MINIMUM WEIGHT

ACCORDING TO EURAMET CG-18

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Application Note

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Abstract

While offering application examples, this paper does not intend to dive into the basic statistical, metrological and mathematical concepts and details.
This document is intended to provide guidance to the Customer in order to make him aware of how fundamental, in the process of weighing samples, is the definition of the Minimum Weight according to EURAMET Calibration Guide No. 18, within the Calibration Certificate of Gibertini Elettronica s.r.l. issued under the ACCREDIA mark.
Explanatory examples of the type of additional service to the ACCREDIA-accredited Calibration Certificate are offered for this purpose.
The minimum weight directly affects the quality and reliability of the scale indication and consequently the final product/process.

WHAT IS THE MINIMUM WEIGHT ?

Determining the minimum weight is crucial to ensure the reliability and accuracy of electronic scales

The minimum weight represents the smallest amount of mass that can be measured with appropriate accuracy and reliability.

This is especially relevant in areas where measurement accuracy is critical, such as sample preparation in testing laboratories, as in pharmaceutical manufacturing, scientific research, the food industry, and other areas that require accurate weighings. In essence, the minimum weight should always be required at the LAT, as it is the fundamental lower and thus starting limit of the balance.

Now imagine you had to weigh 200 mg of gold; would you trust the weighing result of a scale based only on the unit of format? What is the appropriate size unit? Is it 0.01g, 0.1g? And consider that the format unit covers only a basic part of the much more complex process do determine the Minimum Weight. Therefore, the Minimum Weight must always be determined, otherwise the reliability of weighing is compromised.

Here are some of the main reasons why calculating minimum weight is critical :

Accuracy of measurements	The minimum weight defines the smallest quantity that the scale in question can reliably weigh. N.B.: Each scale, even among two of the same model, has different behavour: each has its own deviations, repeatability, eccentricity and minimum weight.
Compliance with regulations	Many industries are subject to strict regulations that require compliance with measurement standards. Calculating the minimum weight according to the relevant regulations ensures that the scale meets the set requirements.
Process reliability	In the manufacturing industry, for example, it is essential to have accurate scales to ensure the consistency and quality of the production process.
Quality control	In the analytical, pharmaceutical, or food industry, where even small variations can have significant impacts on safety and product/result quality, it is essential to ensure accurate weighing.
Avoiding errors and financial losses	Calculating the minimum weight reduces the risk of measurement errors that could lead to financial losses or compliance problems.

Determining the minimum weight is a key practice to ensure that electronic scales are reliable and able to meet the standards required in different industries.

MINIMUM WEIGHT ACCORDING TO EURAMET CG18

Euramet cg18 establishes criteria and procedures for determining minimum weight, defining minimum weight as the smallest measurable amount of mass with an acceptable uncertainty. To calculate the minimum weight, it is necessary to consider instrument-specific requirements, calibration results (deviations and uncertainties), and follow the procedures described in Euramet cg18. These include evaluating the total measurement uncertainty and its relationship to the relevant minimum weight.

The determination of minimum weight involves several key factors:

Measurement uncertainty	Measurement uncertainty is an estimate of the dispersion of measurement values around the true value. It must be evaluated in relation to the minimum weight to ensure that the balance can detect changes in mass below this limit.
Calibration uncertainty	Calibration of the balance is the process of adjusting it to ensure that it provides accurate readings. The calibration uncertainty contributes to the total uncertainty and, therefore, affects the determination of the minimum weight.
Weight sample uncertainty	If weight samples are used to calibrate the scale, the uncertainty associated with these samples must be taken into account when calculating the minimum weight..
Normative requirements	Several industries are subject to specific regulations that establish requirements for measurement accuracy. For example, in the pharmaceutical industry, scales must comply with Good Manufacturing Practice (GMP) standards.
SeScale sensitivity	The sensitivity of a scale is the smallest change in mass that can be detected.

To calculate the minimum weight, these factors are evaluated together, taking into account the scale specifications and industry requirements. This ensures that the scale can accurately measure even the smallest masses, minimizing the risk of error and ensuring compliance with quality and safety standards.

MINIMUM WEIGHT AND SAFE WEIGHING RANGE

It is usual practice for users to define specific requirements for the performance of an instrument. Usually upper thresholds are defined for measurement uncertainty values that are acceptable for a specific weighing application.
Typically, these requirements are stated as a relative value, such as meeting a measurement uncertainty of 0.1 percent.

