STP-30 MECHANICAL SCALES

REFERENCE
Non-Automatic Weighing Devices Specifications.

GENERAL

Although mechanical non-automatic weighing devices are covered by all relevant Standard Test Procedures (STP's) in the Non-Automatic Weighing Device (NAWDS), Field Inspection Manual (FIM), certain mechanical weighing devices may require additional specific tests not otherwise covered in the FIM. These tests are outlined in this STP for reference as required.

Mechanical scales may be fitted with electronic or mechanical indicators. Electronic indicators are covered in other STP's and will not be addressed in this procedure. Mechanical indicators may be broadly grouped into two distinct types - self indicating and non-self indicating types. These should not be confused with Automatic and Non-Automatic weighing devices.

1.0 **Weighbeam** (non automatic indicating)

A mechanical lever scale may be fitted with a *weighbeam* to counterbalance the force generated through the lever system. Each weighbeam will be equipped with a *counterpoise* which is moved along the beam to counterbalance the weighbeam and bring it into an equilibrium or balance condition. Weighbeams equipped with more than one beam and poise are referred to as *compound beams*. The balance condition is usually indicated by the alignment of two points, one on the weighbeam, the other on, or near, the *trig loop*. At this point, the corresponding weight may be read from the scale(s) on the weighbeam. In the case of compound weighbeams, the weight indicated on each is read and then summed to find the total weight. The graphic is intended to be representative of a typical weighbeam only. Not all weighbeams will have all features shown.

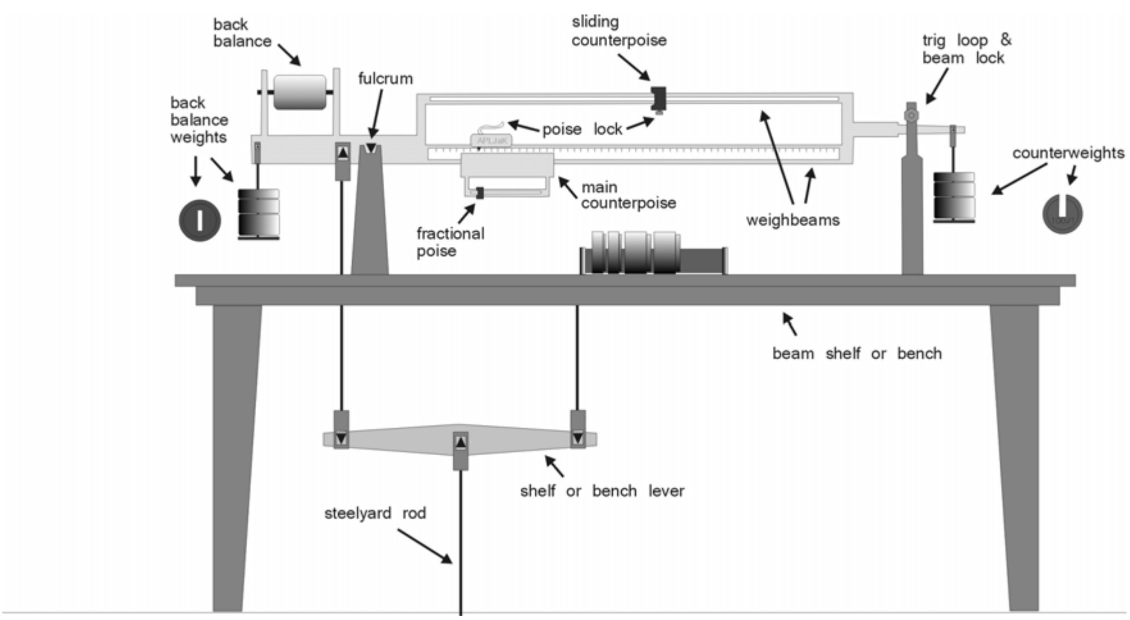

Figure 1 - Compound Weighbeam

STP-30 MECHANICAL SCALES

1.1 Zero Balance / Back Balance

Scales equipped with weighbeams may be zeroed before use by several different methods. The most common is a back balance zero adjustment. This is a weight located on the end of the beam opposite of the counterpoise(s). This back balance weight is usually operated by a detachable tool (screwdriver, etc.) and is used to set the initial zero balance condition of the beam. It should not be adjusted while weighing is in progress.

