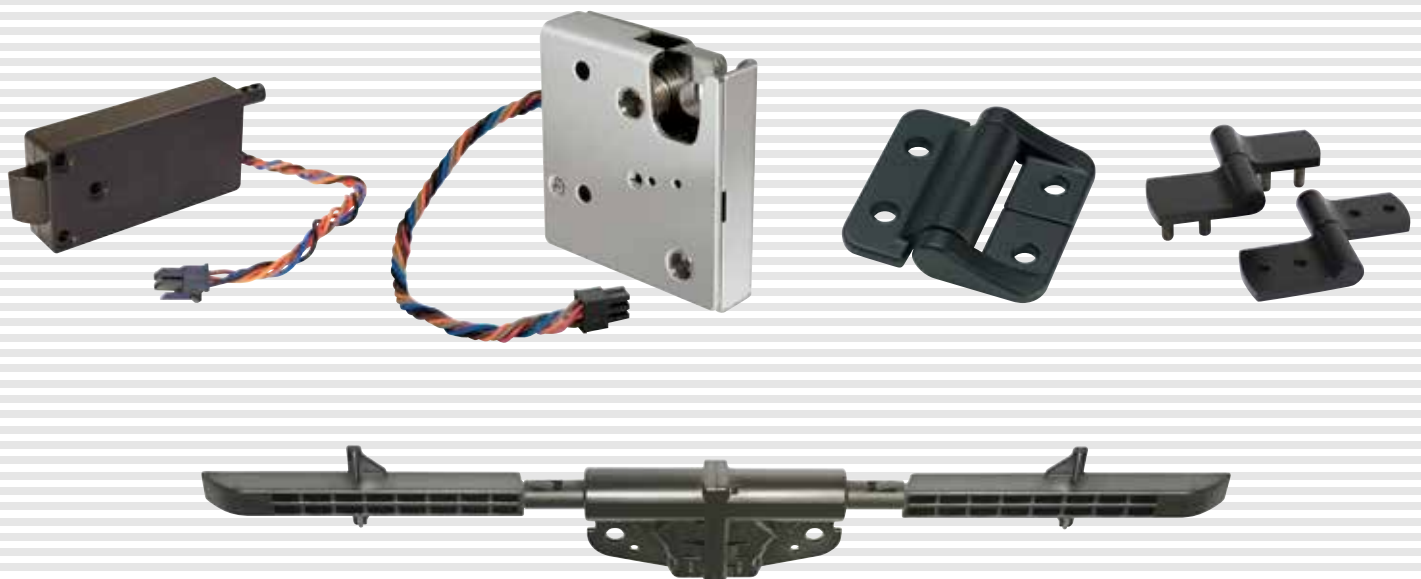


Reducing Fuel Consumption with Lightweight Access Hardware



Solutions for Aerospace Interior Applications

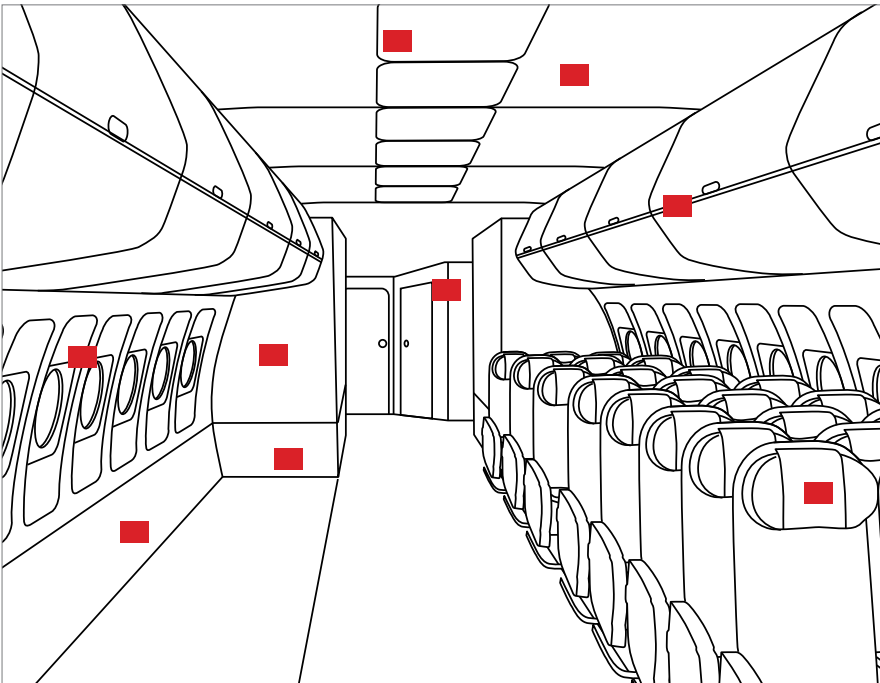


Rising fuel costs affect every aspect of the global Transportation industry – whether bus, train, automobile or airplane. No segment of the market feels the impact more than Aerospace, where fuel consumption is the leading contributor to operational costs. With the average commercial plane weighing anywhere from fifty to seventy thousand pounds, finding ways to reduce the amount of fuel burned per flight takes top priority in aircraft operations and design.

To combat the rising cost of fuel, airline carriers are taking measures to reduce operational costs across their fleets. From airfare increases to fees for checked baggage and other amenities, carriers are passing on these costs to their customers. Many carriers are also choosing to ground older planes, opting instead for modern aircraft designs that integrate innovative new materials to reduce the structural weight of the aircraft.

Modern aircraft designs incorporate lightweight composites and engineered alloys that not only reduce weight, but optimize aircraft speed and fuel consumption. Recognizing that “lightweighting” can contribute significantly to a reduction in fuel cost, original equipment manufacturers (OEMs) are examining every aspect of the aircraft, from engine to body, as well as interior applications involving seating, paneling and galley equipment to see where additional weight can be reduced.

With lightweighting at the forefront of new aircraft designs, engineers are tasked with integrating lightweight materials into interior applications that provide enhanced functionality and promote fuel efficiency. When designing for interior access and positioning applications, design engineers must choose mechanisms that are lightweight, meet global industry standards and provide a quality experience for the end user.



