What is Handbook 44
and
What is NTEP?

RICE LAKE WEIGHING SYSTEMS
Industrial Solutions on a Global Scale®
ISO 9001 REGISTERED

29164

CONTENTS

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What Is Handbook 44?

The Complete Title for Handbook 44 is....

"Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices"

Handbook 44 is a comprehensive set of requirements for weighing and measuring devices that are used in commerce and law enforcement activities.

It is not a federal law. In fact, it was developed and is updated annually by the National Conference on Weights & Measures (NCWM), which is a private organization whose membership includes Weights & Measures officials, government, manufacturers, distributors, and service companies' representatives.

NCWM is supported by the National Institute for Standards and Technology (NIST), formerly known as NBS. NIST is an agency of the federal government. It provides the NCWM secretariat and actually publishes Handbook 44 on its behalf.

Handbook 44 has been adopted by all 50 states as the basis for exercising their control of commercial weighing and measuring devices.

What Is NTEP?

If Handbook 44 has been accepted as the basis for regulating weighing and measuring devices, what then is NTEP?

The National Type Evaluation Program (NTEP) is a program of cooperation between the NCWM, NIST, state Weights & Measures officials and the private sector for determining conformance of weighing equipment with the provisions of Handbook 44.

NTEP does not attempt to duplicate or modify Handbook 44 in any way; on the contrary, it is a process for testing, examination and/or evaluation of weighing equipment to ensure its compliance with the provisions of Handbook 44. NTEP is particularly important since the incorporation of *influence factors* requirements into Handbook 44, since compliance with these can only be determined under laboratory conditions.

NTEP provides a set of procedures for the uniform test/evaluation of weighing equipment, has a number of recognized laboratories where testing may be performed, and issues a Certificate of Conformance (CC) as evidence of compliance with the provisions of Handbook 44. NTEP is a voluntary program in that manufacturers are not required to submit their products for evaluation. Likewise, individual states are not required to accept NTEP certificates as the basis for allowing scale products to be used in commerce in their state. However, more and more states are requiring a CC for devices used in commercial weighing within their jurisdiction. The following is a list of states currently requiring type approval and/or an NTEP CC.

Alabama
Alaska
Arizona
Arkansas
California
Colorado
Connecticut
Delaware
Florida
Georgia
Hawaii
Idaho
Illinois
Indiana
Iowa
Kansas
Kentucky
Louisiana
Maine
Maryland
Massachusetts
Michigan
Minnesota
Mississippi
Missouri
Montana
Nebraska
Nevada
New Hampshire
New Jersey
New York
North Carolina
Ohio
Oklahoma
Oregon
Pennsylvania
South Carolina
South Dakota
Tennessee
Utah
Virginia
Washington
West Virginia
Wisconsin
Wyoming

For more information about NTEP and Handbook 44, see the Office of Weights and Measures web site at www.nist.gov/owm.

What Information is Contained on a Certificate of Conformance?

The Certificate of Conformance (CC) places many restrictions on the use of the equipment listed. Approved equipment is generally not approved for use in all applications. Indeed, two seemingly identical products may be approved for totally different applications and would be "red tagged" if used inappropriately. Hence, it is vital to understand the information listed on a CC and select equipment suited to a particular application.

A typical CC is shown on pages 4–5. As certificates may be issued for complete scales or individual scale elements, the information given varies depending on the product. The following information is always given on a certificate:

1) Certificate Number
In the top right hand corner.

2) Manufacturer's Name

3) Product Description

4) Model Number

5) Standard Features and Options

6) Application
A brief description of how the product may be used.

7) Test Conditions
Description of how the product was tested.

In addition, certificates may contain some of the following information:

8) n_{max} (Maximum Number of Scale Divisions)
This is the maximum number of scale divisions for which the product has been approved. The product's n_{max} must be greater than or equal to ($\geq$) the number of divisions for which the scale will be configured, i.e., $n_{max} \geq$ *number of divisions*.

