

BELT WEIGHING SYSTEMS PENKO ENGINEERING B.V.



▶ INTRODUCTION

This White Paper discusses the challenges, options and solutions for process manufacturers when measuring and totalizing, optionally including regulation of, the continuous mass flow by means of belt conveyors.

PURPOSE OF WHITE PAPER

.....is to explain why it is important to measure the mass flow of bulk material. Whether a conveying belt weighing system is of industrial proportion or simply a small system for testing purposes, similar challenges regarding control apply which have a direct effect on cost and profit margins for the process manufacturer. Overflow and underflow have their effects on the efficiency of the process the conveyor is feeding. The accuracy of totalizing has its effects when the conveyed amount is used for trade as well on the determination of the efficiency.

In addition to such losses, there is the added argumentation of functioning with a quality management system inside international standards and legislations on trade such as for the European region that warrants a scrutinizing view on the accurate, fair and proper determination of loaded or unloaded bulk material.

BACKGROUND ON BELT WEIGHING

Belt-weighers are automated systems designed to control, regulate and totalize continuous flows of bulk material. For this purpose a section of the belt is usually weighed (m/l); giving mass per unit of belt length. A transducer establishes the displacement (l). The multiplication of both the mass per unit of length with the displacement ($m/l \times l = m$), results in the mass transported by the belt. At the same time the belt speed and the displacement per time unit is often calculated (l/t). Subsequently the flow of mass is known ($m/l \times l/t = m/t$).

In addition to this information, there is an option to control the supply to the belt conveyor by on/off switching and/or by regulating the speed. The flow of mass can be controlled and the current mass can be measured. Controllers for belt weighing processes are designed to ensure the mass flow is measured and the conveyed amount is totalized exactly.

For external trade applications, legal requirements are obligatory. The worldwide OIML (International Organization for Legal Metrology) recommendation R50 outlines these rules, while the MID (Measurements Instruments Directive) is Europe specific and the NIST Handbook 44, edition 2014, covering belt conveying instruments in chapter 2.21 is relevant to the United States. In Europe the mentioned OIML recommendation is used as normative document.

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- The required totalizing accuracies according to the MID 2014/32/, chapter V, table 8, are as follows:

TABLE 1 Maximum permissible errors (MPE) for automatic weighing

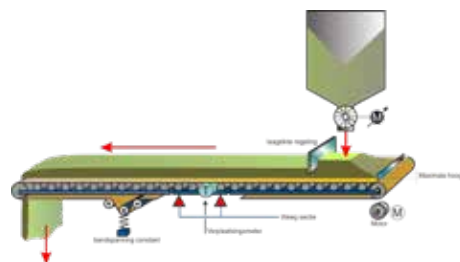
Accuracy class	Maximum permissible error for totalised load
0,5	± 0,25 %
1	± 0,50 %
2	± 1 %

TABLE 2 Maximum permissible errors (MPE) for automatic weighing according to OIML recommendation R50 table 2

Accuracy class	Percentage of the mass of totalized load
0,2	0,07
0,5	0,175
1	0,35
2	0,70

TABLE 3 Minimum totalized load Σ_{min} for automatic weighing according to OIML recommendation R50 table 3

Accuracy class	Number of totalization scale intervals
0,2	2000
0,5	800
1	400
2	200



Construction of a beltweigher

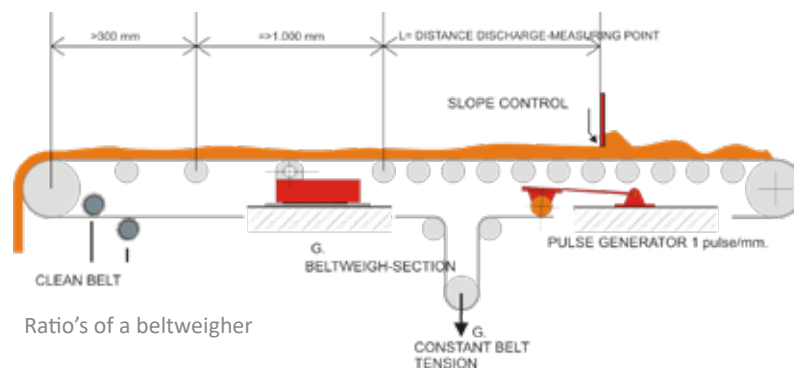
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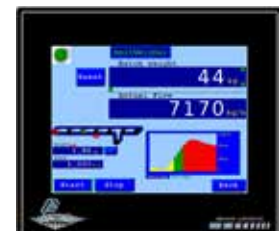
- ▶ During operation our instruments offer a wealth of information:
- Transported mass (m)
 - Mass flow (m/s)
 - Belt speed (l/t)
 - Belt loading (m/l)

