing system shall be conducted in a manner consistent with its normal use. For systems that weigh as part of the lifting cycle, the center of gravity of the load may be shifted in the vertical direction as well as from side to side. In other cases, the center of gravity may be moved to the extremes of the load-receiving element using loads of a magnitude that reflect normal use (i.e., the load for the shift test may exceed one-half scale capacity), and may, in some cases, be equal to the capacity of the scale. The shift test may be conducted when the weighing system is out of level to the extent that the weighing system remains operational.

(Added 1992)

N.1.3.7. All Other Scales Except Crane Scales, Hanging Scales, Hopper Scales, Wheel-Load Weighers, and Portable Axle-Load Weighers. – A shift test shall be conducted using the following prescribed test loads and test patterns. A single field standard weight used as the prescribed test load shall be applied centrally in the prescribed test pattern. When multiple field standard weights are used as the prescribed test load, the load shall be applied in a consistent pattern in the shift test positions throughout the test and applied in a manner that does not concentrate the load in a test pattern that is less than when that same load is a single field standard weight on the load-receiving element.

(a) For scales with a nominal capacity of 500 kg (1000 lb) or less, a shift test shall be conducted using a one-third nominal capacity test load (defined as test weights in amounts of at least 30 % of scale capacity, but not to exceed 35 % of scale capacity) centered as nearly as possible at the center of each quadrant of the load-receiving element using the prescribed test pattern as shown in Figure 1.

(b) For scales with a nominal capacity greater than 500 kg (1000 lb), a shift test may be conducted by either using a one-third nominal capacity test load (defined as test weights in amounts of at least 30 % of scale capacity, but not to exceed 35 % of scale capacity) centered as nearly as possible at the center of each quadrant of the load-receiving element using the prescribed test pattern as shown in Figure 1, or by using a one-quarter nominal capacity test load centered as nearly as possible, successively, over each corner of the load-receiving element using the prescribed test pattern as shown in Figure 2.

Figure 1

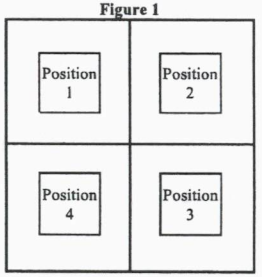
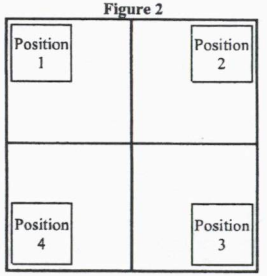


Figure 2



(Added 2003)

(Amended 1987, 2003, and 2007)

N.1.4. Sensitivity Test. – A sensitivity test shall be conducted on nonautomatic-indicating (weighbeam) scales only, with the weighing device in equilibrium at zero-load and at maximum test load. The test shall be conducted by increasing or decreasing the test load in an amount equal to the applicable value specified in T.2. Sensitivity Requirement (SR) or T.N.6. Sensitivity.

N.1.5. Discrimination Test. *– A discrimination test shall be conducted on all automatic indicating scales with the weighing device in equilibrium at or near zero load and at or near maximum test load, and under controlled conditions in which environmental factors are reduced to the extent that they will not affect the results obtained. For scales equipped with an Automatic Zero-Tracking Mechanism (AZT), the discrimination test may be conducted at a range outside of the AZT range.*
[Nonretroactive as of January 1, 1986]

(Added 1985) (Amended 2004)

N.1.5.1. Digital Device. – On a digital device, this test is conducted from just below the lower edge of the zone of uncertainty for increasing load tests, or from just above the upper edge of the zone of uncertainty for decreasing-load tests.

N.1.6. RFI Susceptibility Tests, Field Evaluation. – An RFI test shall be conducted at a given installation when the presence of RFI has been verified and characterized if those conditions are considered "usual and customary."

(Added 1986)

N.1.7. Ratio Test. – A ratio test shall be conducted on all scales employing counterpoise weights and on nonautomatic-indicating equal-arm scales.

N.1.8. Material Tests. – A material test shall be conducted on all customer-operated bulk weighing systems for recycled materials using bulk material for which the device is used. Insert into the device, in a normal manner, several accurately pre-weighed samples (free of foreign material) in varying amounts approximating average drafts.

N.1.9. Zero-Load Balance Change. – A zero-load balance change test shall be conducted on all scales after the removal of any test load. The zero-load balance should not change by more than the minimum tolerance applicable. (See also see G-UR.4.2. Abnormal Performance)

N.1.10. Counting Feature Test. – A test of the counting function shall be conducted on all Class I and Class II prescription scales having an active counting feature used in "legal for trade" applications. The test should verify that the scale will not accept a sample with less than either the minimum sample piece count or the minimum sample weight of 30 e. Counting feature accuracy should be verified at a minimum of two test loads. Verification of the count calculations shall be based upon the weight indication of the test load.

Note:
(1) The minimum sample weight is equal to the marked minimum individual piece weight times the marked minimum sample piece count.
(2) Test load as used in this section refers to actual calibration test weights selected from an appropriate test weight class.

(Added 2003)

N.1.11. Substitution Test. – In the substitution test procedure, material or objects are substituted for known test weights, or a combination of known test weights and previously quantified material or objects, using the scale under test as a comparator. Additional test weights or other known test loads may be added to the known test load to evaluate higher weight ranges on the scale.

(Added 2003)

N.1.12. Strain-Load Test. – In the strain-load test procedure, an unknown quantity of material or objects are used to establish a reference load or tare to which test weights or substitution test loads are added.

(Added 2003)

N.2. Verification (Testing) Standards. – Field standard weights used in verifying weighing devices shall comply with requirements of NIST Handbook 105-Series standards (or other suitable and designated standards) or the tolerances expressed in Fundamental Considerations, paragraph 3.2. (i.e., one-third of the smallest tolerance applied).

(Amended 1986)

N.3. Minimum Test Weights and Test Loads. – The minimum test weights and test loads for in-service tests (except railway track scales) are shown in Table 4. (See Footnote 2 in Table 4. Minimum Test Weights and Test Loads.)

(Added 1984) (Amended 1988)

N.3.1. Minimum Test-Weight Load and Recommended Strain-Load Test for Railway Track Scales.

(Amended 1990)

N.3.1.1. Approval. – The test-weight load shall be not less than 35 000 kg (80 000 lb). A strain-load test conducted up to the used capacity of the weighing system is recommended.

(Added 1990)

N.3.1.2. Interim Approval. – A test-weight load of not less than 13 500 kg (30 000 lb) and a strain-load test up to at least 25 % of scale capacity may be used to return a scale into service following repairs.

(Added 1990)

Note: The length of time the scale may be used following an interim test is at the discretion of the official with statutory authority.

(Added 1990)

N.3.1.3. Enforcement Action for Inaccuracy. – To take enforcement action on a scale that is found to be inaccurate, a minimum test load of 13 500 kg (30 000 lb) must be used.

(Added 1990)

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

Devices in Metric Units			Devices in U.S. Customary Units		
Device Capacity (kg)	Minimums (in terms of device capacity)		Device Capacity (lb)	Minimums (in terms of device capacity)	
	Test Weights (greater of)	Test Loads[2]		Test Weights (greater of)	Test Loads[2]
0 to 150 kg	100 %		0 to 300 lb	100 %	
151 to 1 500 kg	25 % or 150 kg	75 %	301 to 3 000 lb	25 % or 300 lb	75 %
1 501 to 20 000 kg	12.5 % or 500 kg	50 %	3001 to 40 000 lb	12.5 % or 1 000 lb	50 %
20 001 kg+	12.5 % or 5 000 kg	25 %[3]	40 001 lb+	12.5 % or 10 000 lb	25 %[3]

Where practicable:

- Test weights to dial face capacity, 1000 d, or test load to used capacity, if greater than minimums specified.
- During initial verification, a scale should be tested to capacity.

[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)

Note: GIPSA requires devices subject to their inspection to be tested to at least "used capacity," which is calculated based on the platform area of the scale and a weight factor assigned to the species of animal weighed on the scale. "Used capacity" is calculated using the formula:

Used Scale Capacity = Scale Platform Area x Species Weight Factor

Where species weight factor = 540 kg/m^2 (110 lb/ft^2) for cattle, 340 kg/m^2 (70 lb/ft^2) for calves and hogs, and 240 kg/m^2 (50 lb/ft^2) for sheep and lambs.

N.3.2. Field Standard Weight Carts. – Field Standard Weight Carts that comply with the tolerances expressed in Fundamental Considerations, paragraph 3.2. (i.e., one-third of the smallest tolerance applied) may be included as part of the minimum required test load (See Table 4. Minimum Test Weights and Test Loads) for shift tests and other test procedures.

(Added 2004)

N.4. Coupled-in-Motion Railroad Weighing Systems[3].

N.4.1. Weighing Systems Used to Weigh Trains of Less Than Ten Cars. – These weighing systems shall be tested using a consecutive-car test train consisting of the number of cars weighed in the normal operation run over the weighing system a minimum of five times in each mode of operation following the final calibration.

(Added 1990) (Amended 1992)

N.4.2. Weighing Systems Placed in Service Prior to January 1, 1991, and Used to Weigh Trains of Ten or More Cars. – The minimum test train shall be a consecutive-car test train of no less than ten cars run over the scale a minimum of five times in each mode of operation following final calibration.

(Added 1990) (Amended 1992)

N.4.3. Weighing Systems Placed in Service on or After January 1, 1991, and Used to Weigh Trains of Ten or More Cars.

(a) These weighing systems shall be tested using a consecutive-car test train of no less than ten cars run over the scale a minimum of five times in each mode of operation following final calibration; or

(b) if the official with statutory authority determines it necessary, the As-Used Test Procedures outlined in N.4.3.1. shall be used.

(Added 1990) (Amended 1992)

N.4.3.1. As-Used Test Procedures – A weighing system shall be tested in a manner that represents the normal method of operation and length(s) of trains normally weighed. The weighing systems may be tested using either a:

(a) consecutive-car test train of a length typical of train(s) normally weighed; or

(b) distributed-car test train of a length typical of train(s) normally weighed.

However, a consecutive-car test train of a shorter length may be used, provided that initial verification test results for the shorter consecutive-car test train agree with the test results for the distributed-car or full-length consecutive-car test train as specified in N.4.3.1.1. Initial Verification.

The official with statutory authority shall be responsible for determining the minimum test train length to be used on subsequent tests.

(Added 1990) (Amended 1992)

N.4.3.1.1. Initial Verification. – Initial verification tests should be performed on any new weighing system and whenever either the track structure or the operating procedure changes. If a consecutive-car test train of length shorter than trains normally weighed is to be used for subsequent verification, the shorter consecutive-car test train results shall be compared either to a distributed-car or to a consecutive-car test train of length(s) typical of train(s) normally weighed.

[3] A test weight car that is representative of one of the types of cars typically weighed on the scale under test may be used wherever reference weight cars are specified.

