Enhancing The User Experience With Positioning Technology

Refined control for intuitive, ergonomic operation.

Options for reliable, precise, positioning hardware.
The need to control motion and position takes many forms — including the need to make objects easier to move, easier to open, easier to stabilize, or easier to view.

But unlike other access hardware applications where performance is relatively straightforward in terms of load or direction of force, positioning applications are often much more dynamic. This creates more complex requirements for harnessing the benefits of position control devices under real-world conditions — ranging from simplified user interaction, to multi-axis motion, to consistent orientation.

Positioning technology is the process of using creative designs, precision friction elements, detents, torsion springs, specialty alloys, and other features to control motion and enhance user interaction. It can make heavy objects feel lighter and easier to move, or make light objects feel more substantial. It can help hold panels open or closed, maintain objects at specific predetermined positions or hold them steady at any user-determined position throughout the total range of motion. And it does so across a broad spectrum of applications, ranging from the smallest flip-phone covers to cantilever-mounted heavy commercial equipment.
Benefits to be gained from positioning technology.

Positioning technology provides multiple opportunities for designers to differentiate their products, improve form, fit and function, simplify user-friendly performance, streamline production, and do so much more. Here are just a few examples of ways you can harness the advantages positioning technology has to offer:

- **Managing motion.** Controlling door positioning for safety, convenience, and unobstructed access to enclosures has long been a challenge. And as product designs have become more complex — including many applications with movable control panels, display screens, or other components — implementations involving more extreme requirements now demand more sophisticated solutions. Beyond the limitations of simple interference-fit pins or manual screw adjustments for positioning or motion control, highly engineered components are now available to tailor movement and resistance within specific parameters.

- **Ergonomics.** Making equipment more compatible with user interaction provides added value. The precise resistance levels, long life and controlled motion of today’s engineered positioning devices make it possible to compensate for a wide range of forces. This enables quick and easy positioning adjustments, without tools, such as angling display screens to compensate for individual user height differences or glare from changing light sources.
Aesthetics. The ability to integrate positioning technology into a product design without need for external secondary supports, struts, or springs, can make hardware solutions virtually invisible to the end user. Compact, streamlined position control devices molded into the finished product help to enhance product design, and minimize industrial design conflicts.

Economy. Combining multiple functions into one position control device can reduce component costs, component inventories, and assembly costs, to deliver a lower total installed cost for your product. Equally important are the economy of design and the economy of effort made possible by these devices as they enhance ease of use and customer satisfaction.

Quality perception. There are multiple ways to use positioning technology to improve the quality perception of a product. A stored-energy device that makes a heavy object seem lighter and easier to position, enhances the user experience. A torque device used to add a firm, but smooth, touch to a lightweight moveable component, makes it feel more solid and substantial to the end user. And regardless of the application, providing intuitive near-effortless operation and positioning can improve the end-user perception of your equipment, its engineering sophistication, and the value behind it.
Planning ahead for positioning technology designs.

It is always a good idea to plan ahead when considering access hardware requirements. This is especially true with position control devices. Working through all the calculations up front can ensure that an acceptable solution will be available to satisfy load requirements, fit available dimensions, and provide the desired user feel and experience, before any design changes become too difficult or expensive.

Even with the variety of standard devices delivering a range of torque values, where you position them and how you attach them can have a big impact on which product is the best choice and how it will perform in your ultimate application.

Also, many positioning applications end up requiring a custom-engineered solution. Making the specification and configuration of position control hardware an integral part of your initial design, instead of just an afterthought hardware attachment, is the best way to optimize the full potential of positioning technology.
Physical characteristics for integrating positioning technology solutions.

There are a variety of design considerations in any position control device selection – including the physical properties of the application, applied forces, desired motion, and operating environment. Because of the dynamic action and multiple variables involved in positioning applications, it is important to evaluate all those interrelated properties before attempting to identify a specific solution for your application.

For example, consider the effect of these two different design choices and how minimizing the distance from the center of gravity to the pivot point can affect torque hinge selection by changing the operating force from greater than 3 lbs. to just over 1 lb.

Calculating the Moment of a 10” Screen weighing 3 lbs.
Designing with positioning performance in mind.

Engineered position control devices function as an integral part of the product. The optimum user experience is delivered by utilizing the appropriate positioning technologies in response to the overall requirements of the application.

- **Load.** The standalone weight of the object to be mounted and moved with your position control device is an important starting point. But weight is not the only factor in calculating the torque requirements for your application. Even when you can’t reduce the weight of that object, there are several ways to reduce the operating force required to position it.

- **Operating force.** The desired user force needed to lift/position an object is an important consideration. Be sure to consider not only the desired force to reposition the object, but also any input forces that might potentially cause the object to move unintentionally. An example would be a touch-screen display that needs to be easy to position, but not so loose as to get dislodged by normal user interaction with the touch screen. (See “External forces.” on page 7.)