Other means of setting initial zero balance include weights located on either end of the beam. Often, the counterweight hanger will include a zero balance weight. In some cases, there is also a hanging weight on the opposite end of the beam. In both cases, these weights must be securely attached or enclosed so that they cannot be changed while weighing is in progress. Removable open slotted ratio weights, commonly used as counterweights, are not acceptable for use as zero balance weight.

Procedure

Unlock the weighbeam. Adjust the zero balance weights until the weighbeam reaches an equilibrium or balance condition in the center of the trig loop. Relock the weighbeam. Unlock the weighbeam a second time and ensure that the beam again returns to a zero balance condition. Ensure that all material used as zero balance weight is totally enclosed inside a compartment or otherwise not easily removed from the beam. Ensure that the zero back balance adjustment may only be operated by a removable tool and that the zero balance condition may not be readily altered while weighing.

Note, trig loops will sometimes become magnetized causing steel weighbeams to stick. In these cases, the weighbeam may have to be freed by hand. In these cases, the trig loop may need to be demagnetized. This is not a problem with non-ferrous weighbeams.

Always relock the beam before adding or subtracting a significant load from the load receiving element.

1.2 Beam Ratios

Weighbeams and counterpoises must be properly configured for the designed multiplication ratio. When inspecting the scale, the inspector shall verify that the ratio of the scale has been set properly.

Procedure

Begin by zeroing the scale with no load on the load receiving element. This is done using a combination of back balance weights, adjustable back balance and adding or removing weight from the counterweight hanger.

Using known test standards representative of the scale ratio, place a load on the load receiving element and the corresponding load on the counterweight hanger. For example, a 100:1 platform scale should have 100 kg of standards placed on the load receiving elements and a 1 kg standard set on the counterweight hanger. With all the counterpoises set and locked at zero, the beam should indicate a balanced condition. If it does not, then the main scale ratio is not set correctly. All subsequent testing will be problematic. It is recommended that the standards chosen for this test are equivalent to the standard ratio of one of the poise weights. This will facilitate conducting the subsequent tests.

1.3 Counterpoise

Once the correct beam ratio has been confirmed, the counterpoise(s) may be tested.

Weighbeams will be equipped with at least one and sometimes several counterpoises. Sliding counterpoises must be adjusted appropriately for the weighbeam they are to be used with. Counterpoises are sealed at out the time of manufacture. Any subsequent changes to the counterpoise weight will result in erroneous measurements. Counterpoises may be equipped with some form of locking device. These include lock pawls, lock screws, etc. Parts added to or taken away from the counterpoise may result in erroneous measurement on the scale.

Procedure

Visually examine the counterpoise to ensure that it is properly assembled and any fasteners used to assemble it are tight. The counterpoise lock (screw or handle), if equipped, must be of a factory design and must not be removable. If the counterpoise lock screw has been replaced with a generic bolt/screw, the scale will likely not be weighing properly. After the ratio of the device has been confirmed, a load equivalent to the capacity of the lowest capacity beam may be placed on the load receiving element and, with the other counterpoises locked at zero, the appropriate counterpoise moved to this capacity. The beam should again indicate a balanced condition. Return this counterpoise to zero and ensure it is locked. Move each of the other counterpoises to the appropriate capacity indication and ensure that the beam balances. Once this has been done, increase the load on the device to the maximum capacity of the next beam and repeat the test. Continue until all beams have been tested.

Many large capacity beams will have a *fractional poise* incorporated into the main counterpoise. This fractional poise is intended to allow more precise readings within the larger divisions of the main counterpoise. The fractional poise must be tested using known weight on the load receiving element. Always ensure the fractional poise is returned to zero before continuing with testing of the main counterpoise.