(Added 1991)

The difference between the total train weight of the train(s) representing the normal method of operation and the weight of the shorter consecutive-car test train shall not exceed 0.15 %. If the difference in test results exceeds 0.15 %, the length of the shorter consecutive-car test train shall be increased until agreement within 0.15 % is achieved. Any adjustments to the weighing system based upon the use of a shorter consecutive-car test train shall be offset to correct the bias that was observed between the full-length train test and the shorter consecutive-car test train.

(Added 1990) (Amended 1992 and 1993)

N.4.3.1.2. Subsequent Verification. – The test train may consist of either a consecutive-car test train with a length not less than that used in initial verification, or a distributed-car test train representing the number of cars used in the normal operation.

(Added 1990)

N.4.3.1.3. Distributed-Car Test Trains.

(a) The length of the train shall be typical of trains that are normally weighed.

(b) The reference weight cars shall be split into three groups, each group consisting of ten cars or 10 % of the train length, whichever is less.

(Amended 1991)

(c) The test groups shall be placed near the front, around the middle, and near the end of the train.

(d) Following the final adjustment, the distributed-car test train shall be run over the scale at least three times or shall produce 50 weight values, whichever is greater.

(e) The weighing system shall be tested in each mode of operation.

(Added 1990) (Amended 1992)

N.4.3.1.4. Consecutive-Car Test Trains.

(a) A consecutive-car test train shall consist of at least ten cars.

(b) If the consecutive-car test train consists of between ten and twenty cars, inclusive, it shall be run over the scale a minimum of five times in each mode of operation following the final calibration.

(c) If the consecutive-car test train consists of more than twenty cars, it shall be run over the scale a minimum of three times in each mode of operation.

(Added 1990) (Amended 1992)

N.5. Uncoupled-in-Motion Railroad Weighing System. – An uncoupled-in-motion scale shall be tested statically before being tested in motion by passing railroad reference weight cars over the scale. When an uncoupled-in-motion railroad weighing system is tested, the car speed and the direction of travel shall be the same as when the scale is in normal use. The minimum in-motion test shall be three reference weight cars passed over the scale three times. The cars shall be selected to cover the range of weights that are normally weighed on the system and to reflect the types of cars normally weighed.

(Added 1993)

N.6. Nominal Capacity of Prescription Scales. – The nominal capacity of a prescription scale shall be assumed to be one-half apothecary ounce, unless otherwise marked. (Applicable only to scales not marked with an accuracy class.)

T. Tolerances Applicable to Devices not Marked I, II, III, III L, or IIII

T.1. Tolerance Values.

T.1.1. General. – The tolerances applicable to devices not marked with an accuracy class shall have the tolerances applied as specified in Table T.1.1. Tolerances for Unmarked Scales.
(Amended 1990)

T.1.2. Postal and Parcel Post Scales. – The tolerances for postal and parcel post scales are given in Table T.1.1. Tolerances for Unmarked Scales and Table 5. Maintenance and Acceptance Tolerances for Unmarked Postal and Parcel Post Scales.
(Amended 1990)

Table T.1.1. Tolerances for Unmarked Scales

Type of Device	Subcategory	Minimum Tolerance	Acceptance Tolerance	Maintenance Tolerance	Decreasing-Load Multiplier[1]	Other Applicable Requirements
Vehicle, axle-load, livestock, railway track (weighing statically), crane, and hopper (other than grain hopper)		Class III L, T.N.3.1 (Table 6) and T.N.3.2.			1.0	T.N.2., T.N.3., T.N.4.1., T.N.4.2., T.N.4.3., T.N.4.4., T.N.5., T.N.7.2., *T.N.8.1.4.*[4], T.N.9.
Grain test scales	n ≤ 10 000 n > 10 000	Class III, T.N.3.1. (Table 6) and T.N.3.2. Class II, T.N.3.1. (Table 6) and T.N.3.2.			1.0	*T.N.8.1.4.*[4], T.N.9.
Railway track scales weighing in motion		T.N.3.6. except that for T.N.3.6.2. (a), no single error shall exceed four times the maintenance tolerance.			1.0	*T.N.8.1.4.*[4], T.N.9.
Monorail scales, in-motion		T.N.3.8.			1.0	*T.N.8.1.4.*[4], T.N.9.
Customer-operated bulk-weighing systems for recycled materials		± 5 % of applied material test load. Average error on 10 or more test loads ≤ 2.5 %.			1.0	*T.N.8.1.4.*[4], T.N.9.
Wheel-load weighers and portable axle-load scales	Tested individually or in pairs[2]	0.5 d or 50 lb, whichever is greater	1 % of test load	2 % of test load	1.5[3]	*T.N.8.1.4.*[4], T.N.9.
Prescription scales		0.1 grain (6 mg)	0.1 % of test load	0.1 % of test load	1.5	*T.N.8.1.4.*[4], T.N.9.
Jewelers' scales	Graduated	0.5 d	0.05 % of test load	0.05 % of test load	1.5	*T.N.8.1.4.*[4], T.N.9.
	Ungraduated	Sensitivity or smallest weight, whichever is less				
Dairy-product test scale	Loads < 18 g 18 g load	0.2 grain 0.2 grain	0.2 grain 0.3 grain	0.2 grain 0.5 grain	1.5	*T.N.8.1.4.*[4], T.N.9.
Postal and parcel post scales designed/used to weigh loads < 2 lb	Loads < 2 lb	15 grain, 1 g, 1/32 oz, 0.03 oz, or 0.002 lb	15 grain, 1 g, 1/32 oz, 0.03 oz, or 0.002 lb	15 grain, 1 g, 1/32 oz, 0.03 oz, or 0.002 lb	1.5	*T.N.8.1.4.*[4], T.N.9.
	Loads ≤ 2 lb	Table 5	Table 5	Table 5		
Other postal and parcel post scales		Table 5	Table 5	Table 5	1.5	*T.N.8.1.4.*[4], T.N.9.
All other scales	n > 5000	0.5 d or 0.05 % of scale capacity, whichever is less	0.05 % of test load	0.1 % of test load	1.5	T.N.2.5., T.N.4.1., T.N.4.2., T.N.4.3., T.N.5., T.N.7.2., *T.N.8.1.4.*[4], T.N.9.
	n ≤ 5000	Class III, T.N.3.1., Table 6 and T.N.3.2.			1.0	T.N.2., T.N.3., T.N.4.1., T.N.4.2., T.N.4.3., T.N.5., T.N.7.2., *T.N.8.1.4.*[4], T.N.9.

[1] The decreasing load test applies only to automatic indicating scales.
[2] If marked and tested as a pair, the tolerance shall be applied to the sum of the indication.
[3] The decreasing load test does not apply to portable wheel load weighers.
[4] *T.N.8.1.4. Operating Temperature. is nonretroactive and effective for unmarked devices manufactured as of January 1, 1981.*

(Table Added 1990; Amended 1992 and 1993)

Table 5.
Maintenance and Acceptance Tolerances for Unmarked Postal and Parcel Post Scales

Scale Capacity (lb)	Test Loads (lb)	Maintenance Tolerance (±) (oz)	Maintenance Tolerance (±) (lb)	Acceptance Tolerance (±) (oz)	Acceptance Tolerance (±) (lb)
0 to 4, inclusive*	0 to 1, inclusive	1/32	0.002	1/32	0.002
	over 1	1/8	0.008	1/16	0.004
over 4*	0 to 7, inclusive	3/16	0.012	3/16	0.012
	7+ to 24, inclusive	3/8	0.024	3/16	0.012
	24+ to 30, inclusive	½	0.030	¼	0.015
	over 30	0.1 % of Test Load		0.05 % of Test Load	

*See Table T.1.1. Tolerances for Unmarked Scales for scales designed and/or used to weigh loads less than 2 lb.

T.2. Sensitivity Requirement (SR).

T.2.1. Application. – The sensitivity requirement (SR) is applicable to all nonautomatic-indicating scales not marked I, II, III, III L, or IIII, and is the same whether acceptance or maintenance tolerances apply.

T.2.2. General. – Except for scales specified in paragraphs T.2.3. Prescription Scales through T.2.8. Railway Track Scales: 2 d, 0.2 % of the scale capacity, or 40 lb, whichever is least.

T.2.3. Prescription Scales. 6 mg (0.1 grain).

T.2.4. Jewelers' Scales.

T.2.4.1. With One-Half Ounce Capacity or Less. – 6 mg (0.1 grain).

T.2.4.2. With More Than One-Half Ounce Capacity. – 1 d or 0.05 % of the scale capacity, whichever is less.

T.2.5. Dairy-Product Test Scales.

T.2.5.1. Used in Determining Butterfat Content. – 32 mg (0.5 grain).

T.2.5.2. Used in Determining Moisture Content. – 19 mg (0.3 grain).

T.2.6. Grain Test Scales. – The sensitivity shall be as stated in T.N.6. Sensitivity.
(Amended 1987)

T.2.7. Vehicle, Axle-Load, Livestock, and Animal Scales.

T.2.7.1. Equipped With Balance Indicators. – 1 d.

T.2.7.2. Not Equipped With Balance Indicators. – 2 d or 0.2 % of the scale capacity, whichever is less.

T.2.8. Railway Track Scales. – 3 d or 100 lb, whichever is less.

T.3. Sensitivity Requirement, Equilibrium Change Required.

The minimum change in equilibrium with test loads equal to the values specified in T.2. Sensitivity Requirements (SR) shall be as follows:

(a) **Scale with a Trig Loop but without a Balance Indicator.** – The position of rest of the weighbeam shall change from the center of the trig loop to the top or bottom, as the case may be.

(b) **Scale with a Single Balance Indicator and Having a Nominal Capacity of Less Than 250 kg (500 lb).** – The position of rest of the indicator shall change 1.0 mm (0.04 in) or one division on the graduated scale, whichever is greater.

(c) **Scale with a Single Balance Indicator and Having a Nominal Capacity of 250 kg (500 lb) or Greater.** – The position of rest of the indicator shall change 6.4 mm (0.25 in) or one division on the graduated scale or the width of the central target area, whichever is greater. However, the indicator on a batching scale shall change 3.2 mm (0.125 in) or one division on the graduated scale, whichever is greater.

(d) **Scale with Two Opposite-Moving Balance Indicators.** – The position of rest of the two indicators moving in opposite directions shall change 1.0 mm (0.04 in) with respect to each other.

(e) **Scale with Neither a Trig Loop nor a Balance Indicator.** – The position of rest of the weighbeam or lever system shall change from the horizontal, or midway between limiting stops, to either limit of motion.

T.N. Tolerances Applicable to Devices Marked I, II, III, III L, and IIII.

T.N.1. Principles.

T.N.1.1. Design. – The tolerance for a weighing device is a performance requirement independent of the design principle used.

T.N.1.2. Accuracy Classes. Weighing devices are divided into accuracy classes according to the number of scale divisions (n) and the value of the scale division (d).