For a given tolerance requirement, Req, only weighings with an overall relative uncertainty Ugl(W)/R ≤ Req meet the respective user requirement. The limiting value Rmin, i.e., the smallest weighing result that meets the user requirement, is called the "minimum weight."

Since the measurement uncertainty of a weighing result and thus also the overall uncertainty can be difficult to estimate due to specific environmental factors, such as high levels of vibration, air currents, operator-induced influences, etc., or due to influences specific to the weighing application, such as electrostatically charged samples, magnetic stirrers, etc., the measurement uncertainty can be difficult to estimate. The safety factor is a number greater than one by which the user requirement Req is divided.

The purpose is to ensure that the overall relative measurement uncertainty is less than or equal to the user requirement, divided by the safety factor.

This ensures that environmental effects or effects due to the specific weighing application, which have a major effect on the measurement and therefore could temporarily increase the measurement uncertainty beyond the level estimated by the global uncertainty, still allow-with a high degree of safety-the user requirement to be met.

$$\frac{U_{gl(W)}}{R} \leq \frac{Req}{SF}$$

This leads to the definition of the safe weighing range:

IS THE RANGE OF THE INSTRUMENT IN WHICH THE USER CAN WEIGH SAFELY, SATISFYING THE WEIGHING TOLERANCE REQUIREMENT AND MEETING THE DEFINED SAFETY FACTOR.

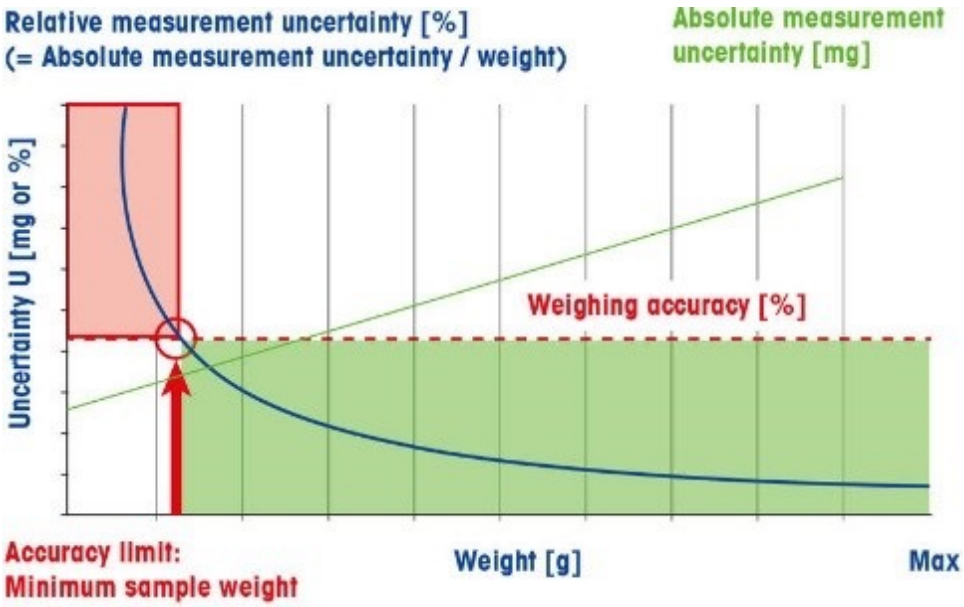

Figure 1. Safe weighing range for a scale derived from calibration data. (Euramet cg.18)

Weighing in the red area results in non-compliance with tolerance requirements, while weighing in the green area ensures compliance with tolerance requirements (safe weighing range). Weighing in the green area meets the user's requirements, but the safe factor is not met. The minimum weight and safe weighing interval refer to the net weight (sample) being weighed on the instrument, i.e., the mass of the vessel (tare) does not have to be considered to meet the user's requirement.

Therefore, the minimum weight is often called the "minimum sample weight."

