BARRIERS FOR INNOVATION

ESSENTIAL BUYING TIPS

FOR YOUR LAB'S NEXT GLOVE BOX UPGRADE

SINCE 1889

Yamato

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Laboratory glove boxes are used in chemistry and materials science to create an isolated environment for the handling of dangerous or atmosphere sensitive samples.

They're also used in movies to make scientists look like they're doing very important science work. Sometimes in space. Sometimes on Earth. But always very important.

And it's a good representation of science for the moviegoer, because gloves boxes are genuinely used in all kinds of scenarios across various fields of science and much of what we know about bacteria and viruses and materials and many, many other things wouldn't be possible without them.

At its most basic, a glove box is a sealed container used to manipulate materials in a separate atmosphere. They are commonly used to protect workers from hazardous substances, or to protect chemicals and solutions that may be sensitive to air or water vapor.

They isolate samples of things from the rest of the world,; where they could be contaminated and take away our ability to learn.

Glove box manufacturers put a lot of energy into refining the airflow and isolation capabilities of the glove box, with the help of purging valves and vacuum gauges to control the inner atmosphere. Glove boxes may be used under either positive or negative pressure and some allow users to alter the humidity and oxygen levels.

From studying meteorites to packaging lithium battery electrodes, glove boxes are essential in many fields.

In this guide, you'll learn the features that can help technicians do their best (and safest) work in any application, and what separates one class of glove box from the next, so you can make an informed purchase when your lab needs new glove boxes.

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TECHNICAL SPECIFICATIONS

Glove boxes are constructed of an optically clear material, usually acrylic, developed for isolation and / or containment.

All units feature a high visibility of the interior and are engineered for cleanliness, safety, complete containment, and a draft-free atmosphere.

Some models are lightweight for easy repositioning through the lab as priorities and projects shift.

Glove boxes typically feature:

- Purging valves and vacuum gauges for atmosphere control.
- A transfer chamber and flat access door to easily introduce equipment into the glove box.
- A pressure relief valve with a small HEPA canister, for quick and efficient filtration.
- White ambidextrous gloves, with flexibility and safety attributes like puncture resistance and high tactile sensitivity.
- Hospital-grade outlet strips for greater reliability.

Most applications in small and mid-sized labs can be tackled by glove boxes in four broad sizes.

SINGLE-SMALL

Inside Dimensions:
28"w x 23"d x 29"h
710mm x 580mm x 740mm h

Outside Dimensions (Includes transfer chamber 12" long)
43"w x 24"d x 31"h
1,100mm x 610mm x 790mm h

Access Door Opening:
15.5" x 22"h
400mm x 560mm

Number of gloves:
Two (2)

SINGLE-LARGE

Inside Dimensions:
35"w x 29"d x 30"h
890mm x 740mm x 760mm h

Outside Dimensions (Includes transfer chamber 12" long)
49"w x 30"d x 31"h
1,250mm x 760mm x 790mm h

Access Door Opening:
21.5" x 22"h
546mm x 560mm

Number of gloves:
Two (2)

MEDIUM

Inside Dimensions:
48"w x 29"d x 32"h
1,220mm x 740mm x 810mm h

Outside Dimensions (Includes transfer chamber 12" long)
63"w x 31"d x 35"h
1,600mm x 790mm x 860mm h

Access Door Opening:
21.5" x 24"h
546mm x 610mm

Number of gloves:
Three (3)

DOUBLE

Inside Dimensions:
60"w x 29"d x 32"h
1,524mm x 740mm x 810mm h

Outside Dimensions (Includes transfer chamber 12" long)
76"w x 32"d x 35"h
1,930mm x 812mm x 890mm h

Access Door Opening:
21.5" x 24"h
546mm x 610mm

Number of gloves:
Four (4)

MATERIALS HANDLING AND STORAGE WITH GLOVE BOXES

Substances used in isolator glove boxes are often hazardous and should be handled with caution. Not only should the materials be isolated from the operator, but the ambient atmosphere should also be taken into account due to its ability to permanently alter and damage the substances.

Many materials and solvents that are used by chemists and materials scientists when used or stored in ambient conditions can absorb moisture or even react with oxygen. Often this can result in permanent changes to the materials properties or the process of removing water from the material can be time consuming and difficult to do. Ideally these materials should be stored and handled within an environment where exposure to either oxygen or water is limited as much as possible.

COMMON AND NOT-SO-COMMON APPLICATIONS FOR COMPACT GLOVE BOXES

Glove boxes are essential for every laboratory. Providing a controlled atmosphere to safeguard sensitive substances is a must for a lot of procedures. The applications are almost endless. Biotechnology, biomedical, nuclear, defense, pharmaceutical, semiconductor, and chemical applications are just a few.