T.N.1.3. Scale Division. – The tolerance for a weighing device is related to the value of the scale division (d) or the value of the verification scale division (e) and is generally expressed in terms of d or e.

T.N.2. Tolerance Application.

T.N.2.1. General. – The tolerance values are positive (+) and negative (-) with the weighing device adjusted to zero at no load. When tare is in use, the tolerance values are applied from the tare zero reference (zero net weight indication); the tolerance values apply to the net weight indication for any possible tare load using certified test loads.
(Amended 2008)

T.N.2.2. Type Evaluation Examinations. – For type evaluation examinations, the tolerance values apply to increasing and decreasing load tests within the temperature, power supply, and barometric pressure limits specified in T.N.8.

T.N.2.3. Subsequent Verification Examinations. – For subsequent verification examinations, the tolerance values apply regardless of the influence factors in effect at the time of the conduct of the examination. (See also G-N.2. Testing with Nonassociated Equipment.)

T.N.2.4. Multi-Interval and Multiple Range (Variable Division-Value) Scales. – For multi-interval and multiple range scales, the tolerance values are based on the value of the scale division of the range in use.

T.N.2.5. Ratio Tests. – For ratio tests, the tolerance values are 0.75 of the applicable tolerances.

T.N.3. Tolerance Values.

T.N.3.1. Maintenance Tolerance Values. – The maintenance tolerance values are as specified in Table 6. Maintenance Tolerances.

T.N.3.2. Acceptance Tolerance Values. – The acceptance tolerance values shall be one-half the maintenance tolerance values.

T.N.3.3. Wheel-Load Weighers and Portable Axle-Load Weighers of Class IIII. – The tolerance values are two times the values specified in T.N.3.1. Maintenance Tolerance Values and T.N.3.2. Acceptance Tolerance Values.
(Amended 1986)

T.N.3.4. Crane and Hopper (Other than Grain Hopper) Scales. – The maintenance and acceptance tolerances shall be as specified in T.N.3.1. Maintenance Tolerance Values and T.N.3.2. Acceptance Tolerance Values for Class III L, except that the tolerance for crane and construction materials hopper scales shall not be less than 1 d or 0.1 % of the scale capacity, whichever is less.
(Amended 1986)

Table 6.
Maintenance Tolerances
(All values in this table are in scale divisions)

Tolerance in Scale Divisions									
	1		2		3		5		
Class	Test Load								
I	0 -	50 000	50 001 -	200 000	200 001 +				
II	0 -	5 000	5 001 -	20 000	20 001 +				
III	0 -	500	501 -	2 000	2 001 -	4 000	4 001 +		
IIII	0 -	50	51 -	200	201 -	400	401 +		
III L	0 -	500	501 -	1 000	(Add 1 d for each additional 500 d or fraction thereof)				

T.N.3.5. Separate Main Elements: Load Transmitting Element, Indicating Element, Etc. – If a main element separate from a weighing device is submitted for type evaluation, the tolerance for the element is 0.7 that for the complete weighing device. This fraction includes the tolerance attributable to the testing devices used.

T.N.3.6. Coupled-In-Motion Railroad Weighing Systems. – The maintenance and acceptance tolerance values for the group of weight values appropriate to the application must satisfy the following conditions:
(Amended 1990 and 1992)

T.N.3.6.1. – For any group of weight values, the difference in the sum of the individual in-motion car weights of the group as compared to the sum of the individual static weights shall not exceed 0.2 %.
(Amended 1990)

T.N.3.6.2. – If a weighing system is used to weigh trains of five or more cars, and if the individual car weights are used, any single weight value within the group must meet the following criteria:

(a) no single error may exceed three times the static maintenance tolerance;

(b) not more than 5 % of the errors may exceed two times the static maintenance tolerance; and

(c) not more than 35 % of the errors may exceed the static maintenance tolerance.

(Amended 1990 and 1992)

T.N.3.6.3. – For any group of weight values wherein the sole purpose is to determine the sum of the group, T.N.3.6.1. alone applies.
(Amended 1990)

T.N.3.6.4. – For a weighing system used to weigh trains of less than five cars, no single car weight within the group may exceed the static maintenance tolerance.
(Amended 1990 and 1992)

T.N.3.7. Uncoupled-in-Motion Railroad Weighing Systems. – The maintenance and acceptance tolerance values for any single weighment within a group of non-interactive (i.e., uncoupled) loads, the weighment error shall not exceed the static maintenance tolerance.
(Amended 1992)

T.N.3.8. Dynamic Monorail Weighing System. – Acceptance tolerance shall be the same as the maintenance tolerance shown in Table 6. Maintenance Tolerances. On a dynamic test of twenty or more individual test loads, 10 % of the individual test loads may be in error, each not to exceed two times the tolerance. The error on the total of the individual test loads shall not exceed ± 0.2 %. (See also Note in N.1.3.5.1. Dynamic Monorail Weighing Systems) *For equipment undergoing type evaluation, a tolerance equal to one-half the maintenance tolerance values shown in Table 6. Maintenance Tolerances shall apply.*
[Nonretroactive January 1, 2002]
(Added 1986) (Amended 1999 and 2001)

T.N.3.9. Materials Test on Customer-Operated Bulk Weighing Systems for Recycled Materials. – The maintenance and acceptance tolerance shall be ± 5 % of the applied materials test load except that the average error on ten or more test materials test loads shall not exceed ± 2.5 %.
(Added 1986)

T.N.3.10. Prescription Scales with a Counting Feature. – In addition to Table 6. Maintenance Tolerances (for weight), the indicated piece count value computed by a Class I or Class II prescription scale counting feature shall comply with the tolerances in Table T.N.3.10. Maintenance and Acceptance Tolerances in Excess and in Deficiency for Count.

Table T.N.3.10.
Maintenance and Acceptance Tolerances
in Excess and in Deficiency for Count

Indication of Count	Tolerance (piece count)
0 to 100	0
101 to 200	1
201 or more	0.5 %

(Added 2003)

T.N.3.11. Tolerances for Substitution Test. – Tolerances are applied to the scale based on the substitution test load.
(Added 2003)

T.N.3.12. Tolerances for Strain-Load Test. – Tolerances apply only to the test weights or substitution test loads.
(Added 2003)

T.N.4. Agreement of Indications.

T.N.4.1. Multiple Indicating/Recording Elements. – In the case of a scale or weighing system equipped with more than one indicating element or indicating element and recording element combination, where the indicators or indicator/recorder combination are intended to be used independently of one another, tolerances shall be applied independently to each indicator or indicator/recorder combination.

(Amended 1986)

T.N.4.2. Single Indicating/Recording Element. – In the case of a scale or weighing system with a single indicating element or an indicating/recording element combination, and equipped with component parts such as unit weights, weighbeam and weights, or multiple weighbeams that can be used in combination to indicate a weight, the difference in the weight value indications of any load shall not be greater than the absolute value of the applicable tolerance for that load, and shall be within tolerance limits.

(Amended 1986)

T.N.4.3. Single Indicating Element/Multiple Indications. – In the case of an analog indicating element equipped with two or more indicating means within the same element, the difference in the weight indications for any load other than zero shall not be greater than one-half the value of the scale division (d) and be within tolerance limits.

(Amended 1986)

T.N.4.4. Shift or Section Tests. – The range of the results obtained during the conduct of a shift test or a section test shall not exceed the absolute value of the maintenance tolerance applicable and each test result shall be within applicable tolerances.

(Added 1986)

T.N.4.5. Time Dependence. – A time dependence test shall be conducted during type evaluation and may be conducted during field verification, provided test conditions remain constant.

(Amended 1989 and 2005)

T.N.4.5.1. Time Dependence: Class II, III, and IIII Non-automatic Weighing Instruments. – A non-automatic weighing instrument of Classes II, III, and IIII shall meet the following requirements at constant test conditions. During type evaluation, this test shall be conducted at 20 °C ± 2 °C (68 °F ± 4 °F):

(a) When any load is kept on an instrument, the difference between the indication obtained immediately after placing the load and the indication observed during the following 30 minutes shall not exceed 0.5 e. However, the difference between the indication obtained at 15 minutes and the indication obtained at 30 minutes shall not exceed 0.2 e.

(b) If the conditions in (a) are not met, the difference between the indication obtained immediately after placing the load on the instrument and the indication observed during the following 4 hours shall not exceed the absolute value of the maximum permissible error at the load applied.

(Added 2005) (Amended 2006 and 2010)

T.N.4.5.2. Time Dependence: Class III L Non-automatic Weighing Instruments. – A non-automatic weighing instrument of Class III L shall meet the following requirements:

(a) When any load is kept on an instrument, the difference between the indication obtained immediately after placing the load and the indication observed during the following 30 minutes shall not exceed 1.5 e. However, the difference between the indication obtained at 15 minutes and the indication obtained at 30 minutes shall not exceed 0.6 e.

(b) If the conditions in (a) are not met, the difference between the indication obtained immediately after placing the load on the instrument and the indication observed during the following 4 hours shall not exceed the absolute value of the maximum permissible error at the load applied.

(Added 2005) (Amended 2010)

T.N.4.5.3. Zero Load Return: Non-automatic Weighing Instruments. – A non-automatic weighing instrument shall meet the following requirements at constant test conditions. During type evaluation, this test shall be conducted at 20 °C ± 2 °C (68 °F ± 4 °F). The deviation on returning to zero as soon as the indication has stabilized, after the removal of any load which has remained on the instrument for 30 minutes shall not exceed:

(a) 0.5 e for Class II and IIII devices,

(b) 0.5 e for Class III devices with 4000 or fewer divisions,

(c) 0.83 e for Class III devices with more than 4000 divisions, or

(d) one-half of the absolute value of the applicable tolerance for the applied load for Class III L devices.

For a multi-interval instrument, the deviation shall not exceed 0.83 e_1 (where e_1 is the interval of the first weighing segment of the scale).

On a multiple range instrument, the deviation on returning to zero from Max_i (load in the applicable weighing range) shall not exceed 0.83 e_i (interval of the weighing range). Furthermore, after returning to zero from any load greater than Max_1 (capacity of the first weighing range) and immediately after switching to the lowest weighing range, the indication near zero shall not vary by more than e_1 (interval of the first weighing range) during the following 5 minutes.

(Added 2010)

T.N.4.6. Time Dependence (Creep) for Load Cells during Type Evaluation. – A load cell (force transducer) marked with an accuracy class shall meet the following requirements at constant test conditions:

(a) Permissible Variations of Readings. – With a constant maximum load for the measuring range (D_{max}) between 90 % and 100 % of maximum capacity (E_{max}), applied to the load cell, the difference between the initial reading and any reading obtained during the next 30 minutes shall not exceed the absolute value of the maximum permissible error (mpe) for the applied load (see Table T.N.4.6. Maximum Permissible Error (mpe) for Load Cells During Type Evaluation). The difference between the reading obtained at 20 minutes and the reading obtained at 30 minutes shall not exceed 0.15 times the absolute value of the mpe (see Table T.N.4.6. Maximum Permissible Error (mpe) for Load Cells During Type Evaluation).

