

Engineering White Paper

NON AUTOMATIC WEIGHING INSTRUMENTS PENKO ENGINEERING B.V.



▶ **INTRODUCTION**

This White Paper discusses the challenges, options and solutions for weighing equipment, used in warehouses, distribution centres, by process manufacturers, machine builders, packing industries and in the processing industry.

PURPOSE OF WHITE PAPER

.....is to explain why it is important to determine weights correctly. Whether a non-automatic weighing system is of industrial proportion or simply a small system on shop level, similar challenges regarding accurate mass control apply which have a direct effect on cost and profit margins for the user. Overweight as well as underweight directly influences the action in process. As a result a wrong decision can be taken. So inaccurate weighing results in product spillage, loss of time, delayed shipments, unhappy customers what means profit loss, and may even cause a legislative fallacy .

In addition to such losses, there is the added argumentation of operating inside a quality management system and of international standards and legislations on trade such as for the European region that warrants a scrutinizing view on accurate, fair and proper filling of packages of any size.

The advantages of fast weighing (PENKO instruments weigh at 1600 samples per second) are faster throughput and less spillage, leading to fast ROI.

BACKGROUND ON WEIGHING

Controllers for non-automatic weighing are designed to ensure the exact amount of mass of a product, bulk material or a package, is established. This mass control is found anywhere in any given process or product flow, from the entrance of raw materials up to the shipment of finished products. The International Organization for Legal Metrology (OIML) recommendation R76 dated 2006 outlines the legal requirements, while the NAWI (Non Automatic Weighing Instruments) Directive 2014/31/EC “on the harmonisation of the laws of the Member States relating to the making available on the market of non-automatic weighing instruments” in combination with the standard EN45501 is Europe specific and the NIST Handbook 44, edition 2014, covering scales in chapter 2.20 is relevant to the United States. Apart of where trade, health and law enforcement is concerned there are no legal requirements for internal weighing. Every type of industry has its own quality requirements, supervised by a management system and accordingly controlled by qualified measuring instruments. The ever increasing cost of materials, growing stringent environmental regulations, consistent quality and tracking and traceability, are insisting that industries, warehouses and distribution centres pay more attention to their quality conformity and/or the quality of their services. The basic and most reliable measuring method to warrant all of the above is still defined by weight, regardless of whether the product is a liquid, a solid mass, granulate or powder, and gasses.

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Weight provides, from a chemical point of view, correct data. Each type of molecule has its own specific mass. So by weighing you are in a way counting molecules. It does not matter if you are preparing a mixture, filling packages or charging or discharging bulk material, the weight always is the truth. This way you are excluding a number of factors, such as:

1. temperature influences (expansion respectively shrinking).
2. compressibility.
3. changes in density.
4. aeration

ACCURACY OF SCALES

The required accuracies according to the NAWI directive 2014/31/EC, annex 1, table 1:

Class	Verification scale interval (e)	Accuracy classes		Number of verification scale intervals n = (Max) (e)	
		Minimum capacity (Min) minimum value	Minimum capacity (Max) maximum value	minimum value	maximum value
I	$0,001 g \leq e$	100 e	50 000	-	-
II	$0,001 g \leq e \leq 0,05 g$	20 e	100	100 000	100 000
	$0,1 g \leq e$	50 e	5000	100 000	100 000
III	$0,1 g \leq e \leq 2 g$	20 e	100	10 000	10 000
	$5 g \leq e$	20 e	500	10 000	10 000
IIII	$5 g \leq e$	10 e	100	1000	1000

This table defines as well the smallest mass to be controlled on the weigher.

