Weighing Guide

A Practical Guide on Workflow Optimization and Data Handling

Efficient Weighing Workflows

In the Pharmaceutical Industry

METTLER TOLEDO

Streamline Your Lab Processes
and Increase Your Productivity

Dear Reader,

In the highly regulated pharmaceutical industry, whether in a general, R&D, production or QC facility, there is an intense focus on laboratory efficiency and productivity and, simultaneously, there are demanding GLP/GMP requirements to meet. The industry is under ever-increasing pressure to improve the efficiency of its procedures, adopting lean processes and automation to try to reduce time-intensive procedures, and using tools such as Six Sigma and POBOS (Pharma Operations Benchmarking of Solids, McKinsey & Company) to help improve performance.

This guide discusses how optimum efficiency and productivity can be achieved by carefully analyzing laboratory procedures, identifying – and, as far as possible, eliminating – any particular inefficiencies, and introducing standardized processes. Weighing is the most important step in virtually any analytical procedure. For many typically occurring issues in pharmaceutical workflows, automation is the solution, helping to streamline procedures and eliminate the potential for manual errors, and ensuring regulatory compliance is maintained. Five typical pharmaceutical workflows are discussed and process improvements suggested.

METTLER TOLEDO

1 Applications and Workflows

Many pharmaceutical processes can benefit from the latest advances in weighing technology and laboratory software. Each application – capsule filling, preparation of culture media, sample preparation for titration, standard preparation and quantitative elemental analysis – involves a workflow consisting of a series of step-by-step actions, many of which are used in research, drug development, production and quality control (Fig. 1).

Fig. 1: Typical applications, where accurate weighing is essential, used in the various stages of drug discovery and development.

The following sections describe the most common use of each individual workflow, identifying potential pain points and highlighting possible solutions.

1.1 Capsule Filling

Workflow description

Pre-clinical and early clinical studies are the most cost- and time-intensive phases of drug development, requiring patient pools to be carefully monitored to correctly assess a drug's effectiveness. The integrity of information relating to the study, including patient identification and experimental data used to evaluate the drug, must always be maintained.

A typical workflow (Fig. 2), involves:

A. Checking the test subject's identification and recording the weight
B. Calculation of the individual fill weights per capsule
C. Accurate weighing of each compound into the capsule
D. Administration and documentation of the prepared dose per test subject

Fig. 2: Workflow of a typical capsule filling process in pre-clinical and early clinical phases.

Workflow challenges and potential improvements

The capsule filling process has a number of challenges:

- Dispensing drug components of known potency into small capsules is a very time consuming task and can have a potential health risk for the laboratory technician.
- Maintenance of proper documentation: When individual weights are required there is an increased risk of incorrect reading, recording or inputting the actual weight, with potentially disastrous consequences for the test subject.

Automation could streamline the whole procedure. An automated capsule filling system is much faster than dosing manually, making huge time savings for your lab. Furthermore exposure of lab personnel to toxic substances is minimized. Software integration and data transfer in your clinical assay management software could eliminate the potential for manual transcription errors.

Solutions

Whether filling individual capsules or entire series – Quantos dosing systems offer a modular solution for every application. You can choose to upgrade your XPE analytical balance into a 1-to-1 system for individual filling or a fully automatic dosing system (Fig. 3)

1-to-1

Configuration	QB5
Number of target containers	1

1-to-12

Configuration	QB5
	+ Ergodisk
Number of target containers	12

1-to-30

Configuration	QB5
	+ QS30
	+ QuantosConnect
Number of target containers	30
Sample change	automatic

Fig. 3: Whether you use a 1-to-1, 1-to-12 or 1-to-30 dosing system, with Quantos you can work fast, safe and with full documentation throughout the process.

Quantos is the ideal solution for small batch dispensing. With its great flexibility, it is a compact, affordable investment that fits neatly between manual filling methods and costly high-throughput filling machines. Quantos has the unique ability to dose different target amounts per capsule, as well as pure API without excipient from just 1 mg. Fill weights are automatically recorded. Quantos also protects the analyst by minimizing exposure to the substances contained in the dosing head.

The Quantos automated dosing technology allows automated dispensing of small quantities – from 1 to 100 mg – of drug directly into capsules down to size 4 can be achieved without spillage (Fig. 4).

Fig. 4: Fully automated capsule filling, XPE analytical balance equipped with a Quantos QS30 autosampler.

Quantos dosing systems can also seamlessly integrate to PDS ToxData® clinical assay management software (PDS Pathology Data Systems, Ltd.) to provide two way data transfer, helping to support complex study designs (Fig. 5).