9) Accuracy Class
Weighing devices are separated into five accuracy classes according to number of scale divisions (*n*) and the value of the scale division (*d*). They are designated I, II, III, IIIL and IIII. Of greatest concern to us are class III and IIIL which are described as follows in Table 7 (a) of Handbook 44:

III: All commercial weighing not otherwise specified, grain test scales, retail precious metals and semi-precious gem weighing, animal scales, postal scales and scales used to determine laundry charges.

IIIL: Vehicle, axle-load, livestock, railway track scales, crane and hopper (other than grain hopper) scales.

Class III is a higher accuracy class than IIIL, hence, a Class III device may be used in a IIIL application; the converse is not true.

NOTE: Using a Class III device in a Class IIIL application is up to the discretion of the state inspector.

IIII: Wheel-load weighers and portable axle-load weighers used for highway weight enforcement.

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10) Temperature Range

This is the temperature range over which the product has been tested and approved. The standard range is 14° to 104° F or -10° to 40° C. A product may be used outside this range as long as it operates within tolerance, regardless of the influence factors at the time of inspection.

11) Capacity

Capacities of the products covered by the certificate. Because of cost, manufacturers will often seek approval for only the most popular capacities. Always check that the specific capacity has been approved.

12) Platform Size

Platform sizes for the products covered by the certificate.

13) v_{min} (Minimum Verification Scale Division)

Found on load cell certificates and is used as follows in selecting an appropriate load cell:

a) Single Load Cell Application

v_{min} must be less than or equal to the scale's division size (d):

$$v_{min} \leq d$$

b) Mechanical Scale Conversion Using One Each Load Cell

v_{min} must be less than or equal to the scale's division size (d) divided by the scale multiple:

$$v_{min} \leq \frac{d}{scale\ multiple}$$

c) Scale Using More Than One Load Cell

v_{min} must be less than or equal to the scale's division size (d) divided by the square root of the number of cells (N):

$$v_{min} \leq \frac{d}{\sqrt{N}}$$

14) Single (S) or Multiple (M)

This will be found on load cell certificates and indicates if the cells have been approved for use in single or multiple cell applications. Note that a cell approved for use in single cell applications may be used in a multiple cell application. The converse is not true.

15) Minimum Dead Load

This will be found on load cell certificates and indicates the minimum dead load which must be applied to the load cell. Manufacturers are allowed to exclude consideration of a load cell's performance close to zero by specifying a minimum dead load. This is beneficial if the load cell is somewhat nonlinear in this range. In selecting a load cell, ensure that the dead load on each cell is greater than or equal to the minimum dead load specified on the load cell certificate.

Typical Certificate of Conformance

U.S. DEPARTMENT OF COMMERCE
NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
GAITHERSBURG, MARYLAND 20899

Certificate Number: 95-088

National Type Evaluation Program
Certificate of Conformance
for Weighing and Measuring Devices

For:

Load Cell
Single Ended Bending Beam
Model : RL1521-N5-YYkg*
n_{max}: Single Cell: 5,000
Capacity: See Below

Accuracy Class: III

Submitted by:

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Tel: (715) 234-9171
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Contact: Mark Erickson

Standard Features and Options

*The specific load cell capacities, v_{min}, and minimum dead loads are listed below and are identified by the model designation RL1521-N5-YYkg, where N represents Class III, 5 represents the number of divisions (in thousands), and YYkg represents the capacity in kg.

Model	Capacity (kg)	v_{min} (g)	Minimum Dead Load (kg)
RL1521-N5-3kg	3	0.38	0.12
RL1521-N5-6kg	6	0.75	0.24
RL1521-N5-10kg	10	1.25	0.40
RL1521-N5-15kg	15	1.88	0.60
RL1521-N5-20kg	20	2.50	0.80
RL1521-N5-25kg	25	3.13	1.00
RL1521-N5-30kg	30	3.76	1.20

- Nominal Output: 2 mV/V
- Excitation Voltage: 10 - 15 VDC Nominal

Temperature range: -10° to 40°C (14° to 104°F)

This device was evaluated under the NATIONAL TYPE EVALUATION PROGRAM (NTEP) and was found to comply with the applicable technical requirements of HANDBOOK 44, "Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices. Evaluation results and device characteristics necessary for inspection and use in commerce are on the following pages.