Our table 2, NAWI directive 2014/31/EC table 3, shows the maximum permissible errors on initial verifica-

Class I	Load Classe II	Maximum permissible errors		Maximum permissible errors
		Classe III	Classe IIII	
$0 \leq m \leq 50\,000 e$	$0 \leq m \leq 5\,000 e$	$0 \leq m \leq 5\,00 e$	$0 \leq m \leq 50 e$	$\pm 0,5 e$
$50\,000 e < m \leq 200\,000 e$	$5\,000 e < m \leq 20\,000 e$	$500 e < m \leq 2\,000 e$	$50 e < m \leq 200 e$	$\pm 1,0 e$
$200\,000 e < m \leq 1\,000\,000 e$	$20\,000 e < m \leq 100\,000 e$	$2\,000 e < m \leq 10\,000 e$	$200 e < m \leq 1000 e$	$\pm 1,5e$

Note 1: The absolute value of the maximum permissible error is 0.5 e, 1.0 e or 1.5 e, i.e. it is the value of the maximum permissible error without the positive or negative sign.

Note 2: For our ranges of instruments the specifications III and IIII are applicable.

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- ▶ For Europe article 1, sub 2 of the NAWI directive 2014/31/EC establishes for which types of instruments the tables 1 and 2 are valid:

2. For the purposes of this Directive, the following categories of use of non-automatic weighing instruments shall be distinguished:

- (a) determination of mass for commercial transactions;*
- (b) determination of mass for the calculation of a toll, tariff, tax, bonus, penalty, remuneration, indemnity or similar type of payment;*
- (c) determination of mass for the application of laws or regulations or for an expert opinion given in court proceedings;*
- (d) determination of mass in the practice of medicine for weighing patients for the purposes of monitoring, diagnosis and medical treatment;*
- (e) determination of mass for making up medicines on prescription in a pharmacy and determination of mass in analyses carried out in medical and pharmaceutical laboratories;*
- (f) determination of price on the basis of mass for the purposes of direct sales to the public and the making-up of pre-packages;*
- (g) all applications other than those listed in points (a) to (f)*

So for all types of non-automatic weighing instruments, not specified under (a) up to (f), the requirements of the directive NAWI 2014/31/EC are not applicable, though they have to fulfil the requirements of your quality assurance system. In general these are weighing systems for internal weighing.

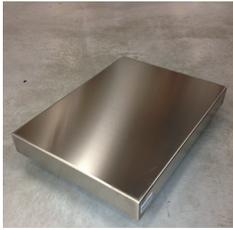
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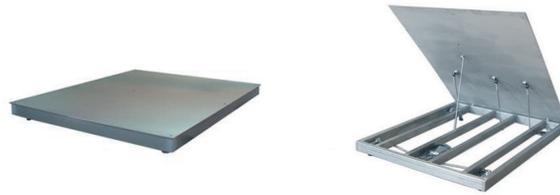


▶ TYPES OF NON AUTOMATIC WEIGHERS

Single Load Cell Platform Scal



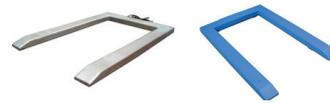
Multi Load Cell Platform Scales, surface or pit mounted



Drive Through Multi Load Cell Platform Scales



Multi Load Cell Pallet Weighers



Hopper and Tank Weighers



Mixers



Silos



Pneumatic conveying hoppers



Belt conveyors



Overhead Crane Weighers



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▶ NON AUTOMATIC WEIGHING SOLUTIONS

Functions:

- Determination stability of equilibrium
- Indication of stable equilibrium
- Tare
- Zero setting and zero indicator
- Semi-automatic zero-setting
- Automatic zero setting
- Zero-tracking
- Semi-automatic subtractive tare balancing / tare weighing
- Overload protection
- Preset tare
- Gravity compensation
- Set points
- Indication of selected set point(s)
- Dynamic setting with event logger
- Printer control
- Data storage
- Acting upon significant faults
- Linearity compensation for a maximum of 8 points
- Indication of additional information

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▶ **COMPETITIVE ADVANTAGE**

A high resolution filtering system combined with high speed – high accuracy measuring, offers smart weighing results for any operation environment.

