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Ability to Adapt, Prioritize Are Keys to Boosting Productivity

By Kevin Ritchart

With limited staffing, a finite number of working hours, and a wide array of tasks to complete, lab managers are always on the lookout for methods that will make their facility more efficient. The challenge is finding ways to ramp up productivity without sacrificing the health and safety of employees or the accuracy of results.

From helping employees learn to manage their time more effectively to updating lab layouts to create a more functional working space, there are a variety of things lab managers can do to have a positive effect on productivity.

Adapt and Overcome

At its core, time management is the decision-making process that structures, protects, and adjusts a person's time as it relates to changing environmental conditions. Years of research have shown that the three key skills separating success from failure in time management are awareness, arrangement, and adaptation.

Awareness is maintaining a realistic view of time by recognizing it as a limited resource. Arrangement is organizing your tasks and goals to use your time effectively. Adaptation is monitoring your use of time while performing tasks, and adjusting to interruptions and changing priorities.

Prioritization and Productivity

When it comes to optimizing productivity, it's vital to focus on tasks that are aligned with your overall objectives and leave the less pressing matters for later. One method that can help in this pursuit is to employ the Eisenhower Matrix of Prioritization.

This approach helps you to prioritize your tasks by classifying them into four categories: urgent and important, important but not urgent, urgent but not important, and neither urgent nor important.

Using this approach can help reduce the number of unimportant tasks that are completed as a means of appearing busy, when in fact those tasks are having the opposite effect on your overall productivity.

Staffing and Sterilization

Like any area where people congregate and interact, labs had to adapt their operations and designs because of the COVID-19 pandemic.

Some of the more successful strategies for encouraging social distancing and enforcing new health and safety guidelines include staggering shifts to have fewer employees in the lab at one time, implementing new protocols for traffic flow, and enforcing the use of additional personal protective equipment.

But despite these additional steps, sanitizing remains the most effective means of combating infection, both inside and outside the lab. Life sciences labs, many of which already employ strict sterilization protocols, have adopted enhanced cleaning measures used by the hospitality and medical industries.

The equipment that's used most often is identified by the lab manager and cleaned on a regular basis to help reduce the risk of contamination. By employing this approach, the need to shut down equipment for longer periods of time to perform deep cleaning is minimized, which can help increase productivity.

Room to Move

While they've been given greater focus during the COVID-19 pandemic, expansion of lab space and enhanced sanitization are here to stay when it comes to optimizing safety in the lab.

Some companies may seek out new, larger facilities or reallocate existing space to accommodate HVAC enhancements, store additional cleaning supplies and personal protective equipment, and add bench space to give employees ample room to perform their tasks.

While these strategies for improving productivity and adapting lab layouts can be useful, it's important to note that there's no one-size-fits-all approach to enhancing productivity. It may take some time to develop an approach that fits your unique needs.

This content was inspired, in part, by "Designing Labs for Productivity," Lab Manager, February 28, 2020; and "Time Management Is About More Than Life Hacks," Harvard Business Review, January 29, 2020.

Kevin Ritchart is a Thermo Fisher Scientific staff writer.

Better by Design

How Ergonomically Designed Hand Protection Delivers a Safer, More Productive Workforce

The true economic cost of workplace injury is more than lost wages or time. Ongoing medical expenses, lowered production, and increased worker compensation premiums are the more obvious and measurable aspects, but there are hidden costs as well.

Although harder to assess, increased workplace injury rates contribute to heightened stress or anxiety among workers and can potentially lower both morale and productivity. Identifying and managing hazard risks before any issues arise requires the recognition of less obvious relationships and choosing personal protective equipment (PPE) that is ergonomically designed for specific conditions and tasks.

Common Working Conditions

In many industrial environments, repetitive manual tasks are unavoidable. Workers perform labor-intensive activities like lifting or lowering, pushing or pulling, and holding or restraining tools and other items. Such tasks require repetitive hand and arm movement and can lead to hand fatigue that puts more stress on other parts of the body, contributing to injuries.

These actions can become hazardous through repetition, the use of sustained pressure or force, maintaining prolonged or awkward postures, and ongoing exposure to vibration. These stress the body and potentially lead to a variety of musculoskeletal disorders (MSDs). MSDs typically result from gradual wear and tear (triggered by repetition) or are brought on by sudden strenuous activity or unexpected movement.

The hands and arms are particularly susceptible to a range of conditions brought on by performing manual tasks, including:

- Muscle, ligament, or tendon sprains and strains
- Joint and bone injury or degeneration in the shoulder, elbow, or wrist
- Nerve injuries and compression
- Muscular or vascular disorders

Most of these can be acute or become enduring chronic conditions that threaten long-term health and productivity.

Prevalent but Preventable

MSDs are categorized as “body stressing” injuries and diseases. Workplace-related body stressing injury and disease is expensive and widespread. In the European Union, musculoskeletal disorders are the most frequently reported work-related health problem.[1] In Australia, over one third of the total number of worker injury cases and total economic costs are associated with body stressing or manual handling injury.[2]

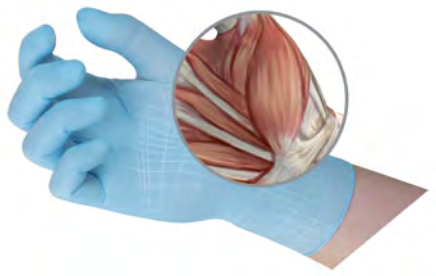
In many cases, operations and safety managers include gloves in programs to mitigate the risk of hand or arm injury. However, issues arise when the chosen “solution” fails to address the immediate requirements. And a poorly selected glove can introduce its own risks.

For example, gloves that restrict movement of the hand or fingers require more muscle effort to perform the required tasks. This increases the risk of strain, which can lead to hand fatigue or persistent and painful conditions such as carpal tunnel syndrome.

Establishing Ergonomics

While safety personnel may be familiar with the concept of ergonomics, they may fail to consider the potential impact of PPE choices or incorporate ergonomic best practices and design principles. Primarily referencing the interaction between the worker’s musculoskeletal system and workspace, ergonomic design aims to minimize exposure to risk factors for MSD while increasing efficiency and comfort.

For gloves, this approach negates the oft-cited “comfort versus protection” argument — anecdotal evidence suggests that workers will simply ignore hand protection solutions that impede function or are otherwise uncomfortable.



If recurring or repetitive tasks are known to place strain on the muscles, nerves, and tendons in one’s hands, performing those activities while wearing thick, rigid, ill-fitting, slippery, or otherwise uncomfortable gloves can exacerbate the problem. Safety and operations managers should select a protective glove designed for the specific hazard types and the functions being performed, considering:

- Fit: gloves that are too small compromise movement; those that are too large restrict dexterity
- Grip: the amount of grip significantly affects the amount of muscle effort required to securely handle, hold, or manipulate objects

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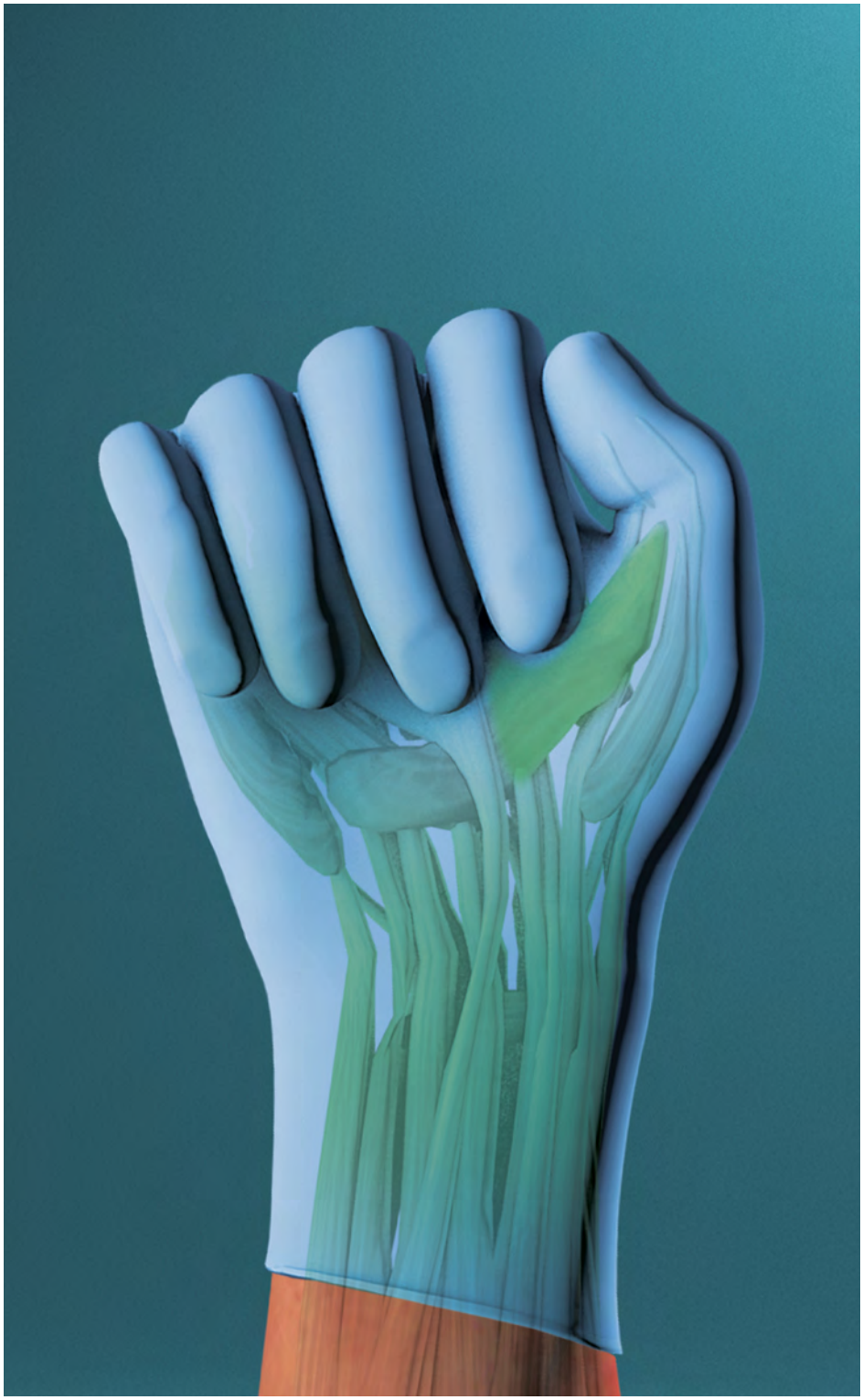
- Construction: materials and comfort dictate overall wearability
- Application-specific issues: wet conditions, contact with abrasive materials, or the use of vibrating machinery present differing needs; assess each application to determine the optimal glove choice