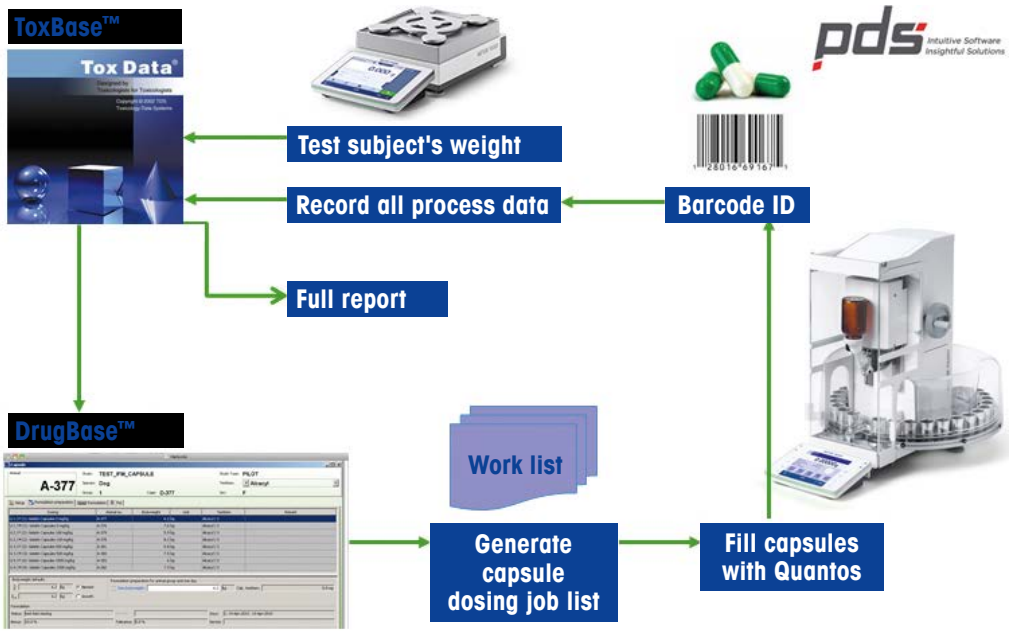

Fig 5: Seamless data transfer, automation and plausibility checks prevent errors in the study.

1.2 Preparation of Culture Media

Workflow description

Culture (growth) media – nutrient solutions used in molecular biology or microbiology laboratories to grow microorganisms – are prepared through a formulation process whereby specified amounts of the individual constituents (powders, gels and liquids) of the media are singularly dispensed and the required quantities weighed out in the right proportions directly into the tare container to create a predefined mixture (Fig. 6). Target quantities may vary according to the final volume needed. Because some of the ingredients may smell unpleasant, or may be toxic or dusty, media solutions are generally prepared in fume hoods or other ventilated enclosures, typically using precision balances with readability ranging from 1 mg up to 0.01 g of the dispensed components. Trace elements – for example copper and iron – present at much lower concentrations, are usually weighed separately on an analytical balance.

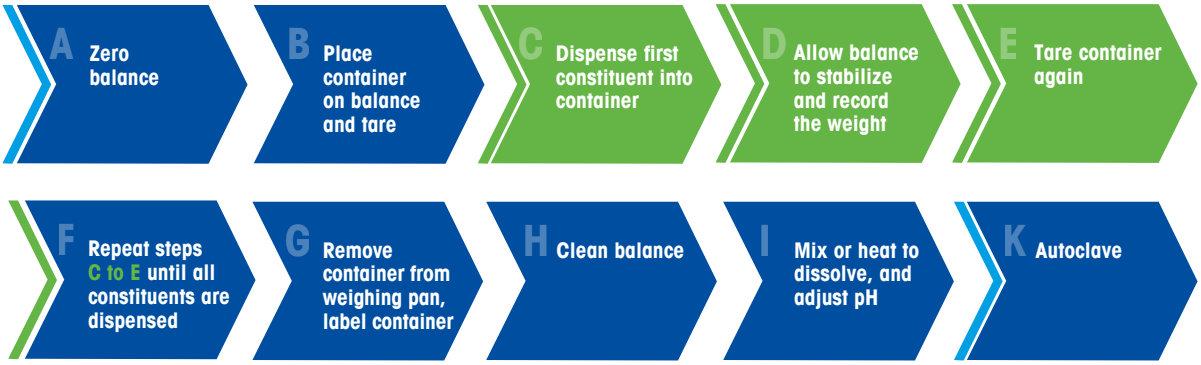

Fig. 6: Typical workflow for preparation of culture media – a tedious process, especially when 30 or more formulation components are involved

Workflow challenges and potential improvements

Culture media mixtures often consist of 30 or more components and this formulation process needs high attendance and concentration – even the fastest lab worker may need 1.5 h to prepare such a mixture. Weighing is performed in a variety of lab ware, from weighing boats up to five liter beakers; weighing boats are often preferred for easier correction in the event of incorrect dispensing. Several influences, e.g. air flow, electrostatic charges or magnetic stirrers, may act as a force on the weighing pan, giving rise to issues such as difficulty in taring the balance, drifting and unstable readings, longer settling times, and poor weighing accuracy. Consequently, the task becomes even more time consuming, productivity is reduced, and it may even be necessary to repeat preparation of the medium.

