

## Motion Control Tips – December 2015

### Motion systems application examples: Shock + vibration-damping components

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Shock and vibration-damping components are as varied as the designs in which they work. That ranges from heavy-duty machine tools to delicate designs that assemble semiconductor components. Addressing these oscillations lets machines run faster, for more throughput and higher-quality (more accurate) moves.

For example, the automotive manufacturing and packaging industries make copious use of mid-bore and smaller-bore hydraulic dampers.

Consider how bottle-blowing machine builders use adjustable shock absorbers instead of rubber bumpers or

springs to increase glass and plastic bottle

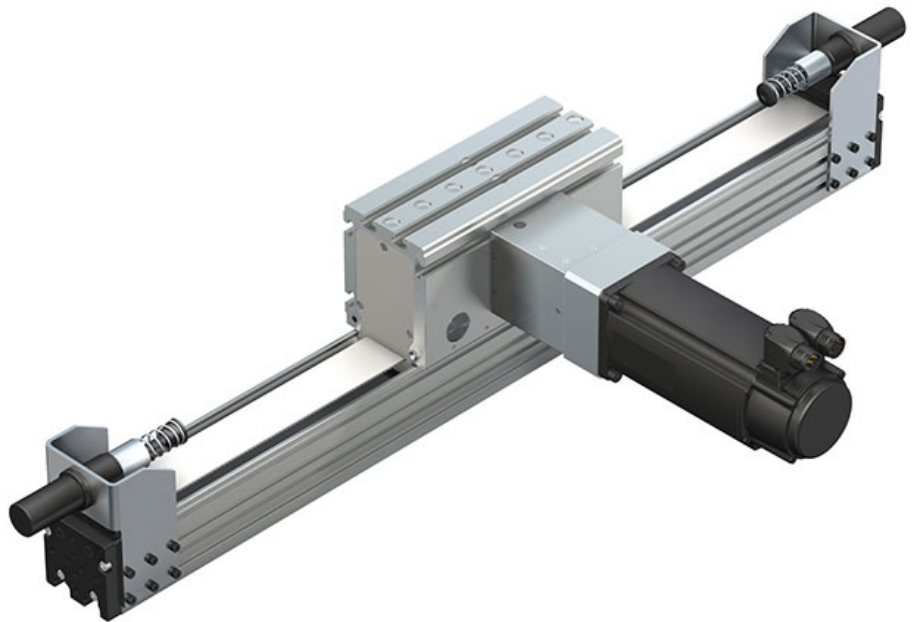
production. The shock absorbers protect the bottle's neck and opening against stress fracture during manufacturing, even in hot and dirty

environments. The shock absorbers in this application sport reinforced bodies to

withstand more energy per second as well as

Teflon-coated piston

rings and piston rod seals formulated to withstand heat.



Linear modules must endure high speeds and loads in automation, handling, and pick-and-place operations, so safety dampers can be used to provide reliable insurance against impact damage. This long-stroke Omega module from Bosch Rexroth uses safety dampers from ACE Controls in its end positions. ACE's SCS33 to SCS64 safety dampers true linear deceleration while protecting the Z-axis against uncontrolled motion. ACE safety dampers are specifically designed for emergency use only and offer reliable protection at an affordable cost.

Shocks and vibration dampers excel in designs that are engineered to avoid the structures' natural frequencies during operation. Adding mass with heavy bases or mounting machines into steel or concrete flooring is one approach. In applications where this is not possible or sufficient, vibration-isolating components and other passive dampers can absorb or attenuate vibrations. Here, the components bear the whole machine weight to shift excitation off the natural frequency. As a general rule of thumb, isolators should shift a design's natural frequency so it's no more than one-third of the excitation frequency. One caveat is that overly compliant isolators can actually increase the magnitude of motion. One solution where this is an issue is hydraulic or magneto-rheological setups that damp at system natural frequency but isolate like undamped designs.