Effective Date: July 14, 1995
Issue Date November 7, 1995

(Signed by the current OWM Chief)
Chief, Office of Weights and Measures

NOTE: The National Institute of Standards and Technology does not "approve", "recommend", or "endorse" any proprietary product or material, either as a single item or as a class or group. Results shall not be used in advertising or sales promotion to indicate explicit or implicit endorsement of the product or the Institute. (See NTEP Policies and Procedures).

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Rice Lake Weighing Systems
Load Cell
Model RL1521-N5-YYkg*

Application: The load cells may be used in Class III scales for both single and multiple cell applications consistent with the model designations and parameters specified in this certificate. Load cells of a given accuracy class may be used in applications with lower accuracy class requirements provided the number of scale divisions, the v_{min} values, and temperature range are suitable for the application. The manufacturer may market the load cells with fewer scale divisions (n_{max}) and with larger v_{min} values than those listed on the certificate. However, the load cells must be marked with the appropriate n_{max} and v_{min} for which the load cell may be used.

Identification: A pressure sensitive identification badge containing the manufacturer, model designation, certificate number, and serial number is located on the load cell. All other required information must be on an accompanying document including the serial number of the load cell, or on the load cell itself.

Test Conditions: This Certificate is issued based on the following tests and upon information supplied by the manufacturer. Two 10 kg capacity load cells were tested at the California NTEP laboratory using dead weights as the reference standard. The cells were tested over a temperature range of -10°C to 40°C. Three tests were run on each cell at each temperature. The temperature effect on zero was measured and a time dependence (creep) test was performed. The data were analyzed for single load cell applications. The barometric pressure test was waived due to the insensitivity of the load cell design to changes in barometric pressure. The results of this test indicate the device meets the applicable requirements.

Type Evaluation Criteria Used: NIST Handbook 44, 1995 Edition

Tested By: G. Castro (CA)

Information Reviewed By: Lynn Sebring (NIST)

How Do I Select a Product Based on the Certificate of Conformance Information?

The information given on a CC is intended to aid in the correct selection of weighing equipment for a given application and to aid Weights & Measures officials in ensuring that equipment has been selected properly and is being used in an appropriate manner.

In selecting equipment for a given application, it is necessary to check certain parameters listed on the CC. Let's look at some specific examples.

I. Indicators

In selecting an indicator, ensure that:

a) The specific model number is listed on the certificate.
b) The indicator's accuracy class is appropriate to the application. Note that if a CC referred only to Class III, that indicator could also be used in a Class IIIL application. The converse is not true.
c) The indicator's n_{max} is greater than or equal to the number of divisions required for the specific application.

II. Platforms (Floor or Bench)

In selecting a platform, ensure that:

a) The specific model number, platform size and capacity is listed on the certificate.
b) The platform's accuracy class is appropriate to the application.
c) The platform's n_{max} is greater than or equal to the number of scale divisions for which the scale will be configured.

III. Load Cells

In selecting load cells, ensure that:

a) The selected load cell model and capacity have been approved.
b) The load cell is approved for the required accuracy class. Note that a Class III cell may be used in a Class IIIL application. The converse is not true.
c) The load cell's n_{max} is greater than or equal to the number of divisions required for the specific application.
d) The cell is rated for single (S) or multiple (M) use as appropriate for the application. Note that a cell rated for single use may be used in single or multiple cell applications. A cell rated for multiple use cannot be used in a single cell application.
e) The dead load on each load cell is greater than or equal to the minimum dead load specified on the certificate.
f) The load cell's v_{min} is appropriate to the application; there are three situations which must be analyzed differently as follows:

1) Fully Electronic Scale Using One Load Cell

In this case, the load cell's v_{min} must be less than or equal to the division size (d) for which the scale will be configured, that is:

$$v_{min} \leq d$$

Example: Tank scale using a single load cell

Capacity 1000 x .5 lb

Hence the load cell $v_{min} \leq$ .5 lb

A load cell with a v_{min} of .5 lb or less must be selected. See Appendix A for more examples.

