



# Measuring Success

Weighing the Precise Role of Analytical Measurement

Whitepaper sponsored by

**OHAUS**

[www.ohaus.com](http://www.ohaus.com)

# Table of Contents

<b>Measuring Success</b>	
<b>Weighing the Precise Role of Analytical Measurement</b>	<b>3</b>
<b>The Application of Measurement</b>	<b>4</b>
Readability and Accuracy	6
Relative Error	7
Uncertainty	8
Balance Installation and Qualification	9
<b>Environmental Considerations</b>	<b>9</b>
Setting a Correct Balance	10
<b>Helping Customers Measure Success</b>	<b>11</b>

©Industry Today 2019. All rights reserved.

All rights reserved. No part of this publication text may be uploaded or posted online without the prior written permission of the publisher.

Email [spoeton@industrytoday.com](mailto:spoeton@industrytoday.com)

[www.industrytoday.com](http://www.industrytoday.com) 973.218.0310 ext. 47

# Measuring Success

## Weighing the Precise Role of Analytical Measurement


*Accurate measurement eliminates waste, improves process efficiencies, gets trusted results key to quality control and product improvement.*

### **Measure twice, cut once.**

The carpenter's adage is a wise counsel to avoid mistakes that result in ill-fitted pieces and wasted material. It's also an underlying principle of product development and testing—you can't make or evaluate or product if you can't accurately measure its components.

Precise measurement is one of the most basic tasks performed in the lab or any production process. It is a foundational principle of science—you measure something to understand its material properties and determine its practical use.

Needless to say, incorrect measurement can cause errors, errors that result in misleading perceptions that can potentially contribute to inefficient product use, even outright failure. Particularly where the increasing use of lightweight materials and composites require exacting measurements, the tools and processes for accurate analytical measurement are absolutely essential.



**Still, even technical people have a poor understanding of the importance of proper measurement. It's particularly surprising considering where misapplication of a point of calibration has serious implications for the performance of a part.**

As a global leader in the scale, balance and weight calibration industry providing sophisticated devices across a range of industries, OHAUS Corporation has been on the front lines of providing customers with measurements that count for over a hundred years. To provide a better understanding of how technological advancements in measurement and measurement tools can make manufacturers even more cost-efficient, this OHAUS sponsored white paper examines:

- The application of measurement
- Key measurement terms and their practical application
- Setting a correct balance for Industry-specific applications.

## **The Application of Measurement**

Measurement is both a process of deciding that something should be measured in a certain way as well as discovery that of other factors that come into play. Test results sometimes lead to values that weren't originally anticipated. Key to any standard of measurement is to establish

a record of measurements, or traceability, by which companies can ascertain if their products are in compliance. It could be the case that a regulatory agency sets standards for industry to follow, or that industry approaches the regulator to help set the standards. For example, a physical laboratory calibrates a material's mass under varying conditions. A company that uses that material then has a reference point to assess whether its own measurements are correct. This ensures not only the integrity of the product, but also the accuracy of the measuring equipment.

Equipment that is used to measure or weigh something must be evaluated in context. For example, the common standard for a car's oil change is every six months or 3,000 miles. Does that mean every kind of vehicle must have an oil change every six months or 3,000 miles? Well, that depends on other factors such as the environmental conditions under which the vehicle must perform, the type of engine, what type of load the vehicle is carrying or pulling. A mid-size car doing mostly highway driving would probably be fine with the standard interval, a heavy-duty truck operating 12 hours a day straight in a desert probably wouldn't.

Similarly, just because you have a piece of equipment that reports a weight, doesn't really mean you have a measurement that provide the best results for your use. What you need to know about is:

- Accuracy and precision
- Relative error and readability
- Absolute vs relative
- Sources of potential error (or uncertainty)
- Installation and qualification of a balance
- Environmental considerations.

