

# / Faster than the eye

## And always high-precision



### **Dynamic weighing with high throughput rates. How it works. What matters most. And what you need to know.**

What is the difference between Formula 1 and regular road traffic? It's not just a matter of the speed. If you want to push it to the limit, you need a complete system in which aerodynamics, chassis, tires, data, motor, and driver work together perfectly. Top performance is the result of the perfect interaction of many factors. Ultra-fast weighing is no different. For example, when you are weighing 700 products per minute. This figure epitomizes a new dimension in weighing, as it translates to around 86 milliseconds of cycle time for each product. In fact, the effective weighing time is significantly shorter. At the same time, external factors have to be taken into account within this extremely short time frame. This is because airflow, vibrations, and product handling become factors that affect measurement accuracy.

# / Ultra-fast weighing:

When milliseconds determine profit margins and customer confidence.

In modern production lines, efficiency is usually mentioned where it is visible: cycle times, downtimes, Overall Equipment Effectiveness (OEE). Weight determination is often not the main focus here. Yet weighing does have far-reaching consequences: A slight overfill adds up to a significant loss in margin when dealing with large quantities. Underfilling can result in complaints, rectifications, or can even have legal consequences in a regulated sector. That is why checkweighers address two key economic objectives:

## **Reducing overfilling and avoiding underfilling.**

What is surprising about this is: Once the line reaches a certain speed, “weighing” is no longer a simple control step, but rather a complex measurement process performed under time pressure. And the faster the line, the more complex the weighing process becomes. So how can ultra-fast weighing function reliably, and what factors determine whether a checkweigher weighs accurately and reliably in actual operating conditions?



# /700 items per minute: This calculation changes everything.

When people hear the term throughput, they think of capacity. In the field of measurement technology, it is primarily a unit of time.

**700 items per minute means:  
60 seconds/700 = 0.0857 seconds  
or about 86 milliseconds each.**

However, these 86 milliseconds are not the actual weighing time. They stand for the tempo budget: Within this time window, a product must roll onto the weighing belt, be scanned there, and roll off again.

And this all has to happen while the next product is already entering the weighing platform. On ultra-fast lines, therefore, only a fraction of those 86 milliseconds remains for actual weight determination.



# / How can scales measure weight accurately in just a few milliseconds?

During ultra-fast weighing, the product is not first placed on the scale and then measured after it comes to rest, as is the case with static scales. It moves across the weighing conveyor, and in that brief moment, the system measures the force exerted by the product. To ensure precise operation even at high speeds, Wipotec checkweighers operate on the principle of electromagnetic force restoration (EMFR).

As soon as a product is placed on the weighing conveyor, its weight acts on the measuring mechanism. This force would cause the mechanics – and thus also the lever-and-coil system – to move slightly from its neutral position. However, in electromagnetic force restoration – which is used in ultra-fast scales – this movement is not permitted. Instead, the system uses an active control loop that immediately compensates for the external force exerted by the product, ensuring that the mechanics remain in neutral position.

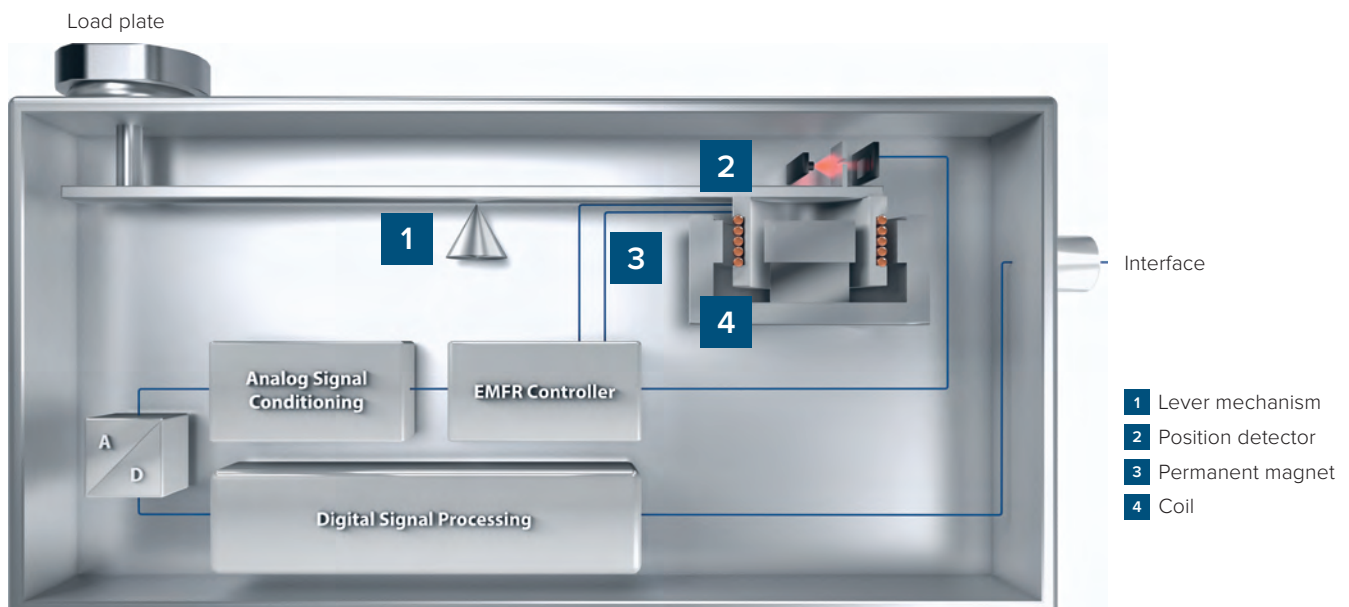
The key component here is a coil located within a permanent magnetic field. Under the weight of the product, the coil “tries” to move out of its ideal position in the magnetic field; the mechanics would thus experience minimal deflection. It is precisely this deviation that is detected by a sensor. It detects even extremely small movements; displacement is only in the range of a few nanometers.

