Frequently Asked Questions
Vehicle and Axle-load Scales
NIST Instructor Training School
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Question 1. Under what circumstances would a remote display be deemed necessary?

Answer: Auxiliary indications are necessary when a device is used in direct sales and the primary indications cannot be accurately read from some reasonable "customer" and "operator" position (See G-UR. 2.2. and G-UR. 3.3.). 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. Several Weights and Measures Officials (Officials) have taken the position that scale installations comply with G-UR.3.3. if the device user permits customers or their representatives (drivers) to enter the building that houses the primary indicator and view the weight indicator.

A remote display would also be necessary on unattended self-service vehicle and axle-load scales (if access to the primary indicator is not provided) to alert users that the scale is on zero prior to vehicles going on the load-receiving element and to then show the weight of the vehicle. See General Code paragraphs G-UR. 2.2. and G-UR.3.3.

Question 2. If the intent of the code is met in regards to installation, does it have to meet the specific criteria of the code? (Example: After the required 3 meter (10 ft) of level approach adjacent to the scale deck, the slope in the remaining portion of the approach is down toward the scale, not away.) If appropriate drainage is provided and ease of testing and vehicle access is not affected, can this be accepted as correct?

Answer: From the description you provide we believe the scale installation would meet the requirements of UR.2.6. Approaches if drainage grates or other means of controlling "normal" water flow keeps the water out of the scale pit or away from the scale. Some installations have drainage grates at the bulkhead next to the scale or at some point in the level area of the approach to the scale.

Question 3. If a scale is interfaced with a computer that generates a customer ticket, does the computer software have to ensure that the printed representation records exactly as the indicating element of the scale. (Example: A tare weight value has been entered on the indicating element and the display shows a net weight value. The operator then accepts this value in the gross weight window on the computer screen.) Is this correct or should the software prevent this from happening?

Answer: If we understand the question correctly our tentative answer is that G-S.5.2.2 Digital Indication and Representation would apply and it requires all digital values in a

system to agree. If the tare mode is being used on the indicator, then the computer indications and any recorded representations must be correctly identified and agree with those displayed on the indicator. Typically, if an indicator displays only in the gross mode, the scale operator identifies each weight as a tare or gross via keyboard entry. Some systems, utilizing stored tares, allow tare weights to be called up when the scale operator enters the truck number via the keyboard. Regardless, all displayed values must be identified properly and agree as required under G-S.5.2.2. and G-S.5.2.4. Values.

Question 4 **If a mechanical lever system scale is retrofitted with a new full electronic load cell system, is this considered a new installation with all aspects of the installation being reconsidered (retroactive and Nonretroactive) or do the other aspects get grandfather status?**

Answer: This question involves two separate, but related issues.

The first relates to the NTEP policy that applies to scales with Certificates of Conformance (CC). NTEP policy says that if the levers of a scale with a CC are replaced with load cells, the instrument is no longer traceable to the original CC and must undergo additional NTEP testing. The NTETC Weighing Sector has taken the position that replacing <u>any</u> levers of a mechanical weighing element with load cells is a modification of the original type that requires NTEP evaluation. The Sector has also decided that the placement of a load cell in the steelyard rod to change from a mechanical to an electronic indicator is an acceptable modification of type that does <u>not</u> require evaluation for an existing CC to apply; however, the modification option does need to be listed on the NTEP CC.

The second response applies to scales that are <u>not</u> covered under an NTEP CC. For these, the decision regarding the need for type approval of a mechanical scale changed over to full electronic rests with the individual State weights and measures director. When a State adopts the Uniform Regulation for National Type Evaluation in NIST Handbook 130, the director generally establishes policies for how the requirements for NTEP CCs will be implemented. Generally, a State requires that devices installed after a specified date must be covered under an NTEP CC. An NTEP CC is not generally required for devices already in use; however, the director may establish specific policies regarding modifications to devices. For example, some States require that, if an electronic indicator on a scale is replaced with another electronic indicator, the replacement indicator must be covered by an NTEP CC.

