Checking for Mass or Weight
Making the right choice
Choosing Between Weight and Mass Inspection: making an informed decision

METTLER TOLEDO offers a broad range of products to ensure compliance with regulatory standards and realization of internal production goals. The Product Inspection Division consisting of HI-SPEED Checkweighers, SAFELINE Metal Detection, and SAFELINE X-ray inspection systems ensures you receive the correct product and technology for your application.

Gravimetric weighing technology is recognized as the only method for checkweighing accurately and reliably with results that can be verified and traced to a certified weight standard. Gravimetric checkweighers, like the HI-SPEED X-series™ are the gold standard ensuring packaging compliance and operational productivity. Thousands of these systems are embedded in production lines around the world ranging from pharmaceutical, to food processing, and even in industrial processes such as metal parts manufacturing.

The sole function of a gravimetric checkweigher is to be the best at weighing; the core competency of the X-ray inspection system is contaminant detection and checking for package integrity. While there has been some recent discussion by some X-ray companies regarding the utilization of that technology for checkweighing the fact is X-ray can estimate mass but it cannot "weigh"!

The SAFELINE InspireX™ delivers contaminant detection in a user friendly, robust design. The X-ray inspection system can calculate a mass value, this tertiary capability may create the following questions:

- When should I choose Mass over Weight?
- Is there a place for using mass determination in the production line?
- Will X-ray obsolete the traditional gravimetric checkweighers currently in use?

\[ W = m \times g \]

**Weight:** (‘w.Af)
The force with which a body is attracted toward the earth or a celestial body by gravitation and which is equal to the product of the mass and the local gravitational acceleration.
(Courtesy of Merriam-Webster Online)

**Mass:** (‘mas)
The property of a body that is a measure of its inertia and that is commonly taken as a measure of the amount of material it contains and causes it to have weight in a gravitational field
(Courtesy of Merriam-Webster Online)

Answers to these questions are actually very simple and straight forward.
Legal or not?
Checkweigher installations may require certification by local Weights and Measures Officials as a legal for trade device. In most jurisdictions only gravimetric check-weighers can comply with this requirement. A core element to this certification is the calibration and performance verification of the checkweigher using a traceable certified standard, also known as a test weight. Since X-ray measures item density and converts that value into a calculated pseudo weight, there is no ability to trace the derived value to the certified test weight standard. Your local METTLER TOLEDO Representative can assist you in understanding the local Weights and Measures requirements and whether the application requires an approved device.

Process validation?
While some checkweigher installations may be legal for trade, others are not. In either case internal quality or maintenance procedures, regulatory or customer driven mandates, may require the process to be validated against a certified standard or test weight. Only a gravimetric checkweigher such as a HI-SPEED Cornerstone can comply with this requirement.

Know your product.
Obviously the higher the value and product cost the more you will be concerned about absolute accuracy requiring the performance of a gravimetric checkweigher.

For applications where estimated weight is a viable solution path, it does not automatically shift the application to X-ray mass measurement. Not all products are suitable for using an X-ray for mass determination; X-ray calculates the mass by comparing each package “gray scale” image to that of a known “Good” package. Deviations from that “Good” package are then calculated as a change in mass. If the calculated mass is within programmed “Accept” tolerance zone the package remains in the production stream, packages with images that deviate outside the “Accept” tolerance zone range are rejected.

In applications where the chemical composition of the product may vary from batch-to-batch or package-to-package the change in chemical composition, even if it is minor, may cause a change in gray scale even though there is no change in actual weight. The X-ray system will interpret this change in gray scale as a change in mass which results in an inaccurately calculated result may yield unwanted and unprofitable false rejects. Products which contain Calcium or Chloride are prime examples where slight changes in chemical composition create inaccurate weight calculations, false rejects, or false accepts.
Gravimetric checkweighers are designed to optimize the weighing process for sustained accuracy and performance. This includes the ensuring the results from the 10,000th package are just as accurate as the 1st. Development by METTLER TOLEDO of the electro-magnetic force restoration (EMFR) weigh cell technology yields unprecedented gravimetric weighing accuracies at high production rates. Unlike conventional analog weigh cells used in more traditional gravimetric checkweighers, the EMFR weigh cell is not influenced by temperature and other environmental conditions which have typically led to reduced long term performance. The table below shows accuracies associated with a gravimetric checkweigher utilizing EMFR weigh cell technology.

You will note there is degradation in delivered accuracy for gravimetric checkweighing as line rates increase. “Time to weigh” is an important element in gravimetric checkweighing, the longer the time the better the result.

METTLER TOLEDO SAFELINE manufactures the highest performance X-ray inspection systems available. Continuing investment and development has yielded impressive advances in accuracy and reliability. Calculation of mass through the measurement of density using X-ray can achieve accuracies of 0.2% of the mass at 1 sigma, while this is still does not deliver the same accuracies of a gravimetric checkweigher it can be suitable for some applications.

