CO_2 Incubator Buying Guide

Key Considerations to take into Account when Purchasing a CO_2 Incubator

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Table of Contents

Introduction - What is a CO_2 Incubator

Chapter 1 - Types of CO_2 Incubators

Chapter 2 - Incubator Location

Chapter 3 - Incubator Parameters

Chapter 4 - Contamination Considerations

Conclusion - Taking the Next Steps

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20-1308-WP-EN-V1-201502

What is a CO_2 Incubator

CO_2 incubators play a critical role in a wide range of clinical and life science research laboratories. They designed to provide a reliable controlled in-vitro environment for optimum tissue cell culture growth. The chamber also provides an environment for the storage and preservation of gametes and animal tissue cell cultures intended for research at or near body temperature. The parameters that contribute to optimum growth conditions are humidity, temperature control, sterility, CO_2 gas control, and/or O_2 control.

Operated effectively, these incubators can maintain cells for extended periods of time, allowing for research and other necessary activities related to the cell and tissue culture contained within. Yet to assure that the cells are maintained in an environment in which they are protected requires purchasing the right incubator for your specific needs. To achieve that requires a strong awareness of the different aspects and features of today's incubators. This buying guide covers the key considerations when making a purchase decision for a CO_2 incubator.

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Two Types of CO_2 Incubators

From a big picture perspective, the first critical decision is what type of incubator will best meet the specific needs in the research or clinical laboratory where it will be housed.

There are generally two main types of CO_2 incubators – water-jacketed and direct heat. With both technologies, the goal is to establish and maintain temperature uniformity to assure proper growth of cells. Specifically, most incubators can maintain a 37°C temperature to within about one-tenth of a degree. To achieve this consistent temperature, the interior chamber is surrounded by water or heating elements. Each technology has specific advantages and disadvantages when it comes to temperature maintenance, humidity, decontamination, ease of use and more.

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Water-jacketed CO_2 Incubators

Because it has greater specific heat capacity than air, water has long been used to regulate the temperature inside lab incubators. In this technology, a jacket of water circulates around the outside of the interior incubator shell; the water exchanges heat with the inner chamber via natural convection. The result is a fairly uniform interior temperature and thermal buffer against outside air. This buffer can be especially useful in the event of a power outage. A water-jacketed incubator has the capability to hold its heat about four to five times longer than units without a large surrounding thermal mass created by the heated water.

Yet, buyers should also consider that water-jacketed incubators, when filled, are very heavy and must be emptied before they can be moved. After they're moved, they can be refilled and started up again—but it takes as long as 24 hours before they're back to a stable operating temperature. On the plus side, the additional mass tends to dampen vibration, which may have a negative effect on the culture of sensitive cells.

NuAire Water Jacket Microbiological CO_2 Incubators provide a stable in-vitro growth environment by heating chamber walls utilizing water. Water circulates within the jacket walls producing a temperature uniformity of ±0.2°C. The larger the mass, the less susceptible the environment within the chamber is to environment fluctuations outside. It also adds cabinet stability for the growth of vibration sensitive cells.

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Direct Heat CO_2 Incubators

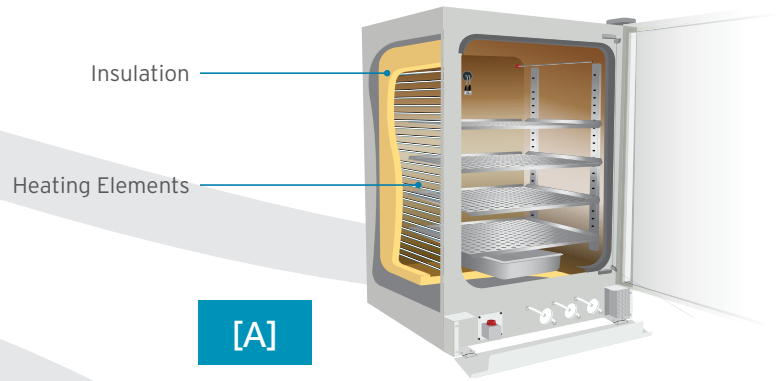
Direct Heat incubators [A] has the interior chamber covered in heating elements, often sandwiched in layers of insulation. The inside air is warmed by one or more heaters. Direct Heat incubators are lighter and, because the interior chamber is heated directly, they can be set up faster and achieve and recover desired temperature more quickly. Some direct heat models rely on natural convection to keep the heat evenly distributed inside the chamber. Meanwhile others maintain heat distribution via mechanical assistance.

A potential challenge with direct heat incubators is that forced air can lead to increased and unwanted evaporation from the cultures. In addition, fans can create vibrations and, in some instances, can create a more conducive environment for contaminants such as fungi and bacteria to grow.