Sliding counterpoises may be equipped with a locking screw, a ratchet stop or other means to hold the counterpoise in the desired location. In all cases, ensure that the sliding counterpoise can be securely located at the intended reading on the beam. The locking mechanism should hold the counterpoise firmly. If the beam is equipped with notches to locate the counterpoise, these notches should be in good condition and not overly worn.

1.4 Counter Weights or Ratio Weights

Weighbeams will often be equipped with counterweights used to increase the overall capacity of the beam. It is important that the ratio of these weights as well as the actual weight is correct for the device they are to be used with.

Procedure

The first thing to check is that the correct counterweights are with the scale. Either the beam ratio or the apparent and actual weights will be marked on the counterweights. If the ratio is not specified, it may be calculated as apparent weight/actual weight. Typical ratios are 100:1, 40:1, etc. Counterweights which are not designed for use with the scale (i.e. wrong ratio) should be removed from the device. Scales commonly referred to as “union scales” will have counterweights with two apparent weights. The two ratios reflect the apparent weight for either the scale pan or the platform.

STP-30 MECHANICAL SCALES

Counterweights are usually adjustable and will contain one or more adjusting holes, each of which must contain adjusting lead. They may also contain one or more weight reducing holes. The adjustment should be made using a suitable scale or balance (see STP-29).

Using known test standards representative of the scale ratio, place a load on the load receiving element and the corresponding load on the counterweight hanger. For example, a 100:1 platform scale should have 100 kg of standards placed on the load receiving elements and a 1 kg standard set on the hanger. With the counterpoise(s) set and locked at zero, the beam should indicate a balanced condition. If it does not, then the main beam ratio is not set correctly (see above). Next, remove the 1 kg standard from the counterweight hanger and replace it with the 100:1 counterweight. The beam should again come into a balanced condition. In no case should the counterweight be adjusted to compensate for an incorrectly set beam ratio. Counterweights should not be adjusted on the scale being tested (see STP-29).

Repeat the test with each of the other counterweights. Note that it may not be possible to apply a sufficient amount of known standards to the weight hanger for the larger counterweights. Since the ratio of the device has already been established, this step is not necessary for all counterweights.

Note: The beam should always be locked when loading or unloading the scale.

1.5 Type Register Printer

Many larger weighbeams were equipped with *type register printers*. If still in use, these printers should be checked during an inspection. The printer should be checked for accuracy at several locations along the length of the beam.

Procedure

Locate the counterpoise at the desired position on the beam. Place a ticket into the printer and firmly squeeze the print handle. Release the handle and remove the ticket. The value printed on the ticket should correspond to the location of the poise on the beam. The scale need not be loaded for this test.

STP-30 MECHANICAL SCALES

2.0 DIAL , DRUM & FAN (self-indicating)

A mechanical lever scale may be fitted with a *dial (drum or fan)* to counterbalance the force generated through the lever system. The dial may be equipped with a tare beam, a capacity beam and/or drop weights (unit weights). The dial is considered to be self indicating as no operator intervention is required to read the weight indication. However, if the capacity beam or drop weights are used, these weights must be added to the dial indication to read the total weight. If a tare beam is used, the total will be Net weight as the tare weight of the container will have been balanced off using the tare beam before a weight is read. Tare beams are not intended to re-zero an unloaded scale. The graphic is intended to be representative of a typical dial indicator only. Not all dials will have all features shown.