(b) Apportionment Factors. – The mpe for creep shall be determined from Table T.N.4.6. Maximum Permissible Error (mpe) for Load Cells During Type Evaluation using the following apportionment factors (p_{LC}):

p_{LC} = 0.7 for load cells marked with S (single load cell applications),
p_{LC} = 1.0 for load cells marked with M (multiple load cell applications), and
p_{LC} = 0.5 for Class III L load cells marked with S or M.

(Amended 2006)

(Added 2005)

Table T.N.4.6.
Maximum Permissible Error (mpe)* for Load Cells During Type Evaluation

mpe in Load Cell Verifications Divisions (v) = p_{LC} x Basic Tolerance in v			
Class	p_{LC} x 0.5 v	p_{LC} x 1.0 v	p_{LC} x 1.5 v
I	0 - 50 000 v	50 001 v - 200 000 v	200 001 v +
II	0 - 5 000 v	5 001 v - 20 000 v	20 001 v +
III	0 - 500 v	501 v - 2 000 v	2 001 v +
IIII	0 - 50 v	51 v - 200 v	201 v +
III L	0 - 500 v	501 v - 1 000 v	(Add 0.5 v to the basic tolerance for each additional 500 v or fraction thereof up to a maximum load of 10 000 v)

v represents the load cell verification interval
p_{LC} represents the apportionment factors applied to the basic tolerance
p_{LC} = 0.7 for load cells marked with S (single load cell applications)
p_{LC} = 1.0 for load cells marked with M (multiple load cell applications)
p_{LC} = 0.5 for Class III L load cells marked with S or M
* mpe = p_{LC} x Basic Tolerance in load cell verifications divisions (v)

(Table Added 2005) (Amended 2006)

T.N.4.7. Creep Recovery for Load Cells During Type Evaluation. – The difference between the initial reading of the minimum load of the measuring range (D_{min}) and the reading after returning to minimum load subsequent to the maximum load (D_{max}) having been applied for 30 minutes shall not exceed:

(a) 0.5 times the value of the load cell verification interval (0.5 v) for Class II and IIII load cells;

(b) 0.5 times the value of the load cell verification interval (0.5 v) for Class III load cells with 4000 or fewer divisions;

(c) 0.83 times the value of the load cell verification interval (0.83 v) for Class III load cells with more than 4000 divisions; or

(d) 2.5 times the value of the load cell verification interval (2.5 v) for Class III L load cells.

(Added 2006) (Amended 2009 and 2011)

T.N.5. Repeatability. – The results obtained from several weighings of the same load under reasonably static test conditions shall agree within the absolute value of the maintenance tolerance for that load, and shall be within applicable tolerances.

T.N.6. Sensitivity. – This section is applicable to all nonautomatic-indicating scales marked I, II, III, III L, or IIII.

T.N.6.1. Test Load.

(a) The test load for sensitivity for nonautomatic-indicating vehicle, axle-load, livestock, and animal scales shall be 1 d for scales equipped with balance indicator, and 2 d or 0.2 % of the scale capacity, whichever is less, for scales not equipped with balance indicators.

(b) For all other nonautomatic-indicating scales, the test load for sensitivity shall be 1 d at zero and 2 d at maximum test load.

T.N.6.2. Minimum Change of Indications. – The addition or removal of the test load for sensitivity shall cause a minimum permanent change as follows:

(a) for a scale with trig loop but without a balance indicator, the position of the weighbeam shall change from the center to the outer limit of the trig loop;

(b) for a scale with balance indicator, the position of the indicator shall change one division on the graduated scale, the width of the central target area, or the applicable value as shown below, whichever is greater:

Scale of Class I or II: 1 mm (0.04 in),
Scale of Class III or IIII with a maximum capacity of 30 kg (70 lb) or less: 2 mm (0.08 in),
Scale of Class III, III L, or IIII with a maximum capacity of more than 30 kg (70 lb): 5 mm (0.20 in);

(c) for a scale without a trig loop or balance indicator, the position of rest of the weighbeam or lever system shall change from the horizontal or midway between limiting stops to either limit of motion.

(Amended 1987)

T.N.7. Discrimination.

T.N.7.1. Analog Automatic Indicating (i.e., Weighing Device with Dial, Drum, Fan, etc.). – A test load equivalent to 1.4 d shall cause a change in the indication of at least 1.0 d. (See N.1.5. Discrimination Test)

T.N.7.2. Digital Automatic Indicating. – A test load equivalent to 1.4 d shall cause a change in the indicated or recorded value of at least 2.0 d. This requires the zone of uncertainty to be not greater than three-tenths of the value of the scale division. (See N.1.5.1. Digital Device)

T.N.8. Influence Factors. – The following factors are applicable to tests conducted under controlled conditions only, provided that:

(a) types of devices approved prior to January 1, 1986, and manufactured prior to January 1, 1988, need not meet the requirements of this section;

(b) new types of devices submitted for approval after January 1, 1986, shall comply with the requirements of this section; and

(c) all devices manufactured after January 1, 1988, shall comply with the requirements of this section.

(Amended 1985)

T.N.8.1. Temperature. – Devices shall satisfy the tolerance requirements under the following temperature conditions:

T.N.8.1.1. If not specified in the operating instructions for Class I or II scales, or if not marked on the device for Class III, III L, or IIII scales, the temperature limits shall be: – 10 °C to 40 °C (14 °F to 104 °F).

T.N.8.1.2. If temperature limits are specified for the device, the range shall be at least that specified in Table T.N.8.1.2. Temperature Range by Class.

Table T.N.8.1.2.
Temperature Range by Class

Class	Temperature Range
I	5 °C (9 °F)
II	15 °C (27 °F)
III, III L, and IIII	30 °C (54 °F)

T.N.8.1.3. Temperature Effect on Zero-Load Balance. – The zero-load indication shall not vary by more than:

(a) three divisions per 5 °C (9 °F) change in temperature for Class III L devices; or

(b) one division per 5 °C (9 °F) change in temperature for all other devices.

(Amended 1990)

T.N.8.1.4. Operating Temperature. – Except for Class I and II devices, an indicating or recording element shall not display nor record any usable values until the operating temperature necessary for accurate weighing and a stable zero balance condition have been attained.

T.N.8.2. Barometric Pressure. – Except for Class I scales, the zero indication shall not vary by more than one scale division for a change in barometric pressure of 1 kPa over the total barometric pressure range of 95 kPa to 105 kPa (28 in to 31 in of Hg).

T.N.8.3. Electric Power Supply.

T.N.8.3.1. Power Supply, Voltage and Frequency.

(a) Weighing devices that operate using alternating current must perform within the conditions defined in paragraphs T.N.3. Tolerance Values through T.N.7. Discrimination, inclusive, when tested over the range of − 15 % to + 10 % of the marked nominal line voltage(s) at 60 Hz, or the voltage range marked by the manufacturer, at 60 Hz.
(Amended 2003)

(b) Battery operated instruments shall not indicate nor record values outside the applicable tolerance limits when battery power output is excessive or deficient.

T.N.8.3.2. Power Interruption. – A power interruption shall not cause an indicating or recording element to display or record any values outside the applicable tolerance limits.

T.N.9. Radio Frequency Interference (RFI) and Other Electromagnetic Interference Susceptibility. – The difference between the weight indication due to the disturbance and the weight indication without the disturbance shall not exceed one scale division (d); or the equipment shall:

(a) blank the indication; or

(b) provide an error message; or

(c) the indication shall be so completely unstable that it cannot be interpreted, or transmitted into memory or to a recording element, as a correct measurement value.

The tolerance in T.N.9. Radio Frequency Interference (RFI) and Other Electromagnetic Interference Susceptibility is to be applied independently of other tolerances. For example, if indications are at allowable basic tolerance error limits when the disturbance occurs, then it is acceptable for the indication to exceed the applicable basic tolerances during the disturbance.

(Amended 1997)

UR. User Requirements

UR.1. Selection Requirements. – Equipment shall be suitable for the service in which it is used with respect to elements of its design, including but not limited to, its capacity, number of scale divisions, value of the scale division or verification scale division, minimum capacity, and computing capability.[4]

UR.1.1. General.

(a) For devices marked with a class designation, the typical class or type of device for particular weighing applications is shown in Table 7a. Typical Class or Type of Device for Weighing Applications.

(b) For devices not marked with a class designation, Table 7b. Applicable to Devices not Marked with a Class Designation applies.

Table 7a.
Typical Class or Type of Device for Weighing Applications

Class	Weighing Application or Scale Type
I	Precision laboratory weighing
II	Laboratory weighing, precious metals and gem weighing, grain test scales
III	All commercial weighing not otherwise specified, grain test scales, retail precious metals and semi-precious gem weighing, animal scales, postal scales, vehicle on-board weighing systems with a capacity less than or equal to 30 000 lb, and scales used to determine laundry charges
III L	Vehicle scales, vehicle on-board weighing systems with a capacity greater than 30 000 lb, axle-load scales, livestock scales, railway track scales, crane scales, and hopper (other than grain hopper) scales
IIII	Wheel-load weighers and portable axle-load weighers used for highway weight enforcement
Note: A scale with a higher accuracy class than that specified as "typical" may be used.	

(Amended 1985, 1986, 1987, 1988, 1992, and 1995)

[4] Purchasers and users of scales such as railway track, hopper, and vehicle scales should be aware of possible additional requirements for the design and installation of such devices.
(Footnote Added 1995)

Table 7b.
Applicable to Devices not Marked with a Class Designation

Scale Type or Design	Maximum Value of d
Retail Food Scales, 50 lb capacity and less	1 oz
Animal Scales	1 lb
Grain Hopper Scales Capacity up to and including 50 000 lb Capacity over 50 000 lb	 10 lb (not greater than 0.05 % of capacity) 20 lb
Crane Scales	not greater than 0.2 % of capacity
Vehicle and Axle-Load Scales Used in Combination Capacity up to and including 200 000 lb Capacity over 200 000 lb	 20 lb 50 lb
Railway Track Scales With weighbeam Automatic indicating	 20 lb 100 lb
Scales with capacities greater than 500 lb except otherwise specified	0.1 % capacity (but not greater than 50 lb)
Wheel-Load Weighers	0.25 % capacity (but not greater than 50 lb)
Note: For scales not specified in this table, G-UR.1.1. and UR.1. apply.	

(Added 1985) (Amended 1989)

UR.1.2. Grain Hopper Scales. – The minimum number of scale divisions for a Class III Hopper Scale used for weighing grain shall be 2000.

