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By Cole Miller

How air casters optimize factory flexibility

Integrated air bearings make it possible to implement a reconfigurable system to improve or supplement manufacturing floor changes

In a plant environment, the ability to move machinery to optimize floor space or flex for lean manufacturing is essential for increasing productivity and profitability. To accomplish that goal, original equipment manufacturers (OEMs) have turned to embedding integrated air bearings or air casters into their machinery and other heavy or oversized equipment for adapting and adjusting to ever-changing manufacturing configurations (see Figure 1). Having reconfigurable manufacturing systems, tools and equipment improves manufacturers' responsiveness to changing demands or circumstances, such as unexpected surges in product demand or equipment failure. That capability offers another important positive: a significant increase in throughput.

Figure 1: Integrated air bearings, or air casters, help adapt equipment to ever changing manufacturing configurations. All images courtesy: AeroGo Inc.

Other reconfiguration benefits

Today's plant floor is more dynamic than ever. If manufacturers expect to maximize productivity and efficiency in an often-unpredictable market, they need to consider the benefits offered by reconfigurable manufacturing systems and compare them with the positives and negatives of dedicated manufacturing lines.

Dedicated lines offer exceptionally high throughput, but practically no flexibility or scalability to adjust to changes in demand. Worse, the failure of a single piece of equipment could potentially necessitate the shutdown

of an entire complex production system until completion of repairs.

What's missing here is "mobility" — the ability to move machinery on the fly, which is the reason for implementing a reconfigurable system to easily and

immediately improve or supplement necessary changes to the manufacturing floor, such as swapping outdated machines for replacements or quickly configuring entirely new production lines. None of this can happen if it's prohibitively difficult or logistically unfeasible for operators to move or replace machinery.

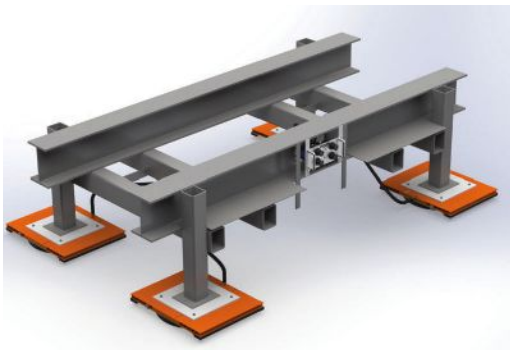
Mobilizing a manufacturing plant

"Flexibility has to be built, or programmed, explicitly into machines," wrote industry consultant McKinsey and Co. in "Optimizing production in the age of the machine."

Companies are increasingly making use of design-to-value techniques to optimize the lifecycle costs of machines. This is a proactive mindset and good advice for OEMs.

Perhaps the best example of this type of thinking and its implementation is embedding air casters to design machinery that does more than perform its needed function. It also solves several key problems for manufacturers, such as the need to adapt quickly to changes and to eliminate the potential risks and impracticalities inherent in other material handling methods. Among the examples of these issues and their resolution are:

- **Ease of movement.** In addition to weight that often exceeds thousands of pounds, manufacturing machinery can be shaped and sized in unconventional forms rendering it unwieldy, especially for relocation. Manual equipment movement may be impossible and even if feasible, risk of damage to the machinery, the floor or potential injury to employees may be too great.
- **Protecting floors.** Traditional equipment that relies on wheels is often impractical, requiring too much mechanical force or human energy likely to damage the floors during load movement. The risk multiplies when a heavy load moves on a downward slope. The wheels may subject the machinery



to potentially harmful vibration, jarring motion or a sudden collision with a wall or other obstruction.

- **Eliminate the need for bulky and expensive forklifts.** In many cases, space is limited and so is the ability of operators to maneuver equipment. On a tightly packed plant floor, inches matter. Forklifts, as useful as they are in certain situations, are not the best resource for precise positioning of large, unwieldy pieces of machinery. Extensive training is often required. Worse, their time in use and the serious disruption on the shop floor caused by their operation can offset whatever benefits might have been gained from moving the machinery.

Making heavy machinery hover

Embedded air bearings excel in making manufacturing machinery mobile. Using compressed air, air bearing systems can lift and float heavy machines, structures and tooling with their own footprint. Like a puck on an air hockey table, air casters eliminate friction by hovering heavy loads above the floor without causing damage to the surface.