This white paper will discuss lightweight materials commonly used in the Aerospace industry, examine industry factors affecting aircraft design, define access hardware solutions for aircraft interior applications and review best practices for selecting a lightweight solutions provider.

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The True Cost of Fuel Consumption

Drag is a key factor in aircraft fuel use, as the amount of drag generated during a flight directly influences the amount of fuel consumption. Drag is caused by every part of the aircraft, from the engine and body to the passengers and items it carries. Because an increase in drag ultimately results in increased fuel expenditure, aircraft OEMs are driving engineers to design interior and exterior aircraft applications that aid in weight reduction.

Fuel costs continue to be a top concern for major aircraft carriers seeking to lower operating costs. For instance, when the price of jet fuel rises by just \$1, it has the potential to add billions to carrier operation costs. In a recent article discussing airline fuel efficiency, National Geographic reported that for U.S. carriers alone, fuel costs have surpassed labor costs as their largest expense in 2012, accounting for approximately 40 percent of operations, or \$47.3 billion USD. This makes it more important than ever for design engineers to choose weight saving mechanisms when specifying aircraft interior applications.

Fuel Impact on Operating Costs

Year	% of Operating Costs	Average Price per Barrel of Crude	Break-even Price per Barrel	Total Fuel Cost
2003	14%	\$28.8	\$23.4	\$44 billion
2004	17%	\$38.3	\$34.5	\$65 billion
2005	22%	\$54.5	\$51.8	\$91 billion
2006	26%	\$65.1	\$68.3	\$117 billion
2007	28%	\$73.0	\$82.2	\$135 billion
2008	33%	\$99.0	\$82.5	\$189 billion
2009	26%	\$62.0	\$58.9	\$125 billion
2010	26%	\$79.4	\$89.6	\$139 billion
2011 F	30%	\$111.2	\$116.1	\$176 billion
2012 F	33%	\$110.0	\$111.9	\$207 billion

The cost of fuel continues to be a key contributor to rising operating cost percentages of global airline carriers.

