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Pharmaceutical Processing Equipment Moves Are Made Easier by Capturing the Power of Air

A proven option to optimize production efficiency is now working its way through the pharma and biotech world: air casters. This technology, similar to air hockey pucks, uses compressed air to ‘float’ tanks, casks, and columns on cleanroom floors with potentially no damage to the floor, equipment, or the cleanliness of the environment. This move system can contribute to continuous manufacturing initiatives, increase the potential for achieving EMA-approved clean room compliance, and facilitate ergonomic goals to meet the needs of employee safety. A case study regarding chromatography columns pinpoints key reasons to consider air casters when moving loads up to 13–18 metric tons.

The goal in pharmaceutical production is to consistently reduce human error, enable more flexible product tracking and tracing, and optimise production efficiency and throughput. An integral

part of any manufacturing and testing workflow is regularly relocating equipment. Chromatography columns, for example, must be regularly cleaned and repacked. This logistical element of the of the workflow offers ample opportunity for improvement that can yield overall improved efficiency and throughput.

Unfortunately, maneuvering heavy equipment through cleanroom, production, or test lab environments is a challenge for pharmaceutical and biotech firms. Choosing the optimal material handling system relies on factors including facility characteristics, production process, and the equipment to be moved.

One innovative option that can satisfy a range of needs should float to the top of anyone’s list: hovercraft technology that can move heavy, awkward, delicate, and/or sensitive loads with ease – even in dense manufacturing environments or pristine cleanroom areas. Medical-grade manufacturing processes are made easier by capturing the power of compressed air

to ‘float’ equipment, casks, chromatography columns, tanks, tools, production and test equipment with ease and efficiency.

What Are Air Casters?

Originally developed for use in the aerospace industry, air casters are inflatable, donut-shaped bags that use compressed air to create a thin film upon which multi-ton loads can float. Once the bags have inflated, excess air escapes underneath and creates lift. This film of air, no thicker than a business card, reduces the friction coefficient of the load to around one percent, so air casters require only about one-tenth the force to move as wheeled casters. A 2.26 metric ton column, for example, would need only 2 to 11 kg of force to move, something even a single operator can manage. A wheeled caster, by contrast, would require as much as 136 kg of force to move across most floor surfaces.

As a result, air casters enable operators to move even giant equipment such as chromatography columns like pucks on an air hockey table. Air caster equipped systems enable multi-ton loads to be moved easily,



precisely, and safely by even just a single operator. This material handling method is inherently safe to operators because of an exceptionally low lift height and an exceptionally low chance of strain due to reduced friction.

How Air Casters Fit into Pharmaceutical Applications

They Meet Cleanroom Standards

Cleanroom facilities for pharmaceutical operations must protect against contamination that can jeopardize product quality and pose safety hazards to staff or end-users, so the material handling system in a cleanroom must itself preserve the environment's cleanliness and purity. That need eliminates most motorised or mechanised systems that require lubricants or fuel due to potentially dangerous fumes, vapors, or other volatile organic compounds that can be released into the environment. Specifically, air casters help to eliminate:

- **Off-gassing:** Unlike motorised wheels, air casters do not require fuel or chemicals to operate.
- **Particulates:** Wheels that move or grind against the floor can release dust, paint flakes, and other particulates.
- **Other issues:** Medical-grade air casters, made from food-grade plastics and stainless steel, can be easily cleaned.

