National Conference on Weights and Measures

National Type Evaluation Program

Multiple Dimensions Measuring Devices

Technical Policy • Checklists • Test Procedures

NCWM

Publication 14

Amendments

Multiple Dimensions Measuring Devices

Section	Amendment	Pages	Source
13	Added new section titled Eccentricity Test		Measurement Canada Lab Manual, Part 3, Section 12
14	Added new section titled Conveyor Belt Seam Test		Measurement Canada Lab Manual, Part 3, Section 7
15	Added new section titled Variable Orientation Test		Measurement Canada Lab Manual, Part 3, Section 16
16	Added new section titled Measurement Speed Test		Measurement Canada Lab Manual, Part 3, Section 8
17	Added new section titled Minimum Spacing Test		Measurement Canada Lab Manual, Part 3, Section 15
18	Added new section titled Touching Objects Test		Measurement Canada Lab Manual, Part 3, Section 15.5
19	Added new section titled Irregularly Shaped Objects Test		Existing test procedure from Ohio NTEP Lab
20	Added new section titled Jam Test		Measurement Canada Lab Manual, Part 3, Section 13
Document	Please note that the Weighing Devices publication has been thoroughly reviewed by NCWM staff. Changes have been made, but none are to change intent of the policies, checklists or test procedures, thus considered editorial. Issues or concerns should be brought to the attention of NCWM staff.	Document	Editorial

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National Type Evaluation Program
Multiple Dimensions Measuring Devices – Technical Policy

A. Models to be Submitted for Evaluation

A type is a model or models of the same design, as defined in the National Type Evaluation Program (NTEP) Policy and Procedures. A complete list and description of all models of a type to be included in the NTEP Certificate of Conformance (CC) shall be submitted with the request for type evaluation. All metrological options and features to be included on the CC must be submitted for evaluation. Nonmetrological features may be listed on a CC, but only if the feature has been evaluated and operates as intended. If the CC is to include more than one model of the same type, the submitter shall contact the evaluation agency to determine which model or models will be evaluated. A CC will be amended when new models of the same type meeting the specified criteria are added by the manufacturer.

B. Certificate of Conformance Parameters

The following guidelines apply.

Device Parameters:

- Minimum dimension for each axis
- Maximum dimension for each axis
- Division (d) for each axis (each axis may have a unique d)
- Minimum and Maximum speed (for dynamic device only)
- Special Applications
- Limitations (e.g. cuboid only, minimum spacing between objects, opaque only, etc.)

A Certificate of Conformance will apply to all models that have:

- Equivalent hardware (measurement technique) and software per axis
- The same or larger value of divisions (d)
- Subsets of standard options and features of the equipment evaluated
- Minimum and maximum dimensions for each axis within the ranges evaluated
- Within the range of speeds evaluated

C. Device with Both a Dimensioning Element and a Weighing Element

Devices which contain both dimensioning and weighing elements must be submitted for and meet the requirements of multiple dimensions measuring devices (MDMD) checklist and the applicable Digital Electronic Scales or Automatic Weighing System checklist. If the MDMD is evaluated with a scale that is traceable to a National Type Evaluation Program (NTEP) Certificate of Conformance (CC) and the device is designed in such a manner that the scale can be removed and another scale placed in the device without altering the structure of the MDMD, the manufacturer will be allowed to substitute any NTEP approved compatible scale in the MDMD,

If the MDMD contains a scale that is not traceable to an NTEP CC, the scale will be tested according to the Digital Electronic Scales sections of *NCWM Publication 14* and the manufacturer will not be allowed to substitute another scale into the system without further evaluation

If the MDMD is evaluated with an indicating element that is traceable to an NTEP CC and the indicating element is only used to display the weight from the MDMD, the indicating element may be replaced with another NTEP certified and compatible indicating element. If the NTEP certified indicating element is modified to display the dimensions from the MDMD, the device will be required to undergo further evaluation.

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National Type Evaluation Program
Multiple Dimensions Measuring Devices – Checklists and Test Procedures

Introduction

The checklist is designed so that the user can determine and record in a logical sequence the conformance of the device with the elements of the checklist. The user should make copies of the checklist to serve as worksheets and preserve the original for reference. Unless specifically requested to do so, the applicant is not required to submit a completed checklist to National Type Evaluation Program prior to the evaluation; however, the applicant is urged to carefully review the checklist prior to submission to ensure that the device meets the requirements of the checklist. In most cases, the results of evaluation for each element can be recorded by checking the appropriate response. In some cases, the user is required to record values, results, or comments. In those cases, space is provided.

This checklist is a guide for conducting prototype examinations to determine compliance with the requirements of *NIST Handbook 44*. These criteria shall apply only to type evaluation examinations, not on a retroactive basis to devices that are currently in service. The General Code requirements apply to all classes of devices. The specific code requirements supersede General Code requirements in all cases of conflict.

1. Marking - Complete Devices

Code References: G-S.1. and G-S.7.

Virtually all weighing and measuring equipment (except separate parts necessary to the measurement process but not having any metrological effect) must be clearly and permanently marked with the manufacturer's name or trademark, model designation, and serial number. "Permanent" markings address two aspects: (1) the printed information will withstand wear and cleaning, and (2) if the markings are on a plate or badge, then the marking badge must be "permanently" attached to the device. Permanence of it must be obvious that the badge or plate containing this information has been removed. All markings must be clear and attachment of the badge means that the identification information required by G-S.1. is not easily removed, if it is removed, then easily readable. The following test procedure shall be used to determine the permanence of the identification markings.

Permanence of Lettering

The lettering for the markings are subjected to the following tests to simulated accelerated wear. The markings are then compared with a typical set of labels exhibiting various degrees of wear, graded from minimal effect (7) to excessive unacceptable wear (1).

Attempts are made to remove the marked information whether on a badge (plate) or on the device itself, using the following means.

1.1. Rub over one letter of the marking at least 20 times using an ink eraser in the same manner and force as one would normally exert while erasing an inscription written with a ball point pen.

Note: For consistency of application, all NTEP labs use Eberhard Faber ink eraser type #110 The Eberhard #110 eraser is no longer commercially available. Alternatives being used are the Papermate Black Pearl and Papermate Union #110.

1.2. Clean the marking or badge with the following cleaners presumed to be "readily available."

a. Disinfecting cleaning liquid and a damp cloth.

b. "Soft" household cleaning powder and a damp cloth.

c. Window cleaning fluids and a damp cloth.

Note: For consistency of application, NTEP labs use "409," Bon Ami, and Windex brands of products for tests in parts 2a., b., and c., respectively.)

Permanence of Attachment of Badge

Attempt to remove the badge by pulling it off or prying off a metal badge that is attached using only adhesive; removal must be "difficult" at all temperatures. If the badge can be removed, it must show obvious evidence that the badge was removed. Acceptable indications are destruction of the badge by tearing, permanent and extensive wrinkling, or repeated exposure of the word "VOID" upon removal of the badge.

As a practical matter, remote displays are not required to have serial numbers because they typically do not use any electronics to analyze the signal received from the weighing/load-receiving, measuring, or dimensioning element. Similarly, the various "peripheral" modules in a modular point-of-sale system (e.g., printer, keyboard module and cash drawer) have not been required to have serial numbers because they do not have any "intelligence." Only the electronic modules that control the "peripheral" modules must be marked with a serial number.

If the required information is located on the back of a device, the same information must also appear on the side, front, or top. The bottom of a device is not an acceptable surface. This information may be located under, but separate from, the scale platform on a scale, weighing/load-receiving or dimensioning element installed at a checkout stand, provided the platter can be easily removed without the use of a tool. If required markings are behind a door or panel, the manufacturer is encouraged to put a label on the outside of the device that explains where the ID information is located. The identification marking must be permanent and attached with pop rivets or adhesive, or equivalent permanent means. Removable bolts or screws are not permitted. A foil badge that is durable, difficult to remove and exhibits obvious evidence of an attempt to remove the marking or badge may be provided.

Location of the information:

_____

_____

Code Reference: G-S.1. Identification

All equipment, except weights and separate parts necessary to the measurement process but not having any metrological effect, shall be clearly and permanently marked for the purposes of identification with the following information.