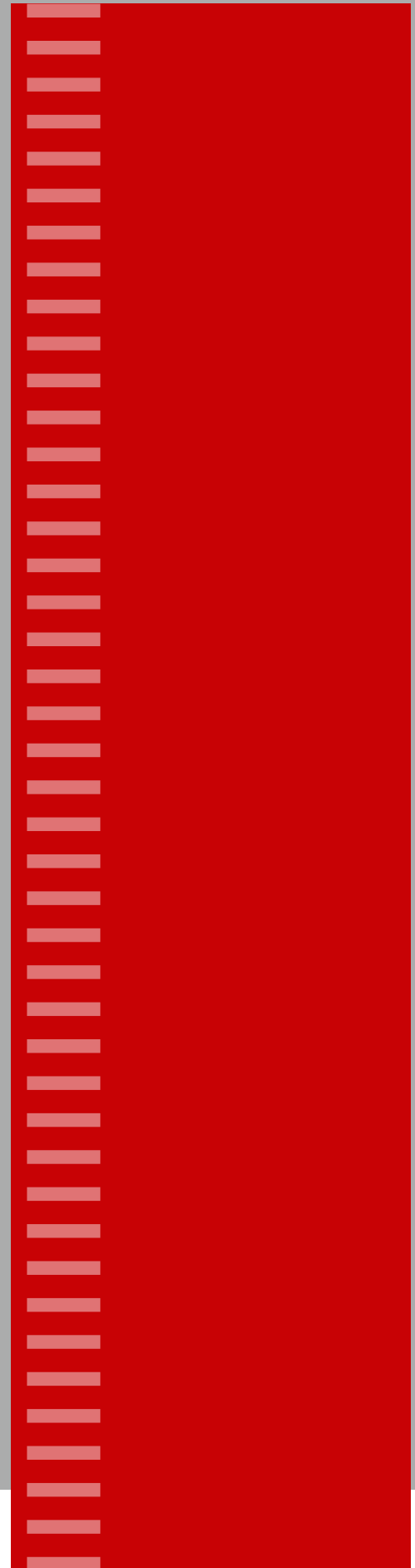
Which is why, as George Hatziemanuel, Market Manager for OHAUS, explains, “Not all balances are created equal. They can vary widely depending on the quality and complexity of the instrument. Users tend to think of balances as commodities, that one balance is as good as another. In fact, to achieve a true