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2) Mechanical Scale Conversion Using One S-Beam

In this case, the load cell's v_{min} must be less than or equal to the division size (*d*) divided by the scale multiple, that is:

$$v_{min} \leq \frac{d}{\text{scale multiple}}$$

Example: Truck scale
Capacity 120,000 x 20 lb (Multiple = 400)

Hence the load cell $v_{min} \leq \frac{20}{400} \leq 0.05$ lb

In selecting a load cell for this application, its v_{min} must be less than or equal to .05 lb. See Appendix B for more examples.

3) Fully Electronic Scale Using More Than One Cell

In this case, the load cell's v_{min} must be less than or equal to the division size (*d*) divided by the square root of the number of load cells (*N*). That is:

$$v_{min} \leq \frac{d}{\sqrt{N}}$$

Example: Floor platform scale using 4 load cells
Capacity 5000 x 2 lb

Hence the load cell $v_{min} \leq \frac{2}{\sqrt{4}} \leq 1.0$ lb

Load cells with a v_{min} less than or equal to 1 lb must be selected. See Appendix C for more examples. Also, see Appendix D for sample tabulations of v_{min} using various combinations of *d* and *N*.

⚠ Caution It is common and accepted practice for load cell manufacturers to market cells with fewer divisions and larger v_{min} values than those listed on the CC for that particular model number.

For example, the approval may be for n_{max} = 10,000 divisions, but the manufacturer may market cells with an n_{max} = 6,000 as well as n_{max} = 10,000 divisions. Do not assume that all approved cells of that particular model number are identical to those listed on the CC. Consult Rice Lake Weighing Systems at time of purchase.

IV. Printers

NTEP approval is typically not required for printers unless the printer itself performs metrological functions. It is usually sufficient for printers to be inspected and approved by local or state Weights and Measures officials as part of their field inspections.

How Do I Select an NTEP-Certified Replacement Load Cell?

A load cell from the same or a different manufacturer may be substituted for an NTEP-certified cell if it:

- Has a Certificate of Conformance
- Has an ACCURACY CLASS appropriate to the application, III or IIIL
- Has an n_{max} that is suitable for the application
- Has been approved for SINGLE or MULTIPLE applications, as appropriate for the application
- Has a MINIMUM DEAD LOAD that is suitable for the application
- Has a v_{min} that is suitable for the application
- Is of the same basic type as the original cell
- Can be fitted without major modification to the load cell mounting assembly.

NOTE:

The following policy applies to the repair or remanufacture of load cells:

1) The original Certificate of Conformance only applies to a repaired cell if that repair was carried out by the original manufacturer or authorized agent.
2) If the load cell is repaired by other than the original manufacturer or authorized agent, then the local Weights and Measures jurisdiction has the authority and responsibility to ensure that the device complies with the influence factor requirements of Handbook 44 by requiring an NTEP evaluation or the jurisdiction's own evaluation.

Appendix A: Load Cell Selection for a Tank/Hopper or Floor Platform

Scale				Load Cell				
Capacity (lb)	Divisions (*d*) in lb	Dead Load (lb)	Number of Cells (*N*)	Capacity (lb)	n_{max}	Min Dead Load (lb)	V_{min} (lb)	Single (S) or Multiple (M)
500	.1	100	1	1 000	≥ 5 000	≤ 100	≤ .10	S
500	.2	100	2	1 000	≥ 2 500	≤ 50	≤ .14	M
1 000	.2	500	3	1 000	≥ 5 000	≤ 167	≤ .11	M
1 000	.5	200	4	1 000	≥ 2 000	≤ 50	≤ .25	M
2 000	.5	200	1	4 000	≥ 4 000	≤ 200	≤ .50	S
2 000	1	200	4	1 000	≥ 2 000	≤ 50	≤ .50	M
3 000	1	200	3	2 000	≥ 3 000	≤ 67	≤ .57	M
4 000	1	300	4	2 000	≥ 4 000	≤ 75	≤ .50	M
5 000	1	300	4	2 500	≥ 5 000	≤ 75	≤ .50	M
5 000	2	300	4	2 500	≥ 2 500	≤ 75	≤ 1.0	M
10 000	5	500	3	5 000	≥ 2 000	≤ 167	≤ 2.88	M
10 000	5	500	4	5 000	≥ 2 000	≤ 125	≤ 2.50	M
20 000	5	1 000	4	10 000	≥ 4 000	≤ 250	≤ 2.50	M
20 000	10	1 000	4	10 000	≥ 2 000	≤ 250	≤ 5.0	M