As noted earlier the ability of an X-ray system to derive a calculated mass value is largely dependent on the consistency of the product’s chemical composition. Careful consideration of the product and process is therefore required prior to making any accuracy assumptions.

While other companies manufacture one or the other, METTLER TOLEDO manufactures both gravimetric checkweighers and X-ray inspection systems, it is our goal as a full line solution provider to deliver the right technology and solution set based on your specific application requirements and business goals. Your METTLER TOLEDO Representative can help you assess the suitability of the product and the application to determine which technology is right for you.

Don’t Compromise

All too often priorities are compromised for the sake of saving money or minimizing floor space. The resulting cost of the compromise may include additional product give-away and the loss of greater profit recovery. While checkweighing is used to comply with fair packaging laws, more frequently they are being employed as a process monitoring tool to enhance overall efficiency and productivity. In this second role the checkweigher may be tied to the filler, a cutter, or other device providing valuable feedback to adjust delivery rates to reduce product and profit give-away! Gravimetric checkweighers enhance “bottom line” performance. For user’s who are looking for greater precision than what the legal standards require there can be no compromising when it comes to delivered performance.
Is there a place for mass determination in the production line?

Absolutely, there are a number of applications where using X-ray can yield results that were previously difficult to obtain with a gravimetric checkweigher. It is important to note that in all cases the application must have accuracy requirements which are consistent with the inspection technology employed and with items which are of consistent density and chemical composition. Some common examples of using X-ray for mass comparison include:

**Multi-compartment packages**

Checking for portion control in multi-compartment packages is an ideal application for X-ray. In the past users of in-line gravimetric checkweighers were forced to check for the “gross” weight of the container assuming that if the gross weight was correct then the individual contents were also correct. For users that desired greater control meant the deployment of multiple checkweighers, one at each critical stop in the process to verify that the individual contents were correctly supplied.

X-ray has the unique ability to view the package and its contents both holistically and by sub-compartments, checking for the correct mass of each, as well as quality measurements such as uniformity of shape, broken or chipped contents, and accuracy of the location placement. In the world of convenience foods such as the traditional TV dinner, it’s not only important that each item is delivered to the correct portion, but that its shape and location accurately resembles the image on the package.

**Broken items**

Gravimetric checkweighers can only determine if the weight is correct, it can not determine if the contents are pristine or have been damaged. A good example is a box of crackers, while passing over a gravimetric checkweigher the package maybe accepted because it had the appropriate content weight; however the same package when passed through the X-ray could be rejected due to the image showing a broken cracker which is an unacceptable quality condition.

**Beverages**

Conventional gravimetric checkweighers can do a good job at checkweighing containers, however to some companies it’s just as important to ensure that the fill line of the container always be at the same position. For example bottles on a store shelf that have the same weight may result in fill heights which are different generally caused by inconsistencies of the container. Consumers looking at the product on the shelf will have a natural reaction to buy the bottle with the highest fill line. Further they may loose confidence in that brand and choose another which “appears” to have a tighter control on quality. X-ray while checking for mass can also check for fill height rejecting product based on one or both criteria.

**High package variability**

In some applications the weight variability of the packaging materials is greater than the “Accept / Reject” tolerances of the package contents. A good example is a blister pack of 12 tablets. Each tablet only weighs 100mg however the variability of the packaging materials is greater than 100mg. A traditional gravimetric checkweigher could not guarantee that all packages would contain 12 tablets, however using X-ray the position of each tablet could be verified, plus a check for broken, deformed, or partial tablets could also be incorporated.
Will X-ray replace the traditional gravimetric checkweigher?

No, as presented earlier each technology has its own unique value proposition which make them more complementary than competitive. Absolute tightening of accuracies to optimize line performance, meet regulatory standards, and eliminate costly product giveaway will draw users to the application of high performance gravimetric checkweighers like the HI-SPEED XS series. Similarly users will, to ensure product safety, maintain delivered quality, and portion control will deploy X-ray inspection systems like the SAFELINE InspireX™.

METTLER TOLEDO is committed to helping our customers to protect their brand by continuing to invest heavily in both gravimetric Checkweighing and X-ray Inspection technologies to ensure that we can deliver the right solution for your process in the most reliable and cost effective manner possible. Combined with our expertise in Metal Detection the METTLER TOLEDO Product Inspection Division consisting of our HI-SPEED and SAFELINE brands are ready to meet the real world challenges faced by our customers both now and into the future. Your local METTLER TOLEDO Sales and Service Representatives are available to work with your organization to deliver the right products and services to achieve your product inspection goals.