UR.1.3. Value of the Indicated and Recorded Scale Division. *– The value of the scale division as recorded shall be the same as the division value indicated.*
[Nonretroactive as of January 1, 1986]
(Added 1985) (Amended 1999)

UR.1.3.1. Exceptions. – The provisions of UR.1.3. Value of the Indicated and Recorded Scale Division shall not apply to:

(a) Class I scales, or

(b) Dynamic monorail weighing systems when the value of d is less than the value of e.

(Added 1999)

UR.1.4. Grain-Test Scales: Value of the Scale Divisions. – The scale division for grain-test scales shall not exceed 0.2 g for loads through 500 g, and shall not exceed 1 g for loads above 500 g through 1000 g.
(Added 1992)

UR.1.5. Recording Element, Class III L Railway Track Scales. *– Class III L Railway Track Scales must be equipped with a recording element.*
[Nonretroactive as of January 1, 1996]
(Added 1995)

UR.2. Installation Requirements.

UR.2.1. Supports. – A scale that is portable and that is being used on a counter, table, or the floor shall be so positioned that it is firmly and securely supported.

UR.2.2. Suspension of Hanging Scale. – A hanging scale shall be freely suspended from a fixed support when in use.

UR.2.3. Protection From Environmental Factors. – The indicating elements, the lever system or load cells, and the load-receiving element of a permanently installed scale, and the indicating elements of a scale not intended to be permanently installed, shall be adequately protected from environmental factors such as wind, weather, and RFI that may adversely affect the operation or performance of the device.

UR.2.4. Foundation, Supports, and Clearance. – The foundation and supports of any scale installed in a fixed location shall be such as to provide strength, rigidity, and permanence of all components, and clearance shall be provided around all live parts to the extent that no contacts may result when the load-receiving element is empty, nor throughout the weighing range of the scale. *On vehicle and livestock scales, the clearance between the load-receiving elements and the coping at the bottom edge of the platform shall be greater than at the top edge of the platform.**
*[*Nonretroactive as of January 1, 1973]*

UR.2.5. Access to Weighing Elements. – Adequate provision shall be made for ready access to the pit of a vehicle, livestock, animal, axle-load, or railway track scale for the purpose of inspection and maintenance. Any of these scales without a pit shall be installed with adequate means for inspection and maintenance of the weighing elements.
(Amended 1985)

UR.2.6. Approaches.

UR.2.6.1. Vehicle Scales. *– On the entrance and exit end(s) of a vehicle scale, there shall be a straight approach as follows:*

(a) the width at least the width of the platform,

(b) the length at least one-half the length of the platform but not required to be more than 12 m (40 ft), and

(c) not less than 3 m (10 ft) of any approach adjacent to the platform shall be in the same plane as the platform. Any slope in the remaining portion of the approach shall ensure (1) ease of vehicle access, (2) ease for testing purposes, and (3) drainage away from the scale.

In addition to (a), (b), and (c), scales installed in any one location for a period of 6 months or more shall have not less than 3 m (10 feet) of any approach adjacent to the platform constructed of concrete or similar durable material to ensure that this portion remains smooth and level and in the same plane as the platform; however, grating of sufficient strength to withstand all loads equal to the concentrated load capacity of the scale may be installed in this portion.
[Nonretroactive as of January 1, 1976]
(Amended 1977, 1983, 1993, 2006, and 2010)

UR.2.6.2. Axle-Load Scales. – At each end of an axle-load scale there shall be a straight paved approach in the same plane as the platform. The approaches shall be the same width as the platform and of sufficient length to insure the level positioning of vehicles during weight determinations.

UR.2.7. Stock Racks. – A livestock or animal scale shall be equipped with a suitable stock rack, with gates as required, which shall be securely mounted on the scale platform. Adequate clearances shall be maintained around the outside of the rack.

UR.2.8. Hoists. – On vehicle scales equipped with means for raising the load-receiving element from the weighing element for vehicle unloading, means shall be provided so that it is readily apparent to the scale operator when the load-receiving element is in its designed weighing position.

UR.2.9. Provision for Testing Dynamic Monorail Weighing Systems. *– Provisions shall be made at the time of installation of a dynamic monorail weighing systems for testing in accordance with N.1.3.5.1. Dynamic Monorail Weighing Systems (a rail around or other means for returning the test carcasses to the scale being tested). [Nonretroactive as of January 1, 1998]*

(Added 1997) (Amended 1999)

UR.3. Use Requirements.

UR.3.1. Recommended Minimum Load. – A recommended minimum load is specified in Table 8 since the use of a device to weigh light loads is likely to result in relatively large errors.

Table 8.
Recommended Minimum Load

Class	Value of Scale Division (d or e*)	Recommended Minimum Load (d or e*)
I	equal to or greater than 0.001 g	100
II	0.001 g to 0.05 g, inclusive	20
	equal to or greater than 0.1 g	50
III	All**	20
III L	All	50
IIII	All	10

*For Class I and II devices equipped with auxiliary reading means (i.e., a rider, a vernier, or a least significant decimal differentiated by size, shape or color), the value of the verification scale division "e" is the value of the scale division immediately preceding the auxiliary means. For Class III and IIII devices the value of "e" is specified by the manufacturer as marked on the device; "e" must be less than or equal to "d."

**A minimum load of 10 d is recommended for a weight classifier marked in accordance with a statement identifying its use for special applications.

(Amended 1990)

UR.3.1.1. Minimum Load, Grain Dockage Determination. – When determining the quantity of foreign material (dockage) in grain, the weight of the sample shall be equal to or greater than 500 scale divisions.

(Added 1985)

UR.3.2. Maximum Load. – A scale shall not be used to weigh a load of more than the nominal capacity of the scale.

UR.3.2.1. Maximum Loading for Vehicle Scales. – A vehicle scale shall not be used to weigh loads exceeding the maximum load capacity of its span as specified in Table UR.3.2.1. Span Maximum Load.

(Added 1996)

Table UR.3.2.1.
Span Maximum Load

Distance in Feet Between the Extremes of any Two or More Consecutive Axles	Ratio of CLC to Maximum Load ("r" factor) Carried on Any Group of Two or More Consecutive Axles.							
	2 axles	3 axles	4 axles	5 axles	6 axles	7 axles	8 axles	9 axles
4[1]	1.000		INSTRUCTIONS:					
5[1]	1.000		1. Determine the scale's CLC.					
6[1]	1.000		2. Count the number of axles on the vehicle in a given span and determine the distance in feet between the first and last axle in the span.					
7[1]	1.000							
8 and less[1]	1.000	1.000	3. Multiply the CLC by the corresponding multiplier in the table.*					
More than 8[1]	1.118	1.235						
9	1.147	1.257	4. The resulting number is the scale's maximum concentrated load for a single span based on the vehicle configuration.					
10	1.176	1.279						
11	1.206	1.301	*See note and formula on next page.					
12	1.235	1.324	1.471	1.632				
13	1.265	1.346	1.490	1.651				
14	1.294	1.368	1.510	1.669				
15	1.324	1.390	1.529	1.688	1.853			
16	1.353	1.412	1.549	1.706	1.871			
17	1.382	1.434	1.569	1.724	1.888			
18	1.412	1.456	1.588	1.743	1.906			
19	1.441	1.478	1.608	1.761	1.924			
20	1.471	1.500	1.627	1.779	1.941			
21	1.500	1.522	1.647	1.798	1.959			
22	1.529	1.544	1.667	1.816	1.976			
23	1.559	1.566	1.686	1.835	1.994			
24	1.588	1.588	1.706	1.853	2.012	2.176		
25	1.618	1.610	1.725	1.871	2.029	2.194		
26		1.632	1.745	1.890	2.047	2.211		
27		1.654	1.765	1.908	2.065	2.228		
28		1.676	1.784	1.926	2.082	2.245	2.412	
29		1.699	1.804	1.945	2.100	2.262	2.429	
30		1.721	1.824	1.963	2.118	2.279	2.445	
31		1.743	1.843	1.982	2.135	2.297	2.462	
32		1.765	1.863	2.000	2.153	2.314	2.479	2.647
33			1.882	2.018	2.171	2.331	2.496	2.664
34			1.902	2.037	2.188	2.348	2.513	2.680
35			1.922	2.055	2.206	2.365	2.529	2.697
36			2.000[2]	2.074	2.224	2.382	2.546	2.713
37			2.000[2]	2.092	2.241	2.400	2.563	2.730
38			2.000[2]	2.110	2.259	2.417	2.580	2.746
39			2.000	2.129	2.276	2.434	2.597	2.763
40			2.020	2.147	2.294	2.451	2.613	2.779
41			2.039	2.165	2.312	2.468	2.630	2.796
42			2.059	2.184	2.329	2.485	2.647	2.813
43			2.078	2.202	2.347	2.502	2.664	2.829
44			2.098	2.221	2.365	2.520	2.681	2.846
45			2.118	2.239	2.382	2.537	2.697	2.862
46			2.137	2.257	2.400	2.554	2.714	2.879
47			2.157	2.276	2.418	2.571	2.731	2.895
48			2.176	2.294	2.435	2.588	2.748	2.912
49			2.196	2.313	2.453	2.605	2.765	2.928
50			2.216	2.331	2.471	2.623	2.782	2.945

Table UR.3.2.1.
Span Maximum Load

Distance in Feet Between the Extremes of any Two or More Consecutive Axles	Ratio of CLC to Maximum Load ("r" factor) Carried on Any Group of Two or More Consecutive Axles.							
	2 axles	3 axles	4 axles	5 axles	6 axles	7 axles	8 axles	9 axles
51			2.235	2.349	2.488	2.640	2.798	2.961
52			2.255	2.368	2.506	2.657	2.815	2.978
53			2.275	2.386	2.524	2.674	2.832	2.994
54			2.294	2.404	2.541	2.691	2.849	3.011
55			2.314	2.423	2.559	2.708	2.866	3.028
56			2.333	2.441	2.576	2.725	2.882	3.044
57			2.353[3]	2.460	2.594	2.742	2.899	3.061
58				2.478	2.612	2.760	2.916	3.077
59				2.496	2.629	2.777	2.933	3.094
60				2.515	2.647	2.794	2.950	3.110

***Note:** This table was developed based upon the following formula. Values may be rounded in some cases for ease of use.

$$W = r \times 500\left[\left(\frac{LN}{N-1}\right) + 12N + 36\right]$$

[1] Tandem Axle Weight.
[2] Exception – These values in the third column correspond to the maximum loads in which the inner bridge dimensions of 36, 37, and 38 feet are considered to be equivalent to 39 feet. This allows a weight of 68 000 lb on axles 2 through 5.
[3] Corresponds to the Interstate Gross Weight Limit.

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, the weight of a:

(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) 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.
(Added 1992)

UR.3.4. Wheel-Load Weighing.

UR.3.4.1. Use in Pairs. – When wheel-load weighers or portable axle-load weighers are to be regularly used in pairs, both weighers of each such pair shall be appropriately marked to identify them as weighers intended to be used in combination.