For single-cell applications, $v_{min} \leq d$

For multiple-cell applications, v_{min} is calculated from the formula:

$$v_{min} \leq \frac{d}{\sqrt{N}}$$

where d = division size, N = number of cells

In the last row of the table above, $d = 10.0$ and $N = 4$. Load cells selected for this application would need to specify a v_{min} value as follows:

$$v_{min} \leq \frac{10.0}{\sqrt{4}} \leq 5.00$$

NOTE: The load cell capacities used in these examples are for illustration only. Load cell capacity must be determined for each unique set of circumstances.

Appendix B: Load Cell Selection for Mechanical Conversions Using One S-Beam

Mechanical Scale				Load at Cell		S-Beam Load Cell			
Capacity (lb)	Divisions (*d*) in lb	Dead Load (lb)	Scale Multiplier	Live Load (lb)	Dead Load (lb)	Capacity (lb)	n_{max}	Min Dead Load (lb)	V_{min} (lb)
1 000	.5	100	10	100	10	250	≥ 2 000	≤ 10	≤ .05
2 000	.5	250	10	200	25	500	≥ 4 000	≤ 25	≤ .05
2 000	1	250	10	200	25	500	≥ 2 000	≤ 25	≤ .10
5 000	1	400	15	333	27	500	≥ 5 000	≤ 27	≤ .066
5 000	2	400	15	333	27	500	≥ 2 500	≤ 27	≤ .13
10 000	2	1 000	20	500	50	1 000	≥ 5 000	≤ 50	≤ .10
10 000	5	1 000	20	500	50	1 000	≥ 2 000	≤ 50	≤ .25
20 000	2	4 000	70	286	57	500	10 000	≤ 57	≤ .028
20 000	5	2 500	40	500	63	1 000	≥ 4 000	≤ 63	≤ .125
20 000	10	2 500	40	500	63	1 000	≥ 2 000	≤ 63	≤ .25
50 000	5	15 000	100	500	150	750	10 000	≤ 150	≤ .05
50 000	10	15 000	100	500	150	1 000	≥ 5 000	≤ 150	≤ .10
100 000	10	30 000	200	500	150	750	10 000	≤ 150	≤ .05
100 000	20	30 000	200	500	150	1 000	≥ 5 000	≤ 150	≤ .10
120 000	20	40 000	60	2000	667	5 000	≥ 6 000	≤ 667	≤ .33
120 000	20	40 000	400	300	100	500	≥ 6 000	≤ 100	≤ .05
200 000	20	50 000	250	800	200	1 500	10 000	≤ 200	≤ .08
200 000	50	50 000	250	800	200	1 500	≥ 4 000	≤ 200	≤ .20
400 000	50	100 000	300	1333	333	3 000	≥ 8 000	≤ 333	≤ .166
400 000	100	100 000	300	1333	333	3 000	≥ 4 000	≤ 333	≤ .33

v_{min} is calculated from the formula:

$$v_{min} \leq \frac{d}{scale\ multiple}$$ where d = division size

In the last example above, d = 100 and *scale multiple* = 300. Load cells selected for this application would need to specify a v_{min} value as follows:

$$v_{min} \leq \frac{100}{300} \leq 0.33$$

NOTE: The load cell capacities used in these examples are for illustration only. Load cell capacity must be determined for each unique set of circumstances.