Weighing issues arising from the use of a safety cabinet or fume hood can be minimized using dedicated draft shields to protect the weighing pan and the tare container from the influence of drafts. While this is an excellent solution for the prevention of weighing errors, there are still some drawbacks that must be taken into consideration:

- During weighing operations, the draft shield doors must be opened and closed several times, which is time-consuming.
- The operator's hands, tare containers, media constituents and samples must pass through the lateral openings in the draft shield to access the weighing pan; ergonomics drastically deteriorate.
- Bulky and/or heavy tare containers are difficult to handle.
- The draft shield is an additional item to clean, often requiring several parts to be dismantled to allow thorough cleaning.
- Some compounds are sticky and hard to remove. For thorough cleaning, some parts of the draft shield and the weighing pan may need to be cleaned in a dishwasher.

To ensure complete traceability, information crucial to the process must be recorded. This includes the user ID, recipe name, date and time of preparation, expiry date, batch number, compounds used, quantity required, tolerances, quantity dispensed, and pH value. Often, this will take the form of handwritten records in a laboratory notebook and instrument printouts of weight and pH, which is both time consuming and prone to human error.

Solutions

Solutions for many of these issues lie in the appropriate choice of weighing equipment and accessories. The XPR and XSR precision balances offer readabilities between 0.1 mg and 0.1 g for weighing small samples all the way up to 10 kg and are equipped with the innovative SmartPan™ weighing pan which works by minimizing the effects of air currents on the weighing cell (Fig. 7). The extraordinary stability provided by SmartPan enables you to weigh-in with 1 mg readability without a draft shield even where moderate drafts may occur. In a fume cupboard or safety cabinet, models with SmartPan deliver results up to twice as fast as with a standard pan (under these conditions a draft shield is required for 1 mg models). Spillages remain on the pan base for safe disposal and cleaning.

Fig. 7: The innovative SmartPan™ weighing pan of the XPR and XSR precision balances minimizes the effects of air currents on the weighing cell resulting in the dramatic improvement in settling time and repeatability. Even in a fume cupboard, SmartPan models deliver results up to twice as fast. Repeatability is improved up to two-fold.

The ErgoStand ensures good posture, through expertly considered design. By making your users more comfortable and efficient, your laboratory ultimately benefits from increased throughput and reduced downtime.

Fig. 8: Avoid stresses and strains from working for long periods in front of the balance by placing your terminal on a stand and adjusting the tilt to suit your height; the display is easier to read and good posture is maintained.

The XPR and XSR analytical balances are equipped with a minimal surface area SmartGrid™ hanging weighing pan, which lessens the effect of air turbulence in the weighing chamber when compared to a conventional weighing pan (Fig. 9).

Fig. 9: The unique SmartGrid™ weighing pan of the XPR and XSR analytical balances ensures fast results. It minimizes the effects of air currents to substantially reduce stabilization times.

Independent left/right, automatic draft shield doors also reduce air flow in the weighing chamber, and hands-free operation of the draft shield and balance taring decrease the risk of cross-contamination (Fig. 10). The overall effect is shorter stabilization times and faster results.

Fig. 10: The special draft shield of the XPR and XSR analytical balances eliminates strains from awkward dosing processes by enabling you to open the right-hand door with the left hand, or vice versa, so dosing is relaxed and straightforward.

Do not let electrostatic charges influence the weighing process. The StaticDetect™ technology of the XPR analytical balances automatically detects electrostatic charges on samples and containers and provide a warning to the user. With the use of an ionizer, electrostatic charges can be completely eliminated to avoid any influence on the weighing result. (Fig. 11).

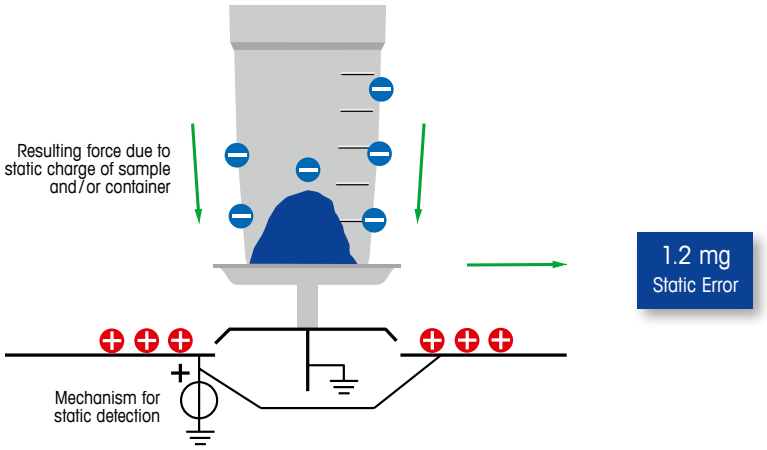

Fig. 11: The StaticDetect technology shows the possible error of static charges on a weighing result in real time and provides a warning if user tolerances are exceeded.