THE NEW GIBERTINI ACCREDIA CERTIFICATE

CERTIFICATO DI TARATURA **LAT094100B/23**
Certificate of Calibration

Incertezza globale estesa espressa rispetto ad una generica lettura ***R***
Extended global uncertainty expressed with respect to a generic reading R

-La formula deve essere utilizzata per la stima dell'incertezza considerando gli errori di indicazione.
Il valore R rappresenta l'indicazione del carico netto nell'unità di misura dello strumento.
-The formula should be used to estimate the uncertainty considering the indication errors.
The R value represents the indication of the net load in the unit of measurement of the instrument.

Incertezza del risultato di pesata Ugl(R):
Uncertainty of the Ugl(R) weighing result:

8,70 * 10^-5 + 3,03 * 10^-6 * R

Misurazione dell'incertezza assoluta e relativa in uso per indicazioni di peso netto
Measurement of absolute and relative uncertainty in use for net weight indications

Indicazione in % *Indication %*	Indicazione R *Indication R*	Incertezza di misura Ugl(W) *Measurement uncertainty Ugl(W)*	Incertezza di misura relativa Ugl(W) rel *Relative measurement uncertainty Ugl(W) rel*
0,1 %	0,060 g	0,000 17 g	0,29 %
1 %	0,60 g	0,000 18 g	0,029 %
10 %	6 g	0,000 19 g	0,003 2 %
25 %	15 g	0,000 22 g	0,001 5 %
50 %	30 g	0,000 26 g	0,000 88 %
75 %	45 g	0,000 31 g	0,000 69 %
100 %	60 g	0,000 36 g	0,000 59 %

The new Gibertini Accredited Certificate also expresses the "Global Uncertainty," or measurement uncertainty for the user, in the form of a linear equation. A typical example of "Global Uncertainty" for a laboratory balance on a calibration certificate may look like this:

Ugl (W) = 8.70 - 10-5 g + 3.03 - 10^{-6} - R

This equation allows calculation of the expanded measurement uncertainty Ugl (W) for each weight value R within the Weighing Range.

Expressed in absolute terms, this translates into uncertainties between

Ugl (0) = 8.70 - 10-5 g + 3.03 - 10^{-6} - 0 g = 0.000087 g and
Ugl (Max) = 8.70 - 10-5 g + 3.03 - 10^{-6} - 60 g = 0.00036 g.

Expressed in relative terms, this uncertainty is negligible at high loads (at Max: 0.00036 g/60 g = 0.00059 %), but increases at low loads (at minimum load d = 0.00001 g: 0.00087 g/0.00001 g = 87 %).

CERTIFICATO DI TARATURA **LAT094100B/23**

Certificate of Calibration

PESATA MINIMA

Minimum Weight

Pesi Minimi per le diverse tolleranze di pesata e fattori di sicurezza / *Minimum weights for different weighing tolerances and safety factors.*

I valori riportati nella tabella sottostante costituiscono i valori minimi corrispondenti ai diversi processi di precisione con altrettanto diversi fattori di sicurezza ; nel caso di multipli intervalli di scala il valore minimo è riportato solo per la risoluzione maggiore.

The values in the table below are the minimum values corresponding to different precision processes with equally different safety factors; in the case of multiple scale intervals, the minimum value is reported only for the highest resolution.

Tolleranza / Accuracy	**Fattore di sicurezza / Safety Factor**				
	1	2	3	5	10
0,1 %	0,087 g	0,18 g	0,26 g	0,44 g	0,90 g
0,2 %	0,044 g	0,087 g	0,13 g	0,22 g	0,44 g
0,5 %	0,017 g	0,035 g	0,052 g	0,087 g	0,18 g
1,0 %	0,008 7 g	0,017 g	0,026 g	0,044 g	0,087 g
2,0 %	0,004 4 g	0,008 7 g	0,013 g	0,022 g	0,044 g
5,0 %	0,001 7 g	0,003 5 g	0,005 2 g	0,008 7 g	0,017 g
10,0%	0,000 87 g	0,001 7 g	0,002 6 g	0,004 4 g	0,008 7 g

The concept of the minimum sample weight according to EURAMET cg-18 stipulates that the user set the maximum relative measurement uncertainty, for example, to 1 %. (Tolerance)
With a relatively simple calculation it can be seen that the sample weight must always be at least 0.0087 g - See Table - at this load, the relative measurement uncertainty is exactly the required 1 %; at higher loads, the relative measurement uncertainty is lower and at lower loads it is higher.