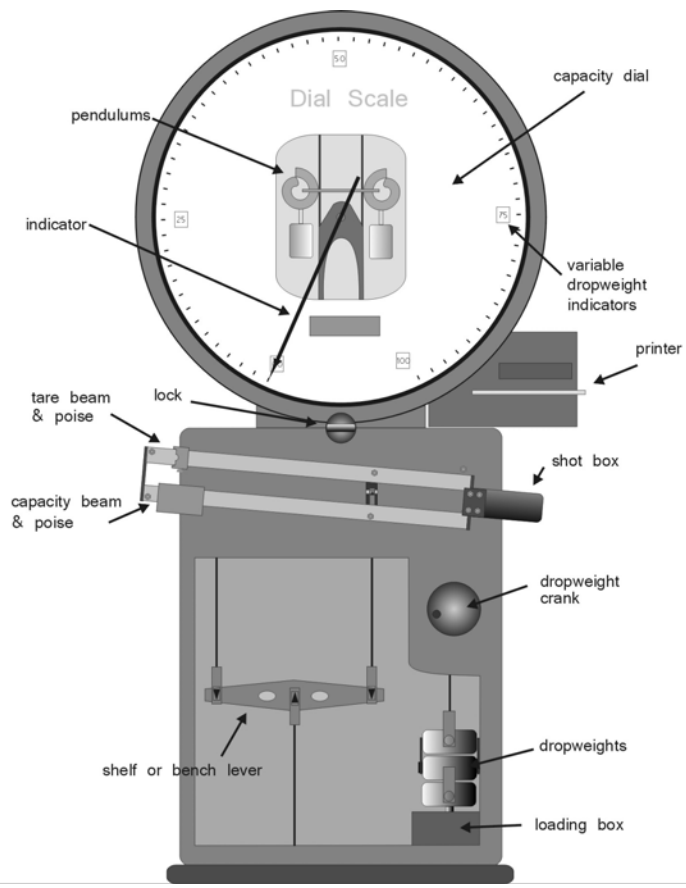

Figure 2 - Cabinet Dial

2.1 Zero Balance

There are several methods for zeroing a self-indicating scale. Coarse zero on a dial is set using the shot box and the loading box. Operator zero is usually in the form of a screw accessible through the dial cabinet. It will typically be covered with a small cover plate which swings aside to allow access. Turning the screw will re-zero the scale.

Coarse zero on a fan scale is accomplished by adjusting the load in the shot box, typically located under the scale platter. Fine zero on some devices may be available through an external user zero screw, often through the scale cabinet.

2.2 Dial Capacity

The dial capacity should be tested using test standards on hand. The dial must be tested from 0 to dial capacity. Whenever loading or unloading a large capacity dial scale, the dial lock should be engaged to prevent damage to the mechanism. Special attention should be paid to testing the dial at the “quarters”.

2.3 Testing Quarters

Pendulum counterbalanced dial scales are designed so that, in addition to the overall ratio of the scale understructure, the dial itself may be adjusted at each of the four quarters or quadrants. These adjustments are relatively independent of one another.

Procedure

In addition to all other tests, weights approximately equivalent to 25%, 50%, 75% and 100% of the dial capacity shall be used to check the quarter adjustments of a dial scale.

2.4 Tare & Capacity Beams

Tare beams (usually unmarked) and capacity beams (marked) are weighbeams equipped with sliding poises commonly found on self indicating dial scales. Tare beams are provided for taring off loads before a Net weight is determined on the scale. Capacity beams are provided to periodically increase the weighing capacity of the dial scale. Both beams have an affect on the overall capacity of the device and therefore must be tested.

Procedure

Tare beams without markings are used to zero off (tare) a containers weight. The container is placed on the scale and the tare beam counterpoise is moved along the beam until the dial indicates zero. The counterpoise is then locked at this point. As the beam is generally unmarked, the tare weight is unknown.

Capacity beams will be marked with additional scale capacity, although usually only a few very large divisions (equivalent to the dial capacity or a fraction thereof). These should be tested as per a weighbeam scale. That is, a load equivalent to the maximum capacity of the tare beam shall be applied to the load receiving element and the poise moved to indicate the same load. The dial shall indicate zero load. This test may be conducted at anytime while testing the device. In all cases, the indicated weight on the dial shall be equal to the actual load on the load receiving element, minus the value indicated by the tare beam.