A key question that arises in these scenarios is: When are such changes simply routine maintenance and replacement of parts, and when are the changes, in essence, creating a new device? We believe that it is this question that you are asking in the scenario you have posed.

While NTEP policy does not cover scenarios involving non-NTEP devices and the decision rests with the State weights and measures to determine how the devices will be handled, some States use the NTEP policy as a guideline for making an assessment of when a change is significant enough to consider a device different

from the original device. Thus, if NTEP policy were used as a guideline, some States would conclude that the original device in your example has been significantly modified or rebuilt differently from its original design, creating, in essence, a new device. As such, a State might decide to treat the device as a new installation, subject to NTEP requirements and current Handbook 44 requirements. Remember that each scenario has to be carefully evaluated to determine what changes have been made in a system and the impact of those changes on the original design.

Question 5 **Why do some states rule that any old obsolete mechanical scale that has a load cell conversion is a "one of a kind device" and exempt from NTEP Pub. 14 policy? Doesn't that defeat the purpose? I've seen load cells in the steelyard rods on truck and hopper scales and even the levers pulled out and replaced with electronic or hydraulic cells. At what point is the device a new scale and subject to NTEP certification?**

Answer: You are correct that there are variations in how States address modifications to existing equipment with regard to NTEP. The provision in the Uniform Regulation for National Type Evaluation in NIST Handbook 130 for accepting "one-of-a-kind" devices is often misapplied. Some States incorrectly apply the "one-of-a-kind" provision to the scenario described in Question 4 above.

Handbook 130 states that a "one-of-a-kind" device is a non-NTEP device designed to meet unique demands for a specific installation and is a device of a specific *design* which is not commercially available elsewhere. Note that the one-of-a-kind designation also means that the manufacturer produces only one of that device design. Thus, if the manufacturer produced another in that same State or in another State, the device is no longer considered one-of-a-kind.

The device created in the example above is *not* a one-of-a-kind device since full electronic truck scales are readily available commercially.

If the State determines that a device is, in fact, a one-of-a-kind device, the State director "may accept the design of a one-of-a-kind device without an NTEP evaluation pending inspection and performance testing to satisfy that the device complies with Handbook 44 and is capable of performing within the Handbook 44 requirements for a reasonable period of time under normal conditions of use. Indicators and load cells in all "one-of-a-kind" scale installations must also have an active NTEP CC as evidence that the system meets the influence factor requirements of Handbook 44."

With regard to the question of when a device is considered a "new" device, see Question 4 above.

Question 6 **We currently use our weight truck to conduct the shift test and do not own any weight carts. Is there a consensus regarding equipment use for shift tests of a vehicle scale? Our test truck has a very short wheelbase and we have rejected scales immediately after they were adjusted using weight carts. Our rear axles will weigh more than the typical weight cart. Our thought has always been that a vehicle scale is designed to weigh trucks and not weight carts. The added weight will also show deflection in the deck if the metal is getting weak.**

Answer: Your state's experience in using a truck to conduct shift tests probably differs from what others have reported over the years. Scale service agencies used to use their trucks to do shift-test but that practice usually involved the use of specially built short wheelbase weight trucks. Today, most service agencies and Officials have turned to calibrated weight carts as the preferred test equipment. Weight carts have been used by Officials for more than 70 years. However, jurisdictions have to do the best job they can with their equipment and each state has the authority to define how it does a test.

Motor trucks cannot be used to conduct section tests under N.1.3. Shift Test in the Scales code of NIST Handbook 44 for several reasons. These include the fact that vehicles are not "calibrated" mass standards and their accuracy cannot be maintained in conformance with Section 3. Testing Apparatus under the Fundamental Consideration of the handbook (See N.2. Verification (Testing) Standards.) Nor are motor trucks suitable for applying the concentrated load within the prescribed test pattern because part of the truck is always on another section of the scale. While the rear tandems are sitting on one section the weight of the front axle is being measured by another section of the scale so it would be difficult to apply the agreement of indication requirements in T.N.4.4 Shift or Section Tests.