- **Center of gravity.** The compound relationship of the center of gravity, the pivot point, and the location where the operating force is applied can significantly affect the operating effort required. In general, minimizing the distance from the center of gravity to the pivot point and maximizing the distance from the pivot point to the point where the operating force is applied will provide the most secure hold with the lowest operating effort. (See Figures 1 and 2.)
External forces. The force of gravity on the object to be positioned is not the only force to be considered when specifying a position control device. For example, when a display screen is also used as an input device – via either a touch screen or pushbuttons/switches along the periphery of the display – the positioning solution must consider the input force in addition to the static weight of the display. For mobile applications – such as an order picking screen on a forklift truck or the display screen on portable medical diagnostic equipment that can be jolted while being moved in a crowded room, hallway or elevator – the positioning device must have adequate resistance to withstand acceleration/deceleration, shock, or vibration.

Consider the previous example of the display used in Figure 2. If the display is now a touch screen device with an applied input force of 2 lbs., then using a simple positioning hinge to hold the screen in position and resist the applied touch screen force would result in an operating effort of greater than 3 lbs. (See Figure 3.)
- **Practical design limits.** As objects become heavier, or in cases where industrial design or other factors dictate the relationship between the pivot point and the center of gravity, simple positioning hinges can begin to lose their effectiveness. Consider the screen-mount example previously shown in Figure 2, executed in a larger scale. If that screen grows from a 3-lb. screen with a 10-inch height to a 15-lb. screen with a 16-inch height, the operating effort for positioning the screen rises above 12 lbs. In many cases, that exceeds acceptable industrial design parameters. *(See Figure 4.)*

- **Counterbalancing forces.** Incorporating a counterbalanced position control solution for the application defined in Figure 4 above, could reduce the operating force for the 16-inch tall 15-lb. screen from more than 12 lbs. to less than 2 lbs. *(See Figure 5.)* This would have the effect of giving the larger screen an operating effort comparable to that of the smaller screen shown in Figure 2.
Physical characteristics for integrating positioning technology solutions. (continued)

Application parameters.

Before specifying a particular type of position control device, be sure to take into consideration the application conditions it will experience in its final operating environment.

- **Life cycles.** The consistency of the output torque that a position control device delivers in use can vary over time, depending on its physical design and construction. If the application you are designing is a high-use application, be sure the device you specify is qualified to maintain its rated performance throughout the expected life span.

- **Operating environment.** The nature of your application environment might call for a specific position control design or design modification. As an example, a constant-torque position-control hinge design would be a better alternative for applications where extreme temperatures can compromise the performance of gas struts. Applications in dusty environments can benefit from special sealed designs to prevent any deterioration in performance. And more corrosive application environments, such as an industrial or marine environment, might call for completely different construction materials.

- **Repeatability/reliability.** While friction adjustments that use screws or threaded jam nuts and washers can be acceptable for non-critical applications, application-specific engineered solutions offer more precise and consistent performance. They eliminate production line variables in setting the initial torque and help to maintain greater performance consistency.
Component configuration options and advantages.

Aside from the physical performance demands of an application, there are other practical considerations that can bring out the best in your position control application. Working with an experienced and knowledgeable supplier will help to ensure that you get the best solution for your specific design.

- **Construction material and finish.** Multiple finish options offer possibilities for color-coordinated designs that can help keep position control hardware from disrupting the style or look of your finished product. Also, special construction materials can be used to accommodate extreme environmental conditions.

- **Mounting.** Options for bolt-on or molded-in hinge mounting offer flexibility for manufacturing convenience and integrated simplicity. Molded-in hinge styles can reduce weight, minimize hardware components and reduce final assembly efforts.

- **Aesthetics.** The ability to use position control devices in lieu of springs, latches, or other bulky hardware, plus the ability to mold compact position control hinges into components for virtually hidden operation, can help improve the aesthetics of your application.
Evaluating your different positioning technology hardware options.

Positioning technology solutions run the gamut from simple to complex. The simplest design might satisfy a lightweight, non-critical positioning need. But for more exacting applications where performance consistency or the “feel” of the moving component is critical, a more sophisticated engineered solution can overcome the limitations of less precise designs. Knowing the inherent advantages and restrictions of each position control device classification can help you zero in on the ideal solution for your application, without compromising end-use performance.

Know your options, and limitations.

Press-fit pins that create friction through an interference fit can be a cost-effective solution for infrequent use or low-demand applications. But because they need more surface area contact as load requirements increase, there are limits to the amount of torque they can deliver. They can also be susceptible to a loss of efficiency over time or with higher temperatures.
Jam nuts and other threaded solutions offer easy torque adjustability but can sacrifice control over establishing consistent torque levels during assembly. They can also be subject to deteriorating performance in use—due to vibration, life cycles, or high wear.