In many application areas, it is common practice to include an additional safety factor (SF) that is used to multiply the measurement uncertainty.
If the user selects, for example, a safety factor of SF = 2, this corresponds to a multiplication of the previous equation for Ugl (W) by 2.

Relative measurement uncertainty multiplied by a safety factor is commonly referred to as process accuracy. The choice of safety factor affects the amount to be weighed to consistently maintain an accuracy greater than that required.

For example, if the required process accuracy is 1 percent with a safety factor of 2, the resulting value would be 0.017 g .

DETERMINATION OF PROCESS ACCURACY AND SAFETY FACTOR ACCORDING TO EURAMET CG-18

The freedom to be able to define the process precision (tolerance) and safety factor for determining the minimum sample weight makes some users uncertain and makes them wonder what values are appropriate.

In general, users must decide for themselves in line with their process requirements.
However, there are obviously some basic recommendations that should be followed:

- First, it should be checked whether there are specifications in regulations, directives, etc., for the specific application. Although a specification for scales is very rare, there are general specifications for process accuracies and safety factors for all types of measuring instrumentation in some directives.

- In addition, the values for process accuracy and factor of safety should be chosen according to one's requirements and process specifications.

For example, it makes no sense to set a process accuracy of 0.1 percent if the work instructions or procedures specify that sample weights can have a tolerance of 1 percent.

For the safety factor in particular, further considerations can be made as to what should be achieved with this "additional safety."
A safety factor >1 may also be useful to compensate for the fact that the balance may be used in worse conditions (e.g., rain during outdoor weighing, scales under a chemical fume hood) than in

HOW DO I CHOOSE THE ACCURACY AND SAFETY FACTOR FOR THE MINIMUM WEIGHING CALCULATION?

The choice of accuracy and safety factor for minimum weighing changes depending on the specific industry sector or laboratory. Below, we provide some general guidelines for different industries:

DEPARTMENT	ACCURACY	SAFETY FACTOR
Pharmaceutical Industry	**High.** Pharmaceutical manufacturing requires extremely high accuracy to ensure product quality and safety. Accuracy should be in line with specific pharmaceutical regulations.	A high safety factor is recommended to handle variations in production conditions and ensure compliance with strict industry standards.
Food Industry	**Moderate to high.** The food industry requires significant accuracy to ensure compliance with food quality and safety	A moderate safety factor may be sufficient, but should be considered based on the complexity of the production process.
Chemical Industry	**Moderate to high.** Accuracy is important to ensure safety and consistency in chemical measurements.	Moderate to high safety factor, especially if there are risks related to chemical reactivity of weighed materials.
General Manufacturing Industry	**Moderate.** In many manufacturing applications, accuracy is important, but it does not always require the same precision as in industries such as pharmaceuticals.	A moderate safety factor may be adequate unless there are special quality control requirements.
Research and Development Laboratory	**High.** In a research environment, high accuracy is often required to ensure reliable and reproducible results.	A moderate safety factor, but priority might be given to accuracy for research purposes.
Aerospace Industry.	**Very high.** The aerospace industry requires extreme accuracy to ensure safety and reliability of components.	A high safety factor should be built in, given the high degree of precision required.
Environmental Sector	**Moderate**. In environmental measurements, accuracy is important, but precision can change depending on specific purposes	A moderate safety factor, unless there are specific requirements to monitor hazardous substances.

ACCURACY

The required accuracy can be influenced by several factors, and should be determined by considering

Industry regulations	Some industries have specific regulations that establish precision requirements for weighing. For example, the pharmaceutical or food industry may have rigorous standards.
Quality control	If your application requires rigorous quality control, higher accuracy may be required..
Related Risks	If there are significant risks associated with variations or inaccuracies in measurements, greater accuracy may be required.
Process Specifications	The specifics of the manufacturing process may require a certain level of weighing accuracy.
GLP Good Laboratory Practices	In analytical or research laboratories, good laboratory practices may require specific accuracy.

Generally, it is advisable to determine the required accuracy based on a complete assessment of the specific requirements of the application. Industry standards and guidelines, if any, often provide important guidance on what levels of accuracy are appropriate for a particular application.

