# REVISED VERIFICATION MANUAL OF ELECTRONIC WEIGHBRIDGES.

1. **DEFINITIONS.**

**1.1 Weighbridge:**

A weigh-bridge is a weighing instrument with

- compound levers (mechanical types) or,
- load cells (electronic types)

and an indicator system.

The indicator is separated from the lever (or load cell) system and weighs loads of 1 tonne or above.

**1.2 Verification scale interval, *e***

Value, expressed in units of mass, used for the classification and verification of an instrument.

**1.3 Actual scale interval, *d***

Value, expressed in units of mass of:

- the difference between the values corresponding to two consecutive scale marks, for analog indication; or
- the difference between two consecutive indicated values, for digital indication.

**1.4 Number of verification scale intervals, *n***

Quotient of the maximum capacity and the verification scale interval:

$n = \text{Max} / e$

**1.5 Maximum capacity (Max)**

Maximum weighing capacity, not taking into account the additive tare capacity.

**1.6 Minimum capacity (Min)**

Value of the load below which the weighing results may be subject to an excessive relative error

**1.7 Maximum permissible error (MPE)**

Maximum difference, positive or negative, allowed by regulation between the indication of an instrument and the corresponding true value, as determined by reference standard masses or standard weights, with the instrument being at zero at no-load, in the reference position.

**1.8 Load Cell**

A load cell is an electronic device (transducer) that is used to convert the gravitational force into an electrical signal. Through a mechanical arrangement, the force deforms a strain gauge. The strain gauge converts the deformation (strain) to electrical signals.

## 2. Classification of Weighbridge.

In most cases, weighbridges are in accuracy class III

**2.1 Identification of Weighbridges:**

Identification of Weighbridges based on the following table.

**Table 1**

| Class | *e* value in g | Verification Scale Interval n = max/*e* | min capacity (g) |
|---|---|---|---|
| III | 0.1 to 2<br>5 or above | 100 to 10 000<br>500 to 10 000 | 20*e*<br>20*e* |
| IIII | 5 or above | 100 to 1000 | 10*e* |

- Check if declared, *e* value matches with the accuracy class
- Find n = max/*e* and check whether it matches with the accuracy class
- Check whether min value matches with the accuracy class
- Some instruments do not declare minimum capacity. Calculate the minimum capacity from the table and check whether the instrument can measure below that quantity

## 3. Metrological requirements

- All Weighbridges should pass the test under normal conditions.
- Once Weighbridges fail in a test, it is no use carrying out any further test.
- Accuracy classes
- Verification scale interval, *e*
- Actual scale interval, *d*
- Sealing/stamping mechanisms.

**NOTE:** Sealing mechanism shall be provided on head work and junction box where junction box is analogue.

## 4. Testing Procedures for Electronic Weighbridge.

### 4.1 Visual examination

All Weighbridges shall have a permanently fixed/engrooved descriptive plate with marking:

- Manufacture`s mark and model
- Accuracy class
- Verification scale interval, *e*
- scale interval, d (when d < *e*)
- maximum capacity (max)
- minimum capacity (min)

4.1.1 All weighbridges shall be:-

- visually inspect clearances around weigh-bridge.
- visually inspect weigh-bridge steel components for corrosion, cracks, and broken bolts.
- visually inspect condition of weigh-bridge deck.
- having adequate drainage system.
- Having free movement of the deck.
- Having strong lightening protection.

### 4.1.2 Construction

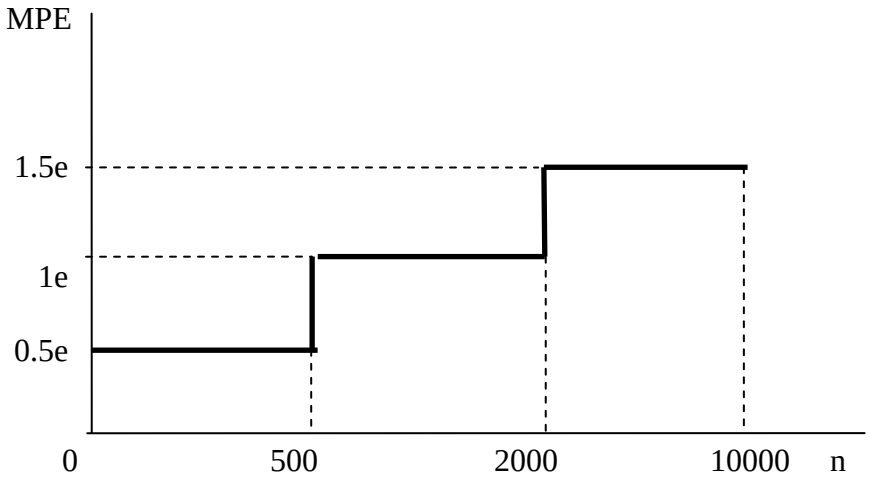
- The weighing deck shall be plain or , rigid and sufficiently strong for carrying maximum load.
- The load cells shall be arranged both sides in pairs.