1.3 Sample Preparation for Titration

Workflow description

In the pharmaceutical industry, quality control of a company's different product formulations is of the utmost importance. One such example is the use of titration during quantitative analysis of benzoyl peroxide, the active ingredient in many acne preparations that are applied directly to the skin. It is crucial that the concentration in the preparation is correct. Typically, the workflow (Fig. 12) comprises the following steps:

A. Placing the titration beaker on the weighing pan and taring the balance, manually, or via barcoded samples, recording information such as the compound ID, balance, date, time.
B. Weighing the compound of interest into the beaker.
C. Adding solvent to the desired quantity, e.g. 50 mL.
D. Transferring the beaker to the titrator.
E. Performing the titration.

Fig. 12: Typical workflow for quantitative analysis of an API.

Workflow challenges and potential improvements

For regulated industries such as pharmaceuticals, traceability is vital. Each step of the process must be rigorously documented to ensure regulatory demands are met, often requiring manual checking of sample ID and data recording. Particular attention should be paid to:

- The inherent risk of transcription errors when manual record keeping is employed.
- The potential for samples to become mixed up during manual transfer between the balance and the titrator if labels are incorrect or illegible.
- Incorrect transfer of the weighing results to the titrator, generating incorrect data.

Solutions

Process security is essential. The risk of crossing samples can be eliminated by the use of a XPR205 analytical balance with SmartSample™ – an RFID reader and writer – and Smart Tags. Samples are automatically tracked via their Smart Tag – an RFID tag – and all relevant information, including sample ID, weight and titration method, is transferred to the RFID tag for storage. Manual record keeping is eliminated (Fig. 13).

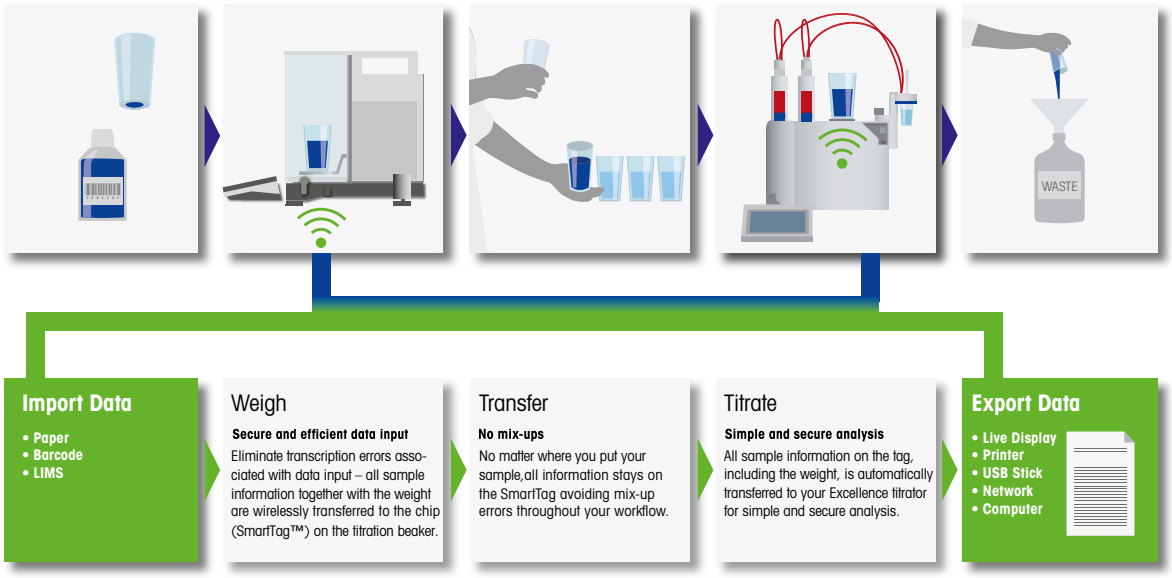

Fig. 13: The SmartSample weighing system for titration automation increases efficiency with RFID technology. Tags attached to the beaker transfer sample information wirelessly, eliminating transcription and ordering errors.

After weighing, the sample is transferred to the titrator – for example the Excellence T9 Titrator with InMotion™ Autosampler – which automatically reads the information from the SmartTag, logs the sample ID and weight, and starts the corresponding method, recording the results automatically.

Fig. 14: Excellence T9 Titrator with InMotion™ Autosampler.

For total traceability of every step of the workflow, the LabX® Laboratory Software – compatible with XPR and XSR balances, as well as the Excellence range of titrators – guides the user through the entire process, automatically recording every result, transferring the weighing results via tag from the balance to the titrator and printing reports, ensuring full data integrity.

Fig. 15: The system of an XPR balance and an Excellence T9 Titrator connected to LabX software offer step-by-step guidance through the entire process and total traceability of every step of the workflow.