Selection will vary based on these and other factors, but the process should include an assessment of the effect on manual performance to help workers operate both safely and efficiently.

Advances in glove technology deliver superior hand protection while providing much-needed support for musculoskeletal health, so workers no longer have to choose between comfort and protection. By supplying ergonomically designed protective gloves, employers, managers, and operators can help minimize the risk of MSD injury, support safety compliance, and maintain productivity levels.

Ansell ERGOFORM is a new technology used to design hand protection that supports musculoskeletal health during repetitive tasks. We measure the toll of occupational activities and apply cutting-edge technologies to produce our gloves. ERGOFORM certified products have been scientifically proven to deliver measurable improvements in worker comfort, fit, and productivity while reducing risk factors for ergonomic injury.

ERGOFORM™
Ergonomic Design Technology



1. European Agency for Safety and Health at Work, Estimating the cost of work-related accidents and ill-health: An analysis of European data sources, p12

2. Safe Work Australia, The Cost of Work-related Injury and Illness for Australian Employers, Workers and the Community: 2012–13, p31

Air-Sensitive Chemistry: Practical and Safety Considerations

Air-sensitive chemicals are commonly used in academic and industrial chemistry laboratories. Examples of air-sensitive reagents include organometallic compounds like organo-lithium, -magnesium, -zinc, and -aluminium; hydrides; borane complexes; and alkaline metals and several transition metals in their (0) oxidation state. Some of these chemicals are also pyrophoric and spontaneously ignite under standard conditions when they come into contact with air.

Many incredibly useful synthetic reactions are air sensitive, including Grignard reactions, reductions using hydrides, metalations and transmetalations, carbolithiation, and many more. These reactions are widely used to synthesize fine chemicals, drugs, polymers, and many other products.

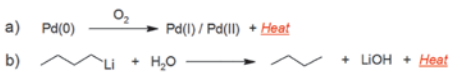
The exposure of these reactions to air, oxygen, or moisture can:

- Favor side-reactions that produce undesired products
- Decompose reagents so that no reaction occurs
- Cause fires, explosions, or other hazardous conditions

Handling Air-Sensitive Reactions

Air sensitivity can be separated into two categories: catalytically and stoichiometrically driven.

Figure 1



A typical example of catalytic air sensitivity, reported in Figure 1a, is the ignition of residual organic solvents or H_2 gas adsorbed on the surface of a reduced Pd (0) catalyst, because of its exothermic oxidation in the presence of atmospheric oxygen. Stoichiometric air sensitivity is very common for many organometallic species, such as the formation of butane gas by reaction of buthyl lithium with water, illustrated in Figure 1b, with strong release of heat that can easily cause a fire.

Handling catalytic air sensitivity requires specialized laboratory apparatus: vacuum lines, Schlenk lines, inert-atmosphere glove boxes, and special reactors. Most of the synthetically useful compounds, however, belong to the stoichiometric category and are frequently used reagents by the majority of chemists.

Extra-dry solvents are another class of air- and moisture-sensitive products, but they do not present intrinsic hazards. In their case, inappropriate handling and storage can cause the product to degrade over time. This is hard to detect but can interfere with experiments, affecting results and often requiring time-consuming troubleshooting.

Laboratory Safety Considerations

While the contact of an extra-dry solvent with moisture may not itself be a hazard, using a water-contaminated solvent in air-sensitive reactions can lead to very dangerous situations. Extra-dry solvents would for this reason be stored with the same care as pyrophoric compounds or solutions and other hazardous substances.

These considerations are very important because laboratory safety is a high priority for industrial and academic researchers alike. During the past fifteen years, there have been multiple high-profile accidents, several of which have been summarily attributed to the inexperience of students working in academic labs. Accidents can rarely be attributed to a single cause, and further investigation of these incidents reveals several contributing factors.

There are no comprehensive datasets about the types and frequency of accidents and near-misses, which makes meaningful laboratory safety research difficult, according to Dana Menard and John F. Trant's review published in *Nature Chemistry* in 2020[1]. Available data, however, show a high incidence of accidents involving reactive gases and pyrophoric materials. Butyllithium, for example, is known to cause problems in academic organic chemistry labs where correct management of air sensitivity can often be an issue.

The presence of more experienced research personnel in industrial and government laboratories may make these labs somewhat safer. However, a study by Schroder and associates[2] found that standardized risk assessments were not routinely used. Industrial and government labs reported higher compliance rates than the average in academic environments, but the average remains worryingly low at 43% and 36% respectively.

Safely Handling Air-Sensitive Chemicals

The use of air-sensitive reagents in chemical research is not new. A significant amount of literature is available to provide foundations for safe handling and operation[3]. An appropriate risk assessment and procedure must be based on the following two practices:

- The use of clean and dry glassware and equipment
- The use of specialized packaging, syringes, and inert dry gases

While the first practice is straightforward, it must be taken seriously. Reagents can react violently in the presence of even tiny amounts of water, and minor air moisture condensation caused by temperature differences between labware and the environment can be enough to cause a fire. The second practice requires a different type of attention. Many air-sensitive reagents and ultra-dry solvents and solutions are specially packaged to help simplify their handling.

AcroSeal Packaging

The Acros Organics and Alfa Aesar brands offer AcroSeal packaging, the industry-leading solution. Its multi-layer septum and innovative anti-tampering cap (with ample surface area) provide convenient and safe storage and dispensing while limiting exposure to the atmosphere. Syringes pass easily through the septum and create only a small hole that self-heals quickly under normal circumstances.

To dispense chemicals from AcroSeal packaging, use a syringe with an 18- to 21-gauge needle and a dry inert gas like nitrogen or argon. First, pressurize the bottle by injecting the gas and then withdraw the desired amount of liquid. Alternatively, use a double or double-tipped needle — one needle to withdraw the liquid and the other to add the inert gas from a gas line or balloon.

Best Practices

Some protocols recommend using glass syringes for pyrophoric reagents, but recent studies[4] suggest that less experienced users may find it easier to substitute a single-use polypropylene Luer lock syringe.

Drying solvents or preparing solutions of air-sensitive reagents can be tedious and time-consuming, and it often presents significant hazards. Ready-made products in specialized safe packaging provide a convenient, cost-effective, and safety-oriented solution.

The AcroSeal technology has undergone several innovations during its 25 years on the market. More than 2,000 Acros Organics and Alfa Aesar products are currently available in AcroSeal packaging.

Visit **fishersci.com/acrosealpromo** or **fishersci.ca/acrosealpromo** to save on select AcroSeal products. Visit **fishersci.com/acroseal** to shop the full line of products with AcroSeal packaging.

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1. A.D. Ménard and J.F. Trant, A review and critique of academic lab safety, *Nature Chemistry* 2020, 12, 17–25

2. Schröder, I., Huang, D. Y. Q., Ellis, O., Gibson, J. H. & Wayne, N. L. Laboratory safety attitudes and practices: A comparison of academic, government, and industry researchers. *J. Chem. Health Saf.* 2016, 23, 12–23

3. D.F. Shriver, M.A. Dredzdon, The manipulation of air sensitive compounds, John Wiley & Sons, 1986

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Webinar

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Focus on Safety Webinar

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Time: **1 p.m. ET**

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Milli-Q IX 7015 Water Purification System	15 L/Hour	**ZIX7015T0**

Disinfect Your Workspace

Decon Labs Disinfectants

Decon Labs offers a variety of products effective against COVID-19, including ready-to-use disinfectant sprays, concentrated disinfectants, surface wipes, phenol-based disinfectants, quaternary ammonium, and sodium hypochlorite. These products are on EPA List N: disinfectants with efficacy.

Product Name	Minimum Contact Time
Conflikt	1 min.
BDD	10 min.
IRADECON	30 sec.
CiDecon Plus Wipes	5 min.
CiDecon II	10 min.

