Engineering White Paper

CHECK WEIGHING SYSTEMS
PENKO ENGINEERING B.V.

INTRODUCTION

This White Paper discusses the challenges, options and solutions for process manufacturers when checking packages for the consumer and/or processing industry. .

PURPOSE OF WHITE PAPER

is to explain why it is important to dose the correct amount of material/product in a package – be it small individual packages, boxes or big bags etc. Whether a check weighing system is static or dynamic, or whether it is of industrial proportion or simply a small system on shop level, similar challenges regarding control apply which have a direct effect on cost and profit margins for the process manufacturer. Where overfilling results in profit loss and product spillage, under filling results in unhappy customers and may even be a legislative fallacy such as the obligation to withdraw packages falling outside of the tolerance levels.

In addition to such losses, there is the added argumentation 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.

Since the opening of the European internal borders, Directive 76/211/EEC „on the approximation of the laws of the Member States relating to the making-up by weight or by volume of certain prepackaged products“ applies to packaging up to 10 kg. Using this directive offers two advantages:

a. The goods can be traded unhindered within the European Economic Area.
b. The prepackages may be filled to medium weight/volume within certain tolerances.

The method used in this directive is also included in OIML recommendation R87 of 2016, which gives an opening to worldwide use. Apart of standardizing and checking prepackages in Europe, the e-mark is beneficial for every packer because of savings on over- and/or underfilling prepackages, what means a more efficient use of raw material and/or finished product.

Engineering White Paper

CHECK WEIGHING SYSTEMS
PENKO ENGINEERING B.V.

An automatically generated e-mark protocol also makes additional checks redundant, saving valuable time and resource. In addition, filling in accordance with this protocol opens opportunity for business in the EU market.
The advantages of fast check-weighing (PENKO instruments weigh at 1600 samples per second) is faster throughput, less spillage,– leading to fast ROI

BACKGROUND ON CHECK-WEIGHING

Check-weighers are automated systems designed for checking the weight of packaged commodities for the purposes of internal control and external trade application. The checking process is usually found at the end of production processes in any given industrial process flow. For external trade applications, legal requirement is obligatory. The worldwide OIML (International Organization for Legal Metrology) recommendation R51 outlines these rules, while the MID (Directive on Measuring Instruments 2014/32/EU) „ on the harmonisation of the laws of the Member States relating to the making available on the market of measuring instruments“ is Europe specific and the NIST Handbook 44, edition 2014, covering check weighers in chapter 2.24 is relevant to the United States.

There are two types of check weighers:

- Category X: determine and compare the weight within defined tolerances for purposes of acceptance or not. Such tolerances are typically mandated, similar to the e-mark registration. Packages that are outside of the given tolerances are automatically removed from the process line.
- Category Y: determine the package mass which is useful when establishing price calculations based on weight

Both categories can be static or dynamic. In the latter case, the package is in motion for example on a conveyor belt. This will typically have an adverse effect on the weighing result due to accelerations and vibrations of the mechanical parts. Under such circumstances PENKO instruments excel because of their sophisticated state-of-the-art filtering processes. Furthermore, they are certified in accordance with the MID directive and OIML R51 recommendation. For registration purposes, PENKO offers specifically designed e-marking software.

MEASUREMENTS INSTRUMENTS DIRECTIVE (MID) REQUIREMENTS

Here is some background information on required accuracies according to OIML recommendation R 51-1, edition 2006, Table 1 OIML accuracy table:

The verification scale interval and number of verification scale intervals, in relation to the accuracy class.

Accuracy class		Verification scale interval, e	Number of intervals n = Max / e Minimum	verification scale Maximum
XI	Y(I)	0.001 g ≤ e*	50 000 -	
XII	Y(II)	0.001 g ≤ e ≤ 0.05 g 0.1 g ≤ e	100 5 000	100 000 100 000
XIII	Y(a)	0.1 g ≤ e ≤ 2 g 5 g ≤ e	100 5 00	10 000 10 000
XIIII	Y(b)	5 g ≤ e	100	1 000

Category X Instruments

For a number of consecutive weighings of a net load greater than or equal to the minimum capacity, (Min) and less than or equal to the maximum capacity, (Max) the maximum permissible mean (systematic) error shall be as specified in Table 3.