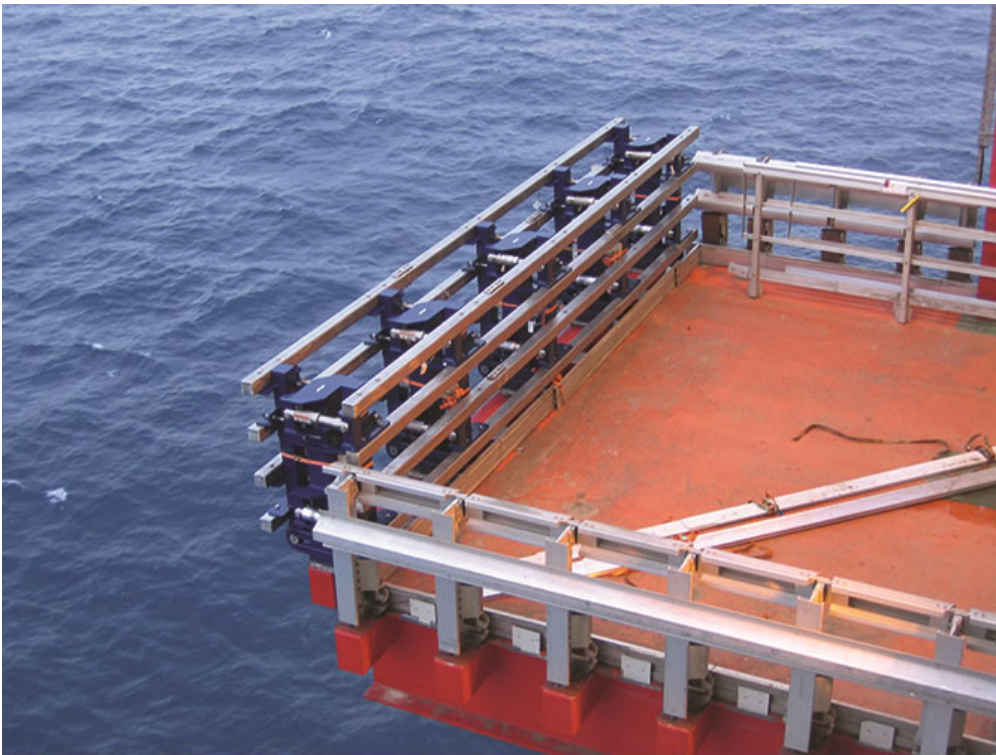
**Outside the enormous mouth of NASA's giant thermal vacuum chamber at Johnson Space Center in Houston, engineers and technicians prepare to test the James Webb Space Telescope. Minus K Technology supplied six negative-stiffness vibration isolators to keep the telescope and test equipment isolated from vibrations during the months of testing.**

In contrast, active vibration controls use actuators and sensors to counteract vibrations with motion having an out-of-phase frequency. Mechanical passive negative-stiffness vibration isolators from Minus K Technology isolate horizontal and vertical vibrations separately using no air or electricity.

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Mechanical subcomponents in the form of wave springs and compliant couplings are still other options to isolate vibrations, in everything from precision electric-motor-driven machinery to those that run off internal-combustion setups.



With a shock and vibration isolation system that includes highly tuned dampers from ITT's Control Technologies, this design absorbs impact energy several times greater than past designs.

As mentioned, one semi-active product to damp vibrations is magneto-rheologic fluid from Lord Corp., a blend of magnetic powder in oil, water or glycol that reversibly changes from free-flowing to semi-solid under an electromagnetic field. Particularly useful in automotive applications that must accommodate changing road and

driving conditions, magneto-rheologic components can replace traditional hydraulic fluid in shock absorbers.

No matter the subtype, shocks and vibration-damping components have a reputation for being a commodity component. In fact, these devices are highly engineered and customized to very specific loads, impacts and machine geometries, and affect overall equipment performance.



# Isolation system manages cargo kinetic energy

Norwegian oil company Statoil's Gudrun Platform operates in the North Sea's Gudrun field. The platform operates cranes for around-the-clock cargo handling. As crane operators hoist supplies from ships to the platform, containers (some weighing as much as 8,000 kg) can move toward the Gudrun Platform at 3 m/sec.

“Moving equipment from a supply ship onto an offshore platform in difficult conditions requires a highly engineered system of shocks and dampers,” said Tomm Kuran, sales manager for pneumatics at Servi Hydranor AS, a Norwegian distributor of hydraulic and hydraulic-related products. “The Gudrun's crane operators move food and heavy, expensive equipment for drilling. If an operator mishandles a container, people can be hurt or equipment destroyed.”

“A mishandled container can also halt drilling operations,” said Peter Bauer, managing director for ITT Control Technologies EMEA. Flexible barriers have been used for approximately 10 years on offshore platforms in the North Sea, but they often sustain damage from containers slamming into them.

Engineers came to Servi Hydranor and ITT's Control Technologies early in the design process of the Gudrun Platform with a set of specifications (including environmental conditions) and space limitations. While offshore rig builders know how to stabilize cranes, engineers saw challenges in

designing a dampening system for its cargo barrier.

So, the two companies engineered a shock and vibration isolation system that includes highly tuned dampers that absorb the cargo's kinetic energy.



Because of the design, the barrier system handles impact energy several times higher than traditional designs. The companies completed the shock and isolation design work in 2013, and the Gudrun Platform is now in operation.