weighing result, you need a quality instrument. Unfortunately, users sometimes think they are measuring something using just any kind of balance and realize too late that tolerances of the instrument weren’t appropriate for their application.”

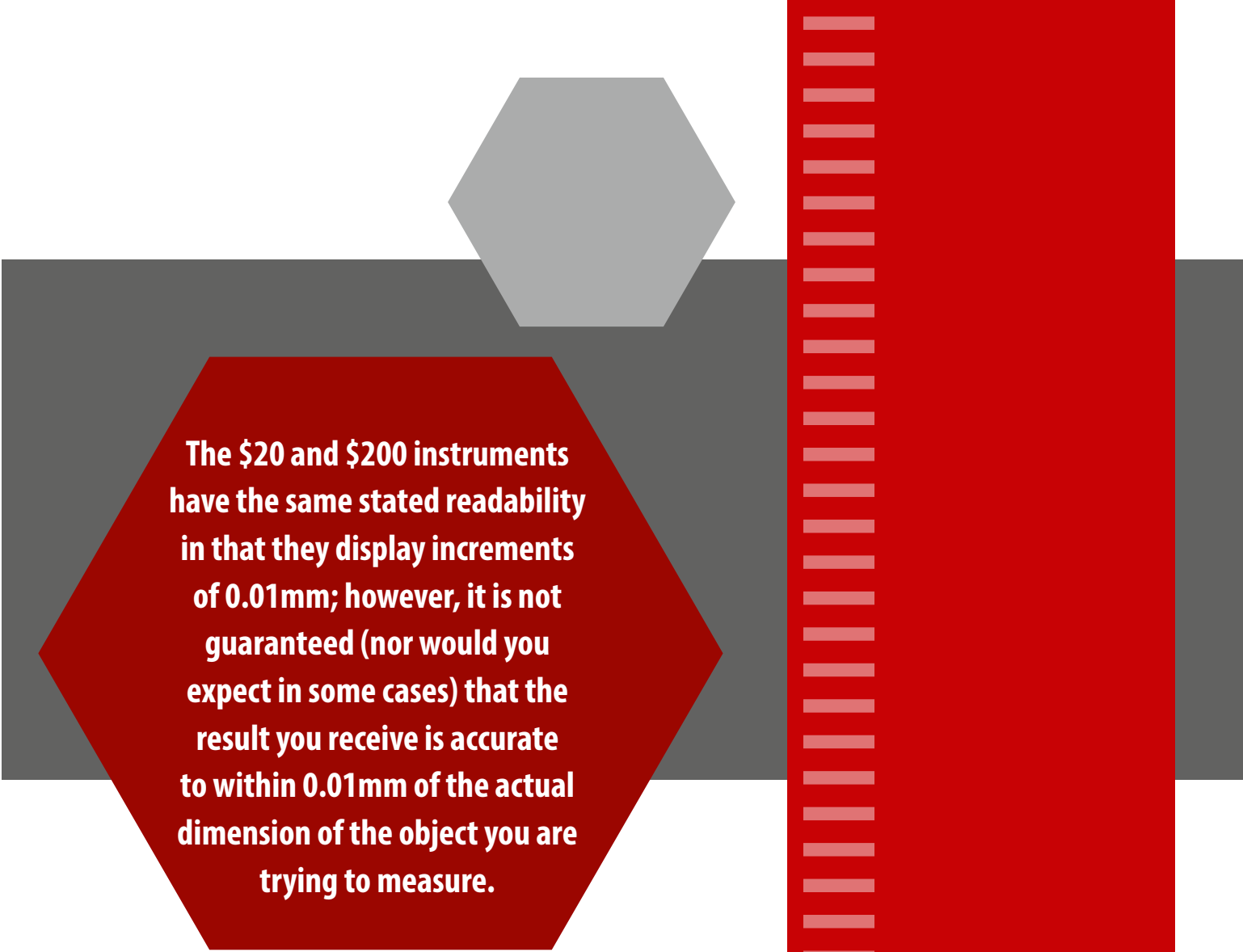
A meaningful measurement needs to account for the following:

## ***Readability and Accuracy***

Readability on a measurement instrument is the smallest step that the device increments, i.e., can read or display to the user. On a balance, the readability is the smallest increment that can be displayed as weight is added or removed. On digital balances, it is the step change in the last significant digit on the display, on mechanical scales, it is the smallest subdivision of the indication, whether it is a dial or a beam. **An example is a scale that can measure up to an eighth of an inch. So if something actually measures  $2 \frac{3}{16}$ ”, the scale rounds up and reads  $2 \frac{1}{8}$ ”.** (Note: scales measure weight, not length or distance.) It is very important to point out that readability does not equal accuracy! A device is not necessarily accurate to plus or minus one digit of readability.

Not all measurement equipment is created equal; there are many options available at different price points. Let’s say that you are shopping online for a digital micrometer. During your search you find instruments ranging from \$20 to \$200, all claiming to measure by increments of 0.01 mm (millimeter). You might expect that the \$20 device may in reality be off by several tenths of a millimeter. And that might be okay for your application. On the other hand, if you needed more precise measurement, the \$200 instrument is probably significantly more accurate.



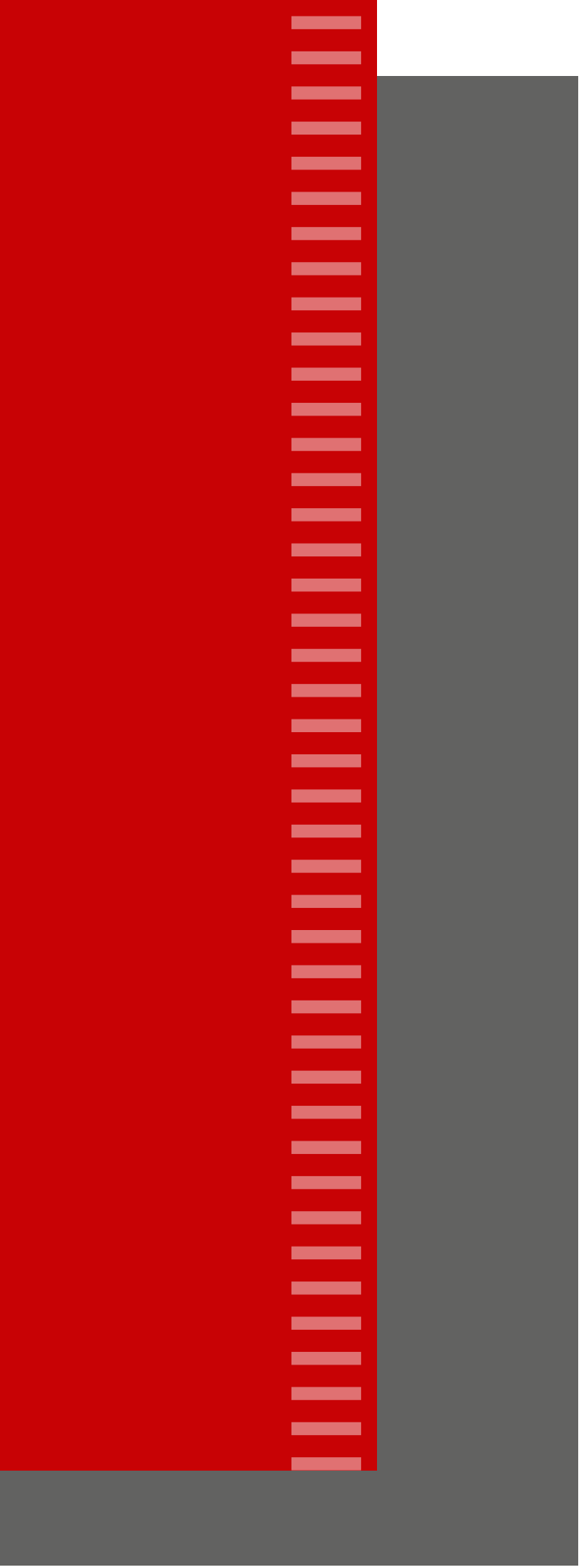


**The \$20 and \$200 instruments have the same stated readability in that they display increments of 0.01mm; however, it is not guaranteed (nor would you expect in some cases) that the result you receive is accurate to within 0.01mm of the actual dimension of the object you are trying to measure.**

What is important to note here is that the readability of a measurement device is not the same as the accuracy tolerance for the device. The same principle applies to weighing equipment. Just because two balances both have a readability of 1mg (milligrams), does not mean that they are both accurate to within 1mg.

### ***Relative Error***

There are two kinds of accuracy—absolute and relative. To understand the difference, let's go back to the micrometer example. You've paid for a less expensive instrument with the understanding that the readability and the accuracy are not necessarily the same thing; you accept that any given measurement you make might be off by +/- 0.04 or 0.05mm, which still seems a good tolerance for most measurements. You want to



measure a part that is about 10 centimeters wide and your micrometer displays 10.03mm, which is pretty good for most applications. When you measure a small part that is supposed to be 0.50 mm, your micrometer reads 0.57mm. That's an uncertainty range of +/- 10% of the part.

This illustrates the notion of absolute vs relative accuracy. In most cases, the error or uncertainty range of the instrument does not scale with the sample. As the samples become smaller, the relative uncertainty range (or relative error) becomes more significant.

## *Uncertainty*

Most people think that just because something is stated to measure a certain weight, that is the correct weight. But that depends on how accurate you need to be. Hatzimanuel points out that, "Just because you've got an instrument that says it can measure to so many milligrams or millimeters doesn't mean it can actually provide an accurate measurement. There is typically a range in which the device will provide a result; the magnitude of this range is the measurement uncertainty or potential error. The size of this range correlates to the tolerance of the balance. In general, less expensive equipment will have a wider tolerance or range of uncertainty in which the measured value will fall. So in general if a given application requires tight measurement tolerances, it will require higher quality measurement equipment."

"In most cases, as long as you are within capacity and can measure the largest sample you need to, you are ways going to be better off with a balance with smaller readability," Hatzimanuel recommends. "However, as you get smaller in readability—from millimeter down to micro—the balance gets more expensive. So the required readability depends on what you're typically measuring.