All instruments are designed and manufactured with an accuracy of 10.000 d. The combination of measuring at high speed (1.600 conversions/s) with a high internal resolution (16.777.216), smart filters and sufficient computing capacity, make the SGM700, SGM800, 1020 and the FLEX range suitable for any weighing application. The combination of the high resolution and conversion speed guarantees the best achievable weighing accuracy, even when dosing at high speed, and thus prevents wastage because of wrong compositions.

PRODUCT SOLUTION

MODEL SGM700

The SGM700 range of digitizers is a compact device for use as standalone converter between the load cell(s) and any PENKO controller. A selection can be made, depending on the model, out of portal Ethernet (TCP) with protocols Modbus, FINS, Ethernet-IP and ASCII, portal RS232/422 with protocol Modbus and ASCII as well as portal Profibus with protocol Profibus-DP. Protocols for printers, web browsers and configuration software between PENKO devices are available on Ethernet (TCP), CAN, RS232, RS422 and USB portals



MODEL SGM800

The SGM800 range of digitizers/controllers is a compact device for use as standalone controller in network configurations, fulfilling a specific check function. All models offer 3 inputs and 4 outputs. A selection can be made, depending on the model, portal Ethernet (TCP) with protocols Modbus, FINS, Ethernet-IP and ASCII, portal RS232/422 with protocol Modbus and ASCII as well as portal Profibus with protocol Profibus-DP. Protocols for printers, web browsers and configuration software between PENKO devices are available on Ethernet (TCP), CAN, RS232, RS422 and USB portals



MODEL 1020

The basic indicator is compact, durable and user friendly. It offers 3 inputs and 4 outputs as well as Ethernet and USB communication portals.

As an option the 1020 allows for an analogous output and communication portals including RS232 and RS422/485 with protocol Modbus and ASCII as well as optional portal Profibus with protocol Profibus-DP. Protocols for printers, web browsers, and configuration software between PENKO devices are available on CAN, RS232, RS422/485 and USB portals.



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► MODEL FLEX -2100

This three-in-one device combines a stunningly-simple touchscreen interface, a core of sophisticated hardware and a clever calibration system. It offers 8 inputs/8 outputs, communication via portal Ethernet (TCP) with protocols Modbus, FINS, Ethernet-IP, ASCII as well as portals RS232 and RS422/485 with protocols Modbus and ASCII. Protocols for printers, web browsers, and configuration software between PENKO devices are available on Ethernet (TCP), CAN, RS232/422 and USB portals.

Additional options are analogue output and portal Profibus with Profibus-DP communication.

The FLEX-2100 also includes all the features of the 1020.



MODEL FLEX

This most versatile apparatus is an all-in-one compact, reliable and user friendly indicator/controller, suitable for automatic and non-automatic weighing.

The FLEX has an integrated PLC, offers an expandable number of inputs/outputs including remote I/O's. Its communication includes portal Ethernet (TCP) with protocols Modbus, FINS, Ethernet-IP and ASCII, portals RS232 and RS422/485 with protocol Modbus and ASCII as well as optional portal Profibus with protocol Profibus-DP. Protocols for printers, web browsers and configuration software between PENKO devices are available on Ethernet (TCP), CAN, RS232/422 and USB portals, making it highly suitable for complex weighing applications. Digital and analogue inputs/outputs are optional.



CONCLUSION

Manual operations such as preparing mixtures to correct and specific weights within the requirements of a quality management system, storage control, checking the mass of objects, measuring dispatch weights and so on in the most effective way, remains a challenge throughout the processing industry and will vary from one manufacturer to another. Consideration not only needs to be given to challenges of wrong compositions, give a way's caused by packages with overweight or unhappy customers because of underweight, overloaded hoists, reduced efficiency or even interruption of a process, each product – particularly natural products – has its own intrinsic weight and volume that influence the dosing result.

To engineer the most efficient way per industry, per product, per manufacturer, there is no "one-size-fits-all" solution. Engineers at PENKO work out the best and most effective way this can be done.

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