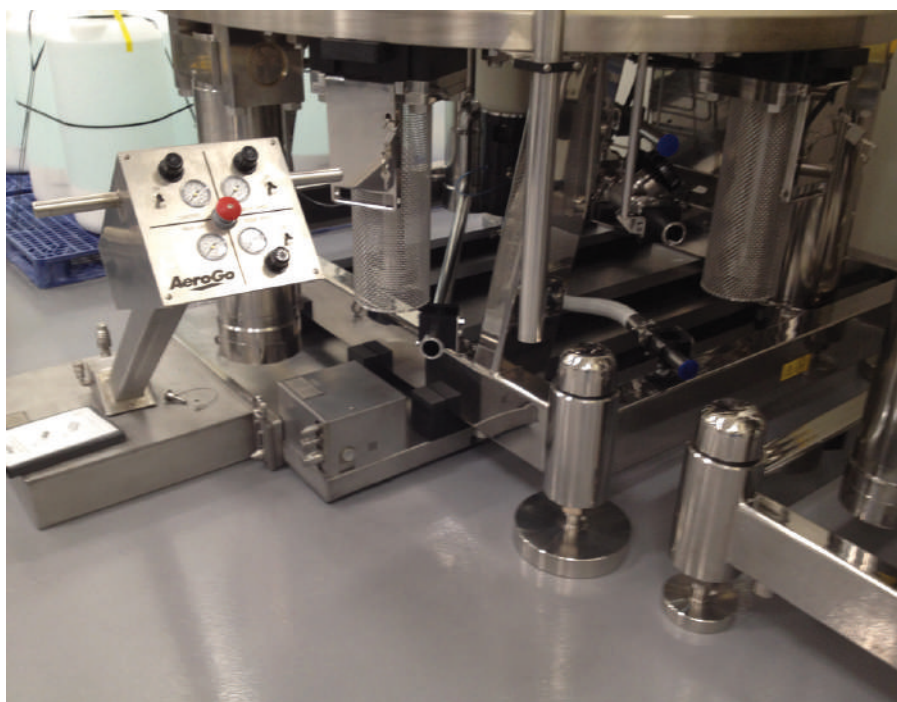
They Protect Floor Surfaces

Unlike wheels or rollers, air casters do not create pits, scrapes, or other damage to expensive cleanroom floors. Epoxy coatings and other special floor surface treatments in particular can be compromised by a wheeled cart carrying a multi-ton load. The floor loading at the wheel can exert more than 3000 psi at each point of contact with the floor surface, which is more than enough to ruin the coating and gouge or scrape the floor.

The ideal material handling methods to reduce floor damage are those that prevent the load from touching the floor as the load moves. Cranes are one solution; air casters are another. By floating the load above the surface, air casters exert only 30 to 60 psi of floor loading, effectively distributing weight across the entire footprint of the load and preventing damage to the floor.

They Protect the Equipment Being Moved

Pharmaceutical equipment floated on air casters is nearly vibrationless, so it protects



calibrated equipment and reduces the need for post-move recalibration.

That smooth movement can especially help with chromatography columns, which are often packed with specialised media at a precise specification to control flow velocity and ensure optimal performance. Vibration from rolling across the floor coupled with shock loads from hitting bumps or gaps can upset the carefully packed media.

The most effective way to isolate the column from vibration or shock loads is to separate the load from the floor surface.

Air casters effectively function as a shock absorber, shielding the equipment against vibration while moving. When the column arrives at its destination, the air casters slowly and gently deflate until the column is once again resting on the floor.

They can Maneuver even through Challenging Environments.

Tuggers are another very common option for pharma and biotech firms to move heavy equipment, but in terms of maneuverability, they have a big limitation: they have the net effect of increasing the size of the load being moved. Because the steering mechanism



extends out from the platform on which the chromatography column or other machinery sits, they add to the total footprint and require more space to operate. In fact, they require a huge amount of open area just to make turns because their turning radius is so extensive. Since tuggers rely on human power, they are also highly vulnerable to problems related to momentum and inertia.

Air casters fit entirely underneath the object being moved, so they reduce the total footprint to the minimum necessary size. They can even be stored under the component when not in use. That way, they can free up more space in a clean room and make it possible to maximise utilisation and place as much productive equipment into the space as is possible.

Since they are floating, they are also very easy to slow or stop as needed. Unlike wheel caster systems and rollers, no additional force is required when you change direction during an air caster move.

The Impact of Air Casters on Pharma Operations

Consider chromatography columns. These are large pieces of equipment, weighing upwards of 18 metric tons, that can be laborious and inefficient to move by traditional methods. Unfortunately, their operation means they must be moved regularly in order to be cleaned and repacked with material. Inefficiency multiplied by frequent moves means productivity losses can stack quickly.

With air casters, these moves can be simplified. For example, one pharmaceutical company uses air casters to move chromatography columns through various workstations to refine and concentrate the proteins used to produce insulin. The columns weigh around 14 metric tons. They use a low-profile stainless-steel transport with an air-powered drive system to move the columns as follows:

1. Operators slide the transporter under the column, inflate the air bags, and then navigate the machine through the corridors of the cleanroom to its interim destination.
2. There, the air caster bags are deflated, and the column gently settles into its new position.
3. Once it is ready to be returned to the production line, the air casters are reinflated, and the operators simply push the machine into position. The omnidirectional movement inherent to air casters makes it possible to position the machine with extreme precision.
4. Finally, the air bags are deflated again, and the air caster system can be tucked out of the way until it is needed again.

In this case, the actual machine move requires only a few minutes of time and never more than a single operator with a spotter or two.