Appendix C: Load Cell Selection for Electronic, High-Capacity Platform Scales

Scale				Load Cell			
Capacity (lb)	Divisions (*d*) in lb	Dead Load (lb)	Number of Cells (*N*)	Capacity (lb)	n_{max}	Min Dead Load (lb)	V_{min} (lb)
20 000	5	10 000	4	20 000	≥ 4 000	≤ 2 500	≤ 2.5
40 000	5	20 000	4	25 000	≥ 8 000	≤ 5 000	≤ 2.5
40 000	10	20 000	4	25 000	≥ 4 000	≤ 5 000	≤ 5.0
60 000	10	35 000	4	40 000	≥ 6 000	≤ 8 750	≤ 5.0
60 000	10	35 000	6	40 000	≥ 6 000	≤ 5 833	≤ 4.08
100 000	10	50 000	6	50 000	10 000	≤ 8 333	≤ 4.08
100 000	20	50 000	6	50 000	≥ 5 000	≤ 8 333	≤ 8.16
120 000	20	60 000	6	60 000	≥ 6 000	≤ 10 000	≤ 8.16
120 000	20	60 000	8	60 000	≥ 6 000	≤ 7 500	≤ 7.07
150 000	20	75 000	8	75 000	≥ 7 500	≤ 9 375	≤ 7.07
200 000	20	100 000	8	75 000	10 000	≤ 12 500	≤ 7.07
200 000	50	100 000	8	75 000	≥ 4 000	≤ 12 500	≤ 17.6
400 000	50	200 000	8	100 000	≥ 8 000	≤ 25 000	≤ 17.6
400 000	100	200 000	8	100 000	≥ 4 000	≤ 25 000	≤ 35.35

v_{min} is calculated from the formula:

$$v_{min} \leq \frac{d}{\sqrt{N}}$$

where d = division size, N = number of cells

In the last row of the table above, $d = 100$ and $N = 8$. Load cells selected for this application would need to specify a v_{min} value as follows:

$$v_{min} \leq \frac{100}{\sqrt{8}} \leq \frac{100}{2.82} \leq 35.35$$

NOTE: The load cell capacities used in these examples are for illustration only. Load cell capacity must be determined for each unique set of circumstances.

Appendix D: Calculating v_{min} for Multiple Cell Applications

Division Size (d) in lb	Number of Load Cells								
	2	3	4	6	8	10	12	14	16
.0002	.00014								
.0005	.00035	.00029							
.001	.0007	.0006	.0005						
.002	.001	.001	.001	.0008					
.005	.004	.003	.002	.002	.002				
.01	.007	.006	.005	.004	.004	.003			
.02	.014	.012	.010	.008	.007	.006	.006		
.05	.035	.029	.025	.020	.018	.016	.014	.013	
.1	.07	.06	.05	.04	.04	.03	.03	.03	.025
.2	.14	.12	.10	.08	.07	.06	.06	.05	.05
.5	.35	.29	.25	.20	.18	.16	.14	.13	.125
1	.71	.58	.50	.41	.35	.32	.29	.27	.25
2	1.41	1.15	1.00	.82	.71	.63	.58	.53	.50
5	3.54	2.89	2.50	2.04	1.77	1.58	1.44	1.34	1.25
10	7.07	5.77	5.00	4.08	3.54	3.16	2.89	2.67	2.50
20	14.14	11.55	10.00	8.16	7.07	6.32	5.77	5.35	5.00
50	35.36	28.87	25.00	20.41	17.68	15.81	14.43	13.36	12.50
100	70.71	57.73	50.00	40.82	35.36	31.62	28.87	26.73	25.00

To find $d / \sqrt{N}$ for a particular scale, go down the left hand column and stop at the scale's division size. Now move across this row to the column headed by the appropriate number of load cells. The number in this box is the $d / \sqrt{N}$ factor for this scale.

Example: Truck scale using 120,000 lb x 20 lb on 6 each load cells (d = 20, N = 6)

Move down the left hand column to 20. Now move to the right to the column for 6 load cells. The number here is 8.16 lb. This is $d / \sqrt{N}$ for this scale. Therefore, you must select a load cell with a v_{min} of 8.16 lb or less.

NOTE: This table can be used for all multiple load cell applications.