Engineered positioning technology solutions can neutralize many of those variables. They provide consistent torque matched to the needs of your application—right from the factory, and throughout their rated lifecycle. The following product classifications describe some of the key options and their potential application benefits for efficiency, cost savings, improved performance, and end user satisfaction.
Detent hinges.

This positioning hinge design uses spring tension and a protruding element on the circumference of one half to engage with corresponding grooves (detents) on the other half, to hold the hinged object securely at one or more predetermined angle(s) – fully closed, partially open, or fully open. It is one of the easiest designs to use where one or several predetermined door positions are acceptable and where there is no need to compensate for external forces acting on the door or hinge.

In hold-open applications, detent hinges can take the place of gas struts or other mechanical supports to keep doors fully open for maximum accessibility without additional hardware. Detent hinges can also eliminate the need for a latch mechanism by being used to hold a door in the closed position where positive locking engagement is not required. This is often used with swinging doors or access panels as a low-cost solution for providing quick, easy user access.

These designs are available in polymer and stainless steel materials for corrosion resistance, and can include snap-on covers to hide mounting hardware for better aesthetics.
Bi-stable mechanisms.

In this design, cam action with detent features at each extreme of rotation help to force the mechanism into one or the other of two desired positions – fully opened or fully closed. While the most familiar examples of this type of mechanism are the ergonomic assisted-opening, assisted-closing flip covers on cell phones or personal digital assistants (PDAs), the bi-stable design is also scalable to larger sizes.

Torque hinges.

Torque hinges use friction – applied through an external mechanism like a screw, or designed into the tolerances of the hinge body, pin, and torsion band – to provide a degree of resistance against motion. That resistance can be adjustable or constant. The type of mechanism and the potential torque values of various hinge designs influence their appropriate selection and use for applications ranging from cabinet doors, to laptop computers, to heavy flat panel displays.

- **Adjustable torque.** Using a screw-operated adjustment provides a simple and inexpensive means of adapting a hinged device to specific operating effort and resistance requirements. This can be a desirable solution in applications where tolerances are not critical, where the weight of the hinged item can vary, where the degree of torque needs to be adjustable to suit end user preferences, or where there is a need to compensate for changes in other components over time.
The physics behind controlled torque devices.

Today’s precision position control hinges use specially engineered torque elements that apply radial pressure against a shaft to create friction between the two surfaces. By utilizing a variety of shaft and torque element combinations with different alloy steels, heat treating, lubricants, and assembly processes, these devices are able to deliver a wide range of capabilities with more precise tolerances for consistent torque control and long-lasting performance.
Evaluating your different positioning technology hardware options. (continued)

- **Constant torque.** Where precise and consistent resistance is desired, a constant torque device matched to the requirements of your application can provide easy positioning control, with zero backlash. In many cases, a device with a single, consistent torque value throughout its entire range of motion is sufficient. A broad range of designs is available to provide high torque in minimum space, for long-term performance in applications ranging from lightweight mirrors to heavy-duty doors and equipment components.

  - **Symmetric torque.** A constant torque device providing equal torque in both directions works well for lightweight devices, well-balanced applications, and objects with a vertically oriented hinge axis.

  - **Asymmetric torque.** Incorporating a torque device with different resistance forces in each direction can be used to help hold a heavier object in a deployed position without compounding operating effort in the opposite direction. Such an asymmetric design can provide a precise, specified level of resistance in one direction and a totally different, yet consistent, level of resistance in the opposite direction.

One specialized asymmetric device offers torque resistance in only one direction. This type of solution can be used in applications that might benefit from a deliberate, controlled closing action and zero resistance on the opening action. Yet another type of specialized multi-level torque device is one that can open freely to a specified angle and then provide a higher level of resistance within an additional range of motion for final positioning adjustment.
Stored energy mechanisms.

Position control devices can do more than just limit a range of motion. Sometimes they can also be used to assist in generating that motion. Stored energy mechanisms using built-in springs can help counterbalance and compensate for the heavy weight of an object, making it feel much lighter to the equipment user. They can also be used as a lift-assist mechanism to help an object deploy automatically at the release of a button.

Damping devices.

A damping-action hinge uses built-in resistance and an energy-storing device to regulate movement. This resistive force moderates the rotation speed to deliver a smooth and consistent motion, throughout the full range of motion.

Linear positioning devices.

In addition to rotational positioning for hinged applications, linear position control devices can also be used in place of motors or complex control systems to deploy and position objects. Locking lever slides that control seatback positioning are one such application. Linear positioning can also be combined with rotational positioning to slide a retracted display screen out from a narrow storage location and then rotate it to an optimum viewing angle.
Combining multiple capabilities for pinpoint positioning technology performance.