Source: Industry Financial Forecast Table (IATA Economics)

Advancements In Aerospace Materials

As the Aerospace industry continues to search for ways to reduce operating costs and increase fuel efficiency, major carriers are grounding older aircraft models or retrofitting existing planes in favor of newer designs that feature lightweight materials and construction. For design engineers, the challenge lies in incorporating these new materials into interior applications, while still providing optimum functionality for the end user.

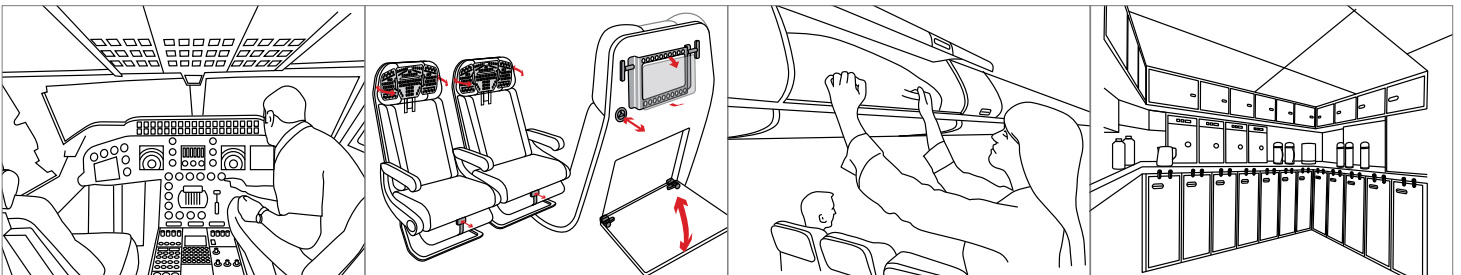
Common materials used in new aircraft design today include engineered alloys and composites such as aluminum and thermoplastics that are lightweight, but still provide durability and strength across many different Aerospace applications. This includes not only structural and exterior areas, but seating, access panels, infotainment and inflight food service carts and cabinets as well.

In passenger seating for instance, new advancements in the types of filler materials used in composites allow OEMs to further limit seat weight. Reducing the overall size and weight of the seat itself also allows design engineers to increase its “feature density,” or the amount of applications on each seat, to enhance the end user experience.

Lightweight Solutions for Interior Cabin Applications

According to the Federal Aviation Administration (FAA), over the next 20 years, the average passenger trip length is projected to grow an average of 7.7 miles per year. Higher fuel costs however, make flying longer-haul routes less affordable for carriers. To offset the rising cost of fuel, OEMs are exploring opportunities to further reduce the weight on systems already being designed with lightweight access hardware solutions.

With the surplus of lightweight composite materials and alloys available, as well as new advances in technology such as smaller, more portable electronics, traditional aircraft cabins are getting a major facelift with regard to seating, lighting and interior paneling. Incorporating Southco's access hardware solutions into aircraft interior applications can improve functionality and weight consumption, as well as end user experience.



Multipoint System

When designing for aircraft interiors, design engineers are tasked with implementing solutions that not only solve the functional needs of an application, but allow for flexibility in how it is accessed. With many global OEMs rolling out new aircraft and retrofit designs, these solutions must accommodate studio styling as well.

In response, design engineers are challenged with incorporating solutions that meet interior styling needs without adding additional weight. For instance, when designing storage panels into cabin designs, design engineers must include mechanisms that allow maintenance personnel or crew to easily access storage or supplies whether located in the lavatory, galley or ceiling.