1.3. The name, initials, or trademark of the manufacturer or distributor. ☐ Yes ☐ No ☐ N/A

1.4. A model identifier that positively identifies the pattern or design of the device. The model identifier shall be prefaced by the word "Model," "Type," or "Pattern." These terms may be followed by the word "Number" or an abbreviation of that word. The abbreviation for the word "Number" shall, as a minimum, begin with the letter "N" (e.g., No or No.) The abbreviation for the word "Model" shall be "Mod" or "Mod." Prefix lettering may be initial capitals, all capitals, or all lower case. ☐ Yes ☐ No ☐ N/A

1.5. Except for equipment with no moving or electronic component parts and not built for purpose, software-based devices, a non-repetitive serial number. The serial number shall be prefaced by the words "Serial Number" or an abbreviation, or a symbol, that clearly identifies the number as the required serial number. Abbreviations for the word "Serial" shall, as a minimum, begin with the letter "S," and abbreviations for the word "Number" shall, as a minimum, begin with the letter "N" (e.g., S/N, SN, Ser. No, and S No.) ☐ Yes ☐ No ☐ N/A

1.6. For not built-for-purpose, software based devices the current software version designation. The version or revision identifier shall be prefaced by the word "Version" or "Revision" as appropriate and either word may be followed by the word "Number." The abbreviations for the word "Version" shall, as a minimum, begin with the letter "V." Abbreviations for the word "Revision" shall, as a minimum, begin with the letter "R." The abbreviations for the word "Number" shall, as a minimum, begin with the letter "N" (e.g., No or No.) ☐ Yes ☐ No ☐ N/A

Code Reference: G-S.1. (e).

1.7. An NTEP Certificate of Conformance (CC) Number or a corresponding CC addendum number for devices that have (or will have) a CC. The number shall be prefaced by the terms "NTEP CC," "CC," or "Approval." These terms may be followed by the word "Number" or an abbreviation for the word "Number." The abbreviation for the word "Number" shall as a minimum begin with the letter "N" (e.g., No or No.) ☐ Yes ☐ No ☐ N/A

The device must have an area, either on the identification plate or on the device itself, suitable for the application of the Certificate of Conformance Number. If the area for the CC number is not part of an identification plate, then note its intended location below and how it will be applied.

1.7.1. Location of CC Number if not located with the identification:

_____

_____

1.8. The required information shall be so located that it is readily observable without the necessity of the disassembly of a part requiring the use of any means separate from the device. ☐ Yes ☐ No ☐ N/A

1.9. If the information specified in the above sections is placed on a badge or plate, the badge or plate must be permanently attached to the device. ☐ Yes ☐ No ☐ N/A

1.10. The device or main elements are marked with the following as detailed in Table S.4.1.a.

1.10.1. Minimum and maximum dimensions for each axis. ☐ Yes ☐ No ☐ N/A
1.10.2. The value of the measuring division (d) for each axis. ☐ Yes ☐ No ☐ N/A
1.10.3. Temperature limits. ☐ Yes ☐ No ☐ N/A
1.10.4. Minimum and maximum speed. Not applicable to static devices. ☐ Yes ☐ No ☐ N/A
1.10.5. Special application. ☐ Yes ☐ No ☐ N/A
1.10.6. Limitation of Use. ☐ Yes ☐ No ☐ N/A

Code Reference: G-S.1.1. Location of Marking Information for Not Built-for-Purpose, Software-Based Devices

For not built-for-purpose, software-based devices, the following shall apply:

1.11. The required information in G-S.1 Identification. (a), (b), (d), and (e) shall be permanently marked or continuously displayed on the device. **OR** ☐ Yes ☐ No ☐ N/A

1.12. The Certificate of Conformance Number shall be:

1.12.1.1. Permanently marked on the device. **OR** ☐ Yes ☐ No ☐ N/A
1.12.1.2. Continuously displayed. **OR** ☐ Yes ☐ No ☐ N/A
1.12.1.3. Accessible through an easily recognized menu and, if necessary, a submenu. Examples of menu and submenu identification include, but are not limited to "Help," "System Identification," "G S.1. Identification," or "Weights and Measures Identification." ☐ Yes ☐ No ☐ N/A

Note: For (1.10.2.), clear instructions for accessing the information required in G-S.1. (a), (b), and (d) shall be listed on the CC, including information necessary to identify that the software in the device is the same type that was evaluated.

Table S.4.1.a.
Marking Requirements for Multiple Dimensions Measuring Systems

To Be Marked With	Multiple Dimensions Measuring Equipment			
	Multiple Dimensions Measuring Device and Indicating Element in Same Housing	**Indicating Element Not Permanently Attached to Multiple Dimension Measuring Element**	**Multiple Dimension Measuring Element not Permanently Attached to the Indicating Element**	**Other Equipment[1]**
Manufacturer's ID	X	X	X	X
Model Designation	X	X	X	X
Serial Number and Prefix	X	X	X	X[2]
Certificate of Conformance Number[3]	X	X	X	X[3]
Minimum and Maximum Dimensions for Each Axis[4]	X	X	X	
Value of Measuring Division, d for Each Axis[3]	X	X	X	
Temperature Limits[5]	X	X	X	
Minimum and Maximum Speed[6]	X	X	X	
Special Application[7]	X	X	X	
Limitation of Use[8]	X	X	X	

Editor's Note: The table may need to be fixed in NIST Handbook 44.

[1] Necessary to the dimension and/pr volume measuring system, but having no effect on the measuring value (e.g., auxiliary remote display, keyboard, etc.)
[2] Modules without "intelligence" on a modular system (e.g., printer, keyboard module, etc.) are not required to have serial numbers.
[3] Required only if a Certificate of Conformance has been issued for the equipment.
[4] The minimum and maximum dimensions and measuring division, d (using upper and lower case type) can be shown as follows: Length: min ___ max ___ d___ Width: min ___ max ___ d___ Height: min ___ max ___ d___
[5] Required if the range is other than -10 °C to 40 °C (14 °F to 104 °F.)
[6] Multiple dimension measuring devices, which require that the object or device be moved relative to one another, shall be marked with the minimum and maximum speeds at which the device is capable of making measurements that are within the applicable tolerances.
[7] A device designed for a special application rather than general use shall be conspicuously marked with suitable words visible to the operator and the customer restricting its use to that application.
[8] Materials, shapes, structures, combination of object dimensions, speed, spacing, minimum protrusion size, or object orientations that are inappropriate for the device or those that are appropriate.

2. Sealing

Code Reference: S.1.11.

Typical Features and Parameters to be Sealed

The following table provides examples of configuration and calibration parameters that are to be sealed. The examples are provided for guidance and are not intended to cover all possible parameters.

Calibration Parameters
Calibration parameters are those parameters whose values are expected to change as a result of accuracy adjustments.

Configuration Parameters
Configuration parameters are those parameters whose values are expected to be entered once only and not changed after all initial installation settings have been made.

A junction box that contains calibration (or configuration) adjustments must have provision for sealing.

Devices equipped with internal automatic or semi-automatic calibration mechanisms do not have to be sealed provided the calibration mechanism and process are not subject to tampering. Sealing is not required because the calibration process for internal calibration systems result in increased accuracy, which is not detrimental to the accuracy of the measurement process.

Table 1.
Multiple Dimensions Measuring Device (MDMD) Features and Parameters

Typical MDMD Features to Be Sealed	Typical MDMD Features and Parameters NOT Required to Be Sealed
• Zero • Initial Zero-Setting Mechanism (IZSM) • Span (minimum and maximum) • Minimum and Maximum Speed (dynamic systems) • Linearity Correction Values • Calibration Coefficient • Motion Detection (on/off) (static systems) • Motion Detection (update rate) (static systems) • Number of Samples Averaged for Dimension Readings • Averaging Time • Selection of Measurement Units (if internally switched and not automatically displayed on the indicator) • Division Value, d • Minimum and Maximum Dimensions (per axis) • Range of Over Capacity Indications (if it can be set to extend beyond regulatory limits)	• Display Update Rate • Stored Tare Capability (per axis) • Selection of Tare Feature Operation (per axis) • Product Codes • Rate Charges • Discounts • Electronic Data Transfer Parameters (e.g., check sums baud rates, protocol, etc.)

Note: The above examples of adjustments, parameters, and features to be sealed are to be considered "typical" or "normal." This list may not be all inclusive, and there may be parameters other than those listed which affect the metrological performance of the device and must, therefore, be sealed. If listed parameters or other parameters which may affect the metrological function of the device are not sealed, the manufacturer must demonstrate that the parameter will not affect the metrological performance of the device (e.g., all settings comply with the most stringent requirements of NIST Handbook 44 for the applications for which the device is to be used.)

	Minimum Counters Required for Devices Equipped with Event Counters	Minimum Event Counter(s) at System Controller
Only one type of parameter accessible (calibration or configuration)	One (1) event counter	One (1) event counter for each separately controlled device, or one (1) event counter, if changes are made simultaneously.
Both calibration and configuration parameters accessible	Two (2) event counters	Two (2) event counters for each separately controlled device, or two (2) or more event counters if changes are made to all controlled devices simultaneously.