UR.3.4.2. Level Condition. – A vehicle of which either an axle-load determination or a gross-load determination is being made utilizing wheel-load weighers or portable axle-load weighers, shall be in a reasonably level position at the time of such determination.

UR.3.5. Special Designs. – A scale designed and marked for a special application (such as a prepackaging scale or prescription scale with a counting feature) shall not be used for other than its intended purpose[5].
(Amended 2003)

UR.3.6. Wet Commodities. – Wet commodities not in watertight containers shall be weighed only on a scale having a pan or platform that will drain properly.
(Amended 1988)

UR.3.7. Minimum Load on a Vehicle Scale. – A vehicle scale shall not be used to weigh net loads smaller than:

(a) 10 d when weighing scrap material for recycling or weighing refuse materials at landfills and transfer stations;

(b) 50 d for all other weighing.

As used in this paragraph, scrap materials for recycling shall be limited to ferrous metals, paper (including cardboard), textiles, plastic, and glass.
(Amended 1988, 1992, and 2006)

UR.3.8. Minimum Load for Weighing Livestock. – A scale with scale divisions greater than 2 kg (5 lb) shall not be used for weighing net loads smaller than 500 d.
(Amended 1989)

UR.3.9. Use of Manual Weight Entries. – Manual gross or net weight entries are permitted for use in the following applications only when:

(a) a point-of-sale system interfaced with a scale is giving credit for a weighed item;

(b) an item is pre-weighed on a legal for trade scale and marked with the correct net weight;

(c) a device or system is generating labels for standard weight packages;

(d) postal scales or weight classifiers are generating manifests for packages to be picked up at a later time; or

(e) livestock and vehicle scale systems generate weight tickets to correct erroneous tickets.
(Added 1992) (Amended 2000 and 2004)

UR.3.10. Dynamic Monorail Weighing Systems. – When the value of d is different from the value of e, the commercial transaction must be based on e.
(Added 1999)

[5] Prepackaging scales and prescription scales with a counting feature (and other commercial devices) used for putting up packages in advance of sale are acceptable for use in commerce only if all appropriate provisions of Handbook 44 are met. Users of such devices must be alert to the legal requirements relating to the declaration of quantity on a package. Such requirements are to the effect that, on the average, the contents of the individual packages of a particular commodity comprising a lot, shipment, or delivery must contain at least the quantity declared on the label. The fact that a prepackaging scale may overregister, but within established tolerances, and is approved for commercial service is not a legal justification for packages to contain, on the average, less than the labeled quantity.
(Amended 2003)

UR.3.11. Minimum Count. – A prescription scale with an operational counting feature shall not be used to count a quantity of less than 30 pieces weighing a minimum of 90 e.

(Added 2003)

Note: The minimum count as defined in this paragraph refers to the use of the device in the filling of prescriptions and is different from the minimum sample piece count as defined in S.1.2.3. and as required to be marked on the scale by S.6.6.

(Note Added 2004)

UR.3.12. Correct Stored Piece Weight. – For prescription scales with a counting feature, the user is responsible for maintaining the correct stored piece weight. This is especially critical when a medicine has been reformulated or comes from different lots.

(Added 2003)

UR.4. Maintenance Requirements.

UR.4.1. Balance Condition. – The zero-load adjustment of a scale shall be maintained so that, with no load on the load-receiving element and with all load-counterbalancing elements of the scale (such as poises, drop weights, or counterbalance weights) set to zero, the scale shall indicate or record a zero balance condition. A scale not equipped to indicate or record a zero-load balance shall be maintained in balance under any no-load condition.

UR.4.2. Level Condition. – If a scale is equipped with a level-condition indicator, the scale shall be maintained in level.

UR.4.3. Scale Modification. – The dimensions (e.g., length, width, thickness, etc.) of the load receiving element of a scale shall not be changed beyond the manufacturer's specifications, nor shall the capacity of a scale be increased beyond its design capacity by replacing or modifying the original primary indicating or recording element with one of a higher capacity, except when the modification has been approved by a competent engineering authority, preferably that of the engineering department of the manufacturer of the scale, and by the weights and measures authority having jurisdiction over the scale.

(Amended 1996)

UR.5. Coupled-in-Motion Railroad Weighing Systems. – A coupled-in-motion weighing system placed in service on or after January 1, 1991, should be tested in the manner in which it is operated, with the locomotive either pushing or pulling the cars at the designed speed and in the proper direction. The cars used in the test train should represent the range of gross weights that will be used during the normal operation of the weighing system. Except as provided in N.4.2. Weighing Systems Placed in Service Prior to January 1, 1991, and Used to Weigh Trains of Ten or More Cars and N.4.3.(a) Weighing Systems Placed in Service on or After January 1, 1991, and Used to Weigh Trains of Ten or More Cars, normal operating procedures should be simulated as nearly as practical. Approach conditions for a train length in each direction of the scale site are more critical for a weighing system used for individual car weights than for a unit-train-weights-only facility, and should be considered prior to installation.

(Added 1990) (Amended 1992)

Scales Code Index

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Appendix A. Fundamental Considerations Associated with the Enforcement of Handbook 44 Codes

1. Uniformity of Requirements

1.1. National Conference Codes. – Weights and measures jurisdictions are urged to promulgate and adhere to the National Conference codes, to the end that uniform requirements may be in force throughout the country. This action is recommended even though a particular jurisdiction does not wholly agree with every detail of the National Conference codes. Uniformity of specifications and tolerances is an important factor in the manufacture of commercial equipment. Deviations from standard designs to meet the special demands of individual weights and measures jurisdictions are expensive, and any increase in costs of manufacture is, of course, passed on to the purchaser of equipment. On the other hand, if designs can be standardized by the manufacturer to conform to a single set of technical requirements, production costs can be kept down, to the ultimate advantage of the general public. Moreover, it seems entirely logical that equipment that is suitable for commercial use in the "specification" states should be equally suitable for such use in other states.

Another consideration supporting the recommendation for uniformity of requirements among weights and measures jurisdictions is the cumulative and regenerative effect of the widespread enforcement of a single standard of design and performance. The enforcement effort in each jurisdiction can then reinforce the enforcement effort in all other jurisdictions. More effective regulatory control can be realized with less individual effort under a system of uniform requirements than under a system in which even minor deviations from standard practice are introduced by independent state action.

Since the National Conference codes represent the majority opinion of a large and representative group of experienced regulatory officials, and since these codes are recognized by equipment manufacturers as their basic guide in the design and construction of commercial weighing and measuring equipment, the acceptance and promulgation of these codes by each state are strongly recommended.

1.2. Form of Promulgation. – A convenient and very effective form of promulgation already successfully used in a considerable number of states is promulgation by citation of National Institute of Standards and Technology Handbook 44. It is especially helpful when the citation is so made that, as amendments are adopted from time to time by the National Conference on Weights and Measures, these automatically go into effect in the state regulatory authority. For example, the following form of promulgation has been used successfully and is recommended for consideration:

> The specifications, tolerances, and other technical requirements for weighing and measuring devices as recommended by the National Conference on Weights and Measures and published in the National Institute of Standards and Technology Handbook 44, "Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices," and supplements thereto or revisions thereof, shall apply to commercial weighing and measuring devices in the state.

In some states, it is preferred to base technical requirements upon specific action of the state legislature rather than upon an act of promulgation by a state officer. The advantages cited above may be obtained and may yet be surrounded by adequate safeguards to insure proper freedom of action by the state enforcing officer if the legislature adopts the National Conference requirements by language somewhat as follows:

> The specifications, tolerances, and other technical requirements for weighing and measuring devices as recommended by the National Conference on Weights and Measures shall be the specifications, tolerances, and other technical requirements for weighing and measuring devices of the state except insofar as specifically modified, amended, or rejected by a regulation issued by the state (insert title of enforcing officer).

2. Tolerances for Commercial Equipment

2.1. Acceptance and Maintenance Tolerances. – The official tolerances prescribed by a weights and measures jurisdiction for commercial equipment are the limits of inaccuracy officially permissible within that jurisdiction. It is recognized that errorless value or performance of mechanical equipment is unattainable. Tolerances are established, therefore, to fix the range of inaccuracy within which equipment will be officially approved for commercial use. In the case of classes of equipment on which the magnitude of the errors of value or performance may be expected to change as a result of use, two sets of tolerances are established: acceptance tolerances and maintenance tolerances.

Acceptance tolerances are applied to new or newly reconditioned or adjusted equipment, and are smaller than (usually one-half of) the maintenance tolerances. Maintenance tolerances thus provide an additional range of inaccuracy within which equipment will be approved on subsequent tests, permitting a limited amount of deterioration before the equipment will be officially rejected for inaccuracy and before reconditioning or adjustment will be required. In effect, there is assured a reasonable period of use for equipment after it is placed in service before reconditioning will be officially required. The foregoing comments do not apply, of course, when only a single set of tolerance values is established, as is the case with equipment such as glass milk bottles and graduates, which maintain their original accuracy regardless of use, and measure-containers, which are used only once.

2.2. Theory of Tolerances. – Tolerance values are so fixed that the permissible errors are sufficiently small that there is no serious injury to either the buyer or the seller of commodities, yet not so small as to make manufacturing or maintenance costs of equipment disproportionately high. Obviously, the manufacturer must know what tolerances his equipment is required to meet, so that he can manufacture economically. His equipment must be good enough to satisfy commercial needs, but should not be subject to such stringent tolerance values as to make it unreasonably costly, complicated, or delicate.

2.3. Tolerances and Adjustments. – Tolerances are primarily accuracy criteria for use by the regulatory official. However, when equipment is being adjusted for accuracy, either initially or following repair or official rejection, the objective should be to adjust as closely as practicable to zero error. Equipment owners should not take advantage of tolerances by deliberately adjusting their equipment to have a value, or to give performance, at or close to the tolerance limit. Nor should the repair or service personnel bring equipment merely within tolerance range when it is possible to adjust closer to zero error.[1]

3. Testing Apparatus

3.1. Adequacy.[2] – Tests can be made properly only if, among other things, adequate testing apparatus is available. Testing apparatus may be considered adequate only when it is properly designed for its intended use, when it is so constructed that it will retain its characteristics for a reasonable period under conditions of normal use, when it is available in denominations appropriate for a proper determination of the value or performance of the commercial equipment under test, and when it is accurately calibrated.

3.2. Tolerances for Standards. – Except for work of relatively high precision, it is recommended that the accuracy of standards used in testing commercial weighing and measuring equipment be established and maintained so that the use of corrections is not necessary. When the standard is used without correction, its combined error and uncertainty must be less than one-third of the applicable device tolerance.

[1] See General Code, Section 1.10.; User Requirement G-UR.4.3. Use of Adjustments.