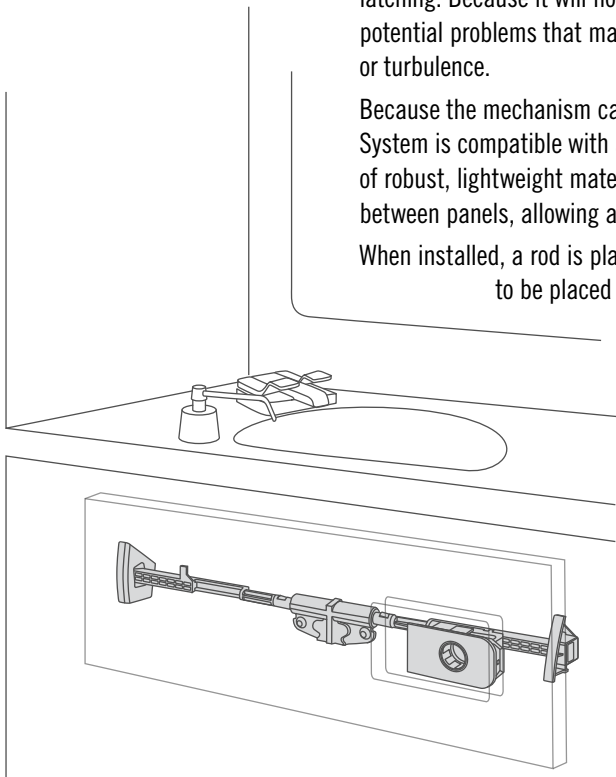
Southco's Multipoint System is a lightweight, standard solution that is engineered to solve a wide variety of design challenges within the aircraft cabin. The Multipoint System features a two-point, dependent pawl latching mechanism which retracts both pawls simultaneously, preventing the risk of false latching. Because it will not latch unless both pawls are fully engaged, this two-pawl solution avoids potential problems that may occur during flight, such as doors randomly popping open due to vibration or turbulence.

Because the mechanism can be actuated anywhere along the length of the assembly, the Multipoint System is compatible with a wide variety of actuation options, regardless of the styling. Constructed of robust, lightweight materials, the compact, cartridge-style Multipoint System can be easily mounted between panels, allowing a clean, flush exterior.

When installed, a rod is placed between the pawl and coupler mechanism, allowing the actuation point to be placed anywhere on that line or on the panel, giving the design engineer control

of where maintenance access points are installed to facilitate tool access. The Multipoint System provides roughly twice as much pawl travel compared to standard market solutions, facilitating assistance with door assembly and gap conditions that exist between the door and surrounding instrument panel. The result is a clean design, consistent actuation and door opening/closing efforts.

Combined with the appropriate actuator, the Multipoint System can also address Aerospace industry standards for redundant latch points and redundant actuation. It accommodates both locking and non-locking actuation needs, and can be integrated with an electromechanical locking system.

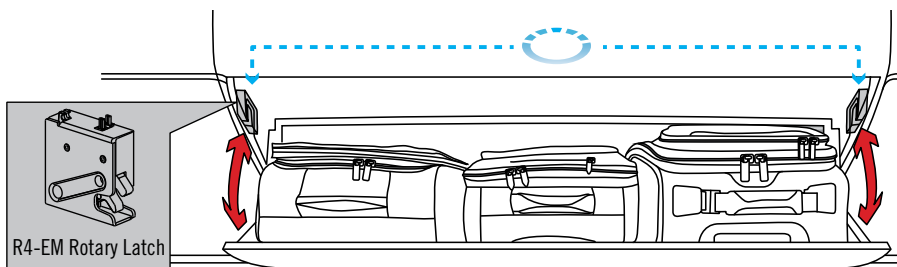


Electronic Access Solutions (EAS)

As aircraft OEMs continue to upgrade interior designs, engineers are beginning to investigate new technologies available, such as electronic locks and latches that can be networked into a plane's control system to secure various interior applications. Electronic locks provide reliable, secure latching, as well as many benefits over traditional mechanical systems, such as remote access and control.