2.1. The device is a category: _____

The method of sealing is: _____

Audit Trails – General

Adequate provision shall be made to apply a physical seal without exposing electronics.	☐ Yes ☐ No ☐ N/A
If the device has a junction box that has calibration adjustments, it must be sealable.	☐ Yes ☐ No ☐ N/A
Event counters are non-resettable and have a capacity of at least 000 to 999.	☐ Yes ☐ No ☐ N/A
Event counters increment appropriately.	☐ Yes ☐ No ☐ N/A
The audit trail information must be capable of being retained in memory for at least 30 days while the device is without power.	☐ Yes ☐ No ☐ N/A
The audit trail information must be readily accessible and easily read.	☐ Yes ☐ No ☐ N/A
Accessing the audit trail information for review shall be separate from the calibration mode.	☐ Yes ☐ No ☐ N/A
Accessing the audit trail information must not affect the normal operation of the device.	☐ Yes ☐ No ☐ N/A
Accessing the audit trail information shall not require removal of any additional parts other than normal requirements to inspect the integrity of a physical security seal, (e.g., a key to open a locked panel may be required.)	☐ Yes ☐ No ☐ N/A

Category 1 Devices (No Remote Configuration Capability)

Either

2.2. The device must be sealable with a physical security seal. **OR**	☐ Yes ☐ No ☐ N/A
2.3. The device must be equipped with at least two event counters: (one for calibration and one for configuration parameters)	
2.3.1. Calibration parameters event counter.	☐ Yes ☐ No ☐ N/A
2.3.2. Configuration parameters event counter.	☐ Yes ☐ No ☐ N/A

Category 2 Devices (Remote Configuration Capability but Controlled by Hardware)

The physical hardware enabling access for remote communication is located at the device.	☐ Yes ☐ No ☐ N/A

Either:

2.4. The physical hardware must be sealable with a physical security seal. **OR**	☐ Yes ☐ No ☐ N/A
2.5. The device must be equipped with at least two event counters: (one for calibration and one for configuration parameters)	
2.5.1. Calibration parameters event counter.	☐ Yes ☐ No ☐ N/A
2.5.2. Configuration parameters event counter.	☐ Yes ☐ No ☐ N/A
An adequate number (see Table 2) of event counters must be available to monitor the calibration and configuration parameters of each individual device.	☐ Yes ☐ No ☐ N/A

The device must either:

2.6. Clearly indicate when it is in the remote configuration mode. **OR**	☐ Yes ☐ No ☐ N/A
2.7. The device shall not operate while in the remote configuration mode.	☐ Yes ☐ No ☐ N/A
If capable of printing in the remote calibration mode, it shall print a message that it is in the calibration mode.	☐ Yes ☐ No ☐ N/A

Category 3 Devices (Unlimited Remote Configuration Capability)
Category 3 devices have virtually unlimited access to sealable parameters or access is controlled through a password.

2.8. The device is equipped with an event logger. ☐ Yes ☐ No ☐ N/A

2.9. The event logger automatically retains the identification of the parameter changed, the date and time of the change, and the new value of the parameter. ☐ Yes ☐ No ☐ N/A

2.10. The system is designed to attach a printer which can print the contents of the audit trail. ☐ Yes ☐ No ☐ N/A

2.11. The event logger must have a capacity to retain records equal to ten times the number of sealable parameters in the device, but not more than 1000 records are required. ☐ Yes ☐ No ☐ N/A

2.12. The event logger drops the oldest event when the memory capacity is full and a new entry is saved. ☐ Yes ☐ No ☐ N/A

3. Indicating and Recording Elements – General (DES 11)

Code References: G-S.2., G-S.5.1., G-S.5.2.2. and S.1.2.
There are several general requirements to facilitate the reading and interpretation of displayed values. Other requirements address the proper operation of indicating and recording elements. The use of the dot as the decimal marker is customary in the U.S. and the use of other types of decimal markers (e.g., comma or ".") is not acceptable.

Code Reference: S.1.1.
A zero or ready condition may be indicated by other than a continuous digital zero indication, provided that an effective automatic means is provided to inhibit a measuring operation when the device is in an out-of-zero or non- ready condition.

3.1. The device indicates or records a zero, out of zero, ready or non-ready condition. ☐ Yes ☐ No ☐ N/A

Code Reference: S.1.2.
Indicated and recorded values are presented digitally. ☐ Yes ☐ No ☐ N/A

Code Reference: S.1.3.
Except when in the tare mode, negative values are not indicated or recorded. ☐ Yes ☐ No ☐ N/A

Code Reference: S.1.4.
If in normal operation the device indicates or records only volume, a testing mode shall be provided to indicate dimensions for all objects measured. ☐ Yes ☐ No ☐ N/A

Code Reference: S.1.5.
The value of the device division "d" expressed in a unit of dimension shall be presented in a decimal format with the value of the division expressed as:

3.2. 1, 2 or 5. **OR** ☐ Yes ☐ No ☐ N/A

3.3. A decimal multiple or submultiples of 1, 2 or 5. **OR** ☐ Yes ☐ No ☐ N/A

3.4. A binary submultiples of a specific inch-pound unit of measure. ☐ Yes ☐ No ☐ N/A

Examples: device, divisions may be 0.01, 0.02, 0, 05; or 0.5; 1, 2, or 5; 10, 20, 50 or 100; .25, .125, .0625, etc.

If an indicator or a video display terminal gives the only indication for the dimensioning system when in the measuring mode, the dimensions, volume and weight, value if applicable, display area must be a continuous live display. It must be located in an area dedicated to the display these values and clearly distinguished and separated from other information on the display. (If the video display is in addition to another primary display, the operator's display need not be a "live" display, but the values displayed must be in a dedicated area and separated from the other information on the display.) ☐ Yes ☐ No ☐ N/A

The minimum acceptable indication of zero balance must be one of the following:

3.5. If a decimal point is used, at least one digit to the left and all digits to the right of the decimal point must be displayed. ☐ Yes ☐ No ☐ N/A

3.6. All decades to the right of a decimal point must be active, (e.g., a fixed zero cannot appear to the right of a decimal point.) ☐ Yes ☐ No ☐ N/A

3.7. If a decimal point is not used, a zero shall be displayed for each place of the displayed division value. ☐ Yes ☐ No ☐ N/A

Examples

Division (d)	Minimum Zero Indication
0.01	0.00
1	0
20	00
100	000

Digital elements shall be designed so that:

3.8. All digital values of like value in system must agree with one another. ☐ Yes ☐ No ☐ N/A

3.9. Displayed and printed values of length, width, and height must be in the same unit of measure. ☐ Yes ☐ No ☐ N/A

3.10. Each digital value must coincide with its associated analog value to the nearest graduation. ☐ Yes ☐ No ☐ N/A

3.11. All digital values must round to the nearest division. ☐ Yes ☐ No ☐ N/A

3.11.1. A dimensioning system must not display or record any values when the correct calculated values exceed the display or printing capability. (An entry of 8 digits made into a defined field length of 7 digits will give an error indication.) ☐ Yes ☐ No ☐ N/A

3.11.2. If the digital display uses only a portion of the most significant decade (MSD) (e.g., the MSD is used for both the minus (-) sign and indicating the number "1" the device is required to meet one of the following two conditions:

- It must not simultaneously display the digit "1" and the minus sign in the MSD. **OR** ☐ Yes ☐ No ☐ N/A
- There must be clearance between the "-" and the digit "1" in the MSD. ☐ Yes ☐ No ☐ N/A

4. Values Defined

Code References: G-S.5.2.4., G-S.5.3.1., G-S.5.6. and G-S.5.6.1.

Graduations, indications, and recorded values that are intended to have specific values shall be adequately identified by a sufficient number of figures, words, and symbols. These defining terms shall be uniformly placed relative to the graduations, indications, and recorded values and as close as practical to them without interfering with their readability. When SI units are used, the symbols shall comply with those in Appendix C (General Tables of Units of Measurement) in NIST Handbook 44 or NIST Special Publication SP 811 "Guide for the Use of International System of Units (SI)." Other symbols shall comply with the abbreviations given in Appendix C (General Tables of Units of Measurement) in NIST Handbook 44.

4.1. Occasionally, a dimensioning system will indicate in one measurement unit and convert the dimension value to another measurement unit for billing and accounting purposes (e.g., indicate in centimeters and convert to inches.) When this is done, the following must be satisfied:

4.2. Primary dimension indications and recorded values must agree as specified in *NIST Handbook 44* and must be in the same unit of measurement. ☐ Yes ☐ No ☐ N/A

4.3. Derived indications and recorded representations may be in other units of measure provided:

4.3.1. They are mathematically correct and based on the General Tables of Weights and Measures found in *NIST Handbook 44*. ☐ Yes ☐ No ☐ N/A

4.3.2. They are of equal resolution to the primary measurement indication. AND ☐ Yes ☐ No ☐ N/A

4.3.3. Rounding is not performed until the last mathematical operation. ☐ Yes ☐ No ☐ N/A

5. Tare

5.1. The tare mechanism shall operate only in a backward direction. ☐ Yes ☐ No ☐ N/A

5.2. On a device designed to automatically clear any tare value entered, means shall be provided to prevent the clearing of tare until a complete transaction has been indicated. ☐ Yes ☐ No ☐ N/A

6. Tare Operation - Facilitation of Fraud

6.1. When units are converted, the measurement unit selector switch must convert all displayed measurement values to the same weight unit. ☐ Yes ☐ No ☐ N/A

7. Recorded Representations

Code References: G-S.5.6., G-S.5.1. and G-S.5.2.5.