SAFETY FACTOR

The safety factor should be determined by considering:

Normative del Settore	Alcune normative o standard del settore possono specificare requisiti relativi al fattore di sicurezza per la taratura e la pesata.
Rischi Associati	Se ci sono rischi significativi associati a variazioni o imprecisioni nelle misurazioni, un fattore di sicurezza più elevato potrebbe essere più appropriato.
Buone Pratiche di Taratura	Linee guida metrologiche e pratiche di taratura possono fornire indicazioni sulla determinazione del fattore di sicurezza.
Requisiti di Qualità	I requisiti di qualità dell'applicazione possono influenzare la scelta del fattore di sicurezza, soprattutto se il processo richiede una maggiore robustezza.
Esperienza e Conoscenza del Processo	L'esperienza e la conoscenza del processo specifico possono guidare la scelta del fattore di sicurezza, considerando le variazioni previste nel processo.

FOR EXAMPLE, STANDARDS SUCH AS EURAMET CG18 FOR THE CALIBRATION OF ELECTRONIC SCALES CAN PROVIDE INFORMATION ON THE DETERMINATION OF THE SAFETY FACTOR.

It is important to note that the choice of safety factor must be balanced between ensuring a reliable measurement and avoiding applying an overly conservative safety factor which could result in additional costs without any real benefit in terms of accuracy. Consulting with industry experts and metrologists can be invaluable in making informed decisions based on your specific needs.

HOW TO CHOOSE THE LEVEL OF ACCURACY FOR THE MINIMUM WEIGHING IN AN ANALYSIS LABORATORY

The choice of the level of accuracy for minimum weighing in an analytical laboratory depends on the nature of the analyzes performed and the specific requirements of the application. However, high precision is usually required in analytical laboratories. Here are some considerations for the accuracy levels provided:

ACCURACY	APPLICATIONS	CONSIDERATIONS
0.1%	High precision chemical analysis, metrological standards	Suitable for laboratories that require maximum precision in measurements.
0.2%	Advanced chemical analysis, quality control in critical sectors.	A high level of precision suitable for laboratories with rigorous needs.
0.5%	Precision chemical analysis, research and development sectors.	It may be adequate for many laboratory applications, but check whether it meets your specific requirements.
1%	General chemical analyses, quality control.	Suitable for many standard laboratory applications, but may be limited in more precise analyses.
2-10%	Less precision sensitive applications, general laboratory operations.	These accuracy levels may be acceptable for less precision-critical applications.

In analytical laboratories the tendency is to obtain the highest possible precision, and therefore accuracy levels between 0.1% and 1% are to be preferred. However, it is essential to evaluate the specific needs of the laboratory, considering the requirements of the analyzes carried out, the applicable regulations and the precision required, to guarantee reliable and reproducible results.

HOW TO CHOOSE THE LEVEL OF ACCURACY FOR THE MINIMUM WEIGHING IN INDUSTRY

The choice of accuracy level for minimum weighing in industry depends on the specific application, manufacturing requirements and industry regulations. Below, we provide some general considerations for accuracy levels:

ACCURACY	APPLICATIONS	CONSIDERATIONS
0.1%-0.2%	High-precision industries such as pharmaceutical, aerospace or electronics..	These levels of accuracy are suitable for industries where precision is crucial to product quality.
0.5%-1%	Process industries, electronics manufacturing, automotive.	Suitable for many industrial applications where precision is important but does not require extremely high levels.
2-10%	Industries less sensitive to precision, production of building materials, logistics.	It may be acceptable for applications where accuracy is less critical and factors such as robustness and process speed are more important.

Some additional considerations include:

Industry regulations	Check to see if there are industry-specific regulations that establish weighing requirements.
Quality control	If the industry requires rigorous quality control, it is likely to require higher weighing accuracy.
Operating Environment	Consider the operating environment in which the scale will be used. Factors such as temperature, humidity and vibration can affect the accuracy of measurements.
Production process	Evaluate how the minimum weight fits into the production process. If precision is critical to the final product, it is advisable to opt for higher levels of accuracy.

In general, it is advisable to consider the right balance between precision, reliability and cost, in order to meet the specific needs of the industry.

HOW TO CHOOSE THE SAFETY FACTOR IN CALCULATION OF THE MINIMUM WEIGH FOR AN ANALYSIS LABORATORY

The choice of safety factor for calculating the minimum weight in an analytical laboratory depends on several factors, including the precision requirements of the analysis, the level of acceptable uncertainty and the operating conditions of the laboratory.