As soon as the sensor detects a deviation, the control system intervenes: The coil current is adjusted so that the coil produces a counterforce in the permanent magnetic field, which counterbalances the product weight. In this way, the deflection is immediately “corrected.” The measuring system is not subjected to any mechanical deflection that could stress the material. It remains virtually in its original position.

The actual measured value is thus not determined by the distance traveled by the mechanics, but by the compensation control variable: The amount of coil current required to compensate for the weight. It is proportional to the weight and thus proportional to the product mass.

This current is detected accurately: It is measured using a measuring resistor and then converted into a digital signal via an analog-to-digital converter. A microprocessor processes this signal and ultimately outputs the result as a digital weight value.

This principle is used to ensure precise weight measurement at very high throughput rates. Simply put: The scale does not wait for a mechanical system to settle; instead, it actively holds the mechanics in neutral position and derives the weight value from the compensation required to do so. And it does all this in just a few milliseconds.





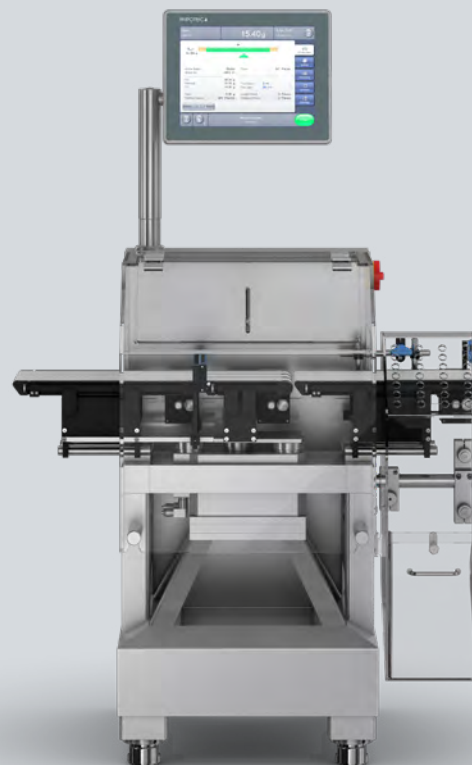
# /What ultra-fast weighing really is: Measurement in motion.

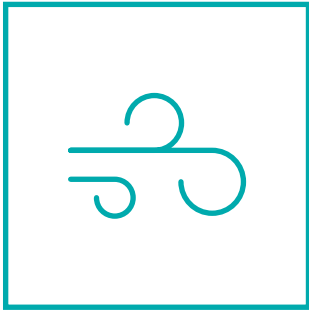
Ultra-fast weighing is not a static process. It's just the opposite. Products move along the weighing conveyor, and measuring takes place while they are in motion. However, given these extremely short time windows, even the slightest external influences can significantly disrupt precise measuring.