7.1. All recorded values must be permanent, legible, and printed in a digital format. Although *NIST Handbook 44* does not require the printing of gross, tare, and net weight, some States may require the printing of all three values.

7.2. All recorded measurement values must be clearly defined.

7.3. The primary measurement indication and the printed value must agree exactly as specified in *NIST Handbook 44* and must be in the same unit of measurement. Derived indications and recorded representations may be in other units of measurement provided the following criteria are satisfied.

7.3.1. They are mathematically correct. That is, they are based upon the values specified in the General Tables of Weights and Measures found in *NIST Handbook 44*.

7.3.2. They are of equal resolution to the primary measurement indication. **AND**

7.3.3. Rounding is not performed until the last mathematical operation.

7.3.4. If the measuring system is equipped to externally select units of measurement, the printer must record the units with the measurement values. ☐ Yes ☐ No ☐ N/A

7.3.5. A printer must record the same value and number of decimal places as indicated in the display. Example: A digital indicator may display measurement values to 0.01 inches and 0.03 cm. The printer must record a measurement value in inches to 0.01; not to 0.010. ☐ Yes ☐ No ☐ N/A

7.3.6. Derived values must be correct mathematical conversions from the indicated values with rounding performed at the last step of conversion to ensure mathematical agreement. ☐ Yes ☐ No ☐ N/A

Code Reference: S.1.5.1.

7.4. Devices used in Indirect Sales. In addition to the values specified above, the value of the division on a system used in indirect sales may be 0.3 inches or 0.4 inches. ☐ Yes ☐ No ☐ N/A

The value of the division is:

7.4.1. 0.3 **OR** ☐ Yes ☐ No ☐ N/A

7.4.2. 0.4. ☐ Yes ☐ No ☐ N/A

Code Reference: S.1.5.2.

7.5. The devices capable of measuring irregularly shaped objects, the value of division size (d) shall be the same for the length axis (x) and the width and the width axis (y) and may be different for the height axis (z), provided that electronic rotation of the object to determine the smallest hexahedron is calculated in only a two-dimension horizontal plane, retaining the stable side plane as the bottom of the hexahedron. ☐ Yes ☐ No ☐ N/A

Code Reference: S.1.6..

7.6. Multiple dimension measuring systems shall provide the information specified in Table S.1.6. ☐ Yes ☐ No ☐ N/A

Code Reference: S.1.7.

7.7. Minimum dimension indicated or recorded for any axis is 12 d. The manufacturer may specify a longer minimum dimension. ☐ Yes ☐ No ☐ N/A

Code Reference: S.1.8.

7.8. Except for entries of tare, when objects are smaller than the minimum dimensions or larger than any of the maximum dimensions plus 9 d, and/or maximum volume marked on the device plus 9 d, or when a combination of dimensions for the object being measured exceeds the measurement capability of the device, the indicating or recording element shall either:

7.8.1. Not display or record any usable values for that axis. **OR** ☐ Yes ☐ No ☐ N/A

7.8.2. Identify the displayed or recorded representation with an error indication for that axis. ☐ Yes ☐ No ☐ N/A

Code Reference: S.1.10.

7.9. Adjustable components shall be held securely in adjustment and, except for a zeroing mechanism, shall be located within the housing of the element. ☐ Yes ☐ No ☐ N/A

8. Design of Zero and Tare

Code Reference: S.2.

8.1. The device shall be equipped with a means by which the zero reference or ready condition can be adjusted or the zero reference or ready condition shall be automatically maintained. ☐ Yes ☐ No ☐ N/A

Note: Belt stopped is NOT a non-ready condition

8.2. The zero reference or ready control circuits shall be interlocked so that their use is prohibited during measurement operations. ☐ Yes ☐ No ☐ N/A

8.3. The tare function shall operate only in a backward direction (under-registration) with respect to the zero reference or ready condition of the device. ☐ Yes ☐ No ☐ N/A

8.4. The value of the tare division or increment shall be equal to the division of its respective axis on the device. ☐ Yes ☐ No ☐ N/A

8.5. There shall be a clear indication that tare has been taken. ☐ Yes ☐ No ☐ N/A

9. Systems with Two or More Measuring Elements

Code Reference: S.3.

9.1. Means is provided to prevent activation of any measuring element (or elements) not in use. **AND** ☐ Yes ☐ No ☐ N/A

9.2. Automatic means is provided to indicate clearly and definitely which measuring element is in use. ☐ Yes ☐ No ☐ N/A

Note: This requirement does not apply to the individual emitter/sensor within a measuring element that uses multiple emitters/sensors in combination to measure objects in the same measurement field. (Amended 2004)

10. Verification of Usage (Field Testing only)

Code Reference: UR.5.

Multiple dimension measuring systems shall provide information as per Table UR.5

10.1. ☐ Customer Present ☐ Customer Not Present ☐ Contractual Agreement

Table UR.5
Customer Information Provided

Information	No Contractual Agreement		Contractual Agreement
	Customer Present	Customer Not Present	
1. Object Identification (e.g. barcode)	N/A	P	P or A
2. Billing Method (scale of dimensional weight if used)	D or P	P	P or A
3. Billing Rate or Rate Chart	D, P or A	P, G or A	P or A
4. Dimensional Weight (if used)	P	P	P or A
5. Conversion Factor (if dimensional weight is used)	D, P or A	P	P or G
6. Dimensional Weight Statement[9] (if dimensional weight is used)	D or P	P	P or G
7. Total Price	P	P	P or A

Hexahedron = An object with six rectangular, plane surfaces (sides.)

A = Available Upon Request by Customer[10]

D = Displayed

G = Published Guidelines or Contracts

M = Marked

N/A = NOT Applicable

P = Printed

11. Operating Temperature Verification of Warm-up Time (Accuracy After Cold Start)

Code Reference S.1.9. Warm-up Transaction Inhibition

11.1. An indicating or recording element shall not display nor record any usable values until the operating temperature necessary for accurate measuring and a stable zero reference or ready condition has been attained. ☐ Yes ☐ No ☐ N/A

To determine whether the difference between the performance of the DUT (device under test) immediately upon being switched on and its performance during its warming up period is greater than the maximum tolerance, a warm-up time test must be performed as outlined below.

Test Procedure:

1. Turn off and disconnect from the power source the DUT for a period of at least eight (8) hours.
2. Connect the DUT to the power source and switch it "on."

[9] This is an explanation that the dimensional weight is not a true weight but is a calculated value obtained by applying a conversion factor to the hexahedron dimensions or volume of the object.

[10] The information "available upon request by customer" shall be retained by the party having issued the invoice for at least 30 calendar days after the date of invoicing.

3. Record the first available indication (e.g., the first indication that can be used for the purpose of the transaction.) Reset to zero or ready condition, if necessary.
4. After a zero or ready indication, apply a test object(s) approximately equal to 1/2 to 3/4 of the maximum capacity for each axis and record the indication.
5. Remove the test object and record the indication.
6. The device must return to zero or ready indication.

Interpretation of Results:

11.2. All measurements are within tolerances. ☐ Yes ☐ No ☐ N/A

12. Performance Tests

Test Procedure:

1. Load the device with a test object(s) with dimensions near the maximum capacities listed on the device.
2. Take a reading of the three dimensions corresponding to this test object(s) and ensure that they are within tolerance.
3. Repeat with test object(s) near the minimum capacities listed on the device.
4. Repeat with a test object(s) near the mid-range capacity listed on the device.
5. Steps 1 through 4 shall be performed a minimum of three times.

Interpretation of Results:

12.1. All measurements are within applicable tolerances. ☐ Yes ☐ No ☐ N/A

13. Eccentricity Test

Code Reference N.1.2.

The purpose of this test is to ensure that the device continues to measure accurately when a test object is presented at different locations in the measurement area.

Test procedure:

1. Ensure that the DUT is at zero or in the ready condition.
2. Place four standards, in increasing sizes from the smallest to the largest in the transverse orientation, in/on the measurement area near the center of the area. Record the measurements.
3. Repeat steps 1 and 2 at least 2 more times
4. Repeat steps 1 to 3, but shifted to one side of the measurement area (at about 0.5 cm from the edge). The consecutive standards will be “widening” toward the center of the measurement area. Record the measurements.
5. Select a standard/object that has vertical measurement at height limit. Place it at the edge of the measurement area (same edge as in previous step) in the vertical orientation (~0.5 cm from the edge). Take at least 3 measurements.
6. Repeat steps 1 to 3, but shifted this time to the other side of the measurement area. The standards in this instance will again be “widening’ toward the center of the measurement area, but this time in the opposite direction of the previous sequence.
7. Select a standard/object that has vertical measurement at height limit. Place it at the edge of the measurement area (same edge as in previous step) in the vertical orientation (~0.5 cm from the edge). Take at least 3 measurements.
8. If the device is capable of operating over a range of speeds perform steps 1 to 7 at the lowest speed, a middle speed and the highest speed.
9. Using the object with the maximum vertical measurement, place it partially outside of the measuring area (i.e. off the edge of the conveyor belt). Take a measurement and record the results.