Over the past few years, there has been a large increase in the number of states and service agencies using gasoline or electrical powered weight carts to test and calibrate vehicle and axle-load scales. One main benefit of the weight cart in the testing of these types of scales is that their use allows a large amount of known mass to be concentrated over a relatively small area of load receiving element. As a result, individual load bearing points can be tested and calibrated providing improved consistency in weighing regardless of where the load is placed on the platform. Additional benefits of the carts are ease of use and increased speed in the testing process.

NIST is in the process of finalizing a NIST handbook, Handbook 105-8, which includes specifications, tolerances, and design considerations for weight carts.

Question 7 **How do other states handle the issue of NTEP? Are NTEP inspections being done on these devices and or the components, i.e. load cells? Are CC's ever checked or is this something which would not be done in the field?**

Answer: We have not done any formal studies or surveys to assess how the majority of States implement NTEP; however, from our experience, we believe the issue of inspecting CC's and verifying NTEP certification varies widely among the states. If you are in

an NTEP jurisdiction, the CC should be carefully reviewed and compared with the device being inspected; this is particularly relevant for initial inspections of new devices. In some cases, inspectors have access to copies of the CCs at the site or through the Internet. In other cases, inspectors must contact their main offices and ask office personnel to read information from the CC. In states with a device registration program, administrative or office personnel sometimes verify that the device is traceable to an NTEP CC as new installations are being reported to the agency for compliance with device registration.

Field verification and oversight are key elements of an NTEP program. Remember that an NTEP CC is not a guarantee that the specific device you are inspecting complies with Handbook 44. You should carefully examine the device and its features and options to ensure that it is consistent with the device evaluated by NTEP, while realizing that there are some tests such as temperature testing that cannot realistically be conducted in a field environment. An NTEP CC may list a number of features, options, and setup parameters that are included on the CC based upon the evaluation conducted by NTEP. It is essential that you verify the device you are inspecting has been set up and installed consistent with the parameters covered by the CC.

Another aspect of this question has to do with the issue of ensuring that "production meets type." That is, are devices being produced consistent with the device evaluated by NTEP? The NCWM is presently developing a formal program to ensure that production devices are consistent with devices evaluated by NTEP.

Question 8 **Do other jurisdictions conduct scale pit inspections? Should they be conducted or avoided? We have recently looked into the issue of confined spaces and OSHA regulations and found there are some issues there. Is a scale pit and or understructure inspection ever necessary?**

Answer: Yes, regulatory officials are still conducting scale pit inspections. There has been a recent increase in the awareness of safety regulations as they relate to scale pit inspections. There are many good reasons why the scale pit should be included as part of the official inspection process. Some of the more important reasons are as follows:

- Determine proper scale maintenance.
- Determine possible causes of large weighing errors observed in an official test.
- Locate required marking information – load-receiving element or load cells.
- Inspect for fraudulent manipulation of the weighing elements, etc.

Pit/weighing element inspections should be conducted only when all potential hazards have been identified, adequate protective equipment has been obtained, and all necessary safety training completed. Regulatory officials conducting pit inspections should also inquire and adhere to all OSHA regulations and company safety policies in effect at the scale site location.

Question 9 **Why are the tolerance values two times the values specified in T.N. 3.1 and T.N.3.2 for wheel load weighers and portable axle load weighers of Class IIII as specified in T.N.3.3?**

Answer: Wheel load weighers and portable axle load weighers are Class IIII devices used in highway weight enforcement. The provision you referenced was included in the handbook as part of the new scales code in 1986. At that time, the tolerances listed in Table 6 were too restrictive for the wheel load weighers and axle load scales of the time. The expanded tolerances for wheel load weighers and portable axle load weighers were implemented to ensure that the new scales code would not prohibit the continued use of these devices for highway weight enforcement.

The practical needs of the law enforcement community to use weighing devices under less than ideal (for commercial devices) conditions and the desire to effectively enforce the highway weight laws have led to acceptance of larger tolerances for highway weight enforcement purposes. The tolerances for these devices are larger in recognition of the conditions under which the devices are used, the purpose of the application, and the fact that no jurisdiction has the resources to place a full size Class III L scale and weigh station on every highway.