1.4 Preparation of Reference Standards and Solutions

Workflow description

The preparation of reference standard and sample solutions is the most common task in all laboratories conducting quantitative analysis. The workflow (Fig. 16) will generally involve a number of different steps, each with its own challenges:

A. Solution preparation. Samples and standards are weighed on weighing paper or in weighing boats, transferred to a volumetric flask and diluted to volume. Serial dilutions are then performed to reach a concentration suitable for analysis.
B. Analysis, for example by HPLC
C. Interpretation of results
D. Data and report storage

Fig. 16: Typical workflow for quantitative analysis in the lab

Workflow challenges and potential improvements

This straightforward workflow can be improved in several ways:

- Eliminating weighing paper/boats by direct dosing into a volumetric flask, reducing the potential for errors due to powder spillage and sample transfer. Back weighing of weighing papers and calculations become obsolete.
- Removal of electrostatic charges from the sample, weighing paper or tare container by using antistatic devices.
- Addition of a label printer to the balance, simplifying sample and standard management.
- Reducing OoS errors in volumetric sample prep by making the shift to mass based methods with enhanced concentration accuracy.
- The use of LabX Laboratory Software, guiding users through every step of the process: dosing, calculations and reporting. This automated procedure complies fully with GxP regulations.

Solutions

METTLER TOLEDO offers a range of weighing solutions to help meet these needs.

Volumetric standard and sample preparation can benefit from METTLER TOLEDO's analytical and micro-analytical balances such as the XPR56 – offering readability of 0.001 mg, a capacity of 50 g, and a typical minimum net sample weight (USP) of 1.4 mg (Fig. 17). ErgoClips allow you to safely position a vast range of tare containers: HPLC sample bottles, test tubes, Eppendorf tubes and PCR tubes, Erlenmeyer flasks and volumetric flasks between 1 and 100 mL for direct dosing into the tare container. Dosing through the small opening in the side door reduces the impact of drafts in the weighing chamber improves repeatability of the net reading by up to a factor 2. For the highest process security, the latest sensor technology and built-in electrode option detect and eliminate any electrostatic charge. Avoid transcription errors and print labels at the time of weighing by adding a label printer.

Fig. 17: Direct dosing into 10 mL volumetric flasks on a micro-analytical balance equipped with ErgoClip flask holder. Transcription erros can be avoided by the addition of a printer.

Gravimetric preparation of standard and sample solutions can help to reduce variability in the process. METTLER TOLEDO analytical balances can be upgraded with a Quantos liquid dosing module (Fig. 18), enabling automated liquid dispensing meeting the requirements of "USP Chapters 41 and 841", improving accuracy and throughput.

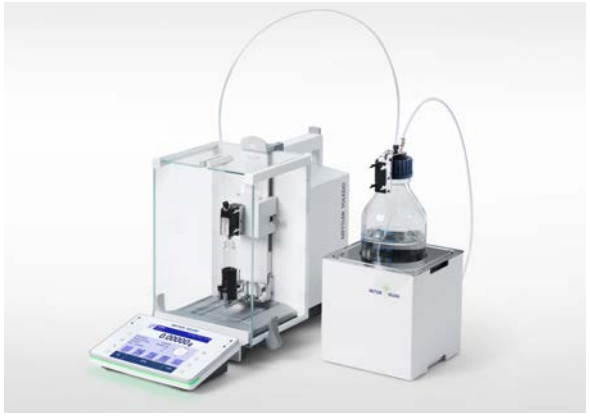

Fig. 18: Gravimetric sample preparation with an XPE analytical balance upgraded with a Quantos liquid dosing module which enables extremely accurate gravimetric addition of liquids and solvents. The analytical balance can still be used in the usual way.

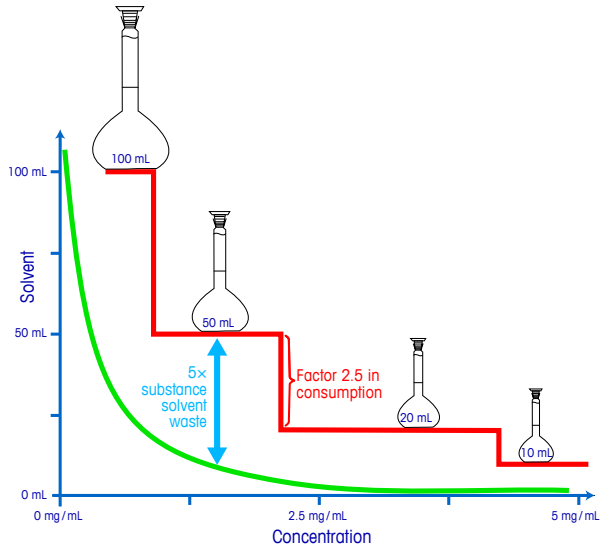

Fig. 19: Save solvents (and money) by preparing smaller amounts of reference substances.

To help boost productivity, processes can be automated using LabX software, providing complete sample traceability and data security. The software database stores details of all active substances and the concentrations for stock solutions, and can be accessed remotely from any connected balance terminal without the need for a directly connected PC. All process data is saved and reports can be printed at any time.

Fig. 20: Quantos liquid dosing system and LabX laboratory software for increased productivity, accurate results and traceable standards, without the risk of manual errors.

1.5 Quantitative Elemental Analysis in Research Labs

Workflow description

Pharmaceutical research and development laboratories typically have just a very small amount of each active ingredient they are investigating, often no more than 50–100 mg. As there are many different analyses to be carried out, each substance must be used sparingly.