For Palletized Freight Devices

1. Ensure that the DUT is at zero or in the ready condition.

2. Place a loaded pallet in the corner of the measuring area. Take at least 3 measurements.
3. Select a loaded pallet that has vertical measurement at height limit. Place it at the edge of the measurement area (same corner as in previous step) ~0.5 cm from the edge. Take at least 3 measurements.
4. Repeats steps 1 and 3 for the 3 remaining corners.

Interpretation of Results:

13.1. All measurements made by the device are within the limit of error, and ☐ Yes ☐ No ☐ N/A

13.2. For objects partially outside of the measuring area, an error code is produced. Otherwise, the approval must state that the measuring area be bound by guards rails or similar to ensure that objects are kept within the defined measuring area. ☐ Yes ☐ No ☐ N/A

14. Conveyor Belt Seam Test

The purpose of this test is to determine if the seam on the conveyor belt affects the accuracy of the measurements.

Test procedure:

1. Set the conveyor belt to its **fastest speed**. Record this value.
2. Ensure that the DUT is at a zero or ready condition.
3. Place a standard of 12d height in a **horizontal transverse orientation**, on the conveyor belt seam, so as to have the seam under the front of the standards, and pass it through the measurement area. The standard should pass through the DUT near the midway point of the measurement opening.
4. Place a standard of 12d height in a **horizontal transverse orientation**, on the conveyor belt seam, so as to have the seam under the middle of the standards, and pass it through the measurement area. The standard should pass through the DUT near the midway point of the measurement opening.
5. Place a standard of 12d height in a **horizontal transverse orientation**, on the conveyor belt seam, so as to have the seam under the rear of the standards, and pass it through the measurement area. The standard should pass through the DUT near the midway point of the measurement opening.
6. Observe the displayed registrations and print or record the results.
7. One at a time, place 3 other standards in increasing size, at the different places on the seam, and pass them through the measurement area. Ensure that the standards are all in the same horizontal orientation and pass through the DUT near the center of opening as in step 3.
8. Observe, print and record all of the registrations.
9. Adjust the conveyor belt speed to its **middle speed**. Record this value.
10. Ensure that the DUT is in the ready condition.
11. Repead steps 3 to 6.
12. Observe, print and record all of the registrations.
13. Adjust the conveyor belt speed to its **slowest speed**. Record this value.
14. Ensure that the DUT is in the ready condition.
15. Repeat steps 3 to 6.
16. Select a standard of maximum height for presentation to the DUT. Pass it through the measurement opening, positioned on a seam, at the same three locations on the seam, through the midpoint of the opening. Watch for any wobbling in the standards that is not attributable to the conveyor belt seam.
17. Observe, print and record all of the registrations.

Interpretation of Results:

The DUT is deemed to have met the requirements if, during this procedure;

14.1. All of the registrations remain within the limit of error; or ☐ Yes ☐ No ☐ N/A

14.2. When the conveyor belt seam in influencing the accuracy of the measurement, the DUT registers error codes or blanks the display and prevents the downloading or printing of any usable measurement information ☐ Yes ☐ No ☐ N/A

15. Variable Orientation Test

The purpose of this test is to ensure that the DUT is capable of sensing and registering the same results when presented repeatedly with the same object but in different orientations.

Test procedure:

1. Ensure that the DUT is at zero or in the ready condition.
2. Select a standard with $x \neq y \neq z$ and place it near the center of the measurement area in the horizontal position (0°) with the "y" axis in the vertical orientation.
3. Record or print the measurement registrations.
4. Repeat steps B and C for the same standard but rotated to the left with each of the following variations from the horizontal axis; 45°, 90°, 135°.
5. Turn the standard onto its side so that the "x" axis is now in the vertical orientation and continue presenting the standard at 180°, 225°, 270° and 315°. Observe the indications, record and print the values obtained.
6. Stand the standard on its end and rotated to 45° and present it to the DUT.
7. Observe, record and print the results.
8. Repeat the above procedure with the irregularly shaped standard, if applicable.

Interpretation of Results:

The DUT is deemed to have met the requirements, if during this test

15.1. All of the results fall within the limit of error; or ☐ Yes ☐ No ☐ N/A

15.2. The DUT responds to the restricted orientations as stipulated by the manufacturer. ☐ Yes ☐ No ☐ N/A

16. Measurement Speed Test

The purpose of this test is to determine that the DUT will maintain the required levels of accuracy when set to the maximum and minimum speeds requested by the approval applicant. This procedure may also be used to determine a narrower range of speeds when the requested speeds fail to meet the performance requirements.

Test procedure:

1. Determine from the documentation provided by the approval applicant, the steps necessary to set the device to a specified speed of measurement.
2. For a device equipped with a conveyor, position the test tachometer over one of the pulleys so that the sensing wheel is driven by the conveyor belt.
3. Activate the device and let the equipment run until a stable speed is achieved.
4. Adjust the measurement speed to the **fastest** setting. For a device equipped with a conveyor, this can be achieved using the test tachometer as a reference. Let the equipment run at the correct speed and fine tune the adjustment if necessary. Confirm that the correct, stable speed has been attained and record the speed.
5. For a device equipped with a conveyor, record the test tachometer speed indication. For other devices, use a stopwatch to establish the time required for one complete measurement cycle.
6. Observe the speed being indicated by the DUT, if available). Record this value.
7. Ensure that the DUT is at a zero or ready condition.
8. One at a time, place two medium standards, in/on the measurement area. The standards should be near the center of the measurement area.
9. Observe the displayed registrations and print or record the results.
10. Place a standard with a length equal to the **maximum length** capacity on/in measurement area and observe the displayed registrations and print or record the results.
11. Place a standard with a width equal to the **maximum width** capacity on/in measurement area and observe the displayed registrations and print or record the results.

12. Place a standard with a height equal to the **maximum height** capacity on/in measurement area and observe the displayed registrations and print or record the results.
13. Place a standard with a length equal to the **minimum length** capacity on/in measurement area and observe the displayed registrations and print or record the results.
14. Place a standard with a width equal to the **minimum width** capacity on/in measurement area and observe the displayed registrations and print or record the results.
15. Place a standard at with a height equal to the **minimum height** capacity on/in measurement area and observe the displayed registrations and print or record the results.
16. Repeat steps 8 to 16 2 more times.
17. Repeat steps 4 to 16 at the **medium** speed setting.
18. Repeat steps 4 to 16 at the **slowest** speed setting.
19. With a long standard in the **horizontal length axis**, slow down the belt during measurement.
20. With a long standard in the **horizontal length axis** speed up the belt during measurement.
21. With a long standard in the **horizontal length axis**, stop it during measurement.
22. With a long standard in the **horizontal length axis**, stop it twice during measurement.

If at different speeds different mechanisms are used to determine the length, width of height, make sure that all mechanisms are tested. (e.g.. Photocell used only > 38m/min, otherwise tachometer).

Interpretation of Results:
The DUT is deemed to have met the requirements, if during this test if;
16.1. All of the measurements remain within the limit of error. ☐ Yes ☐ No ☐ N/A

17. Minimum Spacing Test

Code Reference S.4.1.a.
The purpose of this test is to ensure that the DUT responds appropriately when two or more objects are presented to the measuring element(s) at the same time.

Test procedure:
1. If applicable, determine the measurement and/or conveyor belt speed. Record this value.
2. Ensure that the DUT is at a zero or ready condition.
3. Place a standard on/in the measuring element.
4. Observe the displayed registrations and print or record the results.
5. Place a second, different standard in/on the measuring element as in step 3. Observe, print and record all of the results.
6. Ensure that the DUT is in the ready condition.
7. From the information provided by the manufacturer, determine the minimum spacing between objects that the DUT is designed for. Record this value.
8. Arrange the same two standards in the same order and orientation for presentation to the DUT as previously (one behind the other). Present them to the DUT in such a way that they are seperated by the minimum spacing value determined in step 7.
9. Arrange the same two standards in the same order and orientation for presentation to the DUT as previously. Present them to the DUT in such a way that they offend the minimum spacing value determined in step 7.
10. Observe, print or record all of the registrations and note any other observations or results.
11. Ensure that the DUT is at a zero or ready condition.
12. Using the same standards, take measurements at minimum spacing, but this time with the first standard toward the right side of the measurement opening and the second standard toward the left side of the opening.
13. Using the same standards, repeat steps 6 to 8, but this time with both standards, in the same orientation and positions as previously, presented to the DUT at the same time. The test objects must not be exactly in line or parallel to each other, they are overlapped.
14. Observe, print or record all of the registrations and note any other observations or results.