More specific examples of gloves boxes in action include:

ADDITIVE MANUFACTURING

Over the past decade one of the most exciting developments in manufacturing is the adoption of additive manufacturing techniques. Multiple different methods are available for printing parts with procedures such as fused deposition method, stereolithography, and digital light printing.

Each of these techniques rely on the use of thermoplastic polymers or polymer precursor resins that are reactive under UV light.

Over time exposure of these materials to humidity results in degradation in the quality of parts being manufactured. Recent research has shown that even exposure to humidity during the manufacturing process can cause problems, while processing in humidity free and inert atmospheres can produce parts with improved mechanical properties.

So not only is storage important. Having a reliably sealed glove box for procedures is just as important.

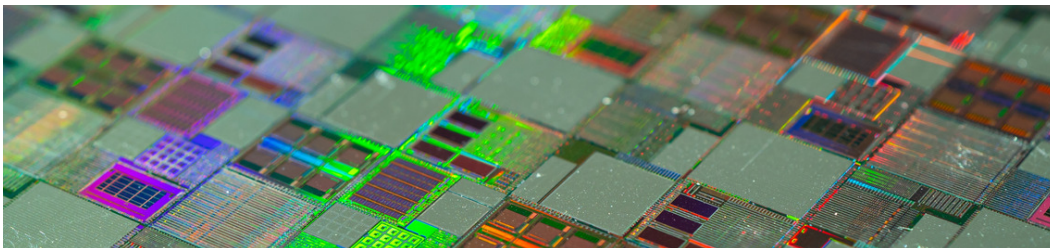
CHEMICAL SYNTHESIS AND ORGANIC ELECTRONICS

Moisture-sensitive substances prove to be the hardest to work with. Accessibility to a glove box that can alter humidity levels, above the ability to control oxygen and atmosphere conditions, is a must for successful procedures.

With an oxygen and moisture free environment, it is possible to synthesize materials and prepare them for analysis without having to expose them to ambient air. This increases experimental success rates by reducing the potential for unwanted reactions with the surrounding atmosphere or moisture.

Moreover, organic semiconductors are used in a wide range of electronic applications. The materials are typically oxygen and moisture sensitive, so providing a sealed atmosphere with calibrated oxygen and humidity levels is needed.

Suitable glove boxes save costs on damaged substances and increase laboratory output.



BATTERY TECHNOLOGY

Modern research greatly focuses on developing batteries, due to their use in a wide range of areas.

Just to give you an idea of how versatile and needed batteries are: Americans alone, purchase nearly 3 billion dry-cell batteries every year. Not to mention the great strides that have been made with electric cars recently. The future where all cars are electric is not too far away.

With the way things are going, advancements in battery technology mean advancements in all modern technology.

Unfortunately, exposure of the active materials of the current lithium-ion technology to moisture leads to unwanted reactions which result in significantly reduced device performance. To overcome this, batteries are made inside completely dry environments with the help of high-isolation glove boxes.

With the next century's technology hanging in the balance, glove boxes like the compact series from Yamato Scientific offer a safe and completely dry environment that aids the progress of battery technology.

STUDYING METEORITES

Space rocks that don't burn up in the atmosphere bring with them valuable insights into the nature of the cosmos and the inner workings of the universe.

These space rocks also contain elements that give scientists a better understanding of the evolution, age, and composition of the solar system. By sustaining a very low-particle, low-humidity environment, glove boxes eliminate the risks if working with such valuable specimens.

Glove boxes that accept nitrogen, argon, or other inert gasses, like Yamato's compact series, help mimic the RH-free atmosphere of space. According to NASA, there are more than 500 scientists around the world studying around 17,000 fragments from other planets, meteorites, and crystals older than the earth.

CONTAMINATION/ LEAK PREVENTION AND DETECTION

When maintaining or using a glove box, it is important to make sure that the inner atmosphere is exposed to as little moisture and oxygen as possible. There are two main ways that the inner atmosphere can be compromised:

- Physical leaks in the box
- The ingression of moisture and oxygen through the materials that make up the chamber

Glove box leaks are inevitable, but with effective detection and a good understanding of how and where leaks occur, the source can be identified and either mitigated or prevented entirely.

Ingression can also be measured, and by choosing a glove box that uses materials with low ingress rates of oxygen and moisture, the extent to which it occurs can be reduced. With the right combination of barrier materials, permanent and non-permanent seals, and effective leak management and mitigation, the glove box can remain intact and efficient for a decade or more.

Contaminants can be removed from a glove box by purging the system with a continuous flow of inert gas, or by circulating the atmosphere through a filtration system that removes oxygen and water. Over time, however, contaminants can re-enter the glove box through a few different pathways. The three main ways that moisture and O2 can be introduced into a glove box are:

- Leaks in the glove box
- Outgassing from used materials inside the chamber
- Ingress through the chamber barriers

PHYSICAL LEAKS

Leaks are the most common source of contamination.