SAFETY FACTOR	APPLICATIONS	CONSIDERATIONS
1	Research and development laboratories, analysis where precision is critical but the risks associated with loss of precision are manageable.	A safety factor of 1 is appropriate if the laboratory can accurately manage risks and variations in operating conditions.
3	Chemical analysis laboratories, quality control environments..	A safety factor of 3 may be appropriate for applications where greater robustness against occasional variations and inaccuracies is required.
5	Advanced chemical analysis laboratories, high precision sectors.	This level of safety factor is suitable for laboratories where precision is of utmost importance and where the possibility of variations is minimized.
10	Metrological standards laboratories, analysis of critical substances.	A safety factor of 10 is particularly suitable for applications where accuracy is crucial and any variation could have a significant impact.

The safety factor should be chosen to provide sufficient coverage to handle any variations or inaccuracies in the weighing process without compromising the quality and reliability of the analyzes conducted in the laboratory.

HOW TO CHOOSE THE SAFETY FACTOR FOR INDUSTRY

The choice of safety factor in an industry depends on various factors, including the specific industry, the criticality of the measurements, regulatory compliance and acceptable error tolerance. Below, we provide some general considerations for safety factor levels:

SAFETY FACTOR	APPLICATIONS	CONSIDERATIONS
1	Industries where accuracy is not critical and the weighing process is relatively stable and controlled..	It may be suitable for less precision-sensitive industrial applications, where the safety factor can be managed internally.
3	Process industries, general manufacturing, where precision is important but not critical.	A safety factor of 3 offers greater robustness against occasional variations or inaccuracies, suitable for applications where accuracy is important but not critical. .
5	Industrial sectors with higher precision requirements, advanced quality control.	Suitable for industries where precision is a significant aspect of the manufacturing process and where greater security against variations is required.
10	High precision industries such as aerospace, medical device manufacturing, where precision is critical.	This safety factor level is appropriate for applications where accuracy is of utmost importance and where even small variations can have significant impacts.

The choice of safety factor should take into account various factors, including the risks associated with variations in operating conditions, the criticality of the measurements to product quality, compliance with industry regulations, and the cost associated with higher levels of accuracy.

WHY SHOULD I REQUEST THE CALCULATION OF THE MINIMUM WEIGHT DURING THE CALIBRATION PHASE?

Requesting the calculation of the minimum weight during the calibration phase is an important practice for several reasons:

Accuracy of measurements	This is especially critical in industries where measurement accuracy is critical, such as scientific research, pharmaceutical manufacturing and chemical analysis.
Regulatory compliance	In many industries, there are stringent regulations that require compliance with measurement standards. Calculating the minimum weight during calibration ensures that the scale meets industry-specific regulatory requirements..
Quality control	The minimum weight is directly related to the sensitivity of the scale. Knowing the minimum weight helps ensure that the scale is able to detect even small changes in mass, contributing to the quality control of the production process.
Error prevention	By requiring minimum weight calculation, you reduce the risk of measurement errors, which can lead to inaccurate results, wasted material and potential compliance issues
Performance optimization	Knowing the minimum weight allows you to optimize the performance of the scale for its specific use. Accurate calibration against the minimum weight helps ensure that the scale is efficient and reliable.
Product safety and quality	In industries such as food and pharmaceuticals, where even small variations can affect product safety and quality, it is essential to ensure accurate weighing, which can be achieved through adequate calibration.

Requesting the calculation of the minimum weight during calibration is a proactive practice that helps to really know what is the smallest quantity of sample that the scale is capable of weighing with a certain safety factor and adequate accuracy.