15. Ensure that the DUT is in the ready condition.
16. If applicable, determine the positioning of two standards that would create a shadowing situation for the DUT sensors. Note this information. For non-singulated: -at min distance; -offending min distance.
17. Ensure that the DUT is at a zero or ready condition.
18. Present the standards, individually, to the DUT in the positions determined in step 16.
19. Observe, print or record all of the registrations and note any other observations or results.
20. Present the standards, together this time, so that the shadowing situation determined in step 16, is seen by the DUT.
21. For devices capable of operation over a range of speeds complete steps 8 to 10 at both maximum and minimum speeds.
22. Observe, print or record all of the registrations and note any other observations or results.

Interpretation of Results:

The DUT may comply in a number of ways depending on the restrictions stated by the manufacturer. The DUT is deemed to have met the requirements if during any of the overlap conditions;

17.1. All of the measurement registrations produced are within the limit of error and the correct measurements are designated to the matching standard; or ☐ Yes ☐ No ☐ N/A

17.2. Accurate measurements were produced and matched to one standard and the other standard was not dimensioned, no measurement information was transmitted and an error message for the unmeasured standard was given; ☐ Yes ☐ No ☐ N/A

17.3. The display shows an error message and the transmission of any measurement information is prevented; or ☐ Yes ☐ No ☐ N/A

17.4. The display blanks and the transmission of any measurement information is prevented; or ☐ Yes ☐ No ☐ N/A

17.5. The display shows an unstable registration that cannot be interpreted and the transmission of any measurement information is prevented. ☐ Yes ☐ No ☐ N/A

17.6. If correct measurements or errors are not produced when minimum spacing is offended the device must be marked with the restriction that minimum spacing be respected. During initial installation inspectors will have to ensure that there is some mechanism to ensure minimum spacing is maintained. ☐ Yes ☐ No ☐ N/A

18. Touching Objects Test

The purpose of this test is to ensure that the DUT responds appropriately when two or more touching objects are presented to the measuring element(s) at the same time.

Test procedure:

1. If applicable, determine the measurement and/or conveyor belt speed. Record this value.
2. Ensure that the DUT is at a zero or ready condition.
3. One at a time, place all the standards to be used during this test on/in the measuring element.
4. Observe the displayed registrations and print or record the results.
5. Ensure that the DUT is in the ready condition.
6. Arrange the standards in the various orientations as described in the test sequences #1 to #14 for presentation to the DUT so that the barcodes (or other identification means) are not visible to the reader.
7. Observe, print or record all of the registrations and note any other observations or results.
8. Arrange two regular corrugated cardboard boxes of identical size in the orientations as described in the test sequence # 8 to #20.
9. Observe, print or record all of the registrations and note any other observations or results.
10. Using the same standards and boxes, repeat steps 6 to 9, but this time with each box with a barcode (or other identification means) facing the reader
11. Observe, print or record all of the registrations (including the associated barcode/identification code for each measurement) and note any other observations or results.

12. Create 10 additional configurations of standards (similar in nature to sequence #7) and present them to the DUT. These configurations should attempt to exploit any possible trouble points in the sensor configuration.
13. Observe, print or record all of the registrations (including the associated barcode/identification code for each measurement) and note any other observations or results.

Interpretation of Results:

The DUT may comply in a number of ways depending on the restrictions stated by the manufacturer. The DUT is deemed to have met the requirements if during any of the touching conditions

18.1. All of the measurement registrations produced are within the limit of error and the correct measurements are designated to the matching standard; or ☐ Yes ☐ No ☐ N/A

18.2. Accurate measurements were produced and matched to one standard and the other standard was not dimensioned, no measurement information was transmitted and an error message for the unmeasured standard was given ☐ Yes ☐ No ☐ N/A

18.3. The display shows an error message and the transmission of any measurement information is prevented; or ☐ Yes ☐ No ☐ N/A

18.4. The display blanks and the transmission of any measurement information is prevented; or ☐ Yes ☐ No ☐ N/A

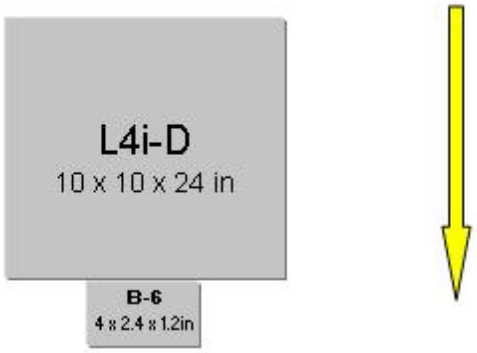
18.5. The display shows an unstable registration that cannot be interpreted and the transmission of any measurement information is prevented. ☐ Yes ☐ No ☐ N/A

NOTE: A limitation of use requesting an offset is not a viable option. If a device is "touching", then all sequences below must be tested.

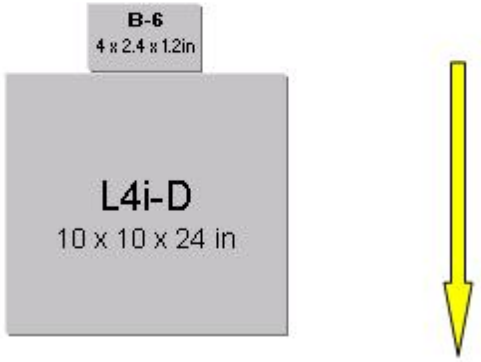
Test Sequences:

Sequence #1

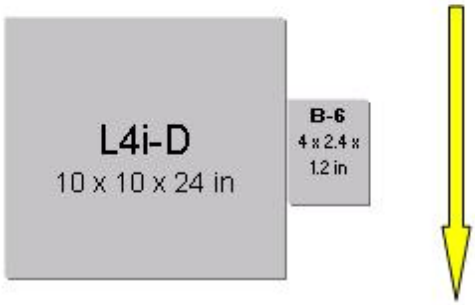
Sequence #2



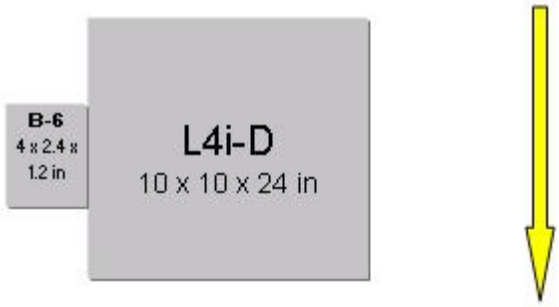
Sequence #3



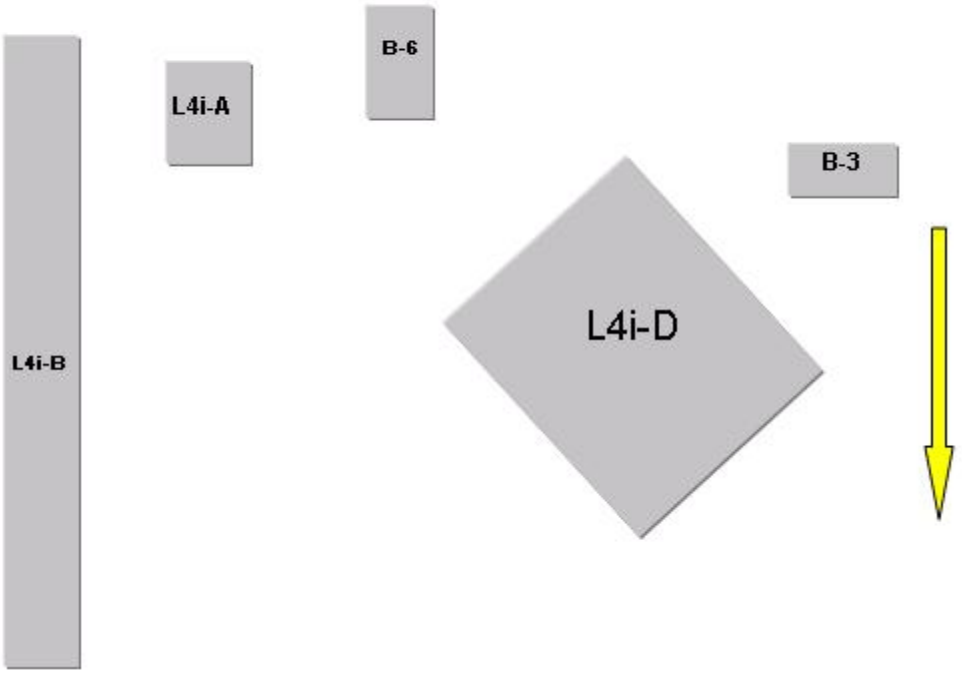
Sequence #4



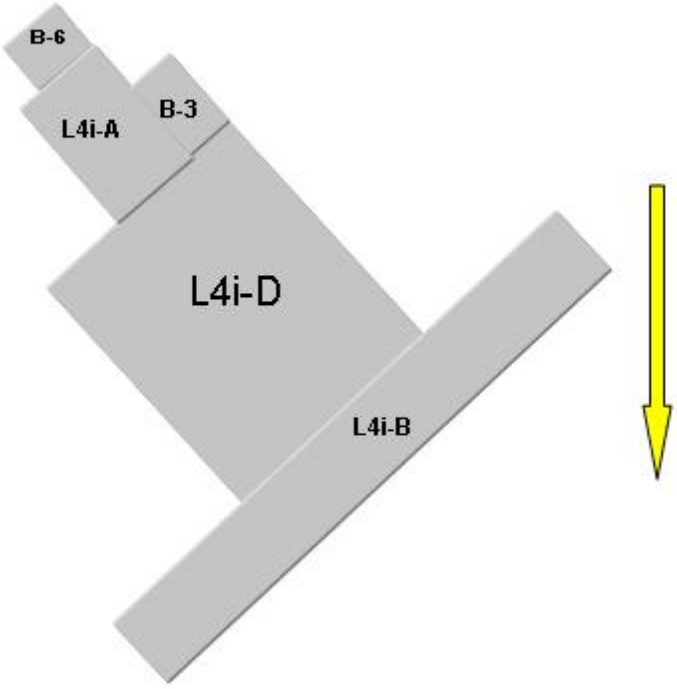
Sequence #5



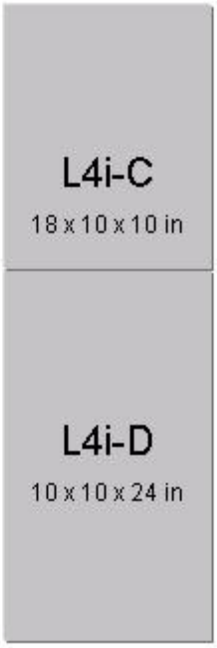
Sequence #6



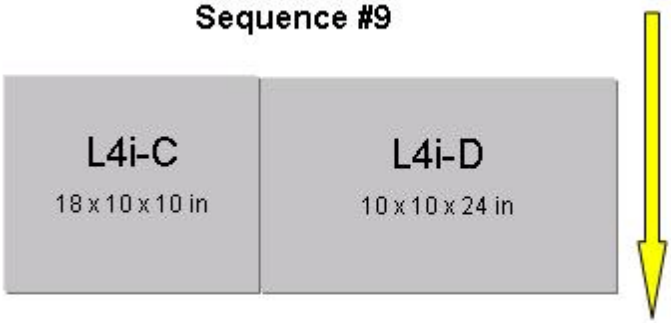
Sequence #7

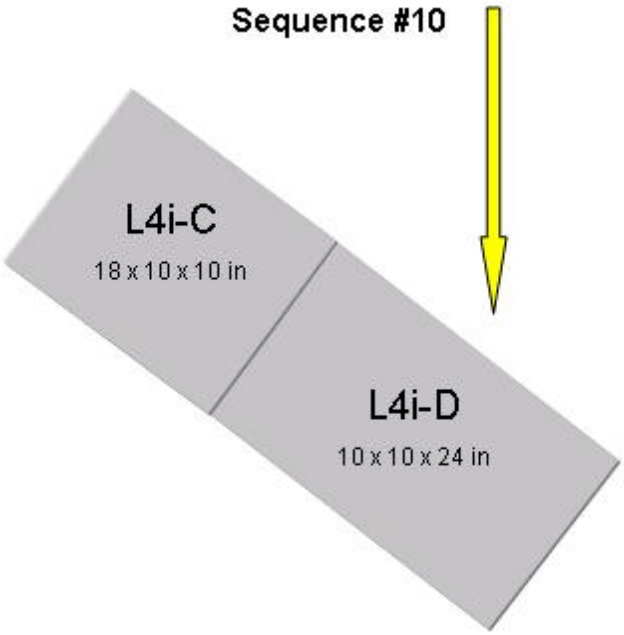


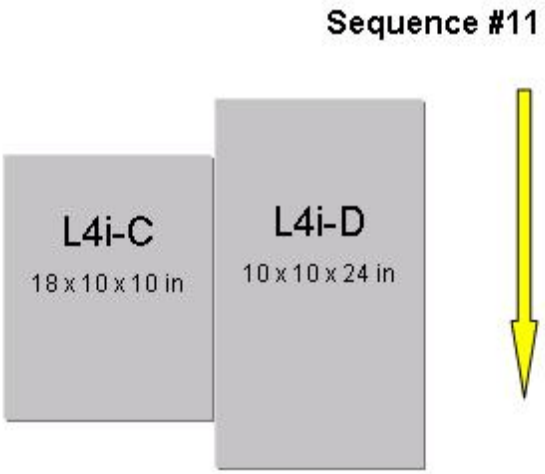
Sequence #8



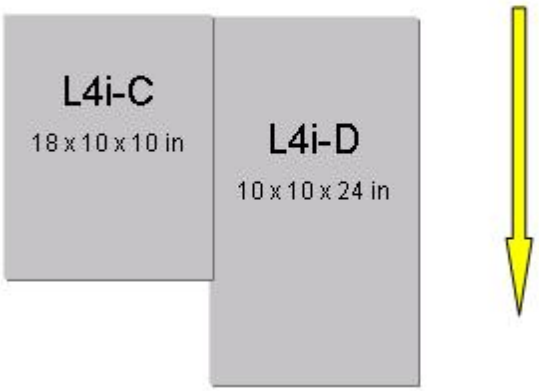
Sequence #9



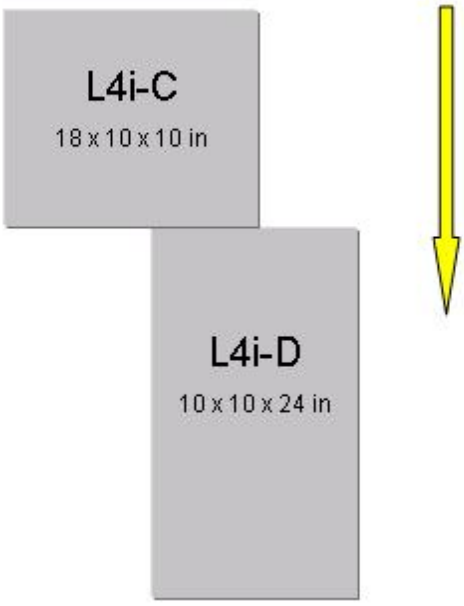

Sequence #10
L4i-C
18 x 10 x 10 in
L4i-D
10 x 10 x 24 in


Sequence #11
L4i-C
18 x 10 x 10 in
L4i-D
10 x 10 x 24 in

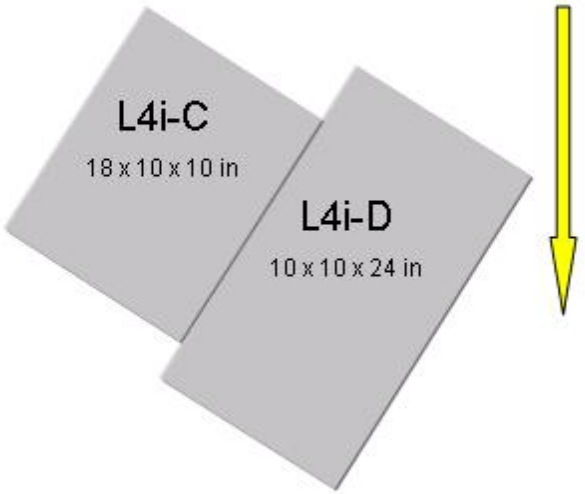
Sequence #12



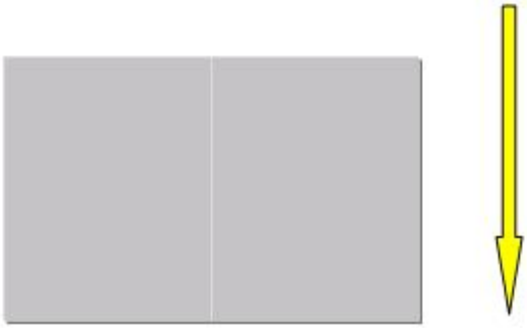
Sequence #13



Sequence #14

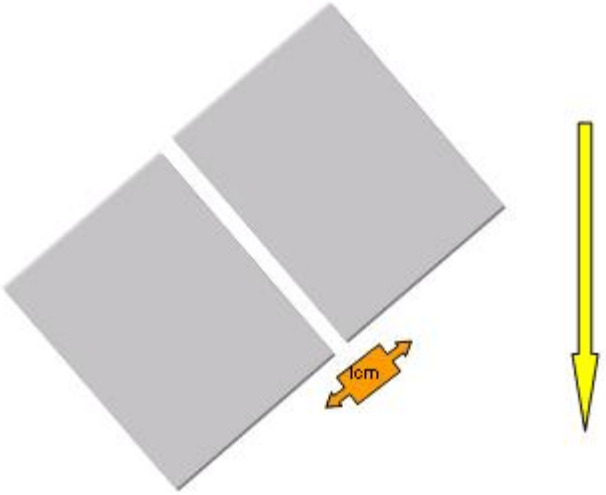


Sequence #15

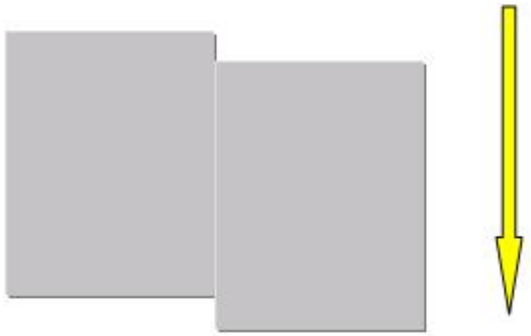


Sequence #16

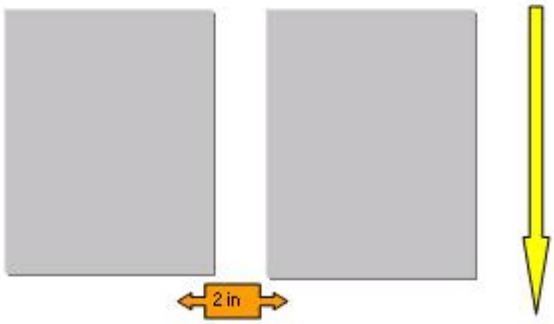
Sequence #17



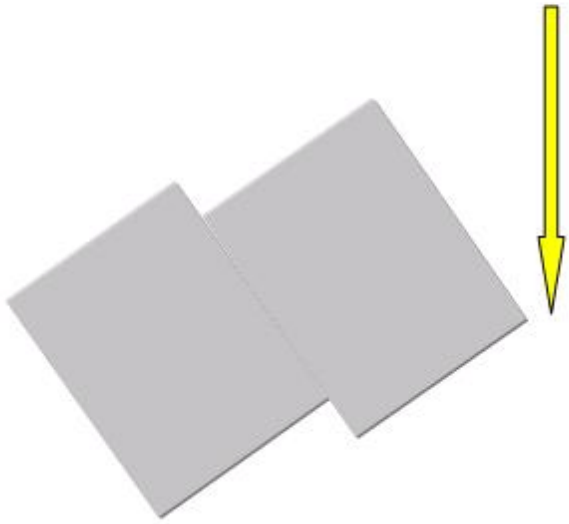
Sequence #18



Sequence #19



Sequence #20



19. Irregularly Shaped Objects Test (Information received from the Ohio NTEP Lab and reworded by D. Flocken.)

The purpose of this test is to determine the devices ability to measure the height, length and width of an irregularly shaped object that is placed in or moves through the measuring field with its most stable side down.

Test procedure:

1. Select 3 test objects and determine the objects most stable side.
2. Place to test objects on a flat surface and measure the height, length and width.
3. Pass the test objects, one after the other, through the center of the measurement area.
4. Observe the display and record or print the registration results.
5. Repeat steps 3 and 4 10 times.
6. Select one test object and repeat steps 3 to 5 with the test object oriented in a position of 45°, 90°, 135° and 180° clockwise for the objects original position.

Interpretation of Results:

The DUT is deemed to have met the requirements, if during this test;

19.1. All of the results remain within the limit of error, or ☐ Yes ☐ No ☐ N/A

19.2. The DUT takes an appropriate step, such as displaying an error message, blanking the display or producing an unreadable display and preventing the transmission and downloading of any useful measurement data. ☐ Yes ☐ No ☐ N/A

20. Jam Test

The purpose of this test is to ensure that conveyor structural elements and guide rails do not interfere with the movement and measurement of packages.

Note: Do not use test standards for this procedure.

Test procedure:

1. Select and measure 5 test objects or boxes (one of them should be a heavy package) and pass them (horizontal orientation) one after another through the center of the measurement area.
2. Observe the display and record or print the registrations results.

3. Repeat steps 1 and 2 but this time place the test objects against the left most rail or side of the conveyor system such that the test objects will drag against the rail as they go through the measurement process.
4. Observe the display and record and print the registrations.
5. Repeat steps 1 and 2 but this time place the boxes against the right most rail of the conveyor system such that they will drag against the rail as they go through the measurement process.
6. Observe the display and record and print the registrations.
7. Repeat steps 1 to 6 at the maximum belt speed and then again at the minimum belt speed.

Interpretation of Results:

The DUT is deemed to have met the requirements, if during this test;

20.1. All of the results remain within the limit of error, or ☐ Yes ☐ No ☐ N/A

20.2. The DUT takes an appropriate step, such as displaying an error message, blanking the display or producing an unreadable display and preventing the transmission and downloading of any useful measurement data, or ☐ Yes ☐ No ☐ N/A

20.3. If results outside of the limit of error are produced then some physical means of preventing objects from touching the guard rail will need to be implemented ☐ Yes ☐ No ☐ N/A

21. Power Voltage

This test is to verify that the device is adequately protected against power voltage variations.

Procedure:

1. Stabilize the DUT at constant environmental conditions and record the following data:
   - Time
   - Temperature