An electronic access system is composed of three primary components: an access control or input device, an electromechanical lock or latch and a system for monitoring the status of the access point.

The electronic rotary locks offer a simple, versatile solution to achieve electronic access within cabin interiors. The lock is mounted inside of a door or panel, requiring minimal interior space and allowing a clean exterior surface that is free of pry points as well. Southco combines its rotary latching solutions, such as the R4-EM Electronic Rotary Latch, with an electronic access controller to provide remote actuation.



Compared to mechanical latching solutions or solenoid-driven mechanisms traditionally used in these applications, Southco's electronic access solutions (EAS) not only offer proven reliability, they also offer space and power reduction capabilities that can help to reduce the overall operational footprint of an aircraft. Gear motor-operated electronic locks, such as

the R4-EM, require less power than a solenoid-based mechanism, allowing the system generating this power to be lighter as well.

From a cost standpoint, gear motors offer more efficiency than solenoids, as power draw required by solenoid systems increases the cost of operation over time. Gear-driven electronic locks provide increased force and minimal power draw, reducing overall operating expenses per flight. The gear motor-driven R4-EM for instance, applies a significant amount of force to an object at a relatively low speed to move heavier loads, which can be useful in applications where more force is needed, such as securing overhead storage bins during flight. Power saved by using the R4-EM allows it to be refocused elsewhere on the aircraft, whether to lighting, motorized seats or galleys.

Electronic access systems can also provide an added safety feature to secure various applications during takeoff, taxi and landing or when experiencing turbulence. Remote access provided by a networked electronic locking mechanism can allow the flight crew to control when passengers may access overhead luggage bins, lavatories, food trays or any other access point that needs to be overridden directly from the galley. The same reliable latching and control can be used to protect access to lifesaving devices such as oxygen masks and life vests. For example, electronic locks can be used to keep these items securely locked in place during routine flights until they must be deployed in the event of an emergency.



Positioning Technology

For aircraft seating designers, reducing weight while preserving a quality experience for the passenger is often a delicate balance. While many OEMs are concentrating their efforts on stripping weight out of seating, using lightweight materials in component applications such as headrests and trays could potentially have a negative impact on the passenger's overall perception of quality towards the aircraft carrier.

In order to ensure that quality and end user comfort is not sacrificed when replacing traditional materials with lightweight options, design engineers are adding torque hinges to seating applications. Constant torque hinges use engineered friction systems to provide continuous resistance against motion, making a lightweight plastic table or tray feel heavier and more substantial, thus improving the passenger experience.

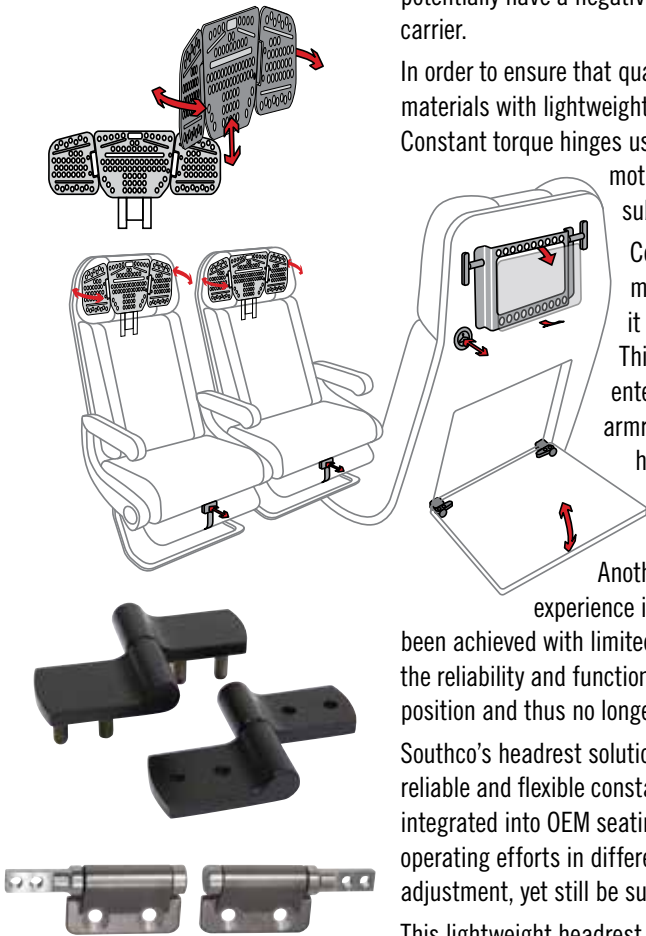
Constant torque hinges provide resistance throughout the entire range of motion, allowing the user to easily adjust the angle of a tray or table or keep it from falling down once it has been restored to its original upright position. This positioning technology can also be used to support a wide range of inflight entertainment systems, whether positioning a screen from the headrest or armrest. Southco's ST series hinges for instance, provide consistent torque over high cycle life requirements and can be easily integrated into seating designs to provide consistent operating effort in the smallest, lightweight package requirements.