## These external factors mainly include:

- Airflow
- Vibrations
- Product and packaging characteristics
- Conveying technology

|   |                             |
|---|-----------------------------|
|  | <b>Air</b>                  |
|  | <b>Vibrations</b>           |
|  | <b>Products</b>             |
|  | <b>Regulatory framework</b> |





## / **Air:** Why the invisible suddenly becomes measurable.

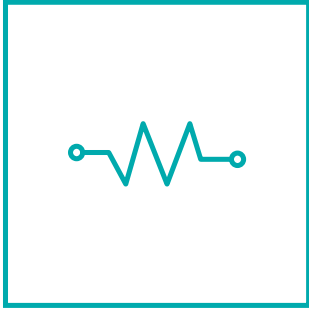
As line speed increases, aerodynamic forces acting on the products also increase. The basic correlation has been established: In the classic resistance equation, force is proportional to  $v^2$ , that is, to the square of the velocity. Air movement can be caused by ventilation systems, pressure differentials, air conditioning systems, fans, and airflows from upstream and downstream machinery. Such flows can generate very small but measurable additional forces, affecting both the product and the measuring system.

### **Why is this important, above all, when it comes to ultra-fast weighing?**

If the measurement window is short, even a small additional effect is enough to shorten or alter the “quiet moment.” This typically affects lightweight or flat packaging – precisely the types of packaging that dominate many production lines for fast-moving consumer goods (FMCG) or pharmaceutical products.

In practice, this means: Air movement is minimized in areas where it could cause measurement errors.

This is because extraction systems, compressed-air nozzles, open doors, or turbulence along fast-moving conveyor belts create local airflow that can affect the measuring system or slightly reduce the load on lightweight packages. Housing, controlled airflow, and shielding of the weighing area minimize external influences, thus ensuring reliable measurements.



## / **Vibrations:** When the line itself causes interference.

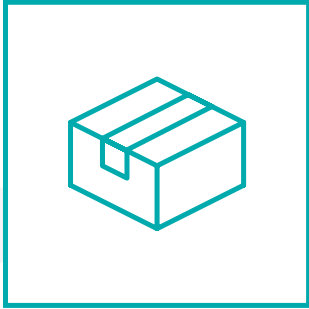
If ultra-fast weighing is inaccurate in practice, the cause often lies not with the measuring system itself, but with the environment at the installation location, and external factors affecting the system. Vibrations are a typical cause and, at the same time, a common source of error in dynamic weighing.

In highly dynamic measurements, any vibration can interfere with the weight signal. A system can stabilize within a wide measurement window. However, this cannot happen in a narrow window where only a few milliseconds are available. Then the unproblematic environment quickly turns into a disruptive factor: Machinery in the vicinity, forklift movements, building structure, technical building services, etc.

In particular, the conveyor system of the scale is also a key element. Rollers, motors, toothed belts, and belts cause disturbances. A low uncertainty is essential for accurate weighing. That is why ultra-fast weighing depends not only on the measuring principle, but also requires a well-coordinated system configuration with appropriate product handling, optimal belt transitions, and constant speeds. All of these factors determine whether a product can be placed on the weighing conveyor without any issues.

Vibrations are one of many parameters that are often overlooked during the line's daily operation, but they are nonetheless important and must be taken into account in weighing tasks of this kind.

The mechanical requirements are a stable system design and effective vibration isolation. Modern, high-performance systems, such as those from Wipotec, use digital compensation methods to provide additional reliability when determining measured values.



## / **Products:** Why all products cannot be weighed in the same way.

One of the biggest challenges in ultra-fast weighing is the product itself. Two products that are identical in every way may have the same target weight, yet still behave entirely different. Shape and center of gravity are key factors. A flat, solid product has position stability, hardly tips over, and behaves neutrally on the conveyor belt. A standing bottle is a narrow cylinder with a high center of gravity; it is prone to toppling and is more sensitive to disturbances and changes. Similar considerations apply to pouches and flexible packaging: They can deform, which causes changes in product behavior and can thus affect the weighing process.

In addition, there are packaging and tare effects: If the container weight fluctuates (a typical example is glass), the net content can no longer be accurately determined, even if the filling process is constant. In some applications, therefore, distinguishing between tare and gross weight is an important concept for gaining a clearer understanding of the process and better interpreting measuring errors.

And then there are liquids, which follow their own dynamic. The contents shift around inside the container during transport. In physics, this effect is known as “sloshing.” This can negatively affect the force transmission to the measuring system. The dwell time is too short for the liquid to settle enough to allow for accurate measuring.

The bottom line: Ultra-fast weighing cannot rely on a single setting to reliably and safely handle the wide range of industrial applications.

It is a task that is increasingly influenced by a growing number of factors and variables as the weighing speed increases. The product itself is just one of them. All of these factors must be taken into account and considered when designing the measuring system. The design and configuration of a ultra-fast scale therefore requires detailed analysis and knowledge of the product itself and its specific transport behavior.



## / **Regulatory framework:** What applicable conditions apply.

In many applications, weight is a legally relevant factor, for example, when fill levels must be adhered to or when measuring results must be reliable for customers and regulatory authorities. There are clear legal regulations that govern this.