Specifically, air casters are aluminum plates. Donut-shaped bags underneath them inflate with compressed air and when fully inflated, the air casters lift the machine. A layer of pressurized air between 0.003 and 0.005-inches thick — about the thickness of a credit card — floats the machine or equipment. Movement of the machinery is virtually frictionless (friction coefficient of less than 2%), rendering extremely heavy objects easily maneuverable in virtually any direction.

Air casters embedded into a piece of heavy, unwieldy machinery allow operators to attach an air hose, inflate the air bearing system and reposition it with minimal energy requiring only 5 to 25 pounds of force to move as much as 5,000 pounds. Air casters sit within the machine's own footprint and move omni-directionally, which is why positioning is so precise. At the target location, operators simply deflate the air casters. Air loss is not instantaneous, so the machine gently settles onto the floor.

Repositioning takes only minutes instead of the hours required for other load movers, enabling unprecedented mobility and safety. Generally, a single operator with minimal training can safely move a 5,000-pound air caster-equipped machine on a typical shop floor with a 0.25-inch slope more than 10 feet. Risk of the object falling from a height or suddenly slamming down onto the operator has been virtually eliminated. Since only minimal force is required to move the object, another risk — that of strain injury — is minimized or even eliminated.

Since the load floats, air casters usually can accommodate slight inconsistencies in the floor, so the mov-

ing machinery is not subject to potentially damaging vibration or jarring. The load can be moved in any direction, including swiveling within its own footprint. Unlike the limitations with forklifts, air caster-moved loads can be slipped into much tighter spots without striking neighboring objects.

Design considerations

OEMs have understood the advantages of embedded systems for years. Thanks to newer technology in the form of an air bearing system kit with models, engineers who design functional but hard to move equipment can integrate systems into their designs. That is good news for customers who no longer need to employ a rigging contractor or lease an expensive,



heavy-duty forklift to move heavy machinery. An embedded air bearing system permanently mounted into the tool, machine or structure serves as its own permanent rigging gear (see Figure 2).

OEM engineers can incorporate embedded air caster designs into their own machines by accessing downloadable engineering models. The system requires OEM designers to determine the number of points of contact required — typically four to six — and then use standardized models that either already fit standard tooling and equipment footers or under wheeled casters. Designers also will need to include space for an integrated control console, which allows operators to adjust air control to individual casters for offset loads. The console is small but does require some space for connecting wiring and hoses. Once designed, OEMs can order the appropriate standardized parts and then simply bolt, weld or screw the tooling footer to the top of the embedded air caster.

This system enables designers to integrate a readily available, adjustable and easy-to-implement mobility option into their machine design, thus sparing their customers the necessity of having to contract with expensive outside service providers.

Making manufacturing systems fly

OEMs can assist manufacturers seeking to implement a partial or fully reconfigurable system by embedding air

Figure 2: An embedded air bearing system permanently mounted into the tool, machine or structure serves as its own permanent rigging gear.

SOLUTIONS

MATERIAL HANDLING

caster systems into their machinery to solve real-world operational issues for their end users. With embedded air casters, adjusting production capacity is simply a matter of attaching an air hose, moving machinery to where it needs to be and putting the production line back in operation in a matter of minutes.


The advantages are layered, but straightforward:

1. Operators can reposition heavy machinery or equipment without a lengthy or expensive move process requiring partial or full shutdowns
2. The movement of such loads can be completed more easily and precisely by just one or two people
3. Operators can reposition the machinery or equipment more easily and more safely than with other solutions like fork trucks, cranes or manpower.

Embedded air casters enable flexible response to external changes such as demand for a current product or the rising demand for a new one, and an internal change: i.e., moving or replacing a machine requiring service into or out of the production line.

Here are four cost-effective options and benefits facilitated by air caster technology:

1. **Optimize existing layout** for increased production or insert new equipment into the existing production line.
2. **Reorient equipment** into an entirely new production line.
3. **Relocate equipment** inside the plant or into a different facility.
4. **Easily accommodate automation** or robotic technologies in production lines.

For OEMs, embedded air casters enable designers to engineer and build a better machine at very little cost for additional design or manufacturing time. Air casters generate genuine return-on-investment by incorporating a mobility system that requires no additional equipment other than an air hose and turns on and off with one switch. 

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