[2] Recommendations regarding the specifications and tolerances for suitable field standards may be obtained from the Weights and Measures Division of the National Institute of Standards and Technology. Standards will meet the specifications of the National Institute of Standards and Technology Handbook 105-Series standards (or other suitable and designated standards). This section shall not preclude the use of additional field standards and/or equipment, as approved by the Director, for uniform evaluation of device performance.

Device testing is complicated to some degree when corrections to standards are applied. When using a correction for a standard, the uncertainty associated with the corrected value must be less than one-third of the applicable device tolerance. The reason for this requirement is to give the device being tested as nearly as practicable the full benefit of its own tolerance.

3.3. Accuracy of Standards. – Prior to the official use of testing apparatus, its accuracy should invariably be verified. Field standards should be calibrated as often as circumstances require. By their nature, metal volumetric field standards are more susceptible to damage in handling than are standards of some other types. A field standard should be calibrated whenever damage is known or suspected to have occurred or significant repairs have been made. In addition, field standards, particularly volumetric standards, should be calibrated with sufficient frequency to affirm their continued accuracy, so that the official may always be in an unassailable position with respect to the accuracy of his testing apparatus. Secondary field standards, such as special fabric testing tapes, should be verified much more frequently than such basic standards as steel tapes or volumetric provers to demonstrate their constancy of value or performance.

Accurate and dependable results cannot be obtained with faulty or inadequate field standards. If either the service person or official is poorly equipped, their results cannot be expected to check consistently. Disagreements can be avoided and the servicing of commercial equipment can be expedited and improved if service persons and officials give equal attention to the adequacy and maintenance of their testing apparatus.

4. Inspection of Commercial Equipment

4.1. Inspection Versus Testing. – A distinction may be made between the inspection and the testing of commercial equipment that should be useful in differentiating between the two principal groups of official requirements; i.e., specifications and performance requirements. Although the term inspection is frequently loosely used to include everything that the official has to do in connection with commercial equipment, it is useful to limit the scope of that term primarily to examinations made to determine compliance with design, maintenance, and user requirements. The term testing may then be limited to those operations carried out to determine the accuracy of value or performance of the equipment under examination by comparison with the actual physical standards of the official. These two terms will be used herein in the limited senses defined.

4.2. Necessity for Inspection. – It is not enough merely to determine that the errors of equipment do not exceed the appropriate tolerances. Specification and user requirements are as important as tolerance requirements and should be enforced. Inspection is particularly important, and should be carried out with unusual thoroughness whenever the official examines a type of equipment not previously encountered.

This is the way the official learns whether or not the design and construction of the device conform to the specification requirements. But even a device of a type with which the official is thoroughly familiar and that he has previously found to meet specification requirements should not be accepted entirely on faith. Some part may have become damaged, or some detail of design may have been changed by the manufacturer, or the owner or operator may have removed an essential element or made an objectionable addition. Such conditions may be learned only by inspection. Some degree of inspection is therefore an essential part of the official examination of every piece of weighing or measuring equipment.

4.3. Specification Requirements. – A thorough knowledge by the official of the specification requirements is a prerequisite to competent inspection of equipment. The inexperienced official should have his specifications before him when making an inspection, and should check the requirements one by one against the equipment itself. Otherwise some important requirement may be overlooked. As experience is gained, the official will become progressively less dependent on the handbook, until finally observance of faulty conditions becomes almost automatic and the time and effort required to do the inspecting are reduced to a minimum. The printed specifications, however, should always be available for reference to refresh the official's memory or to be displayed to support his decisions, and they are an essential item of his kit.

Specification requirements for a particular class of equipment are not all to be found in the separate code for that class. The requirements of the General Code apply, in general, to all classes of equipment, and these must always be

considered in combination with the requirements of the appropriate separate code to arrive at the total of the requirements applicable to a piece of commercial equipment.

4.4. General Considerations. – The simpler the commercial device, the fewer are the specification requirements affecting it, and the more easily and quickly can adequate inspection be made. As mechanical complexity increases, however, inspection becomes increasingly important and more time consuming, because the opportunities for the existence of faulty conditions are multiplied. It is on the relatively complex device, too, that the official must be on the alert to discover any modification that may have been made by an operator that might adversely affect the proper functioning of the device.

It is essential for the officials to familiarize themselves with the design and operating characteristics of the devices that he inspects and tests. Such knowledge can be obtained from the catalogs and advertising literature of device manufacturers, from trained service persons and plant engineers, from observation of the operations performed by service persons when reconditioning equipment in the field, and from a study of the devices themselves.

Inspection should include any auxiliary equipment and general conditions external to the device that may affect its performance characteristics. In order to prolong the life of the equipment and forestall rejection, inspection should also include observation of the general maintenance of the device and of the proper functioning of all required elements. The official should look for worn or weakened mechanical parts, leaks in volumetric equipment, or elements in need of cleaning.

4.5. Misuse of Equipment. – Inspection, coupled with judicious inquiry, will sometimes disclose that equipment is being improperly used, either through ignorance of the proper method of operation or because some other method is preferred by the operator. Equipment should be operated only in the manner that is obviously indicated by its construction or that is indicated by instructions on the equipment, and operation in any other manner should be prohibited.

4.6. Recommendations. – A comprehensive knowledge of each installation will enable the official to make constructive recommendations to the equipment owner regarding proper maintenance of his weighing and measuring devices and the suitability of his equipment for the purposes for which it is being used or for which it is proposed that it be used. Such recommendations are always in order and may be very helpful to an owner. The official will, of course, carefully avoid partiality toward or against equipment of specific makes, and will confine his recommendations to points upon which he is qualified, by knowledge and experience, to make suggestions of practical merit.

4.7. Accurate and Correct Equipment. – Finally, the weights and measures official is reminded that commercial equipment may be accurate without being correct. A piece of equipment is accurate when its performance or value (that is, its indications, its deliveries, its recorded representations, or its capacity or actual value, etc., as determined by tests made with suitable standards) conforms to the standard within the applicable tolerances and other performance requirements. Equipment that fails so to conform is inaccurate. A piece of equipment is correct when, in addition to being accurate, it meets all applicable specification requirements. Equipment that fails to meet any of the requirements for correct equipment is incorrect. Only equipment that is correct should be sealed and approved for commercial use.[3]

5. Correction of Commercial Equipment

5.1. Adjustable Elements. – Many types of weighing and measuring instruments are not susceptible to adjustment for accuracy by means of adjustable elements. Linear measures, liquid measures, graduates, measure-containers, milk and lubricating-oil bottles, farm milk tanks, dry measures, and some of the more simple types of scales are in this category. Other types (for example, taximeters and odometers and some metering devices) may be adjusted in the field, but only by changing certain parts such as gears in gear trains.

Some types, of which fabric-measuring devices and cordage-measuring devices are examples, are not intended to be adjusted in the field and require reconditioning in shop or factory if inaccurate. Liquid-measuring devices and most

[3] See Section 1.10. General Code and Appendix D. Definitions.

scales are equipped with adjustable elements, and some vehicle-tank compartments have adjustable indicators. Field adjustments may readily be made on such equipment. In the discussion that follows, the principles pointed out and the recommendations made apply to adjustments on any commercial equipment, by whatever means accomplished.

5.2. When Corrections Should Be Made. – One of the primary duties of a weights and measures official is to determine whether equipment is suitable for commercial use. If a device conforms to all legal requirements, the official "marks" or "seals" it to indicate approval. If it does not conform to all official requirements, the official is required to take action to ensure that the device is corrected within a reasonable period of time. Devices with performance errors that could result in serious economic injury to either party in a transaction should be prohibited from use immediately and not allowed to be returned to service until necessary corrections have been made. The official should consider the most appropriate action, based on all available information and economic factors.

Some officials contend that it is justifiable for the official to make minor corrections and adjustments if there is no service agency nearby or if the owner or operator depends on this single device and would be "out of business" if the use of the device were prohibited until repairs could be made. Before adjustments are made at the request of the owner or the owner's representative, the official should be confident that the problem is not due to faulty installation or a defective part, and that the adjustment will correct the problem. The official should never undertake major repairs, or even minor corrections, if services of commercial agencies are readily available. The official should always be mindful of conflicts of interest before attempting to perform any services other than normal device examination and testing duties.

(Amended 1995)

5.3. Gauging. – In the majority of cases, when the weights and measures official tests commercial equipment, he is verifying the accuracy of a value or the accuracy of the performance as previously established either by himself or by someone else. There are times, however, when the test of the official is the initial test on the basis of which the calibration of the device is first determined or its performance first established. The most common example of such gauging is in connection with vehicle tanks the compartments of which are used as measures. Frequently the official makes the first determination on the capacities of the compartments of a vehicle tank, and his test results are used to determine the proper settings of the compartment indicators for the exact compartment capacities desired. Adjustments of the position of an indicator under these circumstances are clearly not the kind of adjustments discussed in the preceding paragraph.

6. Rejection of Commercial Equipment

6.1. Rejection and Condemnation. – The uniform Weights and Measures Law contains a provision stating that the director shall reject and order to be corrected such physical weights and measures or devices found to be incorrect. Weights and measures and devices that have been rejected may be seized if not corrected within a reasonable time or if used or disposed of in a manner not specifically authorized. The director shall remove from service and may seize weights and measures found to be incorrect that are not capable of being made correct.

These broad powers should be used by the official with discretion. The director should always keep in mind the property rights of an equipment owner, and cooperate in working out arrangements whereby an owner can realize at least something from equipment that has been rejected. In cases of doubt, the official should initially reject rather than condemn outright. Destruction and confiscation of equipment are harsh procedures. Power to seize and destroy is necessary for adequate control of extreme situations, but seizure and destruction should be resorted to only when clearly justified.

On the other hand, rejection is clearly inappropriate for many items of measuring equipment. This is true for most linear measures, many liquid and dry measures, and graduates, measure-containers, milk bottles, lubricating-oil bottles, and some scales. When such equipment is "incorrect," it is either impractical or impossible to adjust or repair it, and the official has no alternative to outright condemnation. When only a few such items are involved, immediate destruction or confiscation is probably the best procedure. If a considerable number of items are involved (as, for example, a stock of measures in the hands of a dealer or a large shipment of bottles), return of these to the manufacturer for credit or replacement should ordinarily be permitted provided that the official is assured that

they will not get into commercial use. In rare instances, confiscation and destruction are justified as a method of control when less harsh methods have failed.