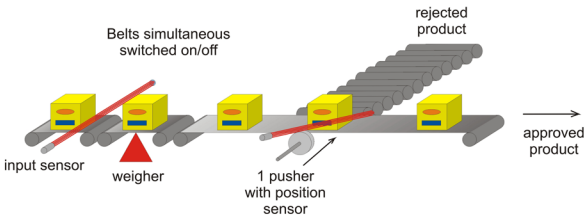
The maximum permissible standard deviation of the error (random error) shall be as specified in Table 4 (Max permissible standard deviation), multiplied by the class designation factor (x).

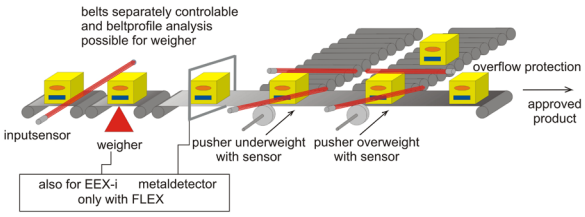
Net load, m, expressed in verification scale intervals, e				Maximum mean error for category X instruments	
				Initial verification	In-service inspection
XI	XII	XIII	XIIII		
$0 < m \leq 50\ 10^3$	$0 < m \leq 5\ 10^3$	$0 < m \leq 500$	$0 < m \leq 50$	±0.5 e	±1 e
$50\ 103 < m \leq 200\ 10^3$	$5\ 103 < m \leq 20\ 10^3$	$500 < m \leq 2\ 10^3$	$50 < m \leq 200$	±1 e	±2 e
$200\ 10^3 < m$	$20\ 103 < m \leq 100\ 10^3$	$2\ 103 < m \leq 10\ 10^3$	$200 < m \leq 1\ 10^3$	±1.5 e	±3 e

Z Value of the mass of the net load, m, in grams (g)	Maximum permissible standard deviation (as a percentage of m or in grams) for class designation factor, (x) = 1	
	Initial verification	In-service inspection
$m \leq 50$	0.48 %	0.6 %
$50 < m \leq 100$	0.24 g	0.3 g
$100 < m \leq 200$	0.24%	0.3 %
$200 < m \leq 300$	0.48 g	0.6 g
$300 < m \leq 500$	0.16%	0.2 %
$500 < m \leq 1\ 000$	0.8 g	1.0 g
$1\ 000 < m \leq 10\ 000$	0.08%	0.1 %
$10\ 000 < m \leq 15\ 000$	8 g	10 g
$15\ 000 < m$	0.053 %	0.067%

CHECK WEIGHING SYSTEMS
PENKO ENGINEERING B.V.

Below are two typical examples of a static or dynamic class Y check weighers. The first graphic depicts a pusher - ; the second image shows discrimination of under- and overweight.





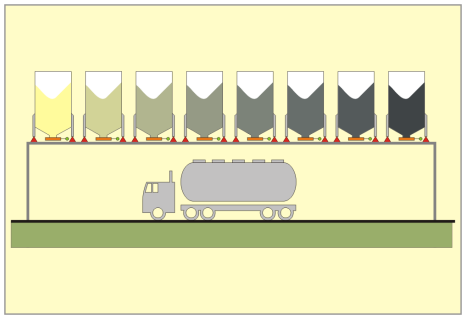
Note: these combinations of belt conveyors belt can also be used, optionally without pusher(s) for class Y applications.

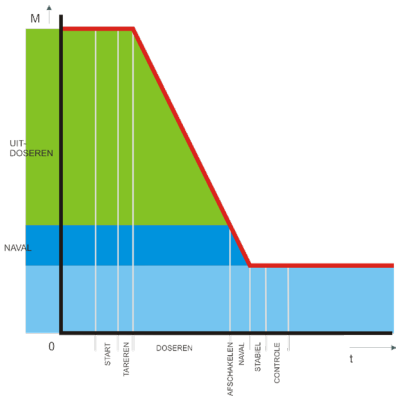
CATERGORY Y INSTRUMENTS

The maximum permissible error for any load greater than or equal to the Min and less than or equal to the Max in automatic operation shall be as specified in Table 5.