Product Description	Packaging	Quantity	Cat. No.
Conflikt: Ready-to-Use Quaternary Ammonium Disinfectant Surface Spray	Trigger-Spray Bottle, 16 oz.	12/Case	**04-355-33**
	Trigger-Spray Bottle, 32 oz.	6/Case	**04-355-34**
	Jug, 1 gal.	4/Case	**04-355-52**
BDD: Concentrated Quaternary Ammonium Disinfectant	Jug, 1 gal.	4/Case	**18-800-101**
IRADECON: Ready-to-Use Sodium Hypochlorite Spray	Trigger-Spray Bottle, 32 oz.	12/Case	**04-355-150**
CiDecon Plus Wipes: Phenolic-Based Disinfectant Surfaces Wipes	Canister, 180 Wipers	12/Case	**04-355-87**
CiDecon II: Concentrated Phenolic Disinfectant	Jug, 1 gal.	4/Case	**04-355-129**

Addressing Classroom Safety Concerns During the Pandemic

By Kylie Wolfe

To keep both students and staff safe, many universities turned to virtual learning this past year. Professors adapted their curriculum to help students get the most from each lesson while changing the way in-person science classes, including chemistry and biology labs, were offered.

Science courses typically require hands-on learning in the form of experiments and demonstrations. Not only do students learn valuable skills, like pipetting and problem solving, they also gain knowledge of lab safety techniques. With the obvious health and safety hurdles resulting from COVID-19, it was necessary for universities to find the right combination of in-person and online education.

Educating from a Distance

At the beginning of the pandemic, some college campuses went completely remote, but the 2020 school year brought about a hybrid model for many. Lab sizes were reduced and social distancing measures were put in place. Yale University installed clear dividers between lab benches for students attending in person and offered live video sessions for students participating online.

"In addition to limiting the number of live participants, we have rearranged our spaces, purchased additional equipment and reorganized our routines in order to minimize foot traffic, limit or eliminate sharing of equipment and maintain social distance at all times," Christine DiMeglio, organic chemistry lab professor at Yale, told *Yale Daily News*.

Labs were well ventilated and staff disinfected surfaces regularly. They understood that online learning may not always be the best option, especially when it's hard to recreate hands-on experiments that require a physical lab space. It was important to keep students safe while giving them a chance to learn in person as often as possible.

At the University of Pittsburgh, biology labs were limited to six students at a time. Chemistry labs also had reduced capacities and some physics labs were conducted at home. One approach paired an in-person student with an online student who could watch the experiment live over Zoom, regulating attendance in the classroom. This unique learning environment gave students flexibility while adhering to safety guidelines.

Protecting the Campus Community

Establishing proper protocols was necessary for laboratory courses as well as university research facilities. While some labs had shut down completely last year, others ramped up to help with COVID-19 studies. For Environmental Health and Radiation Safety (EHRS) offices, this was a time to act, managing traditional responsibilities alongside new obligations.

To bring students back to campus safely, EHRS offices played an essential role. At the University of Pennsylvania, the EHRS team helped educate and support students, staff, and the community. They led the on-campus contact tracing effort, reviewed safety plans, and installed signs and sanitization stations.

> It was important to keep students safe while giving them a chance to learn in person as often as possible.

"When you get a lot of information and individuals are not used to dealing with certain terminology or approaches, that's where we step in: To try to facilitate understanding, provide resources, and enable them to do what they need to do in short order and to help somebody get their job done," said Andrew Maksymowych, associate director of biosafety at the University of Pennsylvania, in an interview with *Penn Today*.

Through consistent communication, COVID-19 safety sweeps, and overall compliance, the team helped the campus reopen. As the pandemic evolves and universities plan for the next school year, safety standards and new ways of holding lectures and labs will already be a tool in their toolbox. The ultimate goal will continue to be finding a balance between safety and education for students and staff.

This content was inspired, in part, by "From PPE to lab safety, supporting the campus community is a full-time job," Penn Today, December 18, 2020; "COVID-19 brings a wave of change to in-person lab courses," Yale Daily News, September 11, 2020; and "Students adjust to new online science lab structure," The Pitt News, January 27, 2021.

Kylie Wolfe is a Thermo Fisher Scientific staff writer.

The Cost of Risk May Be Defined Only After an Accident Occurs

We all share the common experience of breaking a wine glass or a coffee cup. But in the lab, damage from broken glass can have much greater consequences than spilling your favorite merlot on your new shoes.

For example, if a flask breaks, there is risk of getting cut. And if the flask contains dangerous contents, that risk extends to nearby personnel through splash, vapors, fire risk, equipment damage, and more.

You can better address these risks by understanding the various types of glass and their use, care, and safe disposal practices. It is recommended that you implement a proper glass safety standard operating procedure (SOP) to strengthen lab safety, mitigate risk, and help avoid financial loss. Unfortunately, consideration of financial loss sometimes occurs only after an accident occurs. So how do you get started?

Regulatory Standards

A major difference between consumer and laboratory glassware involves standards, regulations, and practices for manufacture and use. Lab glassware has purity and calibration requirements, should be handled to reduce thermal stress, and requires proper cleaning. In regulated labs, your records of the physical inspection of glassware for proper function and conformance will be reviewed by inspectors.

ASTM International (formerly the American Society of Testing & Materials) is a global organization that helps establish standards for the manufacture of laboratory glassware, including materials, testing, calibration, and other manufacturing procedures. For example, ASTM Method E671 sets limits on acceptable thermal stress levels for annealed glass and offers guidelines for testing, calibration, and maintenance.

Regulatory authorities that follow ASTM standards include the U.S. Environmental Protection Agency (EPA), the U.S. Department of Agriculture (USDA), the U.S. Food and Drug Administration (FDA), the AOAC (formerly the Association of Official Agricultural Chemists), and the U.S. National Institute of Standards and Technology (NIST), among others.

Make sure the manufacturer of your lab glassware complies with these standards for safety, purity, and performance.

Selection of Glass Types in the Lab

In the laboratory, soda lime and borosilicate glass predominate. Soda lime glass is used mostly for jars and containers, and it cannot be autoclaved (sterilized). Borosilicate glass is formulated to withstand thermal shock, can be autoclaved, and resists breakage.

Awareness and understanding of glass differences is critical. Analytical and chromatography glassware should be either Type 33 or 51 borosilicate glass. Never autoclave glass unless the manufacturer indicates it is safe to do so.

Application Considerations

Factors such as chemical attack, sample-glass interactions, thickness, content photosensitivity, washing solvents, and calibration are also important when choosing the right glass type for a procedure.

Life Cycle Management

Life cycle management includes the regular inspection and proper maintenance of reusable glassware. The human eye cannot detect some indications of stress — by the time scratches, scrapes, and damage are visible, it's too late.

Alan Arnold Griffith, an English engineer, studied glass stress and fracture. In the 1920s, he discovered what are known as Griffith Flaws, which are introduced by the mechanical stress of day-to-day laboratory use and improper uses like scratching, flexing, bending, and dropping.

Use a polariscope periodically to inspect your glassware for signs of damage. Inspect and dispose of stressed glass to help prevent injuries and collateral damage.

You may also opt to simply replace your glassware on a scheduled basis. If you use serialized or color-coded glassware, you can track usage, or change colors after a span of two or three years. For maximum risk prevention, use safety-coated bottles that help contain the contents if the glass breaks.

Ask these questions before an accident occurs:

- What risks are associated with routine daily use or improper cleaning or handling of lab glassware?
- Are we reducing or increasing the creation of Griffith Flaws during use?
- Do our glass usage SOPs address replacement, disposal, or calibrations?

A well-designed and implemented SOP limits your financial loss, improves lab operations, and mitigates safety and regulatory risks.

Now that you understand more about the risks, take action! Try the free DWK Life Sciences on-site or webinar-based Glassware Safety Training. Contact your Fisher Scientific sales representative to schedule a training session.

Visit **fishersci.com/glasssafety** to learn more.

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DWK LIFE SCIENCES
DURAN WHEATON KIMBLE

The Unmatched Versatility of Tyvek Protective Apparel

By Daniel Hammel, North America Marketing Lead, Chemical Industrial & Controlled Environments, DuPont Personal Protection

Both in and out of the laboratory, DuPont Tyvek garments have long been the first choice in worker protection. Much lighter than spunbond meltblown spunbond (SMS) and microporous film (MPF), Tyvek flash-spun fabric provides a barrier to small hazardous particles. This protection is built into the fabric itself, with no films or laminates to abrade or wear away. Abrasion tests show that Tyvek barriers are more durable than MPF fabrics when tested for hydrostatic resistance.

Garments and Accessories

A breathable barrier against hazardous dry particles (as small as one micron), aerosols, and non-hazardous light liquid splash, Tyvek 400 protective apparel can help minimize risk when used in combination with other personal protective equipment (PPE) in hazardous situations.

Many options are available for garments and accessories, including coveralls, lab coats and frocks, sleeves, hoods, shirts, pants, and aprons. Boot and shoe covers are produced with Tyvek 400 or Tyvek 400 FC, the latter adding a friction coating for better skid resistance.

Tyvek is versatile — other styles and innovations have been developed to provide solutions to growing industrial requirements and end-user needs.

Controlled Environments

Laboratories, cleanrooms, and controlled environment settings — like pharmaceutical, medical device manufacturing, biotech, and electronics manufacturing sites — have high standards for particle and microbiological contamination control.

Tyvek IsoClean garments are part of the DuPont controlled environments product line of single-use apparel and accessories. Tyvek IsoClean products have a long history of cleanroom use and offer an excellent barrier to particles, microorganisms, and non-hazardous liquids.