In the case of incorrect mechanisms such as fabric-measuring devices, taximeters, liquid-measuring devices, and most scales, repair of the equipment is usually possible, so rejection is the customary procedure. Seizure may occasionally be justified, but in the large majority of instances this should be unnecessary. Even in the case of worn-out equipment, some salvage is usually possible, and this should be permitted under proper controls.
(Amended 1995)

7. Tagging of Equipment

7.1. Rejected and Condemned. – It will ordinarily be practicable to tag or mark as rejected each item of equipment found to be incorrect and considered susceptible of proper reconditioning. However, it can be considered justifiable not to mark as rejected incorrect devices capable of meeting acceptable performance requirements if they are to be allowed to remain in service for a reasonable time until minor problems are corrected since marks of rejection may tend to be misleading about a device's ability to produce accurate measurements during the correction period. The tagging of equipment as condemned, or with a similar label to indicate that it is permanently out of service, is not recommended if there is any other way in which the equipment can definitely be put out of service. Equipment that cannot successfully be repaired should be dismantled, removed from the premises, or confiscated by the official rather than merely being tagged as "condemned."
(Amended 1995)

7.2. Nonsealed and Noncommercial. – Rejection is not appropriate if measuring equipment cannot be tested by the official at the time of his regular visit–for example, when there is no gasoline in the supply tank of a gasoline-dispensing device. Some officials affix to such equipment a nonsealed tag stating that the device has not been tested and sealed and that it must not be used commercially until it has been officially tested and approved. This is recommended whenever considerable time will elapse before the device can be tested.

Where the official finds in the same establishment, equipment that is in commercial use and also equipment suitable for commercial use that is not presently in service, but which may be put into service at some future time, he may treat the latter equipment in any of the following ways:

(a) Test and approve the same as commercial equipment in use.

(b) Refrain from testing it and remove it from the premises to preclude its use for commercial purposes.

(c) Mark the equipment nonsealed.

Where the official finds commercial equipment and noncommercial equipment installed or used in close proximity, he may treat the noncommercial equipment in any of the following ways:

(a) Test and approve the same as commercial equipment.

(b) Physically separate the two groups of equipment so that misuse of the noncommercial equipment will be prevented.

(c) Tag it to show that it has not been officially tested and is not to be used commercially.

8. Records of Equipment

8.1. The official will be well advised to keep careful records of equipment that is rejected, so that he may follow up to insure that the necessary repairs have been made. As soon as practicable following completion of repairs, the equipment should be retested. Complete records should also be kept of equipment that has been tagged as nonsealed or noncommercial. Such records may be invaluable should it subsequently become necessary to take disciplinary steps because of improper use of such equipment.

9. Sealing of Equipment

9.1. Types of Seals and Their Locations. – Most weights and measures jurisdictions require that all equipment officially approved for commercial use (with certain exceptions to be pointed out later) be suitably marked or sealed to show approval. This is done primarily for the benefit of the public to show that such equipment has been officially examined and approved. The seal of approval should be as conspicuous as circumstances permit and should be of such a character and so applied that it will be reasonably permanent. Uniformity of position of the seal on similar types of equipment is also desirable as a further aid to the public.

The official will need more than one form of seal to meet the requirements of different kinds of equipment. Good quality, weather-resistant, water-adhesive, or pressure-sensitive seals or decalcomania seals are recommended for fabric-measuring devices, liquid-measuring devices, taximeters, and most scales, because of their permanence and good appearance. Steel stamps are most suitable for liquid and dry measures, for some types of linear measures, and for weights. An etched seal, applied with suitable etching ink, is excellent for steel tapes, and greatly preferable to a seal applied with a steel stamp. The only practicable seal for a graduate is one marked with a diamond or carbide pencil, or one etched with glass-marking ink. For a vehicle tank, the official may wish to devise a relatively large seal, perhaps of metal, with provision for stamping data relative to compartment capacities, the whole to be welded or otherwise permanently attached to the shell of the tank. In general, the lead-and-wire seal is not suitable as an approval seal.

9.2. Exceptions. – Commercial equipment such as measure-containers, milk bottles, and lubricating-oil bottles are not tested individually because of the time element involved. Because manufacturing processes for these items are closely controlled, an essentially uniform product is produced by each manufacturer. The official normally tests samples of these items prior to their sale within his jurisdiction and subsequently makes spot checks by testing samples selected at random from new stocks.

Another exception to the general rule for sealing approved equipment is found in certain very small weights whose size precludes satisfactory stamping with a steel die.

10. Rounding Off Numerical Values

10.1. Definition. – To round off or round a numerical value is to change the value of recorded digits to some other value considered more desirable for the purpose at hand by dropping or changing certain figures. For example, if a computed, observed, or accumulated value is 4738, this can be rounded off to the nearest thousand, hundred, or ten, as desired. Such rounded-off values would be, respectively, 5000, 4700, and 4740. Similarly, a value such as 47.382 can be rounded off to two decimal places, to one decimal place, or to the units place. The rounded-off figures in this example would be, respectively, 47.38, 47.4, and 47.

10.2. General Rules. – The general rules for rounding off may be stated briefly as follows:

(a) When the figure next beyond the last figure or place to be retained is less than 5, the figure in the last place retained is to be kept unchanged. When rounding off 4738 to the nearest hundred, it is noted that the figure 3 (next beyond the last figure to be retained) is less than 5. Thus the rounded-off value would be 4700. Likewise, 47.382 rounded to two decimal places becomes 47.38.

(b) When the figure next beyond the last figure or place to be retained is greater than 5, the figure in the last place retained is to be increased by 1. When rounding off 4738 to the nearest thousand, it is noted that the figure 7 (next beyond the last figure to be retained) is greater than 5. Thus the rounded-off value would be 5000. Likewise, 47.382 rounded to one decimal place becomes 47.4.

(c) When the figure next beyond the last figure to be retained is 5 followed by any figures other than zero(s), treat as in (b) above; that is, the figure in the last place retained is to be increased by 1. When rounding off 4501 to the nearest thousand, 1 is added to the thousands figure and the result becomes 5000.

(d) When the figure next beyond the last figure to be retained is 5 and there are no figures, or only zeros, beyond this 5, the figure in the last place to be retained is to be left unchanged if it is even (0, 2, 4, 6, or 8) and is to be increased by 1 if it is odd (1, 3, 5, 7, or 9). This is the odd and even rule, and may be stated as follows: "If odd, then add." Thus, rounding off to the first decimal place, 47.25 would become 47.2 and 47.15 would become 47.2. Also, rounded to the nearest thousand, 4500 would become 4000 and 1500 would become 2000.

It is important to remember that, when there are two or more figures to the right of the place where the last significant figure of the final result is to be, the entire series of such figures must be rounded off in one step and not in two or more successive rounding steps. [Expressed differently, when two or more such figures are involved, these are not to be rounded off individually, but are to be rounded off as a group.] Thus, when rounding off 47.3499 to the first decimal place, the result becomes 47.3. In arriving at this result, the figures "499" are treated as a group. Since the 4 next beyond the last figure to be retained is less than 5, the "499" is dropped (see subparagraph (a) above). It would be incorrect to round off these figures successively to the left so that 47.3499 would become 47.350 and then 47.35 and then 47.4.

10.3. Rules for Reading of Indications. – An important aspect of rounding off values is the application of these rules to the reading of indications of an indicator-and-graduated-scale combination (where the majority of the indications may be expected to lie somewhere between two graduations) if it is desired to read or record values only to the nearest graduation. Consider a vertical graduated scale and an indicator. Obviously, if the indicator is between two graduations but is closer to one graduation than it is to the other adjacent graduation, the value of the closer graduation is the one to be read or recorded.

In the case where, as nearly as can be determined, the indicator is midway between two graduations, the odd-and-even rule is invoked, and the value to be read or recorded is that of the graduation whose value is even. For example, if the indicator lies exactly midway between two graduations having values of 471 and 472, respectively, the indication should be read or recorded as 472, this being an even value. If midway between graduations having values of 474 and 475, the even value 474 should be read or recorded. Similarly, if the two graduations involved had values of 470 and 475, the even value of 470 should be read or recorded.

A special case not covered by the foregoing paragraph is that of a graduated scale in which successive graduations are numbered by twos, all graduations thus having even values; for example, 470, 472, 474, etc. When, in this case, an indication lies midway between two graduations, the recommended procedure is to depart from the practice of reading or recording only to the value of the nearest graduation and to read or record the intermediate odd value. For example, an indication midway between 470 and 472 should be read as 471.

10.4. Rules for Common Fractions. – When applying the rounding-off rules to common fractions, the principles are to be applied to the numerators of the fractions that have, if necessary, been reduced to a common denominator. The principle of "5s" is changed to the one-half principle; that is, add if more than one-half, drop if less than one-half, and apply the odd-and even rule if exactly one-half.

For example, a series of values might be $1\frac{1}{32}$, $1\frac{2}{32}$, $1\frac{3}{32}$, $1\frac{4}{32}$, $1\frac{5}{32}$, $1\frac{6}{32}$, $1\frac{7}{32}$, $1\frac{8}{32}$, $1\frac{9}{32}$. Assume that these values are to be rounded off to the nearest eighth ($\frac{4}{32}$). Then,

$1\frac{1}{32}$ becomes 1. ($\frac{1}{32}$ is less than half of $\frac{4}{32}$ and accordingly is dropped.)

$1\frac{2}{32}$ becomes 1. ($\frac{2}{32}$ is exactly one-half of $\frac{4}{32}$; it is dropped because it is rounded (down) to the "even" eighth, which in this instance is $\frac{0}{8}$.)

$1\frac{3}{32}$ becomes $1\frac{4}{32}$ or $1\frac{1}{8}$. ($\frac{3}{32}$ is more than half of $\frac{4}{32}$, and accordingly is rounded "up" to $\frac{4}{32}$ or $\frac{1}{8}$).

$1\frac{4}{32}$ remains unchanged, being an exact eighth ($1\frac{1}{8}$).

$1\frac{5}{32}$ becomes $1\frac{4}{32}$ or $1\frac{1}{8}$. ($\frac{5}{32}$ is $\frac{1}{32}$ more than an exact $\frac{1}{8}$; $\frac{1}{32}$ is less than half of $\frac{4}{32}$ and accordingly is dropped.)

$1\frac{6}{32}$ becomes $1\frac{2}{8}$ or $1\frac{1}{4}$. ($\frac{6}{32}$ is $\frac{2}{32}$ more than an exact $\frac{1}{8}$; $\frac{2}{32}$ is exactly one-half of $\frac{4}{32}$, and the final fraction is rounded (up) to the "even" eighth, which in this instance is $\frac{2}{8}$.)

$1\frac{7}{32}$ becomes $1\frac{2}{8}$ or $1\frac{1}{4}$. ($\frac{7}{32}$ is $\frac{3}{32}$ more than an exact $\frac{1}{8}$; $\frac{3}{32}$ is more than one-half of $\frac{4}{32}$ and accordingly the final fraction is rounded (up) to $\frac{2}{8}$ or $\frac{1}{4}$.)

$1\frac{8}{32}$ remains unchanged, being an exact eighth ($1\frac{2}{8}$ or $1\frac{1}{4}$.)

$1\frac{9}{32}$ becomes $1\frac{2}{8}$ or $1\frac{1}{4}$. ($\frac{9}{32}$ is $\frac{1}{32}$ more than an exact $\frac{1}{8}$; $\frac{1}{32}$ is less than half of $\frac{4}{32}$ and accordingly is dropped.)

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