Multiple positioning technology capabilities can be integrated into one unit to satisfy compound position control requirements for an application. The component mechanisms can be specified independently for different torque levels and different positioning attributes – including controlled motion, lift assist, and positioning stops.

A tilt-and-swivel mechanism is a common application in providing multi-axis control for raising, rotating, and positioning a display screen or a piece of equipment for optimum user convenience. It can provide rotation in both the vertical and the horizontal axis — with independent operating force values for each axis.

Another option for more ergonomic control in applications with heavier objects could be the use of lighter resistance in the opening direction or the inclusion of a lift-assist torsion spring to simplify raising the component, plus a detent at the stop position to help hold it in the desired location.

The more complex your positioning requirements — in terms of weight, mounting position, range of motion, and multi-axis motion — the more valuable it can be to work with an experienced positioning technology resource to help you tailor the design and the forces to your unique needs. This will provide the greatest opportunity to accommodate the physical requirements of the application, to integrate the position control device seamlessly into the physical product, and potentially to reduce the overall cost of the solution.
Personal electronics offer many opportunities to employ precision-engineered position control devices for user convenience in everything from display screens to speakers. **Mobile phones** and **PDA devices** benefit from compact built-in bi-stable devices that hold covers down for carrying, then pop them up and hold them open for easy access during use. Miniature position control hinges help to store and deploy **PC card antennae** in wireless access applications or to aim **Web cameras** attached to personal computers. Precisely engineered asymmetric position control hinges make it easier to lift and position **laptop screens** at the optimum angle for glare-free viewing in any environment. Even larger consumer electronics applications, like **flat panel TVs**, can also benefit from fingertip ease of positioning with the appropriate position control device designs.
Automotive applications encompass a variety of uses — from deploy-and-position display screens for GPS navigation and passenger DVD entertainment screens, to closure doors on center consoles, glove boxes, and storage compartments, to passenger convenience items like headrests, armrests, and cup holders. These applications include hinges that deploy easily, but then provide resistance to remain steady despite forces from bumps, acceleration, or braking. Stow-away seating equipped with lift assist hinges makes it easier for any member of the family to adjust to changing seating and cargo requirements.

Other transportation uses include ergonomic adjustments for armrests and headrests in automotive, airplane, train, and bus seating applications. They make it easy for users with a wide range of preferences to set these support points to the angle they want and then to maintain that position under the weight of use, until the next user adjusts it.
Satisfying positioning technology requirements for practical applications. (continued)

In industrial applications, continuous positioning hinges allow operators of process control equipment to position and adjust control panels and display screens to their own preferences for maximum convenience. Simple applications can also include safety shields and access doors, where bi-stable mechanisms and detent hinges can be used to hold them in the closed position without need for latches, and in the fully open position for easier obstruction-free access during production set-up or maintenance. In outdoor applications, like pole mounted telecom enclosures, constant torque hinges provide the resistance to prevent enclosure doors from slamming shut when being serviced during windy conditions.

The increased popularity of cart-mounted medical diagnostic equipment benefits from position control hinges and lift-assist devices that permit operators to adjust display screens for clear viewing in variable lighting conditions, from any position around a patient’s bed. Lift-assist devices help individual nurses and technicians to position heavier equipment with one hand. Tilt-and-swivel devices offer the same single-handed intuitive operation and 360-degree access for bedside patient communication terminals. And from storage cabinets to portable medicine cabinet doors, sealed hinges with easy-to-clean surfaces and concealed mounting options offer desirable performance for hygiene-conscious hospital environments.
Furniture and appliance OEMs can also benefit from incorporating a variety of position control devices into **cabinet doors, mirrors, lighting units, storage units,** and home-entertainment systems. And self-service store environments can take advantage of positioning technology in applications ranging from slow closing hinges for **storage bin covers** to convenient positioning devices that can stand up to heavy user interaction on **touchscreen POS display terminals.**

The examples here outlined are only a hint of what you can achieve with proper evaluation and implementation of the ideal positioning technology. The possibilities are as wide open as your imagination. And best of all, there’s no need to solve the selection and implementation puzzle on your own. Taking advantage of the experience of a Southco positioning technology specialist is the quickest route to exploring, creating, and implementing the best solutions for your unique applications.
For more than 60 years, Southco has been advancing the state of access hardware design. From the simplest friction hinges to the most carefully balanced lift-assist hinges, our engineering expertise in positioning technology can help simplify your product designs and your assembly processes. It can also satisfy a wide range of application needs — including positioning larger, heavier objects and accommodating more extreme conditions of shock, vibration, and movement. Incorporating that experience into your planning cycle will help you optimize your design to take advantage of the most cost-effective overall positioning technology solutions.

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