Find Tyvek IsoClean garments and accessories in clean-processed and sterile options, and in non-sterile bulk packaging. Tyvek Micro-Clean 2-1-2 coveralls are individually packaged as sterile or non-sterile. Sterile Tyvek apparel is gamma sterilized to a Sterility Assurance Level (SAL) of 10^{-6} and is fully traceable.

Available in white and blue coverall options, Tyvek apparel allows you to designate workers who are allowed in restricted areas or can perform certain tasks in your laboratory or controlled environment. Or you can use color coding to easily identify team leaders or supervisors.

Enhanced Chemical Resistance

Tyvek 800 is a liquid-tight garment that combines comfort and durability with protection against low-concentration, water-based inorganic chemicals and particles as small as one micron.

Tyvek 800 garments even stand up to pressurized jets of liquids and are suitable for a variety of industrial cleaning, food manufacturing, agriculture, petrochemical, wastewater, environmental remediation, laboratory, and maintenance applications.

Tyvek 500 protects against light liquid aerosols and airborne solid particles. Tyvek 600 offers a chemical permeation barrier to low-concentration water-based inorganic chemicals, including infectious agents and bodily fluids.

Tyvek 500, Tyvek 600, and Tyvek 800 are tested and classified according to EN 14126.

Breathability, Form, and Fit

Your body generates heat and moisture vapor whether you're working hard or standing still, but some garments don't

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DUPONT™

"breathe." Trapped heat and moisture can lead to heat stress that not only makes you uncomfortable but also compromises safety. Based on moisture vapor transmission rate (MVTR), Tyvek 400 fabric is 30% more breathable than typical microporous film fabrics.

Tyvek 400 D garments suit applications with limited frontal exposures. These include exposure to tacky resin molds that may stick to (or delaminate) other garments and sanding and grinding operations that release fine airborne particulates.

These comfortable garments combine the protection and durability of Tyvek fabric on the front with the softness and breathability of DuPont ProShield 10 fabric on the back.

The Need to Be Seen

Low-visibility hazards are common in construction, transportation, waste handling, mining, and other industries, and high-visibility protective apparel lets workers be seen more easily.

With Tyvek 500 HV coveralls, workers benefit from breathable and durable high-visibility garments with the added particle protection of Tyvek. Suitable for the dirty jobs common in many industries, Tyvek 500 HV coveralls also helps ensure compliance with PPE requirements.

The bright fluorescent orange color of the Tyvek background fabric combined with silver-gray retroreflective material makes these garments highly visible during the day or at night when exposed to a light source. The reflective symmetric "X" on the back of the coverall helps distinguish the worker's front and back.

Making a Difference

Tyvek offers unmatched versatility, superior overall barrier protection, improved breathability, and better garment durability for laboratory applications, pharmaceutical handling, general manufacturing, and dirty jobs.

Precise Heating and Stirring

OHAUS Guardian Hotplate Stirrers

Durable OHAUS Guardian Hotplate Stirrers deliver intelligent performance and enhanced safety features*:

- SmartHousing is cool to the touch and chemical resistant
- SafetyHeat internal protection system monitors heating and unit function
- SmartRate temperature selection enables fast or slow ramp rate speed
- SmartHeat controls and monitors maximum temperature to prevent overheating
- SmartLink turns off the heating function if the Bluetooth connection is broken
- SmartPresence proximity sensor technology turns off the unit when no one is nearby

Description	Surface Dimensions	Surface Material	Cat. No.
Hotplates			
Guardian 5000 Hotplates	7 × 7 in.	Ceramic	**01-922-000**
Stirrers			
Guardian 5000 Stirrers	7 × 7 in.	Ceramic	**01-922-001**
Stirring Hotplates			
Guardian 5000 Hotplate Stirrers	7 × 7 in.	Ceramic	**01-922-002**
	10 × 10 in.	Ceramic	**01-922-003**
	Dia. 5.3 in.	Aluminum	**01-922-004**
Guardian 7000 Hotplate Stirrers	7 × 7 in.	Ceramic	**01-922-005**
	10 × 10 in.	Ceramic	**01-922-006**
	Dia. 5.3 in.	Aluminum	**01-922-007**

*Guardian 5000 units have SmartHousing and SafetyHeat features only; Guardian 7000 units have all six safety features.

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Fisherbrand Sonic Dismembrators create energy that is transmitted through a titanium probe into a liquid sample to create cavitation (the implosion of micro-bubbles with high shear forces).

Each Fisherbrand Sonic Dismembrator includes a generator, converter, cables, wrench set, and one probe. Other probes and accessories, including the stand and clamp shown here, are sold separately.

Model 505

Model	Applications	Capacity	Power	Cat. No.
50	• Basic Cell Disruption	0.2 to 50 mL	50w	**FB50110**
120	• Cell Disruption • Protein Extraction • DNA Shearing/ChIP	0.2 to 50 mL	120w	**FB120110**
505	• Cell Disruption • Nanoparticle Dispersion • Homogenization/Mixing	0.2 to 1000 mL	500w	**FB505110**
705	• Cell Disruption • Protein Extraction • DNA Shearing/ChIP • Nanoparticle Dispersion • Homogenization/Mixing • Sonochemistry	0.2 to 1000 mL	700w	**FB705110**

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Quantity	Cat. No.
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500 Reactions	**11-756-500**

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Quantity	Cat. No.
1 x 1 mL	**44-445-56**
1 x 5 mL	**44-445-57**
1 x 50 mL	**44-445-58**
2 x 5 mL	**44-449-63**
5 x 5 mL	**44-449-64**
10 x 5 mL	**44-449-65**

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Measure pathway- and disease-related gene expression with Applied Biosystems TaqMan qPCR Array Plates (pre-spotted panels of TaqMan Real-Time PCR Assays). These arrays feature the most popular TaqMan gene expression assays targeting relevant genes. They're ideal for profiling and verification applications that require the analysis of thousands of targets.

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Reducing the Environmental Impact of Disposable Face Masks

By Christina P. Hooton

Since the beginning of the pandemic, disposable face masks have become a part of everyday life as we know it. It's estimated that 129 billion face masks are used globally every month.[1] While these are a proven and necessary way to curb the spread of COVID-19, according to data shared by the Centers for Disease Control and Prevention (CDC), they are also adding to the already significant amount of plastic pollution throughout the world. [2,3]

A Plastic Problem

Although most disposable face masks appear to be made from cloth, they're usually produced from non-woven polymer fabrics made of polypropylene or polycarbonate. The typical disposable blue mask has three layers: an outer layer of non-woven fibers, a filtering middle layer, and a soft inner layer. The filter in the middle is made by forcing melted polymer through tiny nozzles using high-speed blowing gas.

As these disposable masks make their way into the environment, they sometimes pollute waterways or are disposed of in landfills. Like other plastics, they can also break down into microplastics, particles smaller than 5 mm.

Plastics and microplastics are a known threat to the health of marine species, a large part of our food supply. They also enter the food we eat and significantly contribute to climate change through carbon emissions. And, in a rather perverse twist, these plastic particles are also known to spread microbes such as invasive pathogens.[4]

Other Considerations

One solution to this growing problem might be for everyone to wear reusable instead of disposable masks, especially for personal activities like grocery shopping. If a reusable cloth mask offers the right level of protection for a given situation, it must be washed at least daily, and several must be on hand so one is always ready to wear.

However, according to CDC data, a cloth mask alone blocks only 51.4 percent of airborne cough particles compared to properly worn surgical masks that block 77 percent of airborne particles. Wearing both a cloth and a surgical mask proves even more effective, blocking 85.4 percent of particles.[5] Laboratories and other workplace settings may require the level of protection these disposable face masks provide.

Face Mask Recycling

It may seem obvious to dispose of your face mask along with all other recyclable materials. However, face masks and other forms of single-use personal protective equipment (PPE) are not easy to recycle and may be too expensive for local recyclers to collect. It is not likely that your current waste management solution is offering this recycling service.

> It's estimated that 129 billion face masks are used every month globally.[1]

The world needs an economical, efficient solution for recycling disposable face masks as safety restrictions from the pandemic persist. Face mask recycling programs present an attractive option especially for organizations like universities and colleges trying to establish and maintain sustainability targets.

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Reducing the Environmental Impact of Disposable Face Masks

TerraCycle, a company known for its ability to recycle challenging materials, offers a mask recycling program through the Fisher Scientific channel. To start, an institution purchases the TerraCycle Disposable Masks Zero Waste Box, a cardboard box clearly marked for face mask disposal and recycling, and places it in their facility.

"It's a very simple process. The box is shipped direct to the customer. They assemble the box and then they start collecting," said Madeleine Chadwick, General Management, Leadership Development Program, Thermo Fisher Scientific.

The boxes come in three sizes with the largest option accommodating up to 2,100 masks. Once the box is full, the institution seals and ships it back to TerraCycle where face masks are recycled and processed into new materials. Chadwick said, "The price of the box includes shipping costs and the recycling service."

Although the program is not intended to recycle conventional medical waste, the boxes are quarantined upon arrival for a minimum of 72 hours to protect the employees that handle the waste. Items are hand-sorted, and any visibly contaminated masks are removed and forwarded to third-party facilities for processing and recycling.

Turning Trash into Treasure

The mask waste is collected until there is enough volume to perform processing, then sorted based on material composition. Metal wires or nosepieces are removed from the masks, grouped together, and processed separately, for example.

The materials are then sent for third-party processing where they are recycled into usable forms like plastic pellets and granules. The polypropylene mixture typically found in face masks is turned into a raw material used in plastic lumber and composite decking applications. That material is then sold to manufacturers for the creation of a variety of new products, including outdoor furniture, shipping pallets, and more.