However, from a positive perspective, direct heat incubators often have the capability of incorporating heat decontamination by using a moist-heat or dry-heat cycle. Water-jacketed models do not have this capability.

NuAire Direct Heat CO_2 Incubators provide a stable in-vivo growth model with heating elements located on all 6 sides of the chamber. High-density insulation stabilizes the interior chamber temperature requiring less energy to maintain. Unique features such as dual sterilization cycle, humidity and hypoxia control help ensure research needs are met.

Before making decisions regarding whether to purchase a direct heat or water jacketed incubator several factors should be taken into consideration.



[A]

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Incubator Location

The performance of an incubator can be affected by the surrounding environment so it is important to consider the planned location of the incubator when making a purchasing decision. Specifically, it is best to avoid placing incubators in direct sun, next to an oven or autoclave, or underneath air diffusers. Also instruments placed in the incubator, such as shakers, can generate heat, causing a well-insulated box to go above the set temperature. If this is a concern - or if the incubator is not placed in an air-conditioned space - a unit with refrigeration capacity may be the right choice.

Manufacturers generally test their incubators for hot and cold spots and follow up by publishing temperature-uniformity statistics. Obtaining test results may also be useful when considering the ultimate location of a unit.

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Temperature Control

While location and other physical factors can influence incubator performance, improvements to the quality and functionality of incubators typically assure consistent temperature control. A much more pressing consideration is making sure that those using the incubator are properly trained in regards to keeping the door closed whenever possible.

Every time the door of an incubator is opened, the temperature of the interior is disrupted. As currents of warm and cool air swirl around inside, the incubator's temperature control system must work to return the interior's temperature to the set level. While again, user awareness is key to limiting the potential for temperature variations due to opening the incubator, it is worth considering that water jackets typically make incubators less susceptible to fluctuating temperatures.

Prior to purchasing any incubator make sure there is a plan in place to properly train users in the operation and procedures regarding the instrument.

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Humidity Control

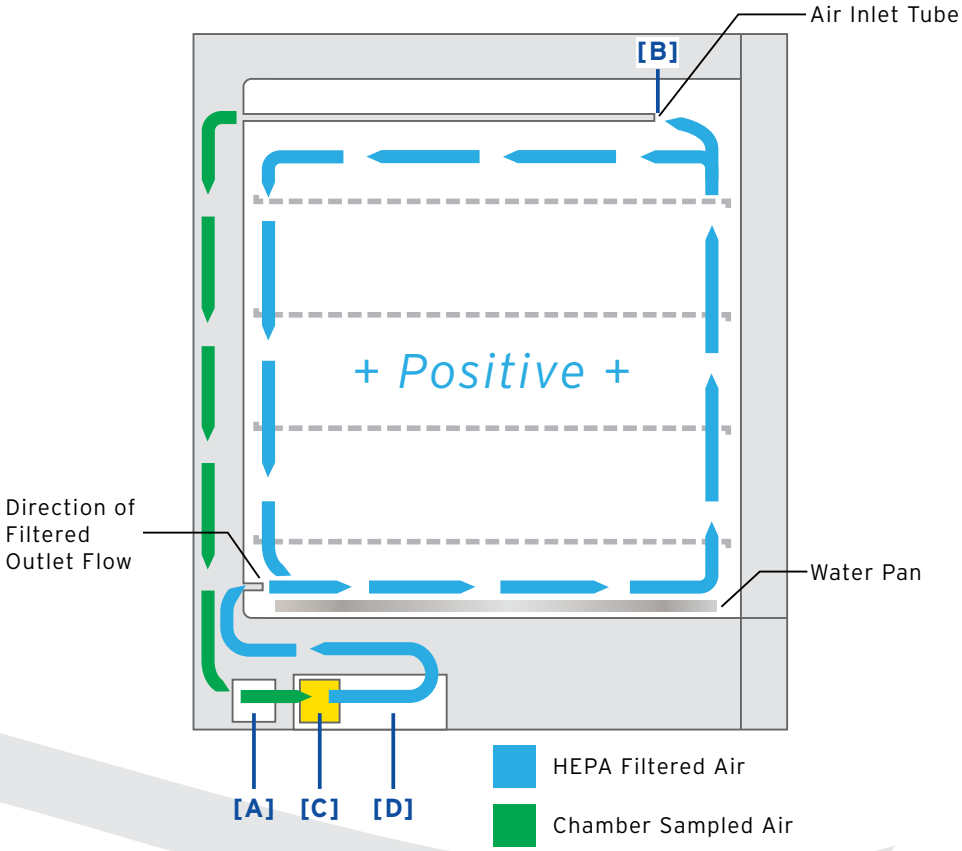
Maintaining the ideal humidification within an incubator is essential because it prevents the cell cultures from drying out. Additionally, it supports the important function of maintaining uniform osmotic cell pressure.