For quantitative organic elemental analysis, accurate weighing of samples is a prerequisite since results are calculated on a weight percent basis.

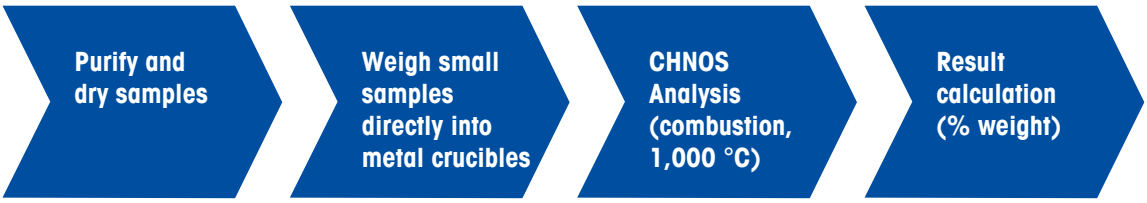

Fig. 21: Typical workflow for elemental analysis.

Workflow challenges and potential improvements

Typical sample weights for elemental analysis are 3 mg with tolerances lower than ±1%. For this reason a microbalance with a reliable performance and a low minimum weight is needed to perform the weighing of the sample into the tin or aluminum crucible.

Usually there are performed 2–3 repetitions per analysis and often 20 or more samples a day plus references are analyzed. However weighing such small quantities requires high concentration and experience. There is always the danger to easily mix up the samples as well as to make mistakes in writing 6-decimal place numbers of the weighing result. Transfer the results to a PC or print it out for documentation could avoid manual transcription errors.

Usually space in research laboratories is limited – instruments with a footprint as small as possible are desirable.

Solution

To make the most of your valuable resources, XPR microbalances and ultra-microbalances deliver a unique level of accuracy with exceptionally low minimum weights (Fig. 22). By setting up Tolerance Profiles you can ensure weighing tasks meet defined quality requirements and regulations. In addition, as the same profile is used each time a specific task is carried out, you can be sure of consistent settings to guarantee traceable results. The GWP Approved function continuously monitors the balance status and ensures you always weigh within the safe weighing range. An on-screen icon is your reassurance of accurate, reproducible results.

The two-terminal concept simplifies operation: The main terminal can be placed wherever is most convenient and the SmartView terminal sits above the weighing chamber – right where you need it for all the basic functions you want as you carry out your weighing tasks. The compact footprint of the XPR microbalance saves valuable space in your laboratory.

The draft shield provides 270° access to the weighing pan to make dosing of small samples easier and more comfortable.

The results notepad of the XPR microbalance simplifies documentation. As you carry out your tasks, all parameters are automatically recorded on the built-in results notepad, an integral part of the main terminal. You no longer need to record results by hand or spend time typing-in data. Simply transfer task parameters and results to a PC or software application via USB. Transcription errors are completely eliminated and the integrity of your data is preserved.

Fig. 22: The high-resolution XPR microbalance incorporates a range of innovative new technologies to deliver the highest accuracy in their class and to help make your micro-weighing tasks simpler, safer and more secure.

2 General Process Optimizations

Balances are precision instruments, requiring care and maintenance to ensure continued correct operation, which plays a critical role in the reduction of day-to-day reproducibility issues.

2.1 Accuracy and Routine Testing

Regular verification and control of weighing equipment is an essential part of ISO, GLP or GMP quality management systems, ideally conforming to a risk management process. It ensures that instruments continually perform to a high standard, meeting specifications and fulfilling current regulatory demands. This requirement is made clear in the OECD (Organisation of Economic Co-operation and Development) publication "Principles of Good Laboratory Practice, Chapter 4.2: Use, Calibration, and Maintenance of Equipment", which states that 'Apparatus used in a study should be periodically inspected, cleaned, maintained and calibrated according to Standard Operating Procedures (SOPs). It is the responsibility of test facility management to ensure that instruments are adequate and functioning according to their intended use'. The US Pharmacopeial Convention takes this one step further, with "USP Chapter 41" recommending the adoption of a risk management approach to scheduled calibration and routine testing of weighing equipment.

The first, and essential, step in any laboratory application or workflow is to ensure that all balances are correctly calibrated and routine testing of equipment is up to date; optimizing maintenance procedures and balance verification intervals will help eliminate inaccurate readings and reduce downtime. Generally, laboratory balances are checked on a regular basis for any deviation in sensitivity – the difference between the calibrated weight and the displayed value, ideally measured at the maximum capacity of the balance – and repeatability, defined as the standard deviation of 10 measurements of a weight below 5% of the capacity of the balance. Further testing, including linearity and eccentricity, is best performed by a fully trained service technician during annual/biannual balance calibration procedures.