It's encouraging to think that some of these recycled face masks could one day become something useful like park benches or picnic tables that people will freely gather on and around once pandemic restrictions are lifted. Fisher Scientific customers alone have already diverted more than 735,000 face masks from landfills using this program.

The TerraCycle program offers organizations a flexible, easy-to-set-up solution. Boxes can be placed in high-traffic areas along with hand sanitizers to reinforce both safety and sustainability. They can be especially useful in areas where a new disposable face mask is required upon every entry, for example outside a research lab. The program was recently expanded to include boxes for gloves, eyewear, and other hard-to-recycle items.

> "It's a very simple process. The box is shipped direct to the customer. They assemble the box and then they start collecting."

It's unclear how much longer we'll be wearing face masks. Even after the pandemic, face mask use might be more prevalent than before, especially during periods like flu season or when traveling. One thing that's absolutely clear is the need to understand and mitigate their environmental impact, one face mask at a time.

Visit **fishersci.com/terracycle-mask-box** or **fishersci.com/terracycle-glove-box** for more information about TerraCycle recycling opportunities.

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Christina P. Hooton is a Thermo Fisher Scientific staff writer.

Preparing Samples for Long-Term Cryogenic Storage

How can controlled-rate freezers be used to prepare samples and therapies for long-term cryogenic storage?

The term "cryopreservation" is derived from the Greek word *kryos*, which means cold. Practically, cryopreservation is a method for preserving biological samples in a vitrified state.

Rapid freezing prevents the formation of ice crystals by chilling the sample to the amorphous ice phase while circumnavigating the hexagonal ice phase. Because cryopreservation temperatures are so low, the water inside cells in a sample is vitrified or removed by osmosis and stopping metabolic processes.

Advantages of sample cryopreservation:

- Reduced risk of microbial contamination or cross-contamination
- Less risk of morphological and/or genetic changes
- Techniques are well established and methods and outcomes are well documented

Cryopreservation is effective but not trouble free. Researchers must determine optimal conditions for the viability and recovery of their samples.

What Are the Freezing Phases?

ISBER guidelines state that LN_2 cryopreservation is optimal for long-term specimen storage. These systems offer storage below the glass transition phase temperature of -132°C. In this case, the term "glass" refers to a liquid that is too cold to flow.

Nucleation is the onset of the change from liquid to crystalline. It involves the progressive separation of ice from the unfrozen part of the solution. The solute concentration increases as water separates as ice. This change is also associated with an energy change. The localized increase in temperature is called the latent heat of fusion, which evolves as the solution reaches the equilibrium freezing point.

Best Practices

While storage below the glass transition temperature is important, properly preparing samples for storage at very low temperatures is equally important. When the rate at which a specimen is frozen is controlled, it fosters greater cellular viability when the sample is removed from its cryogenically frozen state.

The International Society for Biological and Environmental Repositories (ISBER) publishes *The ISBER Best Practices: Recommendations for Biorepositories Fourth Edition*, which offers guidelines for sample preservation. In 2019, the *ISBER Best Practices Addendum: Liquid Nitrogen-Based Cryogenic Storage of Specimens* was also published.

These guidelines comprise the most effective evidence- or consensus-based practices for managing biological and environmental specimen collection, long-term storage, retrieval, and distribution and support the availability of high-quality research specimens.

Thermo Scientific CryoMed Controlled-Rate Freezers

Controlled-rate freezers can help reduce the stress on samples during the freezing and vitrification processes.

CryoMed Controlled-Rate Freezers have six factory-set freezing profiles and users can create up to 14 custom profiles. For samples and therapies, CryoMed users can take advantage of a new pre-set profile that has an end-temperature of -140°C.

This profile, labeled Pre-Set Profile #3, controls sample freezing through the glass transition phase (when amorphous ice can form). It creates a 1°C/minute

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cooling rate from nucleation to -45°C and a 10°C/minute cooling rate to the final temperature of -140°C. It is commonly used for hemopoietic stem cells in volumes from 65 to 100 mL.

Long-Term Sample Storage

Choose from two LN_2 cryogenic freezer platforms for long-term sample storage:

- Thermo Scientific CryoExtra High-Efficiency LN_2 Storage Tanks
- Thermo Scientific CryoPlus LN_2 Storage Devices

To choose the right platform, consider the number of samples being stored and whether liquid or vapor phase liquid nitrogen will be used.

- CryoExtra is preferred for larger numbers of samples stored in vapor phase; four capacity options accommodate between 19,500 and 93,000 vials (2 mL)
- CryoPlus is preferred for fewer samples and accommodates both liquid or vapor phase storage; 2 mL vial capacity ranges from 6,318 to 39,000

Thermo Scientific CryoMed Controlled-Rate Freezers, used in combination with CryoExtra or CryoPlus platforms, provide a workflow solution for laboratories or biorepositories with reliable sample preparation and cryogenic storage.

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96-Well MICROLON 600 Plate	High	Round Bottom	650061	**07-000-608**
96-Well MICROLON 200 Plate	Medium	Flat Bottom	655001	**07-000-100**
96-Well MICROLON 600 Plate	High	Flat Bottom	655061	**07-000-102**
96-Well MICROLON 200 Plate, Chimney Well	Medium	Flat Bottom	655080	**07-000-099**
96-Well MICROLON 600 Plate, Chimney Well	High	Flat Bottom	655081	**07-000-101**
96-Well MICROLON 200 Strip Plate, 1 x 8 Single Break	Medium	C-Bottom	705070	**07-000-779**
96-Well MICROLON 600 Strip Plate, 1 x 8 Single Break	High	C-Bottom	705071	**07-000-780**

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Quantity	Cat. No.
96 Extractions	**09-920-080**
1,000 Extractions	**09-920-081**

Cytiva Superdex 200 Prepacked Columns

The Cytiva Superdex 200 Increase is a next-generation size exclusion chromatography (SEC) resin used for high-resolution purification and analysis of monoclonal antibodies (mAbs) and proteins. It's available pre-packed in three sizes to meet the needs of various applications. With smaller and more rigid beads than their predecessors, Superdex Increase columns deliver improved resolution in shorter run times.

Description	Cat. No.
Superdex 200 Increase 10/300 GL Prepacked Columns	**45-002-570**
Superdex 200 Increase 5/150 GL Prepacked Columns	**45-002-571**
Superdex 200 Increase 3.2/300 Prepacked Columns	**45-002-572**

Visit **fishersci.com/cytiva** or **fishersci.ca/cytiva** to shop.

Nitrile Allergies? Accelerator-Free Nitrile Can Help

by Fritz Maskrey, Vice President, Business Development, TechNiGlove International

When thinking of allergies in the disposable glove world, natural rubber immediately comes to mind.

A simple solution for this problem was introduced in the 1990s using synthetic polymers. This new material would mimic the properties of natural rubber without the protein allergens that were causing some users to develop allergic reactions. Hence the product we know today as "thin-walled disposable nitrile gloves" was born.

Nitrile Glove Production: Simple but Complicated

To create nitrile products, liquid nitrile is refined and coated onto a ceramic form then cured to create an elastic polymer in the desired shape. The elastic polymer, which has been molded into the shape of varying sizes and lengths of gloves, is then chlorinated inside and out and finished based on the specifications of the intended cleanroom environment or general laboratory use.

Since the inception of nitrile, manufacturers have been competing to create a better and more efficient process for making gloves. The competition has led manufacturers to add certain accelerators intended to decrease the time needed for a glove to cure, reduce the cost of the overall material, give the material a softer feel, and generally provide the customer with an affordable high-performance product.

Certain sulfur-based chemicals have been developed to accomplish these goals. These chemicals have incredibly complicated chemical structures and even more complicated scientific names. While this list of chemicals can have many positive effects, one unfortunate side effect can be an allergic reaction (now known as "nitrile allergies") similar to that of latex.

Current examples of accelerators used in nitrile glove production include:

- N-cyclohexyl-2-benzothiazole sulfenamide
- 2-Dibenzothiazole disulfide
- Tetramethylthiuram disulfide
- Diphenylguanidine
- 2-Mercaptobenzothiazole
- 3-Methylpiperidine

Does This Mean I'm Allergic to Nitrile Gloves?

Since most of these reactions are not to nitrile itself but to chemicals added during manufacturing, they are considered "Type 4" allergies. Also called cell-mediated or delayed allergies, they occur when T-cells are activated and produce inflammation in the affected area. Type 4 allergies are not antibody related but rather are a type of white blood cell response.

One of the newer technologies used in the production of thin-walled disposable gloves is "accelerator-free" nitrile. Production managers, line engineers, and corporate purchasers should be aware of this option. Choosing gloves made

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with this material and these methods can drastically reduce reactions for users with Type 4 allergies.

Unlike latex allergies, which can cause more life-threatening allergic reactions, people who react to the accelerators in nitrile gloves usually experience only contact dermatitis (Type 4 Hypersensitivity).

Reactions to nitrile gloves may include hives, blisters, itching, burning, and sensitivity to the sun. These symptoms usually appear one or two days after exposure. Nitrile glove wearers can also experience non-allergic irritant contact dermatitis, the symptoms of which include blisters, lesions, ulcers, and dry skin.