Any leak in a glove box, however small, has the potential to result in contaminants entering the chamber and compromising the internal chamber and atmosphere. The perfectly sealed system does not exist, but both the frequency and severity of leaks can be managed by choosing a well-designed glove box and following good maintenance and operational procedures.

When leaks occur, it is important that they are identified and fixed as soon as possible.
Small leaks do not pose a great threat to the procedure being performed. The integrity of the glove box atmosphere can be maintained for a while if an overpressure is maintained. The overpressure in the glove box results in a flow of gas from the inside of the system to the outside. If the leak rate is below the fill rate that the glove box can maintain, then the box can be kept at an overpressure but with a high usage rate of inert gas.

So, no matter the procedure, small leaks from any cause can be managed for a short period of time.

But you don't want to have to manage these small leaks often. So choose a glove box design with a track record of success in the lab, like Yamato's compact series, and you may only encounter a handful of leaks in the lifetime of the glove box (compared to quarterly leaks from value-priced brands).

OUTGASSING

Outgassing is the slow release of trapped moisture/oxygen from materials brought into the glove box. Over time, this can change the internal atmosphere.

To prevent outgassing as much as possible, proper storage of the substances with water-trapping materials before using them in the glove box is important.

Not only should storage be taken into account, but hydrophilic compounds that can trap water also pose a threat to outgassing due to high humidity levels.

Big access doors and efficient airflow will reduce outgassing errors, if they happen.

INGRESSION

Ingress, in the case of glove boxes, is the diffusion of unwanted oxygen and water into a sealed chamber.

This typically occurs due to moisture and oxygen passing directly through materials used in the construction of the glove box. When talking about ingress, the permeability properties of the materials used should be thoroughly studied to ensure the best results with low infiltration.

GLOVE BOX GLOVES AND OTHER BENEFICIAL DESIGN FEATURES

Even though glove boxes were originally created for radioactive materials research for the military, they are used for almost unlimited applications nowadays.

The gloves are typically made from a handful of types of rubber, and more advanced research generally opts for newer glove compositions:

- Butyl for the prevention of static in the electronics industry
- Neoprene, hypalon, and nitrile which offer a high level of chemical resistance

As we outlined above, the design features you can ask your manufacturer or distributor about include:

- Humidity and moisture control
- Oxygen control
- Pressure control
- Temperature control
- HEPA filtration
- Transfer chamber
- Access doors and airtightness
- Product support

TAKING CARE OF YOUR GLOVE BOXES

Daily inspections are important for all glove boxes. It takes just a few minutes but can save the spoiling of hours and hours of research. As part of your daily checklist, perform the following:

1. **Check the gloves.** Look for holes, discolorations, and gaps or breaks in the connection to the exterior.
2. **Check the window.** Pay close attention to the corners where the window is connected to the rest of the box. You never know if another lab technician accidentally bumped the glove box in passing after you finished on the previous day.
3. **Check the vacuum pump and connections.** Ensure all lines are in good shape and that the oil (if applicable) has been changed recently.
4. **Check the pressure gauges.** Make sure they work and are functioning within acceptable ranges.

OTHER PRACTICAL GLOVE BOX TIPS

- Gloves boxes are often shared by multiple operators in the lab. If that's the case in your space, assign a senior operator to ensure maintenance stays up to date.
- If your manufacturer offers service contracts, subscribe to them and ensure the manufacturer-recommended maintenance is always completed.
- Provide training so operators don't abruptly extend the gloves into the box. This quickly changes the pressure in the box and can cause overpressurization.
- Use nitrile gloves on the glove box gloves to extend the life of the glove box gloves, make cleanup easier, and avoid cross contamination.
- Train all staff on new gloves boxes (even if they're just newer models of the glove boxes staff are familiar with) and document that training in a file.
- Verify backup measures are in place in case power or facility nitrogen are cut off.

CONCLUSION

Glove boxes are essential for many sensitive procedures.

Future advancements in many fields will rely on gloves box manufacturers, and the inert atmosphere they provide in their equipment.

Glove boxes are built for a range of applications, from general lab use to highly specific applications like the handling of pharmaceutical ingredients in powder form or stem cell research in an anaerobic environment.

For most general applications, we recommend Yamato's compact series of glove boxes. They're built in the USA, give your operators the high visibility interior they need to work with, and are commonly used in academic settings working with toxic substances, asbestos, fibers, sewage residue, and harmful liquid vapors.

Whether you are ready to make a purchase or still need to do more research, Yamato Scientific America is here to help. Contact us at **1-800-292-6286** or email us at **customerservice@yamato-usa.com**.