As both beams increase the effective overall capacity of the scale, the scale must be tested with both beams in use. Sufficient capacity is to be added to the load receiving element so that both the Tare and Capacity beams (if so equipped) are in full use. The remaining dial capacity is then tested. The additional load compensated for by the tare and capacity beams should be left on the device during this testing.

2.5 Drop Weights

Large capacity dial scales may be equipped with drop weights (sometimes referred to as unit weights) to increase the overall capacity of the scale. Each of these drop weights must be properly calibrated to ensure that the second and subsequent ranges are set appropriately for the device. Drop weights will be added to the loading box, one at a time to increase the capacity of the dial. Drop weights are usually configured to be equal to the total range of the dial. That is, adding one drop weight will increase the weighing capacity of the device by an amount equal to the dial capacity. In most cases, the weight indications on the dial will increment to correspond to the number of drop weights added.

Procedure

Starting in the first range (no drop weights), load the device to 100% of the dial capacity. Note any error. Leaving the load on the scale, engage the first set of drop weights. The variable drop weight capacity indicators, if equipped, should change to reflect the new capacity of the device. The dial pointer should return to the start of the dial. Test the entire range of the dial again. Repeat for each set of drop weights.

Dials and lever ratios should not be adjusted while drop weights are in use. Doing so will introduce an error into the first range (no drop weights) of the device.

2.6 Printers

Although not common, some dial scales were equipped with mechanical printers. If still in use, these must be tested during inspection of the device.

Procedure

A weight ticket is to be inserted into the printer and a print initiated. The printed ticket must show the same weight as is displayed on the dial. This test must be repeated several times during the inspection with particular attention paid to printing when drop weights have been introduced. These printers will not usually include units or other information. All other required information must be preprinted on the weight tickets.

2.7 One Spot Indicators

Some dial scales are unique in that instead of a weight indication being given through the use of a moveable pointer, the entire weight chart turns in relation to the load applied. These devices will have the chart completely covered except for a small weight indication window. The weight is read off of the chart through this window. Typically, several weight divisions will be visible, with the actual weight indicated by a hairline indicator or a pointer. Previous tests apply as appropriate.

2.8 Fan Scales

Fan scales are similar to dial scales except that the pointer moves through an arc indicating from zero to full capacity. These indicators are usually seen on lower capacity devices. Fan Scales may be simply weight indicating or the fan may include computing charts. Some scales typically referred to as “check weighers” may include a fan that merely indicates over or under the target weight. In this case, the fan is not graduated with actual weight values. Previous tests apply as appropriate.

Additional Procedures

Conduct a visual examination to see if the pointer is bent near the fulcrum or pivot point. The pointer will appear to be skewed to the chart if it is bent. This is most noticeable on fan scales with hairline indicators and computing charts. Check that the scale returns to zero indication. Scales with bent pointers have been found readjusted to indicate zero rather than repairing or replacing the bent pointer. These scales will often not have enough range to indicate full scale capacity. This can be tested by placing full scale capacity on the load receiving element and ensuring that the scale indicates correctly.

Ensure that the hairline indicator is intact. Load the device and check the computing charts if equipped.

2.9 Drum Scales

Drum Scales use a preprinted horizontally mounted drum to display weights. Often, these drums are also printed with price computing information. The weight is displayed through a window and the price computations are read across the drum, usually with the assistance of a hairline indicator. Previous tests apply as appropriate.

Additional Procedures

Check that the drum revolves through its entire range smoothly and without binding. Look for dents in the drum which will result in erroneous readings. Ensure that the hairline indicator is intact and mounted horizontally across the drum.

3.0 MISCELLANEOUS

3.1 Multiple indicating methods

Many mechanical scales use a combination of indicators. This may include beams in conjunction with dials or fans. Counterweights and trade weights may also be encountered. All means of indication should be tested both independently and again in conjunction with each other to ensure accuracy.

Many self-indicating devices will have two side displays. If so equipped, the inspector must ensure that both indications are in agreement. Unlike an electronic indicating element, mechanical indicating elements are often not in agreement with each other.