Another area where torque hinges can be used to provide a quality end user experience is in headrest design. With current designs, vertical adjustment has previously been achieved with limited success, resulting in inconsistent cycle life. Outdated vertical friction affects the reliability and functionality of headrests over time, resulting in a design that cannot maintain position and thus no longer supports a passenger's head.

Southco's headrest solutions feature standard integrated positioning technology, which provide reliable and flexible constant torque capabilities in a small package, allowing them to be seamlessly integrated into OEM seating designs. Asymmetric torque allows the design engineer to specify various operating efforts in different directions of motion, allowing end users to easily pull the wings forward for adjustment, yet still be supported when resting their full weight against it.

This lightweight headrest solution can be integrated into reduced weight seat designs and mounts to the back of a seat body or existing structure. Rather than bolting on additional hardware, Southco can also incorporate both vertical slide and wing tilt elements directly into the headrest solution. These integrated solutions result in additional weight savings that can be achieved over traditional headrest designs.

These lightweight positioning solutions enable functionality and quality in aircraft seating applications, providing the comfort and ergonomic advantages that end users desire. Adding torque hinging solutions into seating applications helps to control motion and vibration, creating a quality experience for the passenger, whether seated in economy or first class.



Complying with Industry Regulations

When designing for interior aircraft applications, design engineers must balance the need for lightweight functionality with Aerospace industry compliance requirements. Because material removed during maintenance and retrofits is often recycled into new aircraft components, it is essential for aircraft OEMs to select materials that meet global design standards.

Composite materials and metals specified into Aerospace applications must also comply with Federal Aviation Administration (FAA) requirements regarding fire, smoke and toxicity (FST). To prevent fires and the release of toxic chemicals, the FAA requires that materials exposed to an open flame withstand an amount of time before they begin to smoke or catch fire. Products selected for interior cabin applications must be tested against these requirements before they can be used in an aircraft.

On August 22, 2012, the Securities and Exchange Commission (SEC) issued a final rule on conflict minerals pursuant to Section 1502 of the Dodd-Frank Act that outlines the assessment and reporting requirements for issuers whose products contain or are produced with conflict minerals. Because these minerals are commonly used in the Aerospace industry, it is important that engineers seek a Conflict Minerals or Metals Statement from a supplier prior to selecting a product.

In anticipation to changes to RoHS (Restriction of Hazardous Substances) Directive 2011/65/EU, which is scheduled for review by the European Union (EU) in 2016, manufacturers and suppliers who export to the European Union as well as around the world are exhausting products that contain lead. In response, engineers must ensure that their designs contain components that are free of these materials.

Another EU-mandated requirement is compliance with REACH (Registration, Evaluation and Authorization of Chemicals). Regulation No. 1907/2006 establishes specific duties and obligations on companies in the European Union that manufacture or import chemical substances on their own, in preparations, or in articles. Aircraft OEMs must ensure that their global suppliers are compliant with REACH to protect future end users against materials that may not be fit for reuse in newer aircraft.