This kind of move speed and simplicity has several implications for pharmaceutical operations:

1: Facilitating Continuous Production

Continuous manufacturing is key to maximising throughput and has become a popular approach in the pharma/biotech world for producing drugs and other bioproducts faster and at lower cost. Janssen Therapeutics, a pharmaceutical company of Johnson & Johnson, reduced production time for its HIV medicine Prezista (darunavir) from 2 weeks to 3 days after it switched to continuous manufacturing.¹

2: Increasing Productive Space

The sheer maneuverability and compactness of air caster-based solutions can even enable more efficient production facilities and layouts. For example, an engineering firm tasked with designing a new pharmaceutical production facility realised air casters required far less space than wheeled solutions. They were able to reduce the width of hallways through the environment by around six inches, which translated into millions of pounds in construction cost savings.

3: Increasing Throughput

Most material handling systems can be surprisingly slow. Cranes, for example, require operators to painstakingly attach the load, wait for a certified operator to become available, carefully make the move, and gently unload the equipment. A wheeled vehicle may need to move even more slowly to avoid risk to the equipment, the facility, or other personnel in the area. Air casters require minimal setup and can be pushed with little fear of tipping, tripping, or collisions. They can move in minutes what might take a crane and other systems half an hour. That can speed up production processes enough to increase overall throughput.

4: Enhancing Flexibility

Because air casters don't require any kind of permanent installation, they also improve the overall flexibility of the facility. If an operation based on cranes or conveyors wanted to reconfigure the production layout, they wouldn't be able to. Facilities using air casters can reconfigure their flow as often as they like. That way, the operation can continue to use air casters no matter how their production processes change or evolve over time.

How to Pick the Right Air Caster for Your Application

Air caster systems are often customized and tailored to fit specific needs, but pharmaceutical manufacturers generally utilise one of two broad styles of air casters for use with chromatography equipment, with

a small number of alternative solutions also available.

1: The Air Caster Transporter

The Air Caster Transporter is ideal for chromatography equipment weighing only a few tons. Shaped like a pallet jack with either a solid flat surface or two forks to accommodate the structure of the machine, the transporter slides under the column and fits almost entirely within the footprint; it does not extend out to the sides at all. Since air casters can move omnidirectionally and rotate 360 degrees in place, the operator uses a handle to maneuver the machine including the ability to back up and navigate even 90 degree turns with ease.

2: The Air Caster Drive System

The Air Caster Drive System is for heavier chromatography columns up to 13.6 metric tons that require more force than one or two operators can safely provide. In this situation, an air caster system with a built-in throttle and drive enables operators to propel the column from point to point on air, without requiring muscle power alone to actually move the equipment. Integrated controls

help the operator maintain control over move direction and speed at all times, improving maneuverability.

Operationally, the drive system functions much like the human-powered transporter: it slides underneath the column and lifts it up. Even with the drive system incorporated, the air caster is not much bigger than the column itself and requires less overall space when compared to other solutions, like tuggers.

3: The Embedded Air Caster System

Alternatively, it's also possible to integrate air casters directly into your pharmaceutical equipment for the capability to adapt to everchanging manufacturing configurations. The embedded systems serve as permanent rigging for on-demand capability to reposition machinery. The system includes air bearing modules and an integrated control console for adjustable air control for offset loads. Design engineers are offered immediate access to online models at aerogo.com/products/embedded-systems.

Ultimately, too many pharmaceutical and biotech firms get stuck on a particular move

system because it's what they already have or what they are already familiar with, not because it is the best option. If the overall goal is to maximise floor space, increase efficiency and enable a safe move for the operator and the equipment, air casters are not just a better way to move machines from one place to another. They have proven themselves essential to operating an optimally cost-effective, continuous manufacturing process in chromatography and pharmaceutical facilities.

For more information and detail, download and read "Buying Guide for Pharma Handling Equipment," a white paper that details considerations specific to the pharmaceutical, biotech, and medical industries.

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Live chat is available along with other case studies online at www.aerogo.com/applications/pharmaceutical-biotech/

REFERENCES

1. <https://www.biopharmadive.com/news/pharmas-slow-embrace-of-continuous-manufacturing/532811/>



AeroGo

AeroGo manufactures innovative load moving equipment, utilizing hovercraft technology, to move heavy, awkward, delicate or sensitive loads in manufacturing. Medical-grade manufacturing processes are made easier by capturing the power of compressed air to 'float' chromatography columns, tools, test equipment and columns with ease and efficiency. Companies large and small benefit from a worldwide dealer network, experienced product specialists, and skilled engineers. We work with you to find a load moving solution that is safe, efficient, and cost-effective.