The airflow within the incubator's interior can lead to excessive and damaging evaporation. Preventing damage to stored cells and cell tissues is not only a function of humidification controls—it also is affected by the amount and type of airflow that occurs within the chamber. Some manufacturers, including NuAire, reduce the airflow within its incubators to avoid drying out cell cultures. NuAire's "Closed Loop HEPA Filtration System" [B] achieves this and is standard equipment on all NuAire CO_2 incubators. The technology slows airflow to one air exchange per 30 minutes within the inner chamber, which minimizes evaporation or desiccation of the cell samples.

[B]

Closed Loop HEPA Filtration

View: Side, Airflow



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CO_2 Control

Maintaining a healthy CO_2 level within the incubator is important as the CO_2 interacts with the buffering system of the cell culture media to determine the media's pH. A key choice to make for CO_2 control is what type of CO_2 sensor the incubator will have. While many incubators use either the more traditional thermal conductivity (TC) sensor, the newer type of infra red (IR) sensor is often more effective as it is not as sensitive to chamber humidity and temperature.

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Contamination Considerations

In addition to considering the many factors that influence maintaining the right culture conditions, another major consideration is preventing contamination of your cultures. Contaminants can be introduced in a range of ways. For instance, contamination can occur when a non-sterile hand or glove touches the inside of the incubator or when an open door introduces airborne contaminants. A filtration system such as NuAire's Closed Loop HEPA Filtration System can help to reduce contamination by airborne species.

For cleaning the interior surfaces of the incubator, most models use sterilization cycles (run at high heat, so the incubator must be emptied first). NuAire's NU-5800 series offers two types of sterilization cycle (+95°C wet and +145°C dry). It also uses air pressure, another incubator defensive device, to protect cultures during door openings.

Additionally, look for incubator interiors that have rounded corners, making it easier to clean by chemical disinfection, as there are no tight crevices in which contaminants could grow. Like wise its wise to be aware of the incubator gasket that creates the seal around the inner door. The gasket is an area where humidity can build resulting in the growth of contamination if left unchecked. Make sure the gasket is removable and easy to clean. If using a v-gasket beware of the direction of the flap. A flap that points outwards towards laboratory [C] will collect particles keeping from entering the growth chamber. A flap that points inwards in an area for humidity to collect breading ground for contamination.

[C]

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Contamination Considerations Continued...

Another way to obtain continuous protection is to select an incubator whose inside surfaces contain copper. Copper has anti-microbial properties that can protect against contaminants introduced by a user or perhaps by the bottoms of culture plates. NuAire offers CuVerro® Antimicrobial Copper surfaces [D] to the incubator growth chamber and/or shelving to kill bacteria* to minimize potential incubator contamination. CuVerro® is laboratory tested and EPA registered. CuVerro® Antimicrobial Copper Surfaces kill more than 99.9% of bacteria* within 2 hours, and continues to kill 99% of bacteria* even after repeated contamination, when cleaned regularly.

NuAire's incubators are based on the company's well-regarded biosafety cabinets, which also use HEPA filtration to control contamination. By incorporating the HEPA filtration technology in its incubators, along with humidity controls designed to maintain the proper humidity level for cell growth, NuAire has been a leader in limiting contamination. NuAire has been monitoring contamination events in its incubators with less than 75 incidents since 1986.

The best method to reduce the probability of contamination is to clean the interior of the incubator often, this includes all nooks and crannies (shelves, brackets, etc.) and to change the water pan (if using) routinely.

Laboratory testing shows that, when cleaned regularly, CuVerro® antimicrobial copper surfaces kill greater than 99.9% of the bacteria within 2 hours of exposure: MRSA, Staphylococcus aureus, Enterobacter aerogenes, Pseudomonas aeruginosa, O157:H7. CuVerro® antimicrobial copper surfaces are a supplement to and not a substitute for standard infection control and have been shown to reduce microbial contamination, but do not necessarily prevent cross contamination; users must follow all current infection control practices, including those practices related to cleaning and disinfection of environmental Reg No 85353-5, EPA Est No 088257-MN-001

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Taking the Next Steps

Ultimately the decision about which incubator, or incubators, to purchase is a critical one that can impact the quality of work and results at your facility. Armed with a greater awareness of the different types of incubators and the range of considerations regarding features and capabilities, those involved in the buying decision should connect with those who will be using the equipment on a regular basis. Gaining insight and input from those on "the front lines" in the laboratory or clinical setting, will help ensure that the right incubator is purchased to meet current and future needs. And involving users in the purchasing decision can also lay the groundwork for greater adherence to effective operating procedures. The end result will be incubators that enhance the performance of your organization for years to come.

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The incubator growth environment is a delicate balance of temperature, gas, humidity, air, sterility, and reliability. Put your trust in a NuAire CO_2 Incubator so you can concentrate on what matters.

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