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Best Cool Containers for Transporting Vaccines: Active vs. Passive

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It’s time for pharma logistics providers to assess their cool container fleets. But what's best for transporting coronavirus vaccines: passive or active?

The long-awaited coronavirus vaccines have started to arrive, and the cold supply chain is going to play a critical role in their distribution. If it doesn’t have the capability to transport the vaccines at the correct temperature, it can’t guarantee their effectiveness.

What the correct temperature is depends on the supply characteristics of the vaccine. The first two vaccines to be approved in the West—Pfizer and Moderna—need to be stored at extremely low temperatures (minus 70°C and minus 20°C respectively). Therefore, they need freezer or ultra-freezer conditions while being transported.

Conversely, the AstraZeneca-Oxford vaccine can be stored at a regular refrigerator temperature of between 2°C to 8°C, just like flu vaccines, which means they can be transported in cool containers. And it is this supply characteristic—plus the fact that it is more affordable than either the Pfizer or Moderna vaccines—that makes this a more likely candidate for mass vaccination programmes in remote and disadvantaged communities around the world.

The vital importance of cool containers to the pharmaceutical supply chain

Temperature-controlled Unit Load Devices (ULDs) help all those involved in shipping pharmaceuticals by air to meet IATA’s strict Temperature Control Regulations. Used properly, these cool containers prevent the cargo being exposed to higher or lower temperatures than permitted. This is crucial for vaccines, which rarely show any outward signs of temperature excursions.

With so much riding on a successful COVID-19 vaccination programme, those tasked with transporting the much-anticipated vaccines by air need to re-evaluate their ULD fleets. But what type of cool container is best for transporting such fragile cargo?

Let’s look at the pros and cons of two common but different cool containers used in the air cargo industry today:

- **Passive cool containers:** These rely on insulation, fans and a finite source of cold (such as wet ice, gel packs, dry ice or liquid nitrogen) to prevent fluctuations in the cargo’s temperature. They come with or without thermostatic regulation, which may use batteries, but they do not adjust for the ambient temperature.
- **Active cool containers:** These rely on an insulated enclosure under thermostatic regulation to maintain a temperature-controlled environment. The internal battery powers the Temperature Control Unit, which run the sensors, ventilators and air duct. They actively adjust the internal temperature according to the external temperature.

For comparison purposes, we'll examine four key areas of active and passive transport systems: reliability, sustainability, cost-effectiveness and ease of use.

Comparing passive and active cool containers

1: RELIABILITY

No matter what the temperature is outside, active containers maintain a temperature range without any significant deviations. This is because its Temperature Control Unit (TCU) actively controls the internal temperature throughout the entire journey.

All active containers monitor permanently the temperature of the cargo compartment. The minimum and maximum temperatures depend on the configuration, but can be as low as 2°C and as high as 30°C.

In contrast, passive containers may or may not come with a temperature monitoring system, and they maintain a narrower internal temperature range of between 2°C and 8°C. However, this range can deviate if the ambient temperature becomes colder or hotter than normal conditions.

The lack of active control means passive containers shouldn't be overly exposed to temperatures above or below the set temperatures. Having said that, some passive containers are designed to maintain a certain temperature for a given payload capacity and a specified time.

The specific risk-profile of your cargo and the ambient temperature during shipment often determine whether an active or passive shipping system is most suitable for you. This is especially true of vaccines, which can be extremely temperature sensitive.

2. SUSTAINABILITY

All active containers have an internal battery system. Some use single-use D-Cell batteries; others use a rechargeable battery pack. Certainly, rechargeable batteries are kinder to the environment than single-use batteries, but both come with an environmental cost. Even the rechargeable types use natural resources (like lithium), require energy to produce, and are toxic if not disposed of properly.

The sustainability of passive containers depends largely on the source of cold that they use and whether they use batteries to run a thermostatic system. Some shippers add single-use or multi-use coolant packs as an additional source of cold. The single-use variety (which are destroyed by the receiver of the cargo) are the most wasteful, of course, but even the multi-use variety can be used only so many times.

When it comes to dry ice, which is a common refrigerant for passive containers, it may surprise you to learn that it's actually environmentally friendly. In fact, it helps achieve net zero emissions. That's because dry ice is made from reclaimed carbon dioxide (CO_2), doesn't create any significant chemicals when manufactured, and never produces or releases excess CO_2 into the environment when it sublimates.

The flip side to this environmental advantage is that it does rack up quite a few delivery miles because dry ice can't be stored by the shipper. Naturally, this has environmental considerations.

3. COST-EFFECTIVENESS

When looking at the financial advantages of both types of containers, it is best to consider the overall cost of ownership. In other words, the capital cost and the operating costs.

Passive containers typically cost less to buy and maintain than active containers, although prices vary according to configuration and the level of customisation. However, you do have to take into account their running costs such as batteries and cooling agents.

The cost of D-cell batteries for passive cool containers can be considerable, especially if you're operating a large global fleet. Rechargeable batteries are a more cost-effective alternative since you fork out for a replacement only when they've reached the end of their useful life.

Dry ice—commonly used for passive air cargo containers—is generally priced by weight, but the exact cost depends on which retailer you use and how much you order at a time. Usually, the more you order, the less it costs as you get a volume discount. Of course, when global demand for dry ice increases, which is currently the case, the price is subject to upward pressure.

In complete contrast, active containers don't need any add-ons such as batteries or dry ice, so their running costs are much lower. However, that is counterbalanced by the higher cost of buying and maintenance compared to passive containers.

4. EASE OF USE

The TCU of an active container is usually relatively simple to operate. You just select the desired temperature range via the external control panel. In fact, some TCUs offer pre-set ranges to simplify the operation even further. The loading of cargo is also simple in comparison as there is no dry ice or any other coolant to add.

Conversely, dry ice requires careful handling. It's so cold when it's solid that you must wear heavy gloves when filling up the dry ice tank of a passive container. Otherwise, you'll get frostbite. You also need a well-ventilated area. It's not toxic when managed correctly but, in confined areas, dry ice can produce a build-up of released gases, which in turn can raise carbon dioxide levels in the blood.

Possibly the biggest drawback to dry ice is the difficulty in calculating how much you need to use for each shipment. There are many considerations, such as the type of container, set point, total shipment time, and ambient temperature of each stage of the journey. One way to overcome this drawback is to use a dry ice calculator. The more data you input, the more indicative the results.

One other thing to bear in mind is that you can't store dry ice, so you have to get it delivered close to the time it will be used. You'll need a reliable supplier and an efficient ordering system to ensure you have it when you need it.

When it comes to batteries, ease of use depends on the battery type. It can be fiddly to take out and reinsert 8 or 16 D-cell batteries. Plus, you have to keep a lot of spares in stock. Rechargeable batteries, on the other hand, come in dedicated battery packs so they're easier to handle. However, your container can't be used while the battery is being recharged, which can take around eight hours.

One solution to this downside is to use a removable rechargeable battery. This can be taken out and replaced with a fully charged battery in a matter of seconds (added bonus: this type of battery

doesn’t need replacing, only refurbishing by the manufacturer, which is much cheaper and more environmentally friendlier than buying a new battery pack).

Both passive and active containers are excellent for transporting vaccines and other pharmaceuticals, but which one is best for your operations depends on a number of factors. Hopefully, the pros and cons that we’ve outlined above provide a useful guide.

Alternatively, you can always speak to one of our specialists to aid your decision-making. Just drop us a line at info@vrr.aero or call us on +31 (0)10 479 8100. You can ask about our range of cool containers at the same time.