To ensure the global accessibility of their products, Aircraft OEMs must choose parts that perform against even the most stringent requirements. When integrating lightweight access control hardware, engineers must be aware of global standards and design accordingly.

Best Practices for Lightweight Design

When lightweighting Aerospace applications, it is vital for the design engineer to choose a trusted access hardware supplier that not only knows the industry, but also offers validated solutions and engineering expertise. A supplier must have the ability to modify proven solutions or integrate them into existing designs to accommodate lightweight requirements. Products selected should improve functionality and weight consumption, equating to increased fuel savings.

Southco offers access hardware solutions that are standardized and ready to drop into cabin interior applications so engineers can devote more of their time to the overall design of the aircraft. Through a “design for assembly” approach, Southco uses the least amount of materials and components necessary for optimal design. This ultimately reduces the total weight and total cost of the hardware selected and allows the design engineer to increase feature density across applications, whether incorporating a multipoint system, electronic access or headrest positioning solution.





Southco's engineered access hardware solutions provide the following benefits to the Aerospace industry:

- Validated solutions for the Aerospace industry that are flexible enough for high volume production needs
- Innovative product design and development to meet the unique requirements of the Aerospace industry
- Products that meet industry compliance standards across the globe
- Global supply and manufacturing presence

Additionally, Southco is researching new ways to leverage design technologies and materials used in other transportation markets for the Aerospace industry. For example, *MuCell[®] technology, an injection molding process that reduces material density, is already used by Southco to reduce the weight of plastic parts for Off-highway and Automotive applications, and shows potential for future use in Aerospace applications as well. Southco can also assist in selecting the right material for an application, whether from a weight, cost or performance standpoint, and offers different filler material options should a part's structural strength need to be adjusted.

Conclusion

When designing for aircraft interior applications, engineers must anticipate new challenges presented by lightweighting and adjust their designs to suit these requirements. In order to conserve fuel, chosen solutions must save weight; however, they must also maintain their core functionality. According to a fuel cost study performed by the FAA, oil prices are projected to rise to over \$115 USD per barrel by 2020, with a gradual increase to over \$118 USD per barrel by 2025, making it more important than ever for design engineers to reduce weight wherever they can when specifying aircraft interior applications.

By integrating lightweight access hardware and positioning technology into aircraft interior applications such as seating, access paneling, lavatories, storage equipment, carts and galleys, OEMs can improve usability, safety and reliability for the end user for years to come. These versatile, proven products for the Aerospace industry provide design engineers with standardized solutions for conserving weight across applications, ultimately contributing to the overall reduction of operation and fuel costs in large scale aircraft design.

**MuCell[®] is a registered trademark of Trexel, Inc.*



About Southco, Inc.

Southco's dynamic history begins in the late 19th century, when specialty pipe manufacturer South Chester Tube Company was founded to meet the extraction and transportation needs of the bustling oil industry. The success of the company led to its establishment of Southco, Inc. in 1945, to target the emerging fastener and latching business. Over the last 60 years, Southco's success has extended its manufacturing capabilities and representation worldwide, positioning the company as the leading global provider of Engineered Access Hardware solutions.

Today, Southco's passion for providing quality engineered solutions has cultivated new and innovative products such as traditional mechanical and electronic locks and latches, wireless electronic controllers, positioning hinges, captive fasteners and inject/eject mechanisms. The quality and flexibility of these "touch points" allows them to be used in applications across many different industries such as networked telecommunications, medical equipment, self-service kiosks and enclosures, automotive, off-highway/construction, RV/caravan, marine, HVAC and industrial machinery.

Southco continues to prepare for the possibilities of the future by investing in next generation technologies to refresh and expand its diverse product catalog. Southco remains poised to utilize the engineered touch points of its access hardware solutions to improve customer products, and is committed to helping its customers solve and overcome engineering challenges for another 100 years, and beyond.

Please visit www.southco.com to view our complete range of solutions.