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Key attributes of our accelerator-free products include:

- Elongation and tensile strength over 300% stronger than traditional nitrile formulations
- Fit, feel, and function almost identical to latex gloves
- Less material with superior strength

Contact your Fisher Scientific sales representative for information about a wide selection of nitrile gloves including Rival (RV400 Series) accelerator-free, low extractable, powder-free nitrile examination gloves.

TechNiGlove International is a leading manufacturer of disposable gloves for contamination-controlled environments. TechNiGlove's nitrile, sterile nitrile, and latex gloves offer consistent quality for use in cleanrooms, sterile non-medical environments, pharmaceutical environments, and industrial settings.

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Tyvek® IsoClean® garments are offered in clean-processed and sterile options, as well as non-sterile bulk-packaged options. Tyvek® IsoClean® sterile garments are gamma sterilized to a sterility assurance level (SAL) of 10^{-6} and are fully traceable.

Bead Mill Basics

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In the science community, time is of the essence and results are critical. Efficiency is crucial when lab personnel need to extract different analytes from a variety of samples.

Sample preparation is especially important with problematic materials or specimens and may create a bottleneck in the overall extraction process. Traditionally, samples were individually and manually processed, sometimes ground using a mortar and pestle or subjected to long enzymatic digestions. Bead mill homogenizers help speed this process up and keep your work on schedule.

How Do Bead Mills Work?

Bead mills are one of the most effective methods for processing samples into smaller particle sizes and can be used to process multiple samples simultaneously.

Bead mills are used for dispersion processing — they reduce the size of solid particles and disperse them into the sample. The beads are placed inside a tube with the sample and agitated vigorously. Homogenization occurs with impact or collisions between the sample and the beads (macro-scale), between the beads and the tube (micro-scale), and shear forces created by rapid bead movement (macro-scale).

Choosing the Right Beads

The type and size of the beads are important factors when processing samples. Larger beads can break down large or dense structures while small beads are more effective with cellular components.

Bead shape and density matter as well. Denser beads will be more effective on tougher or harder materials. Irregularly shaped beads create greater mechanical shear forces and work well with tough or fibrous materials.

The variation in beads makes bead mills suitable for multiple applications. Bead mills can be used to dissociate tissue and recover live cells or extract small molecules like nucleic acids and proteins. Bead mill tubes do not require additional liquid, so they can be used for milling or dry grinding solid samples.

Advantages of Bead Mill Sample Prep

Bead mill homogenizer tubes are disposable — single use reduces the risk of cross-contamination. And because homogenization occurs inside a closed tube, there is less chance of creating aerosols or other user exposure. This is especially important if samples contain toxic, infectious, or otherwise hazardous substances.

Use Fisherbrand Bead Mill Homogenizers for grinding, lysing, or homogenizing biological samples for molecular extractions. A unique tube carriage motion provides efficient bead movement, producing impact forces that match or exceed other bead mills in the market. And increased power reduces processing times to maximize your sample prep efficiency.

- Simultaneously homogenize up to 24 samples
- Front-loading tube holder for convenience, ease of use, and optimal bead/sample interactions
- Non-stop processing — no need to cool down between runs
- Rapid processing means less sample degradation
- Timer range: 1 to 99 seconds
- Performance range: 0.8 m/s to 6 m/s in increments of 1.5 m/s
- Cycles: 1 to 9
- Small footprint

Fisherbrand Bead Mill Homogenizers, coupled with sample-specific bead beating materials, can help you produce thorough homogenates regardless of the sample. Compared to conventional methods, bead mill homogenization increases the yields of nucleic acids, proteins, and other small molecules to improve the results of your downstream assays.

Fisherbrand Bead Mill 4 Homogenizer
Cat. No. 15-340-164

Fisherbrand Bead Mill 24 Homogenizer
Cat. No. 15-340-163

The Basics of Cleanroom Upkeep

By Mike Howie

Cleanroom upkeep is essential to protecting the quality of your finished products. In some cases, even one small contaminant can be destructive, potentially costing millions of dollars in wasted effort and material.

Every cleanroom is unique — built for a specific purpose and subject to specific guidelines. Your cleanroom upkeep routine should be just as unique, designed with your physical space and applications in mind. There are, however, general guidelines that can help you build the right routine for your needs. Broadly, there are four parts to cleanroom upkeep:

- Prevent as much contamination from entering the cleanroom as possible
- Clean as well as you can using the right tools for your environment
- Monitor surfaces and the air for contaminants
- Validate that your routine is keeping the environment adequately clean

Here are just a few tips for keeping your cleanroom clean.

Keep Contaminants Out

If you start with a clean cleanroom, upkeep is much simpler.

Anything entering the cleanroom, including people, is the largest source of potential contamination. Restricting items like cardboard and using sticky mats to remove particles from shoes can help prevent contaminants from entering the cleanroom in the first place. Take care when introducing any new people or items to the cleanroom. People should be wearing the right garments and donning them properly.

Use the Right Cleaning Products

Your choice of cleaning products is important because lower-quality products can introduce more contamination into your cleanroom. Keep in mind that there are always new mops, wipers, disinfectants, and other products entering the market and what you've been using may no longer be in line with best practices. String mops, for example, effectively spread disinfectant but don't reliably remove contaminants. A cleanroom mop should help disinfect surfaces and successfully remove contaminants.

While these cleaning products can be more expensive, ask yourself how much you're willing to pay for peace of mind. If a 0.5 µm particle could ruin a 1 million USD product, purchasing effective cleaning products is likely worth the investment.

Be Wary of Laundering Garments and Supplies

In some situations, laundering and reusing garments, mops, or other supplies can effectively reduce costs. But it also carries a risk: laundering may not remove all contaminants. If contaminants remain in a cleaning product after laundering, there's a risk that those contaminants could be reintroduced into the cleanroom. While using new cleaning products every time may be more expensive, it helps reduce the risk of introducing contaminants while cleaning.

Clean Before You Disinfect

Sterile is not the same as clean. While disinfecting may render contaminants inert, sterile contaminants can still adulterate your final product. By removing contaminants before disinfecting, you can be more confident that your cleanroom is truly clean.

Remain Vigilant

Continuously monitor surfaces and the air in your cleanroom for particles, viables, volatile organic compounds, and any other potential contaminants. By tracking conditions within your cleanroom, you'll have a better idea of the challenges you face and can evolve your cleaning procedures as needed.

After a while, you can analyze the collected data to identify any trends. Any increase in contamination is worthy of investigation — even if your cleanroom is still within defined limits.

Follow Applicable Guidelines

Multiple organizations publish guidelines for building, operating, and maintaining cleanrooms, including the Institute of Environmental Sciences and Technology (IEST), the Parenteral Drug Association (PDA), ASTM International, and the United States Pharmacopeia (USP). In some instances, these organizations even provide detailed direction on how to clean. Research which guidelines apply to your cleanroom and follow their guidance.

Cleanroom upkeep should be a constant priority and a daily consideration. By keeping your cleanroom as clean as possible at all times, you're protecting the quality of your finished products.

Mike Howie is a Thermo Fisher Scientific staff writer.

Curbside Recyclable Packaging

SONOCO ThermoSafe EOS Shippers

Make sure your temperature-controlled packaging waste won't end up in a landfill.

The outer and payload boxes of new Sonoco ThermoSafe EOS shippers are made from corrugate, using post-consumer recycled content. The EOS product offers high insulation, has cushioning to protect your precious samples and products, and is curbside recyclable. Just place the entire knock-down package into your recycling bin when you're finished.

Sonoco ThermoSafe is serious about sustainability and works hard to develop products that help minimize environmental impact while maintaining the quality and reliable transport conditions you've come to trust.

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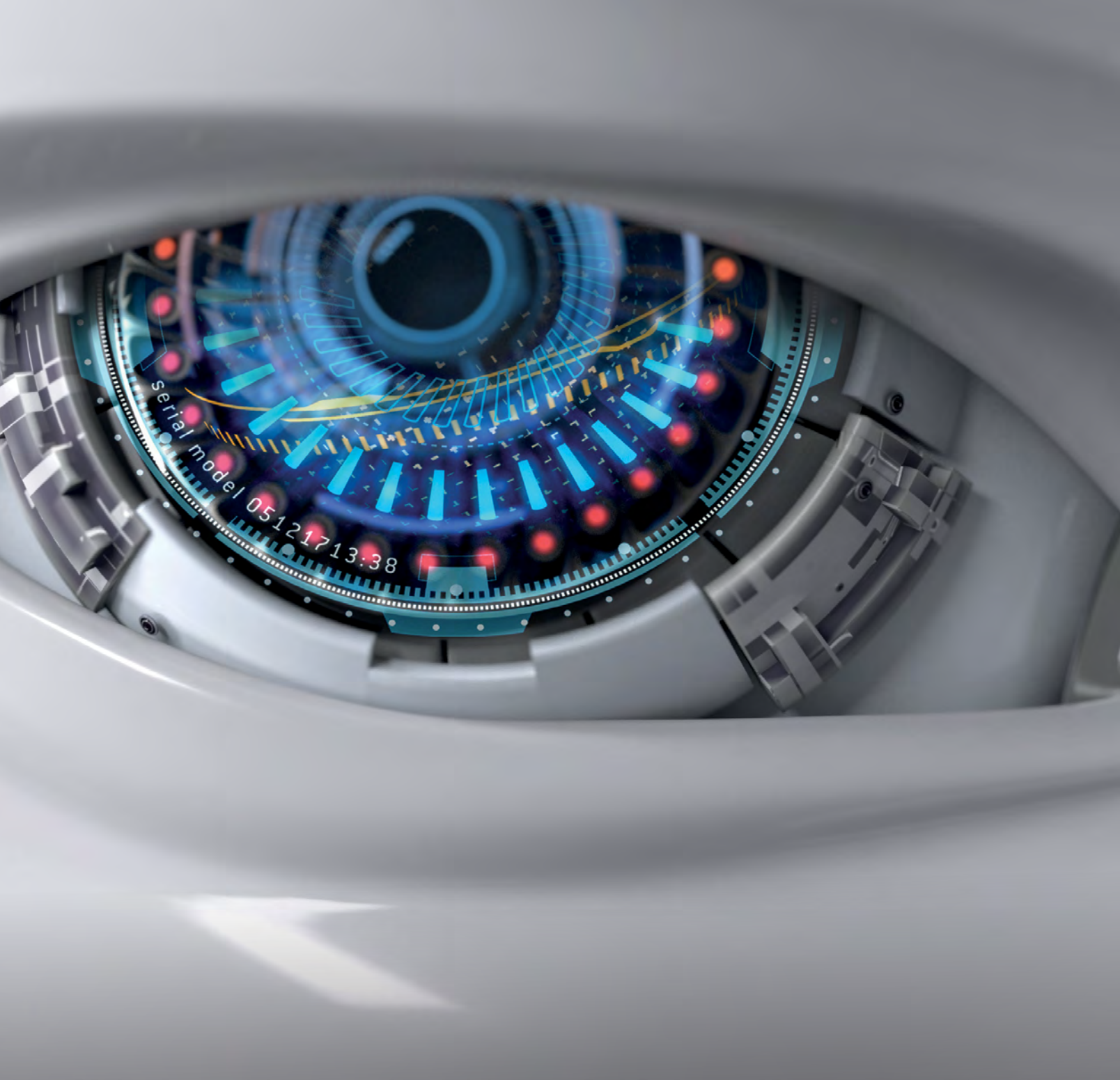