**NOTE: Weighbridges Class III, shall be Verified by Standard mass of class M.**

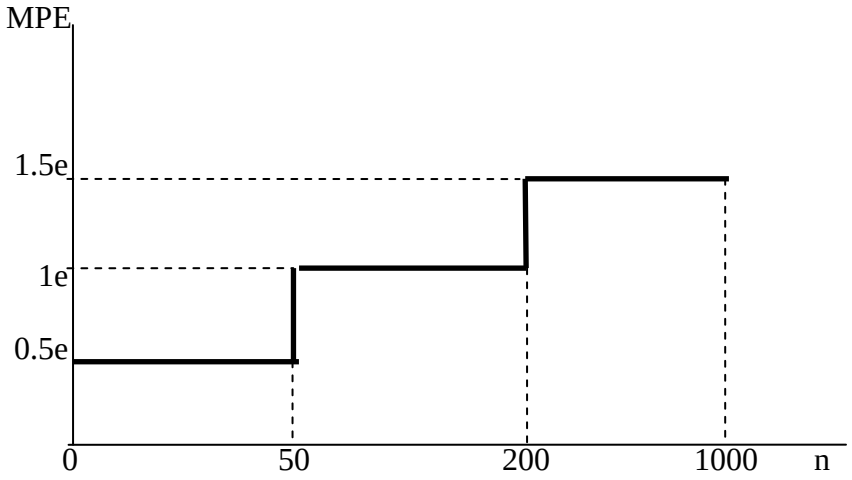
## 4.2 Determination of maximum permissible error (MPE)

In every class of digital scale has MPEs which correspond to number of verification scale intervals (*n)*. See the graphs below.

Class III




Class IIII




The above graphs are simplified in Table 2 below

**Table 2: MPEs for initial verification.**

| | Class III | Class IIII | MPE ± |
|---|---|---|---|
| Load in *e* | min to 500 | min to 50 | 0.5*e* |
| Load in *e* | 501 to 2 000 | 51 to 200 | 1*e* |
| Load in *e* | 2 001 to 10 000 | 201 to 1 000 | 1.5*e* |

**NOTE: • MPEs for subsequent verification is twice MPEs for initial verification.**

**• Load in *e is proportional load applied which corresponds to number of verification scale interval(n) and verification scale interval(e).***

From the minimum and maximum value obtained for particular scale, this will show where the scale falls between boundaries of MPE, eg. 0.5*e*, 1*e*, 1.5*e*.

Example: Class III, Max Capacity 80000000g, *e*=10000g

Minimum Capacity = $n_{min} \times e$

Maximum Capacity = $n_{max} \times e$

**When Minimum capacity is not given, refer to Table 1 above for class III which is 20*e*.**

$n_{min}$ = Minimum number of verification scale intervals

$n_{max}$ = Maximum number of verification scale intervals

$$n_{min} = \frac{\text{Min. Capacity}}{e}$$

$$\therefore n_{min} = \frac{20e}{e} = 20 \text{ intervals.}$$

$$n_{max} = \frac{\text{Max. Capacity}}{e}$$

$$= \frac{80000000}{10000}$$

= 8000 intervals

From the graph of class III, our Weighbridge 80000000g(80tonnes) capacity lies between three boundaries as follows.

(i) 20 – 500 (boundary i)
(ii) 501 – 2000 (boundary ii)
(iii)2001 – 8000 (boundary iii)

So the MPE for these 3 boundaries are as follows.
Boundary i: MPE = 0.5*e* = 0.5(10000) = ± 5000g

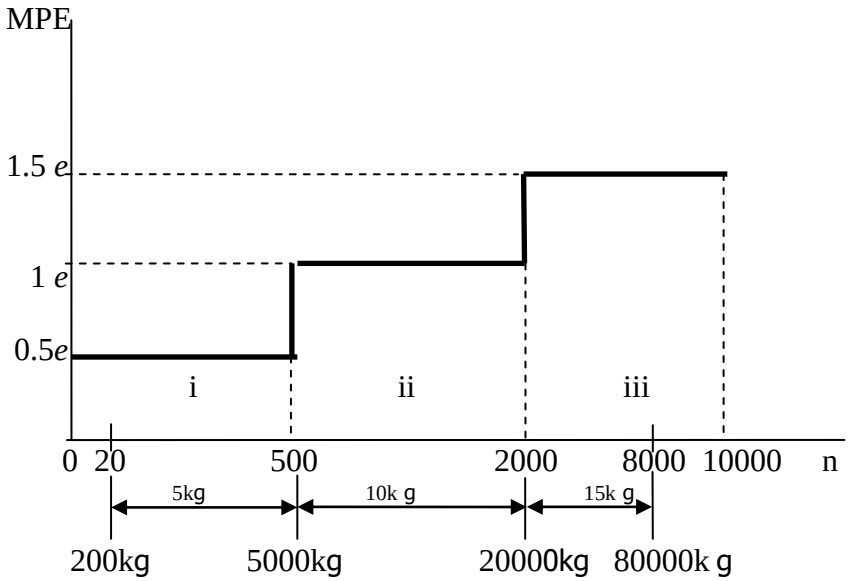
Boundary ii: MPE= 1$e$ = 1(10000) = ± 10000g
Boundary iii: MPE= 1.5$e$ = 1.5(10000) = ± 15000g