METTLER TOLEDO developed GWP®, Good Weighing Practice™, as a standardized scientific methodology for secure selection, calibration and operation of weighing equipment (Fig. 23). GWP ensures that all balances meet the measurement accuracy requirements of quality standards such as ISO, GMP and GLP, providing recommendations for routine testing methods and frequencies, test weights and pass/fail criteria, as well as the adoption of SOPs. A careful choice of the frequency of testing, establishing a schedule that is appropriate for the particular balance and application, eliminates excessive checking and decreasing downtime while maintaining measurement quality and leading to increased productivity. More information: **www.mt.com/gwp**

Fig. 23: The GWP Approved label is the highest quality label in weighing, which confirms that the balance has undergone a risk based assessment (GWP® Verification), in which the safe weighing range has been defined and confirmed according to customer's tolerances and specifications.

Learn more

Webinar "The Global Weighing Standard": **www.mt.com/GWPWebinar**
Part 1: Measurement uncertainty and minimum weight
Part 2: Routine testing of weighing systems

2.2 Data Integrity, Connectivity and Workflow Guidance

Data integrity refers to the maintenance and assurance of data accuracy and consistency over a balance's entire life cycle, as well as secure, error-free data recording and its transfer into and out of Enterprise Resource Planning (ERP) software and Laboratory Information Management Systems (LIMS) throughout the entire workflow. Accurate weighing is essential in all weighing processes – the first step in virtually any downstream analytical procedure – and any errors at this point can have a profound impact on data integrity and product quality.

SOPs should be embraced, and workflow guidance given to all staff in order to increase data integrity. Moving from a manual to an electronic process, adopting automated procedures and data management software that replaces the laboratory journal, spreadsheets and even printouts, can also have a big impact. Fully electronic processes with a single system log-on can be implemented, using the laboratory's LIMS to define a batch of samples for processing, specify procedures and analytical methods, and record all data electronically. By adopting fully guided, paper-free procedures, manual data entries, with the associated potential for transcription errors, are eliminated. Data quality is improved, and all the technical controls necessary to ensure compliance with GxP regulations for electronic records and signatures are incorporated. The time taken to perform a given task is reduced, speeding up the overall process for a fast, efficient workflow.

Learn more

Webinar "The Importance of Data Integrity in a GxP Regulated Laboratory": **www.mt.com/lab-data-webinar**
This webinar will look at the criteria for data integrity, the recent guidance issued by both FDA and MHRA, and the regulatory citations for non-compliance. The presentation will include areas for assessment and improvement in data integrity, such as what constitutes raw data when a computerized system is involved. Practical solutions to improve data management processes and address data integrity weaknesses in a typical laboratory will be discussed.

2.3 External Physical Influences and Cleaning

Balances are sensitive to external influences, which can significantly affect weighing accuracy. Typically, the stability and accuracy of the balance is influenced by:

- Rapid temperature changes, sunlight, and temperature differences between the sample, weighing vessel, balance and the environment
- Air turbulence due to open doors and windows, staff walking past the balance, air conditioning systems, or use of a safety cabinet, fume hood or glove box.
- Electrostatic charges from the weighing vessel, or if the sample becomes electrostatically charged. These charges dissipate very slowly – often taking several hours – from materials with low electrical conductivity, such as glass, plastics, powder or granulates.
- Vibrations from another instrument or device located close to the weighing bench, or from equipment in adjoining rooms – even on floors above and below the laboratory.
- Volatile substances losing weight – for example due to the evaporation of water – or hygroscopic samples gaining weight by absorption of atmospheric moisture.
- Samples with magnetic properties displaying a different weight depending on the orientation of the weighing pan.

These influences may result in balance readings drifting, much longer stabilization times, and weighing results that are not reproducible. In addition, if a fault is identified with the balance itself, a repair may be necessary, temporarily interrupting running procedures. Carefully controlling these external physical influences, reducing or eliminating the effects as far as possible, enables faster, more stable and more accurate weighing, considerably improving the basic weighing steps involved in the workflow, making procedures far easier and less time consuming to perform.

Learn more

E-Learning "External Influences and Cleaning": ▶ **www.mt.com/lab-elearning-influences**
This e-learning course focuses on the 6 most common external influences which can seriously affect weighing results, and also offers solutions and tips to eliminate or at least reduce their effects. It also offers guidelines for the proper location of a balance in the lab, as well as proper methods for cleaning.

In routine lab work, balances are frequently used by different people. To ensure optimum performance, balances should be kept clean and free from dust or contaminants. This also protects subsequent users from accidental exposure to – and contamination from – hazardous substances.

Fig. 24: Cleaning of METTLER TOLEDO balances is easier than ever before. The SmartPan and SmartGrid weighing pans make sure that any spilled substances remain in the tray underneath for safe disposal and cleaning. The complete weighing chamber, weighing grids and draft shields can be disassembled within seconds, and the drip tray removed without tilting. All parts can be cleaned efficiently in just a few seconds and all are dishwasher safe. Smooth surfaces and rounded edges make the whole balance easy to clean.