As we will discuss in the vehicle and axle-load scales course, the theory of tolerances is to achieve a level of accuracy that does not cause economic harm to either the buyer or the seller while remaining at a level that enables the device manufacturer to produce the device at a reasonable cost. In this case, the tolerances must be small enough to ensure proper enforcement of highway weight enforcement laws, yet not so small that the effects of the environment in which the devices are used make it unrealistic to manufacture devices to meet the requirements.

Question 10 **Why does U.R.3.3 (Single Draft-Vehicle Weighing) not apply to highway law enforcement scales?**

Answer: NIST Handbook 44 specifically exempts these applications from the requirement because the primary goal of highway weight law enforcement is to control axle weights in order to protect highway surfaces and bridges from damage. While gross weight is a factor it is the individual axle loads that must be controlled as a truck can be legally within the gross weight load limit and still have axle weights that can seriously damage roads. As stated above, portability and cost are the also factors as no jurisdiction has the resources to place a full size Class IIIL scale and weigh station on every highway.

In addition to the higher tolerances applicable to these scales, enforcement personnel, prior to the issuance of over weight citations, typically grant special allowances and most state laws provide for those allowances. We also understand that many law enforcement agencies will offer a trucker the opportunity to drive the truck to a permanently installed vehicle scale to have the weights confirmed prior to issuing a citation.

The accuracy of weights obtained from split-draft weighing has been argued for many years. It is accepted that split-draft weighing has the potential to result in weighing errors that exceed the scale tolerances applicable to vehicle scales used for commercial transactions. The maintenance tolerance for vehicle scales used commercially is effectively 0.2 percent of the applied test load. Due to the potential errors, split-draft weighing is not permitted for commercial applications. However, the practical needs of the law enforcement community and the desire to effectively enforce the highway weight laws have led to acceptance of split-draft weighing for this purpose.

The accuracy of weights obtained by split-draft weighing depends upon many factors, including the accuracy of the scale, the shifting of the load on the truck as the truck goes onto the scale, the extent to which the scales are level when being used, the setting of the truck brakes during the weighing process, the care used in the weighing process, and the truck suspension system. The limited amount of testing to date indicates that, although there is significant potential for weighing errors in split-draft weighing, the actual errors tend to be distributed in a manner where most are "relatively" small, but occasionally rather significant weighing errors occur. Studies of the magnitude of weighing errors from split-draft weighing has been limited, but they have convinced the weights and measures community that split-draft weighing is not sufficiently accurate for commercial purposes. When this issue was last reviewed by the NCWM, split-draft weighing was considered sufficiently accurate for law enforcement purposes when all factors were considered. The appropriateness of split-draft weighing for law enforcement and its associated accuracy are still often questioned.

Question 11 Does UR.2.6.2 (Axle-Load Scales Approaches) also apply to portable axle-load weighers?

Answer: No. UR. 2.6.2. does not apply to portable axle-load scales; the handbook defines an axle load scale as a one that is "permanently installed in a fixed location." However, note that UR. 3.4.2 Level Condition requires vehicles weighed on portable axle load scales to be "in a reasonably level position at the time of such determination."

Question 12 Why are wheel load weighers and portable axle load weighers exempt from the shift test under N.1.3.8?

Answer: Wheel load weighers and portable axle load weighers are typically excluded from shift test requirements because there is a physical limitation of the size of the load receiving element. This limitation in size prevents an adequate test load from being loaded onto each shift test position.

Question 13 What is the definition of a "reasonably level position" as described in paragraph U.R.3.4.2. in NIST Handbook 44?

Answer: The application of this paragraph requires you to use your knowledge of good weighing practices, and the condition must be determined on a case-by-case basis.

The note included in Paragraph S.2.4. requires portable wheel-load weighers and portable axle-load scales to be accurate when placed out of level up to and including 5 percent (approximately 3 degrees) so this offsets some of the concern over the exact level of the weighing site. Remember that most highways are designed to drain water so a perfectly level location may not be readily available for the weight enforcement officer to use. However, if the scale is placed on a solid - "reasonably" level surface it should provide a good weighing result.