   - Relative Humidity
   - Power Supply Voltage
   - Test Load
   - Device Indication
   - Device Errors
2. Place on the DUT a test object of side dimension equal to 1/2 to 3/4 of the maximum capacity for each axis. Take readings of the dimensions.

Alternating Current

1. Reduce the power supply voltage for the dimensioning element to 85% of nominal line voltage at 60 Hz.
2. Record the device indication with and without a test object between 50% and maximum capacity of the DUT.
3. Increase the power supply voltage for the dimensioning element to +110% of nominal line voltage at 60 Hz.
4. Record the device indication with and without a test object between 50% and maximum capacity of the DUT.
5. Remove the load and reapply the nominal power supply voltage for the dimensioning element (to within ±2% of nominal line voltage at 60 Hz.)
6. Record the data indicated with and without a test object between 50% and maximum capacity of the DUT.

Direct Current

Devices that operate using direct current shall operate and perform within the applicable tolerance at any voltage level at which the device is capable of displaying metrological registrations. Tests shall be performed at the lowest voltage where a display can be obtained and at the highest voltage the manufacturer states (or 110% of nominal battery voltage.)

Interpretation of Results:

21.1. All measurements are within tolerances or provide an error indication ☐ Yes ☐ No ☐ N/A

22. Influence Factor

Code Reference T.5.1.
This test is to verify that the device continues to perform adequately when subjected to temperature fluctuations. Test objects shall not be soaked with DUT. Leave the test objects outside of the chamber while not performing tests.

Test Temperatures:
Do not exceed a temperature change rate of 1 °C/min. Take readings after each temperature variation.

First Round: Nominal temperature (approximately 20 °C)

Second Round: High temperature (40 °C unless marked less than 40 °C)

Third Round: Low temperature (-10 °C unless marked greater than -10 °C)

Fourth Round: Nominal temperature (approx. 20 °C)

Note: The high and low temperature tests do not necessarily need to be run in this order, the low temperature may be run first if it is desirable to do so.

Test Procedure:
Note: *After temperature of the environment chamber has stabilized, allow the DUT to stabilize for at least 2 hours. Change to 2 hours to harmonize this with Measurement Canada and International Organization of Legal Metrology.*

1. With the DUT switched "on" and in the environmental chamber, stabilize the DUT at the selected test temperature.
2. Monitor the temperature of the environmental chamber.
3. Zero the DUT.
4. Prior to the application of test objects, record:
   - Time and Date
   - Temperature
   - Relative Humidity
5. Conduct the test with three or more test objects with dimensions within the range of each axis listed on the device.
6. Record dimensions of test objects and any error indication.
7. Repeat 10.4 to 10.5 three times.

Interpretation of Results:
22.1. All measurements are within applicable tolerances. ☐ Yes ☐ No ☐ N/A

23. Minimum and Maximum Measurement Capabilities

Code Reference S.1.18.
Except for entries of tare, when objects are smaller than the minimum dimensions identified in paragraph S.1.7. or larger than any of the maximum dimensions plus 9 d and/or volume marked on the device plus 9 d, or when a combination of dimensions for the object being measured exceeds the measurement capability of the device, the indicating or recording element shall either:

1. Not display or record any usable values for that axis. **OR**
2. Identify the displayed or recorded representation with an error indication for that axis.

Test Procedure:
1. Place on the device a test object that has smaller dimensions than those rated as minimum dimension measurement capabilities.

2. Place on the device a test object that has larger dimensions than those rated as maximum measurement capabilities plus 9 d.

Interpretation of Results:
Ensure that the indicating or recording element shall either:

23.1. Not display or record any usable values for that axis. **OR** ☐ Yes ☐ No ☐ N/A

23.2. Identify the displayed or recorded representation with an error indication for that axis. ☐ Yes ☐ No ☐ N/A