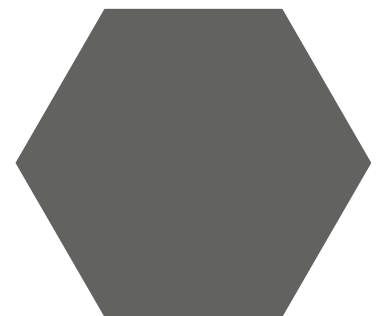


## ***Balance Installation and Qualification***

“We receive a fair amount of calls here at OHAUS from customers asking for a ‘calibration certificate’ or a ‘certificate of compliance’ for a newly purchased balance,” says Hatzimanuel. “While we can provide proof that the balance was calibrated and within stated tolerances when it left our factory, we cannot guarantee that the instrument will meet those specs when installed and used at the customer’s location.” There are many factors that affect a balance’s performance and ability to produce accurate weighing results. For one, a balance can be affected by transit conditions. But what is probably the most critical factor is the setup of the balance and the environmental conditions in which the balance is used which can vary from customer to customer.

## ***Environmental Considerations***

Balances are sensitive to disturbances or changes in the environment in which they are used. For example balances do not typically react well to rapid changes in temperature and humidity. According to Hatzimanuel, “Expansion and contraction of materials such as metals might seem negligible and without consequence. However, in high precision applications, this can create challenges.” Additionally a buildup of an electrostatic charge may cause instability or erroneous results.





## Setting a Correct Balance

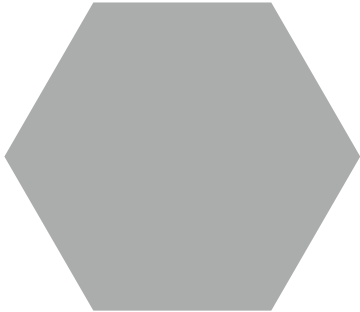
For industries such as packaging, shipping logistics and food processing, measurement is a more basic matter of weighing and documenting product. High accuracy electronic scales and balances provide the ability to:

- Measure ingredients
- Track incoming raw materials
- Maintain accurate inventory
- Ensure customers are shipped and billed for accurate quantities.

The food industry, in particular, depends on “legal-for-trade weighing” for commodities purchased or shipped to comply both with regulatory standards and ensure customer confidence. Equipment must be certified as proof that scales can repeatedly provide accurate weighing of goods.

Accurate weighing is also a safety issue. The International Convention for the Safety of Life at Sea, for example, sets standards to verify the gross mass of packed containers loaded on ships. According to the [International Maritime Organization \(IMO\)](#), “Knowing the accurate gross mass of a packed container is critical to ensure correct stowage and stacking and avoid collapse of container stacks or loss overboard. This is an important safety measure, which is aimed at saving lives and preventing injury and the destruction of property.”

Incorrect usage of weighing equipment or use of the equipment in unsuitable conditions can result in errors that could result in legal liability, poor customer service and/or safety issues. This is particularly the case for balances and scales used to weigh the lightest samples. General rules for proper weighing include:

- 
- Place the balance in a dedicated weighing room, free from drafts and vibrations, at a constant temperature suitable for the products being weighed.
  - Keep the balance plugged in and on stand-by when not in use. Providing constant electricity ensure the parts are properly warmed up. Newly installed equipment can require up to 12 hours of warm-up before optimal operation is achieved. If you unplug the device, you need to reinitiate the warm up period to ensure accuracy.
  - Ensure the balance is stable and the display indicates “0” before weighing.
  - Perform regular calibration to ensure weighing results are accurate and consistent.

## Helping Customers Measure Success

Measurement has historically been the foundation of commerce and progress. OHAUS provides the tools that provide the right measurements that lead to the right results. But, to borrow a phrase from a famous menswear advertising campaign, an educated consumer is our best customer. Refer to the specifications in a product sheet or user guide to determine and compare the accuracy of scales and balances. The accuracy of the scale/balance should be appropriate for the application and the cost of the item being weighed

Selecting the right tool for what you need to measure and knowing how to evaluate the proper use of that tool is the balance OHAUS promotes in this first in a series of educational whitepapers.

**You can find out more about our products [here](#), or call us with general inquiries at 1.800.672.7722. Our products are sold through authorized dealers, but we're happy to answer your general questions and provide general support in the proper use of our products.**



# Measuring Success

**Weighing the Precise Role of Analytical Measurement**

Whitepaper sponsored by

**OHAUS**

[www.ohaus.com](http://www.ohaus.com)