Pharmaceutical Applications of Artificial Intelligence

By Iva Fedorka

The pharmaceutical industry has confidence in artificial intelligence (AI). They hope that it will help to reduce workload, shorten timelines, identify drug repurposing possibilities, improve industry productivity, and make clinical trials more successful.

Drug discovery and development for a single medication can take more than a decade and cost an average of 2.8 billion USD. Despite this time and resource commitment, nine out of ten still fail Phase 2 clinical trials and never get regulatory approval.

Increased data digitalization in the pharmaceutical sector lends itself to AI tools and networks that mimic human analytical thought processes and can be programmed to interpret, "learn," and make "intelligent" decisions.

History

AI pioneers in the 1950s talked about machines that could sense, reason, and think like people. The rapid increase in computer processing power and large amounts of data and advanced algorithm development since then have significantly improved so-called machine learning (ML). This form of AI is task-focused, supports analysis, understands and generates text and speech (natural-language processing), and truly mimics the way we think.

More than 50 years later, on June 12, 2007, the robot Adam successfully identified the function of a yeast gene. Adam searched public databases and developed hypotheses about the genes that code for key enzymes in the yeast *Saccharomyces cerevisiae*. When these hypotheses were tested, researchers found nine genes that were new and accurate and only one that was wrong.

"Robot scientists using AI can test more compounds, and do so with improved accuracy and reproducibility, and exhaustive, searchable record-keeping," said systems biologist Steve Oliver of the University of Cambridge, a member of the group that developed Adam. Later, the same team announced that Adam's colleague Eve had discovered a possible new treatment for drug-resistant malarial parasites.

Success Stories

Researchers at Berg, a biotechnology company near Boston, Massachusetts, used AI to find potential treatments based on the cause of a disease. They tested more than 1,000 cancerous and healthy human cell samples, varying the growth conditions and then measuring cell production and output. The key differences between the diseased and healthy cells were demonstrated by the AI analysis, which incorporated patient biological and outcome data.

"We are turning the drug-discovery paradigm upside down by using patient-driven biology and data to derive more-predictive hypotheses, rather than the traditional trial-and-error approach," said Niven Narain, Berg's co-founder, president, and chief executive officer. His team used this approach to identify specific cancer metabolism molecules and determine how a new cancer drug would work. The drug (BPM31510) is now in a Phase 2 clinical trial for patients with advanced pancreatic cancer. The company is using the same AI system to find drug targets and therapies for diabetes, Parkinson's, and other diseases.

London-based Benevolent^{AI} has a cloud-based AI platform that analyzes data from research papers, patents, patient records, and clinical trials. The database includes over one billion documented or inferred relationships between genes, symptoms, diseases, proteins, tissues, species, and medications. Used like a search engine, it can produce graphs of medical conditions, associated genes, and effective compounds. "AI can put all this data in context and surface the most salient information for drug-discovery scientists," said Jackie Hunter, Benevolent^{AI} board director.

When Benevolent^{AI} was asked to suggest treatments for amyotrophic lateral sclerosis (ALS), they identified about a hundred existing compounds with potential. Their scientists chose five to test at the Sheffield Institute of Translational Neuroscience, UK. At the December 2017 International Symposium on ALS/MND in Boston, Massachusetts, four of the compounds were reported to show promise and one even delayed neurological symptoms in mice.

Some think the potential for AI to pinpoint previously unknown causes of disease will accelerate the trend toward treatments designed for patients with specific biological profiles. "Personalized medicine has been talked about for a long time," said Hunter. "AI is going to enable it."

The Future

AI has already shown its ability to predict a drug's pharmacokinetics, target receptors, physicochemical properties, solubility, binding affinity, bioactivity, toxicity, and other features that affect its effectiveness.

Industry leaders agree that the use of AI may create changes in the drug-discovery process. Some experts opine that future students will need an understanding of biology coupled with computer science, statistics, and machine learning. Some schools have already created undergraduate programs in biomedical computation, although demand for these degrees may change as new therapies emerge.

Others believe that predictions about AI's ability to revolutionize drug discovery are too optimistic. Narain, who expects AI to drive major advances, agrees that claims may be exaggerated, but it won't be long before they are proved or disproved. "The hype can't last very long because over the next five years or so, the truth will come out in the data," he said. "If by then we are creating better drugs, and doing it faster and cheaper, then AI will really take off."

This content was inspired, in part, by "How artificial intelligence is changing drug discovery," Nature, May 30, 2018; "Transforming Drug Discovery Through Artificial Intelligence," Forbes, March 3, 2020; and "Artificial intelligence in drug discovery and development," Drug Discovery Today, January 26, 2021.

Iva Fedorka is a Thermo Fisher Scientific staff writer.

Fact or Friction: Your Balance Static Questions Answered

Is your balance display slowly drifting while trying to take a weight? Are balance readings unstable?

These issues can be attributed to a well-known culprit: static electricity. Electrostatically charged samples can not only create frustration but also adversely affect weighing accuracy and waste material and lead to significant errors. Here are some common questions and answers about static.

Fact: Friction is by far the most common cause of electrostatic discharges.

Many laboratory tasks — like using a cloth to dry a glass beaker, picking up a measuring flask with disposable gloves, or filling a weigh pan with powder — can generate measurable electrostatic charges that interfere with weighing results.

Fact: The climate conditions of your lab affect your weighing results.

Relative humidity levels less than 40 to 50 percent increase electrostatic charge issues. The lower the humidity, the less chance that charged particles will find water molecules to "surf" on to get to a convenient place.

Depending on the relative humidity, a charge may take anywhere from a few seconds to several minutes to dissipate. In controlled and dry atmospheres with less than 20% relative humidity, charges on materials can cause weights to drift several hundred milligrams and may persist for many hours.

Fiction: There is no way to dissipate electrostatic charges.

METTLER TOLEDO anti-static kits use alternating current (AC) to generate ions and immediately neutralize electrostatic charges from samples or containers. This method is effective, completely safe, and does not disturb air currents or increase stabilization time. The time savings, efficiency gains, and safety improvements make it a sound investment for your lab.

The XPR Solution

Advances in METTLER TOLEDO analytical weighing technology enable the latest generation of analytical balances to automatically detect, measure, and record electrostatic charges during a weighing operation. The integrated ionizer module can then eliminate these charges to avoid any influence on the weighing result. The static detection cycle is performed in just a few seconds while the balance settles, so there's no delay in obtaining the weighing result.