Basic design requirements

- a measuring part of the belt of 1 000 mm, with in the centre one or more roller set(s) on load cell(s).
- distance between loading point and measuring part in meters $\geq 3 \times$ belt speed in m/s.
- distance between the measuring part and the conveyors end ≥ 300 mm.
- a belt displacement measuring device.
- a provision to keep the belt tension constant, preferably on gravity.
- exactly aligned top sides of the return pulleys and roller sets.



PENKO instruments excel in these applications because of the sophisticated state-of-the-art filtering processes. Instruments possess an evaluation certificate and in accordance with the MID and OIML. Data transfer software enables data transfer directly to a printer or a centralised storage base on a computer system.



Information, supplied by a continuous totalizing weigher

Engineering White Paper

**FOR BELT WEIGHING SYSTEMS
PENKO ENGINEERING B.V.**



**BELT WEIGHER SOLUTIONS
(SOME REQUIRE THE FREE PROGRAMMABLE VERSION)**

Functions SGM800 and 1020:

- Suppresses dynamic effects by belt profile specification
- Read flow of mass, belt speed, transported mass and belt load via a menu.
- Belt and bulk supply on/off switching
- Belt displacement transducer control
- Mass flow regulation option
- Mass total pre-set switch on/off



Belt weigher for concrete manufacturing

FLEX-2100 and FLEX extras include:

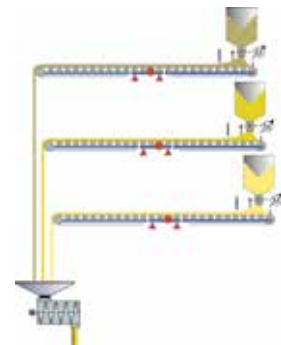
- User friendly touch screen panel offers ease of operation
- Simultaneous display of mass flow, belt speed, transported mass and belt load
- Funnel spout overflow protection control



The belt length metering device

FLEX extras include:

- Control variable belt speeds
- Pre-set the mass flow by means of an analogous input
- Create master/slave controls with several instruments



Preparing mixtures by means of belt weighers

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Some call it process automation – we call it PENKO

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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 certified 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 SGM800, 1020 Controller and FLEX range suitable for any belt weighing application. The combination of the high resolution and conversion speed guarantees the best achievable accuracy for mass flow regulation and control, even when conveying at high speed, and thus prevents for inconsistent process conditions or, in case of trade applications, over- or under-filling. This is essential for trade applications.

PRODUCT SOLUTION

MODEL SGM800

The SGM800 series of digitizers/controllers are compact devices for use as standalone controllers in network configurations, fulfilling this specific belt weighing function. All models offer 3 inputs and 4 outputs as well as, depending of 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, configuration software and between PENKO devices are available on Ethernet (TCP), CAN, RS232/422 and USB portals. As an option Type SGM800 series allow for an analogous output.



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, configuration software and 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, portals RS232 and RS422/485 with protocol 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 outputs and portal Profibus with Profibus-DP communication. The FLEX-2100 also includes all the features of the SGM800 and 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. The FLEX range has all the features of the models 1020 and FLEX-2100.



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► CONCLUSION

PENKO instruments control and regulate the belt weighing systems including the mass flow control and mass totalizing application all in one. All PENKO systems are “Slave” systems.

Controlling mass flows by means of belt conveyors to correct and specific weights while adhering to regulations in the shortest time possible and 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 over- or underflow challenges, but each product – particularly natural products - has its own intrinsic weight and volume that influences the mass flow.”

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, Check weighing Systems, Filling Systems, Continuous Totalizing with Loss-in-Weight, 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