Weighbeams must be visually examined to ensure that the markings are correct and legible. Weighbeams must be straight and true.

3.2 Electro-Mechanical indicating

Although no longer common, some mechanical scales were equipped with both a mechanical indicator and an electronic indicator. In these cases, the operation of the latter must be inhibited during use of the former. This is often accomplished through the use of a micro-switch on the trig loop of a weighbeam.

3.3 Dampening (Dash-pots)

Most dial and fan scales and some weighbeam scales incorporate a method for dampening the movement of the indicator. In many cases, this is a liquid (commonly oil) filled *dashpot*. Do not tilt or invert a device containing an oil filled dashpot or the oil will be spilled. Empty or dry dashpots will result in an oscillating indication which takes a long time to settle out at a reading. Sticky dashpots sometimes occur when the oil has hardened in the dashpot. This will result in an indicator which does not move freely and will almost certainly result in erroneous readings. There are also other dampening devices in use including magnetic dampeners. In all cases, the dampening device must be checked to ensure it is functioning correctly and is not causing the scale to bind which could result in an incorrect indication.

3.4 Pivots and Bearings

Scales which utilize pivots and bearings are often found with broken or missing parts. These should be visibly checked during the inspection to ensure that they are intact and appropriate for the device in question. Scales commonly known as *Union Scales* will often be found missing the bearing loops from the lower weighing element. Replacements for these bearing loops can be hard to find and there will often be homemade replacements installed. These bearings must be properly sized and hardened to ensure the device works properly. Improperly made bearings are not suitable and will often fail on a eccentricity testing. Pivot and bearing failure can be catastrophic and care must be taken to ensure that the load will remain stable should a part fail during testing.

Pivots will often be equipped with anti-friction plates to prevent lateral motion of the pivot on the bearing. These plates must be present and in good shape.

In an effort to incorporate a self checking pivot system, some manufacturers have used ball bearing style pivots. These bearings are captured in hardened cups. The arraignment allows for a controlled amount of lateral motion with an automatic return to a central or neutral position. The inspector must ensure that each of these balls is still present and in good condition.

Check links must be present and not causing binding of the load receiving element. Check links which are not free need adjustment. They must not simply be removed.

3.5 Counterpoise or ratio weights

Counterpoise (ratio) weights of the wrong ratio for the device are a common problem. When checking the ratio weights for general condition and to ensure that all adjusting lead is still intact, also note the ratio and ensure that it is appropriate for the device being tested. Ratio weights of the incorrect ratio for the device will cause significant measurement errors. These should be noted on the inspection certificate and removed from the device.

3.6 Beam and dial locks

Always lock a beam or dial scale when adding or subtracting a significant load from the load receiving element. Failure to do so can cause damage to the device. Unlock the beam or dial slowly and only after ensuring that the settings are correct for the load to be weighed. This will ensure that the indicator does not slam into a stop with undue force.

STP-30 MECHANICAL SCALES

3.7 Levers

Lever scales utilize a system of levers mounted on pivots and bearings. There are several different lever trains in common use. In each case, a visible inspection must be made to ensure that all levers are in relative alignment with one another and that there is no possibility of binding while in use. Unlike fully electronic scales, there is an appreciable amount of relative movement of parts in a lever scale.

3.8 Mounting and installation

Weighbeams and dials used on high capacity scales must be securely mounted to a rigid base. They are often affixed to the floor of a scale house. Any relative movement of the scale house floor, in the area of the indicating element mounting, will result in incorrect or non-repeatable indications from the indicating element during use.

3.9 Scale decks (load receiving elements)

Wooden decked scales must be inspected carefully before testing begins. Wooden decks may have deteriorated to the point that they can no longer safely support a test load. This deterioration is not always immediately obvious. Vehicle scales with wooden decks will usually be equipped with longitudinal planking designed to support the tires of the vehicle. This planking is supported by the main frame members of the load receiving element and is therefore where the scale should be loaded. In no case should a vehicle be driven off of these planks onto the transversely mounted timbers.

REVISION

Original