Net load, m, expressed in verification scale intervals, e				Maximum permissible error for category Y instruments	
				Initial verification	In-service inspection
Y(I)	Y(II)	Y(a)	Y(b)		
$0 < m \leq 50\ 10^3$	$0 < m \leq 5\ 10^3$	$0 < m \leq 500$	$0 < m \leq 50$	±1 e	±1.5 e
$50\ 10^3 < m \leq 200\ 10^3$	$5\ 10^3 < m \leq 20\ 10^3$	$500 < m \leq 2\ 10^3$	$50 < m \leq 200$	±1.5 e	±2.5 e
$200\ 10^3 < m$	$20\ 10^3 < m \leq 100\ 10^3$	$2\ 10^3 < m \leq 10\ 10^3$	$200 < m \leq 1\ 10^3$	±2e	±3.5 e

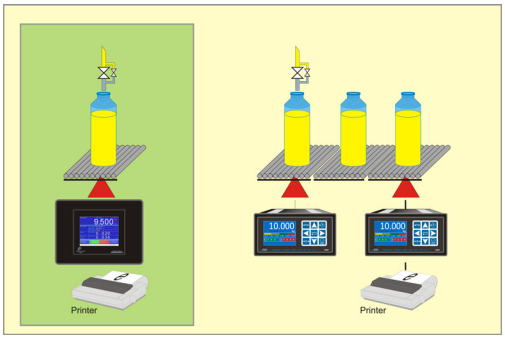
The following image shows a typical example of a combination of eight class Y check weighers; in this particular case for bulk loading of trucks. The mass/time graph shows a the effect of negative dosing.





Engineering White Paper

CHECK WEIGHING SYSTEMS
PENKO ENGINEERING B.V.



PENKO instruments excel in these applications because of the sophisticated state-of-the-art filtering processes. Instruments are certified and approved in accordance with the MID and OIML Unique software, based on the e-marking protocol, allows for registration. The data transfer software enables data transfer directly to a printer or a centralized storage base on a personal PC. Where filling on average weight is not permitted, this feature still offers excellent data analysis opportunity to optimize filling results. The fill data is sent from a certified system directly to an -mark registry. This process eliminates expensive and time consuming check weighing and allows hassle-free export into the European Economic Area (EEA).

CHECK WEIGHING SOLUTIONS

All instruments

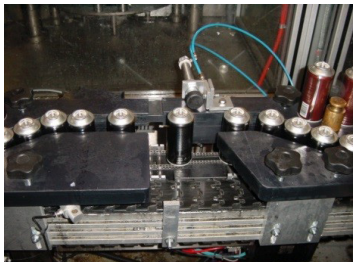
- Simultaneous on/off switching of 3 belt sensor
- Variable belt speed option
- Controls push-out and push-in positions
- Storage or printing of weighing results
- Input for belt displacement
- Connection to a bar code reader option
- Selects “OK” or “Reject”
- Optional e-mark registration

Extras for FLEX-2100 and FLEX

- Independent on/off switching of 3 belts
- Controls the push-out position on overfilling
- Ease of operations with user friendly touch screen panel
- Stops the supply when interrupted
- Independently pushes out too light and too heavy parcels
- Suppresses dynamic effects by means of the belt profile

Additional for FLEX

- Connection for a metal detector
- Control of measuring circuit by an active sense, rendering load cells intrinsically safe for use in hazardous areas



Engineering White Paper

CHECK WEIGHING SYSTEMS
PENKO ENGINEERING B.V.

PRODUCT SOLUTIONS

The SGM800 range of digitizers/controllers is a compact device for use as standalone controllers 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 and between PENKO devices are available on Ethernet (TCP), CAN, RS232/422 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 and between PENKO devices are available on CAN, RS232, RS422/485 and USB portals.

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, portals RS232 and RS422/485 with protocol Modbus and ASCII. Protocols for printers, web browsers, and configuration software and 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, configuration software and 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

PENKO instruments control the checking application all in one. All PENKO systems are “Slave” systems.
Checking packages for trade at high speed and accurate while adhering to regulations 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 dynamic effects, but the prevention for not correct filled packages to enter the market and disapproving of parties of packages and recalls.

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.

Following White Paper will discuss Non Automatic Weighing Systems, Filling Systems, continuous totalizing with Loss-in-Weight and Belt Weighing, discontinuous totalizing with Hopper Weighers, Grading Systems by means of Weighing and Batch Control on Weight for Mixing Plants.

For more information: www.penko.com