2.4 Safety Cabinets and Fume Hoods

Many substances are hazardous, and require careful handling within a safety cabinet or fume hood. Unfortunately, this makes weighing an even more tedious and time-consuming task for a number of reasons:

- It can be difficult to access and operate the balance using the safety cabinet's integrated gloves.
- Opening the balance door can cause weighing instability due to air turbulence.
- Electrostatic charges have a greater influence when working under a neutral atmosphere (argon blanket).
- Data handling is difficult; the use of a printer within a safety cabinet is undesirable due to the risk of the paper becoming contaminated.

To help minimize weighing irregularities, dedicated draft shields with automatic, independently operating doors can be used to protect the weighing pan and the tare container from the influence of drafts, along with grid weighing pans that have been cleverly designed to have minimal surface area, reducing the impact of air turbulence. For ease of use, optical sensors and footswitches provide touch-free operation, and the potential for contamination of the balance printout is eliminated by electronic data recording or the use of Bluetooth® technology to enable printing outside of the safety cabinet. The combined effect is shorter settling times and faster results.

Ultimately, by automating the weighing of your substances the balance can work door closed under a laminar air flux with perfect stability and even handle statically charged substances thanks to integrated and automatic anti-static kits.

Learn more

E-Learning "Safe Weighing Under Harsh Conditions": **www.mt.com/lab-elearning-safeweighing**
This e-learning course explains the proper and safe use of balances in safety enclosures. It also aims to provide awareness on safety and risk types when weighing toxic substances, choosing appropriate equipment for your application, common hazards, safe weighing, and maintenance and routine testing.

2.5 User ergonomics

When working at a balance for a long period of time, ergonomics plays an important role. Users should ensure that they adopt the correct sitting or standing position. When seated, the lumbar spine should be supported, and a foot rest shall be used if necessary. Users weighing from a standing position should try to avoid working with the neck or back bent over the worktop or balance (Fig. 25). To ensure that measurements can be read easily by all operators, the balance should incorporate a large-digit display, and the brightness, contrast and display angle should be adjustable. Dual-sided access to the weighing pan enables all users, whether left- or right-handed, to weigh with ease, while optical sensors and footswitches provide hands-free operation of the balance. If heavy weights need to be lifted, placing the balance on the floor or at knee height, if possible, minimizes travelling distances. Simple steps, such as using a chair instead of a stool, or mounting the balance display at eye level – either fixed to the wall or on a terminal stand – can go a long way to increasing user comfort, productivity and health.

Fig. 25: Correct posture and ergonomic, adjustable working places help to avoid health injuries.

Learn more

Checklist to evaluate and optimize your laboratory ergonomics: **www.mt.com/labtec-ergonomics**
This checklist contains 44 questions for self-evaluation of your laboratory workplace. It also includes many useful tips and techniques to work safer and be more productive.

3 Conclusion and Solutions

This guide discusses how optimum efficiency and productivity can be achieved by carefully analyzing laboratory procedures, identifying – and, as far as possible, eliminating – any particular inefficiencies, and introducing standardized processes. For many typically occurring issues in pharmaceutical workflows, automation is the solution, helping to streamline procedures and eliminate the potential for manual errors, and ensuring regulatory compliance is maintained.

4 Useful Links

Laboratory balances, **www.mt.com/balances**
Quantos dosing solutions, **www.mt.com/quantos**
LabX Laboratory Software, **www.mt.com/labx**
GWP and routine testing, **www.mt.com/gwp**
E-Learning courses, **www.mt.com/lab-elearning**

Guide: Proper weighing with laboratory balances, **www.mt.com/weighing-guide**
Everything you need to know about electrostatic influences on weighing, **www.mt.com/lab-static**
SmartPan weighing pans – minimizing the effects of air currents, **www.mt.com/smartpan**
Checklist: Lean lab – optimizing workplaces and workflows, **www.mt.com/lean-lab-checklist**
Checklist: Evaluate and optimize laboratory ergonomics, **www.mt.com/labtec-ergonomics**

On-demand Webinar "Safe and Cost-Effective Capsule Filling for Pre-Clinical and First-In-Man Studies",
www.mt.com/Labtec-capsule
On-demand Webinar: "Preventing Costly Out-of-Specification Investigations",
www.mt.com/labtec-oos
On-demand Webinar "The Importance of Data Integrity in a GXP Regulated Laboratory",
www.mt.com/lab-data-webinar

Accurate Measuring Through GWP®
The Global Weighing Standard

Good Weighing Practice™ (GWP®) is the science based global weighing standard for the efficient life cycle management of weighing systems. The risk-based approach allows you to improve control of your whole measuring process, which in turn helps to avoid costly out of specification results.

Benchmark Your Quality Management System

GWP® Verification helps you assure accurate weighing results as part of your quality management system. Applicable for all balances and scales, it provides an optimized testing and calibrating scheme which may translate to sustainable time and cost savings.

Your Benefits

- The accuracy of your weighing instruments is matched to your process tolerances.
- A comprehensive summary report provides an overview of the status of all weighing equipment.
- An optimized routine testing and calibration schedule results in sustainable cost savings.
- Audit-proof and up-to-date documentation complements your quality management system.

For your success: you focus on your process, we take care of the measurement.

www.mt.com/gwp

www.mt.com/balances

For more information

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