Convert the number of scale intervals into Mass (grams) by n×$e$.

∴ $n_1e$ = 20×10000 = 200000g =200kg
$n_2e$ = 500×10000 = 5000000g =5000kg
$n_3e$ = 2000×10000 = 20000000g=20000kg
$n_4e$ = 8000×10000 = 80000000g=80000kg

Graph

Class III




Range intervals with respective MPEs shown in table 3,

**Table 3**

| Range | MPE (kg) |
|---|---|
| 200kg to 5000kg | ±5 |
| >5000kg to 20000kg | ±10 |
| >20000kg to 80000kg | ±15 |

### 4.3 Weighing Performance Test

On carrying out performance test, the Weighbridge must be allowed to warm up, and then loaded with a known mass not exceeding maximum capacity at least three times.

#### 4.3.1 Procedures:

` The weighbridge is tested by loading the standard mass in the following sequence

(i) Loading in ascending order up to maximum capacity
(ii) Unloading in descending order to zero.

(a) Select five different standard mass :

- Minimum capacity of instrument.
- 20% of the maximum capacity of the instrument.

- 40% of the maximum capacity of the instrument.
- 60% of the maximum capacity of the instrument.
- 80% of the maximum capacity of the instrument.

**NOTE: MPE of the Weighbridge must be known according to the class of weighing instrument and standard mass used.**

(b) Determine $E_o$ (error calculated at/or near zero) by putting the smallest standard mass that can just be detected.

(c) Put the selected mass as stipulated in part (a) above in turn on the Weighing deck and note the indications (The same procedure is repeated backwards). On every indication *I* observed above, add smallest standard mass (*ΔL)* that will be sufficient to change readings.

From the above procedure error is calculated by the following formula.

$\boldsymbol{E = I + 1/2\ e - \Delta L - L}$

Now error corrected $E_c$

$\boldsymbol{E_c = E - E_0}$ with $E_0$ = error calculated at or near zero

All results should be recorded in the following table, Arrow indications ↓ and ↑ means forward and backwards respectively.

**Table 4**

| Load, L | Indication, I | | Add Load ΔL | | Error, E | | Corrected error, $E_c$ | | MPE |
|---|---|---|---|---|---|---|---|---|---|
| | ↓ | ↑ | ↓ | ↑ | ↓ | ↑ | ↓ | ↑ | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

In every test if |*E*c| ≤ |MPE|, the Weighbridge ***Passed***

Remarks:……

**4. Eccentricity Test**

The aim of the test is to indicate actual value of load within MPE regardless position of load on weighbridge.

Procedures

- Determination of Load receptor. Check whether the load receptor of instrument has more than four points of supports.

## For example Weigh-bridge, with weighing deck of more than Four Points support.

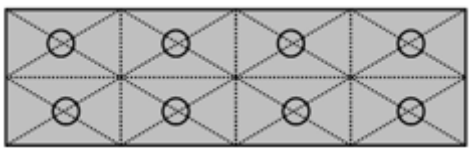


Fig1: Weighing Deck ○ Load position

1. Determine the number of support points (load cell).
2. Divide the weighing deck into **X** approximately equal segments, where X is the number of points of support.
3. Set instrument to zero
4. Apply **1/(X - 1)** Maximum capacity in all marked load position in-turn.
5. Record the load ***(L)*** and indication **(*I*)**
6. In all position add and record smallest mass ***(ΔL)*** that will be detected.
7. Every test, Calculate **E** by using formula $E = I + \frac{1}{2} e - \Delta L - L$ and $E_c = E - E_0$
8. Record the results above in Table 5
9. Repeat steps 3 to 8 at all the other locations in turn for all points of support.

Table 5

| location | Load, L | Indication, I | Add Load ΔL | Error, E | Corrected error, $E_c$ | MPE |
|---|---|---|---|---|---|---|
| | | | | | | |
| 1 | | | | | | |
| | | | | | | |
| 2 | | | | | | |
| | | | | | | |
| 3 | | | | | | |
| | | | | | | |
| *4* | | | | | | |
| | | | | | | |

If $|Ec| \leq |MPE|$, the instrument ***Passed***

The indications for different positions of a load shall meet the MPEs, when the instrument is tested.