Specific regulations requiring consideration of minimum weight during calibration may vary by industry and region. However, there are some international guidelines and standards that are often followed in different industries. Here are some examples:

ISO 9001 (Quality Management System)	Although ISO 9001 does not detail minimum weight specifications, it encourages the appropriate management of measurement processes, including the calibration of measurement equipment.
ISO/IEC 17025 (General requirements for the competence of testing and calibration laboratories)	This international standard provides guidelines for the accreditation of calibration and testing laboratories. While it does not explicitly require consideration of minimum weight, it places significant emphasis on the accuracy of measurements. (General requirements for the competence of testing and calibration laboratories)
Ph.Eur. (European Pharmacopeia)	In the pharmaceutical industry, the Ph.Eur may contain specific guidelines on the calibration of measuring instruments, including the minimum weight for scales used in pharmaceutical environments.
GMP (Good Manufacturing Practice)	The pharmaceutical and food industries often follow GMP guidelines which may include detailed requirements for the calibration of electronic scales, including minimum weight..
Euramet cg18 (Guidelines on the Calibration of Non-Automatic Weighing Instruments)	This is a specific guide for the calibration of electronic scales in Europe. Includes guidelines on determining minimum weight.
Industry-specific regulations	Some industries, such as the aerospace or automotive industry, may have specific regulations that require minimum weight to be considered when calibrating scales used in critical processes.

IN WHICH SECTORS IS THE MINIMUM WEIGHING MANDATORY OR SHOULD IT BE CARRIED OUT?

The need to carry out the minimum weighing of scales may vary depending on the sector and specific regulations.

Some industries where minimum weighing is particularly important include:

Pharmaceutical industry	Accurate weighing is critical to ensure correct dosing of active ingredients in medications.
Food industry	In the food and beverage industries, weighing accuracy is critical to meeting quality and food safety standards.
Chemical industry	In the chemical industry, accurate weighing is essential to prepare chemical mixtures and substances safely and in compliance with regulations.
Research and analysis laboratories	In scientific laboratories, weighing precision is essential to obtain reliable results in chemical and physical analyses.
Healthcare sector	In environments such as hospitals and medical laboratories, accurate weighing is necessary for the preparation of drugs and diagnostic tests.
Manufacturing industry	In several manufacturing sectors, weighing is used to control the quantity of materials used in production processes.

WHY IS WEIGHING BELOW THE MINIMUM WEIGHT OF THE SCALE UNRELIABLE?

Weighing below the minimum weight of a scale can lead to unreliable results for several reasons:

Sensitivity and Accuracy	Scales are designed to be most accurate in the middle portion of their weighing range. Below the minimum weight, the sensitivity of the scale may decrease, and the accuracy of the results may be compromised.
Calibration Error	Scales must be calibrated to ensure their accuracy. However, below the minimum weight, the calibration error can become significant, negatively affecting the accuracy of the measurements.
Environmental effects	Environmental factors such as drafts, vibrations or temperature changes can affect measurements more when working below the minimum weight of the scale.
Linearity	Scales have a linear relationship between the actual weight and the electrical signal generated. Below the minimum weight, this linearity may not be guaranteed, leading to unpredictable behavior.
Mechanical Stability	The mechanical stability of the scale may be compromised when weighing below the minimum weight. This can lead to unwanted fluctuations and unstable results.

To obtain accurate and reliable results, it is important to use the scale within its rated weighing range or, if necessary, consider using weighing instruments more suitable for measuring small quantities. Consulting manufacturer specifications and following recommended calibration and usage procedures are critical to ensuring reliable results in weighing operations.

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These are only general guidelines, and specific needs may vary even within the same industry. In any case, it is important to take into account specific regulations, environmental conditions, associated risks and manufacturing process requirements to determine the appropriate accuracy and safety factor. Advice from industry experts, especially in specific regulatory areas, can be invaluable.

Reference

[1] JCGM 200 (VIM), “International Vocabulary of Metrology – Basic and General Concepts and Associated Terms”, 3rd ed., JCGM, 2010.
[2] ISO 5725-1, “Accuracy (trueness and precision) of measurement methods and results – Part 1: General principles and definition”, International Organization for Standardization, Geneva, 1994.
[3] ISO/IEC 17025, “General Requirements for the Competence of Calibration and Testing Laboratories”, International Organization for Standardization, Geneva, 2017.
[4] EURAMET cg-18, “Guidelines on the Calibration of Non-automatic Weighing Instruments”, 4th ed., EURAMET, 2015.
[5] OIML R111-1, “Weights of Classes E1, E2, F1, F2, M1, M1–2, M2, M2–3 and M3, Part 1: Metrological and Technical Requirements”, OIML, 2004.
[6] A. Reichmuth, “Weighing Small Samples on Laboratory Balances”, Proceedings of the 13th International Metrology Congress, Lille, France, 2007.

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