This applies in particular to the production and inspection of prepackaged items. In this context, it is not just a matter of being “as accurate as possible,” but also of being “demonstrably compliant with regulations.” The measurements must fall within permissible error limits and must be verified using specific defined testing and control mechanisms. The European Prepackaged Goods Directive 76/211/EEC (as last amended by 2007/45/EC) defines what constitutes a prepackaged product:

A product is considered to be prepackaged if it has been filled and sealed in the absence of the buyer; the quantity contained has a predetermined value, and cannot be altered without opening or making a noticeable change to the package.

Dynamic checkweighers play a key role in this case: They make it possible to monitor compliance with fill volume specifications during the production process, and to detect deviations early enough in order to prevent these errors from being discovered during spot checks or in response to customer complaints. This turns the scale into more than just a sorting station. It becomes a vital component of process quality and process stability, as well as production documentation.

In addition, Europe has the Measuring Instruments Directive (MID) 2014/32/EU, which serves as the central legal framework for measuring instruments. It defines “instrument-specific” requirements for various types of measuring instruments in separate annexes (MI-001 through MI-010).

For dynamic checkweighers, the relevant section is MI-006 (Automatic Weighing Instruments). It sets out the specific requirements for automatic weighing instruments, such as error limits and operating conditions. The MID requires that measuring instruments undergo a conformity assessment procedure before being placed on the market. These procedures (conformity assessment modules) ensure that the measuring instrument in question meets the essential requirements of the Directive and can thus be placed on the market and used in compliance with the law.

In short: Dynamic checkweighers are an effective way to meet the legal requirements for prepacked goods inspection. The regulations do not define measuring quality solely as a feature of checkweighers.

Quality must be verifiable under defined operating conditions; that is, under the conditions that are characteristic of a real production line, including product guidance, conveying technology, air movements, and vibrations. The measuring quality must be consistently reproducible over the long term. And this applies not only to applications that must be legal for trade.

# / **Holistic system solution:** Experience and technical expertise for dynamic weighing with a promising future.

For a weighing solution to work properly, the entire system must be balanced. It is crucial to understand the interactions between the product, conveying technology, line layout, and environmental conditions, and to coordinate them in such a way that measuring remains consistently stable even at ultra-fast speeds. This requires in-depth know-how and careful analysis of the specific application. This should serve as the foundation for designing and configuring a dynamic weighing system in a holistic and targeted manner. Wipotec's approach is a perfect example.

## **Clarifying customer requirements and specifications (URS)**

Customer requirements, throughput, tolerances, product and packaging variants, line architecture, and environmental conditions are jointly determined and considered.

## **Application evaluation**

Factors such as vibrations, airflows, transfer behavior, and product-specific dynamics are evaluated and, if necessary, verified through appropriate tests.

## **Design, engineering, and manufacturing**

Working closely with the customer, the dynamic weighing system is then configured step by step for the specific application. The first step is not the equipment itself, but to ask what the line needs to accomplish and under what conditions it needs to do so: Which products are available in which weights, shapes, and packaging? What speeds and tolerances are needed? How is the conveyor line configured? How should the product be handled, and what solutions are needed to minimize or overcome potential disruptions?

This coordinated approach enables a comprehensive design of the checkweigher and selection of the appropriate system components: Weigh Cell, weighing conveyor, product handling, and conveying technology. Everything must work together seamlessly to ensure that weight measurements are stable, accurate, and reproducible in practice. The design and manufacturing processes are carried out in a targeted manner once these parameters have been established: The system is designed to be compatible with the product and production line, to minimize or intelligently filter out the effects of interference, and to deliver stable, precise measurement results at high throughput rates.

## **Long-term partnership**

Including inspection, maintenance, and spare parts services.

## **Conclusion**

Ultra-fast weighing is a dynamic measurement task performed within extremely limited time windows. The achievable measuring accuracy is determined not only by the measuring principle, but also significantly by the interaction of system dynamics, product handling, conveying technology, and environmental conditions. Only a holistically designed and application-specific optimized system solution can ensure stable, reproducible measuring results at high throughput rates.



# /Talk to us about ultra-fast weighing.

The higher the throughput, the more dynamic weighing becomes a measuring task performed under immense time pressure. The available time window for each weighing operation is reduced to just a few milliseconds. Factors such as airflows, vibrations, product dynamics, as well as conveying technology and belt transitions play a disproportionately significant role in this context.

Let's discuss the factors that determine measuring stability in your production line and how precision, throughput, and process safety can be reliably combined in your specific application. **Our experts are here to assist you.**



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