Question 14 Should I reject a scale on a strain load test if the range in the vehicle's weight alone (not the error between empty and loaded) is more than the applicable tolerance, and there are no other failing errors in the remainder of the test?

Answer: We don't understand the use of the term "range." Under what circumstances is a range in the vehicle's weight being observed? When conducting a strain load test, the tolerance is applied only to the known weight of the load.

Question 15 When a test load or vehicle is removed from a scale, if any value remains (whether positive or negative) and that amount slowly returns to zero, is this scale failing the zero load test? In other words, is there a time allowance for the scale to return to zero after a load is removed? Some scale technicians say that it is the characteristic of a particular make of instrument to be slow returning to zero, is this true?

Answer: Handbook 44 does not specify a time limit for the return to zero. It is true that some scales will return to zero more slowly than others. For example, digital indicators update their indications at varying rates that, in many instruments, can be changed to suit the installation. Assuming the question pertains to a scale with a digital indicator, a possible remedy may be simply for a service technician to increase the update frequency of the indicator, which may speed the return to zero. The slow return to zero is permissible providing that under routine normal use, the scale is returning to zero each time a load is removed and before the next vehicle is weighed. See also paragraph UR. 4.1. Balance Condition, which requires the user to maintain the scale in a zero balance condition with no load on the scale.

Question 16 Is there a need to perform a strain load test on in-line multiple platform scales such as the CAT scales?

Answer: Each scale should be tested to at least the used capacity. If insufficient known test weights are available for this purpose, it may be necessary to use substitution and/or strain load test methods.

Question 17 Should two vehicle scales that are installed at the same business location (an inbound and outbound for instance) agree to within applicable tolerance of each other? For example, if 80 lb is the maximum permissible error and one scale indicated + 80 lb and the other indicated – 80 lb, could both scales be rejected because of the deviation in the two?

Answer: No. Tolerances are applied separately to each individual scale. However, if you suspect they are being intentionally adjusted to take advantage of the tolerances consider applying G-UR.4.1. Maintenance of Equipment.

Question 18 For scales with an Automatic Zero Setting Mechanism (AZSM), should the AZSM be turned off prior to conducting an official test if it can be easily done?

Answer: It is not necessary to turn off AZSM to conduct a routine test, but it can be turned off at the discretion of the inspector. However, if the scale is normally used with the AZSM on it should be tested with the AZSM activated. It is acceptable to test with the AZSM in either the "on" or "off" position. Effective January 1, 2001, NIST Handbook 44, Scales Code, Paragraph S.2.1.3.1. (Added 1999) requires Class III L devices equipped with AZSM to be designed with a sealable means to allow AZSM to be disabled during the inspection and test of the device.

Question 19 Are side-to-side tests necessary and if so, how frequently should they be performed?

Answer: An off-center (side-to-side) shift test should be conducted on all vehicle and axle-load scales. Adhere to the prescribed test patterns and maximum loads specified in N.1.3.4. (Shift Test) when conducting this test.

Question 20 Besides looking for binding between pit wall and deck, cracks in decks, foreign objects and dirt buildups underneath the deck, what other inspections should be done routinely?

Answer: In addition to verifying compliance with other Handbook requirements such as device specifications and suitability, the inspection phase of an examination is concerned with the physical characteristics and condition of a device and how it is installed, maintained, and used. We will also cover this aspect of inspection in class.

Question 21 If a mechanical scale's levers appear to be out of plumb or anything else appearing to be not level to the naked eye, are there grounds (specifications in Handbook 44) to condemn the scale or have it re-installed?

Answer: To operate properly, the lever systems of mechanical scales must be installed so they are plumb, square, and level. Since these elements are typically specified by instrument manufacturers, G-UR.2.1. Installation would apply. You should confirm the problem using a suitable level (there are leveling lugs on most levers) and take appropriate action based on the results.