**5. Discrimination**

This test is done to check if the weighbridge is capable of sensing a small change in load.

The most weighbridges are in class III or IIII where $e = d$, $e$ is used in the procedure. If the weighbridge to be tested has $d \neq e$ then $e$ becomes $d$ in this instance for the whole procedure.

**Procedure**
Select three different standard mass as stipulated below:

- Minimum capacity of the weighbridge
- Half capacity of the weighbridge
- Maximum capacity of weighbridge /80% of maximum capacity of weighbridge.

Start putting the selected standard mass on the instrument and note the indication ($I$). On every indication ($I_1$) observed above add $1.4d$ and note indication ($I_2$) where d is the actual scale interval which is the difference between the values corresponding to two consecutive indicated values.

In all three tests compute $\boldsymbol{I_2 - I_1}$

Results are recorded in Table 6

Table 6

| Load, L | Indication, $I_1$ | Extra load = 1.4*d* | Indication, $I_2$ | $I_2 - I_1$ |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

Finally, in every tests if $\boldsymbol{I_2 - I_1 \geq d}$ the weighbridge *Passed*

**6. Repeatability**

This test is designed to check whether the instrument gives consistent reading for the same load when the load is placed on the same position on the receptor for a number of times.

**Procedures**

Repeatability test is done at half load of the maximum capacity of weighbridge.

**NOTE**: MPE of the instrument must be known at the particular load.

Start putting selected half load on the instrument for about 5 times and add smallest standard mass ($\Delta L$) that will change the indications

Calculate E by using the formula.

$E = I + \frac{1}{2}e - L - \Delta L$

Record results calculated above in Table 7.

Table 7

| Load | Indication | Add. Load $\Delta L$ | E | MPE |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
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| | | | | |
| | | | | |

Finally in every tests: If $\boldsymbol{E \leq MPE}$ ***and*** $\boldsymbol{E_{max} - E_{min} \leq |MPE|}$ the weighbridge ***Passed***

# TEST FORM FOR WEIGHBRIDGE

**Owner Name and Address……..**

**……**

**Location:.....**

**General Examination:**

**Type……** **Model…….**

**Value of *e*……** **Value of *d*……...**

**Serial Number……** **Last Verification …….**

**Local Identification: .....**

**Sealing Mechanism (Provide/not Provide)……**

**Maximum Capacity ……** **Minimum Capacity……..**

**Visual Examination:**

**(a) ……**

**(b) ……**

**(c) ……**

☐ **Passed** ☐ **Failed**

**WEIGHING PERFOMANCE TEST.**

**Table**

| Load, L | Indication, I | | Add Load ΔL | | Error, E | | Corrected error, $E_c$ | | MPE |
|---|---|---|---|---|---|---|---|---|---|
| | ↓ | ↑ | ↓ | ↑ | ↓ | ↑ | ↓ | ↑ | |
| | | | | | | | | | |
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| | | | | | | | | | |

**Check if $|E_c| \leq |MPE|$** the weighbridge ***Passed***

☐ **Passed** ☐ **Failed**

**Remarks**……

……

ECCENTRICITY TEST

Table

| location | Load, L | Indication, I | Add Load ΔL | Error, E | Corrected error, $E_c$ | MPE |
|---|---|---|---|---|---|---|
| | | | | | | |
| 1 | | | | | | |
| | | | | | | |
| 2 | | | | | | |
| | | | | | | |
| 3 | | | | | | |
| | | | | | | |
| *4* | | | | | | |
| | | | | | | |

**Check if $|E_c| \leq |MPE|$** the weighbridge *Passed*

☐ **Passed** ☐ **Failed**

**Remarks**……

……

**DISCRIMINATION TEST**

Table

| Load, L | Indication, $I_1$ | Extra load = 1.4*d* | Indication, $I_2$ | $I_2 - I_1$ |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

Finally, in every tests if $\boldsymbol{I_2 - I_1 \geq d}$ the weighbridge ***Passed***

☐ **Passed** ☐ **Failed**

**Remarks**……

……

**REPEATABILITY**

Table

| Load | Indication | Add. Load $\Delta L$ | E | MPE |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

Finally in every tests: If $\boldsymbol{E \leq MPE}$ and $\boldsymbol{E_{max} - E_{min} \leq |MPE|}$ the weighbridge ***Passed.***

☐ **Passed** ☐ **Failed**

**Remarks**……

……

Final Remarks:

……

……

……

……

| | | | |
|---|---|---|---|
| Name of Inspector: | …… | Name of Owner/Agent:…….. |
| Signature: | ……..…... | Signature: …… |
| Date: | …… | Date: …….. |