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XPR Balance XPR205, Single Range	220 g	0.01 mg	30355411	**01-919-124**
XPR Balance XPR225DR, Delta Range	121/220 g	0.01/0.1 mg	30594483	**01-915-004**
XPR Balance XPR225DU, Dual Range	121/220 g	0.01/0.1 mg	30594488	**01-915-003**
Ionizing Modules and Kits				
XPR Integrated Internal Ionizer Modules			30460823	**13-940-060**
Anti-Static Kits, with Large U-Electrode and Power Supply*			63052302	**01-910-021**

*Universal kit; works with all balances and weighing substances

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- **Model Y6701:** Disposable, 100% lightweight white cotton, full fingers, women's and men's sizes
- **Models M088 and M089:** Reusable, 100% white nylon knit, form fitting, flexible, and comfortable, half- and full-finger options, universal sizing, made in the USA

M005 Y6701 M008

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M005	Reusable	100% Nylon Filament	Full	Green	Small	12/Pack	**19-086-521**
				Orange	Medium	12/Pack	**19-086-520**
				Blue	Large	12/Pack	**19-086-522**
				Red	X-Large	12/Pack	**19-002-852**
M006	Reusable	100% Nylon Filament	Half	Red	Women's	12/Pack	**19-086-524**
				Black	Men's	12/Pack	**19-086-525**
Y6701	Disposable	100% Cotton	Full	White	Women's	12/Pack	**11-462-26A**
				White	Men's	12/Pack	**11-462-26B**
M088	Reusable	100% Nylon Knit	Half	White	Universal	12/Pack	**18-999-4591A**
M089	Reusable	100% Nylon Knit	Half	White		12/Pack	**18-999-4591B**

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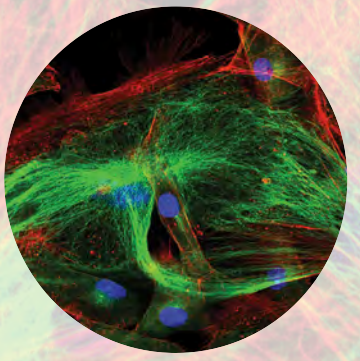

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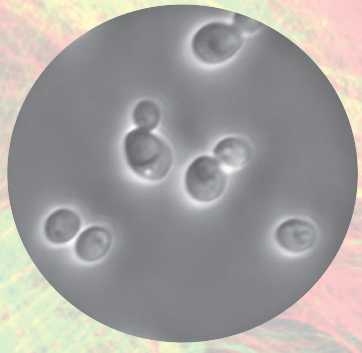

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Maximizing Pipette Accuracy

One of the most frequently used tools in a typical laboratory is the air-displacement or air-cushion pipette. Convenient and easy to use, single-use pipette tips minimize the chance of cross contamination between samples.

Do you know how to select the correctly sized pipette for maximum accuracy? Let's first look at the mechanics.

Air displacement pipettes are based on a simple concept:

- A piston of consistent diameter is pushed through a seal to move a column of air; the air movement, in turn, moves liquids in and out of a disposable pipette tip
- An air cushion exists inside the pipette tip between the liquid and the end of the pipette; the liquid never touches the pipette itself
- After a pipette tip is affixed, the piston is moved from its resting position and through the piston seal to push air out of the pipette tip
- The tip is then immersed just below the surface of the liquid to be aspirated; the spring-action piston is returned to its resting position, creating a vacuum that fills the pipette tip with liquid
- Adjustable volume pipettes use a screw mechanism to change the stroke length to set the volume at 50% of the nominal capacity

For pipettes with nominal volumes of 100 µL or greater, the inaccuracy of an air displacement pipette is treated as a constant volume throughout the range of the pipette. ISO 8655 Part 2 lists this value at ≤± 0.8% of the nominal capacity (i.e. ≤± 0.8 µL for a 100 µL pipette) and depends mostly on the mechanics of the pipette. For smaller volumes, the inaccuracy increases due to the compressibility of air and other factors.

Typically, pipette data sheets or catalogs present the accuracy as a percentage of the nominal volume, often with no additional information, so the user must determine the implications. When estimating the accuracy percentage for partial volumes, the numerator (the amount of inaccuracy) remains the same; the denominator (the set volume) changes.

Clearly, an air displacement pipette is most accurate at or close to its nominal capacity. Furthermore, accuracy decreases significantly as the set volume goes below 50% of the nominal capacity. Most pipettes therefore have a stated volume range with both upper and lower volume limits.

Volume Setting	Percentage of Nominal Capacity	Volume of Inaccuracy	Pipetted Volume Accuracy
100 µL	100%	≤± 0.8 µL	≤± 0.8%
75 µL	75%	≤± 0.8 µL	≤± 1.1%
50 µL	50%	≤± 0.8 µL	≤± 1.6%
20 µL	20%	≤± 0.8 µL	≤± 4%
10 µL	10%	≤± 0.8 µL	≤± 8%

The amount of liquid to be pipetted often falls within the range of several different pipettes. For example, 20 µL could be measured with 2 to 20 µL, 5 to 50 µL, or 10 to 100 µL pipettes. The volume would be most accurately pipetted using the 2 to 20 µL pipette. If that size is not available, choose the pipette with the lowest capacity relative to the volume you need. In this case, the 5 to 50 µL pipette is a better choice than the one that measures from 10 to 100 µL.

If your lab has pipettes with only marginally overlapping ranges, the addition of one or two more pipettes with more overlap may increase the accuracy of your measurements.

The BRAND Transferpette *S* is a manual single-channel pipette available in ten different adjustable volume sizes (0.1 to 1µL up to 1 to 10 mL); these sizes cover nearly the entire range from 0.5 µL to

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10 mL, overlapping the upper halves of the pipette ranges. Similarly, manual Transferpette 8- and 12-channel pipettes are available in five adjustable volume ranges (0.5 to 10 µL to 30 to 300 µL) for 1 to 300 µL sample volumes.

The BRAND Transferpette is also available in an electronic version with similar options. Five different single-channel Transferpette electronic pipettes cover volume ranges from 0.5 to 10 µL to 250 µL to 5 mL; five multichannel models cover volumes from 0.5 to 10 µL to 15 to 300 µL.

NOTE: In most literature, "accuracy" is used to denote the amount of inaccuracy. To stay consistent with other literature, we use "accuracy" in this article when referring to percentages.

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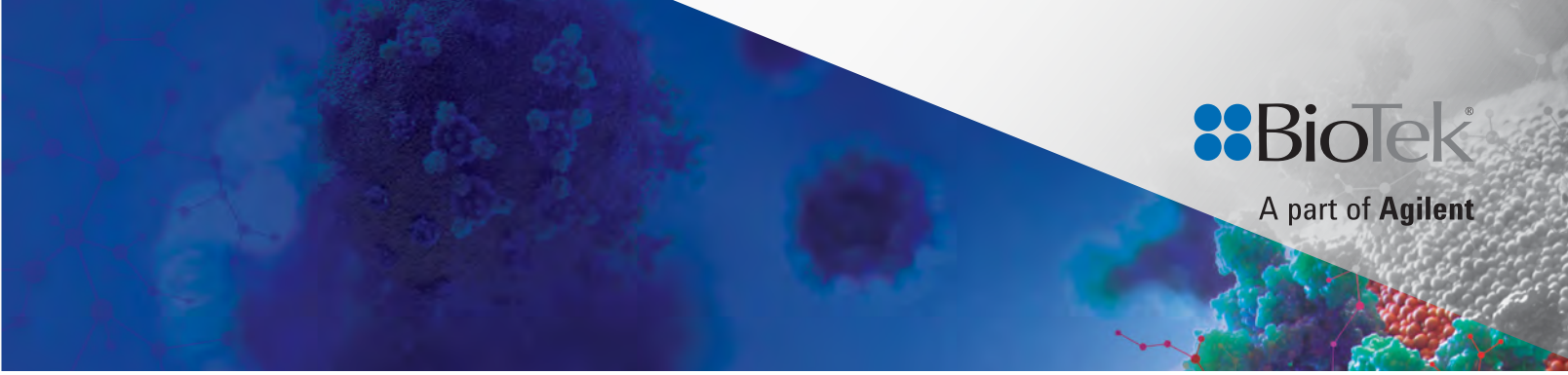

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• Dual Top PMT, Top and Bottom Monochromator Fluorescence with Variable Bandwidth, Top and Bottom Filter Fluorescence, Fluorescence Polarization, Time-Resolved Fluorescence, TR-FRET, TRF Laser, Luminescence, Filter Luminescence, Monochromator UV-Vis Absorbance, Alpha Laser • For 1- to 1536-Well Microplates • Incubation to 65°C, Shaking	**NE2MALPHABT**

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N 820 G	Rotary Evaporation, Degassing, Fluid Aspiration, Centrifugal Concentration, Vacuum Oven, Gel Drying	4.5 torr, 6 mbar	20 L/min.	Yes	Yes	**13-880-905**
N 840 G	Rotary Evaporation, Filtration, Centrifugal Concentration, Vacuum Oven	4.5 torr, 6 mbar	34 L/min.	Yes	Yes	**13-880-906**

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Ramp, Nonslip, Polyethylene, 55.5 x 28.5 x 8.75 in.	**19-130-4953**
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Ultra-Drum Rack P2 Racks, Holds Two (55 gal.) Drums	**19-820-937**
Ramp, 24 x 32 x 5.75 in.	**19-058-033**
Ultra-Spill Deck, Four Drum, 52 x 52 x 5.75 in.	**19-058-074**
Ultra-Spill Berm, Orange, 10 ft. x 4 in.	**19-058-009**
Ultra-Spill Trays, Capacity: 1.8 gal. (6.8 L), 17 x 12 x 4 in.	**19-130-2734**
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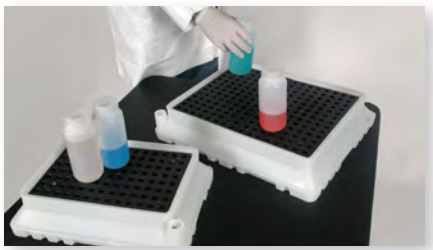

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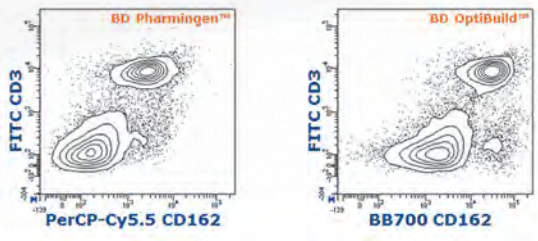

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