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Haydon Switch & Instrument Catalog of Switch Products

Table of Contents

Haydon Switch and Instrument represents quality, flexibility and dependability

Haydon's success and reputation is built on a commitment to attain total customer satisfaction through quality, flexibility, ingenuity, dependability and value. We have been building switches and electric motors for over 50 years. Giving our customers a technological advantage has always been one of our primary concerns. We are continually working on new products and product improvements to guarantee our customers receive the best switches on the market.

Many of the world's most demanding manufacturers rely on Haydon switches

Haydon's sealed switches are used in commercial jets, military aircraft, military ground equipment, space applications and industrial applications with harsh environmental conditions, such as gas turbines and high temperature research instrumentation. Haydon switches are built to meet stringent military specifications. To achieve and sustain such high levels of quality requires a combination of skilled engineering and production teams, special support facilities and coordinated quality control from design through production. Haydon has all of these factors in place and, because of this, our switches are recognized for their quality and robustness by engineers throughout the world. The unique manufacturing methods, process controls and quality systems utilized in the production of our advanced aerospace switches are also integral parts of our motor operations.

Haydon also offers a selection of stepping motors that is second to none

Haydon is recognized worldwide as a leader for subfractional horsepower stepper motors and linear actuators. We custom design and manufacture small electric motors for medical equipment, instrumentation, industrial equipment, machinery automation, HVAC, office equipment, and many other custom applications. Our unique designs provide precise, reliable motors with unmatched performance-to-size ratios. Our motors are simple and versatile, making them well suited for custom-ization and manufacturing. These factors, coupled with Just-In-Time manufacturing and quality assurance programs, have made Haydon a key source for companies that require quality motors from a responsive supplier. We currently ship our extensive line of can-stack steppers throughout the world to OEMs in the Americas, Europe, Asia and Australia.

Our modern manufacturing facility, located on ten acres in the heart of Connecticut, supports today's most efficient technology and manufacturing methods. More important, our quality products represent the proud effort of a skilled, empowered and highly motivated workforce.

Whether your application requires a standard item, custom design, new product or a more sophisticated complete assembly, in high volume or a limited run, our experienced engineering team will assist you. You will find our complete package and our unlimited flexibility hard to match. We are here to help you, please feel free to contact us.

Bernard C. Dubois
President

Switches: Technical Overview

Precision Snap Action Switches

Figure S-1. Series 6100 with various actuating pin options

Haydon's snap action switches are designed to deliver reliable performance and long life under extremely harsh environmental conditions. Switches are designed and tested under specific conditions to insure their reliability and stability. To obtain the best performance it is important to operate a switch in a manner consistent with its design. A basic understanding of switch characteristics and terminology will enable the user to optimize switch performance for their application.

Basic switch components include a transfer blade, contacts, terminal posts, and an internal actuator, figure S-2. In addition to these components, Haydon's sealed switches incorporate a glass-to-metal sealed header. A resilient seal around the actuating pin, a wobble diaphragm or a bellows is used as a means of actuating the switch through the sealed housing.

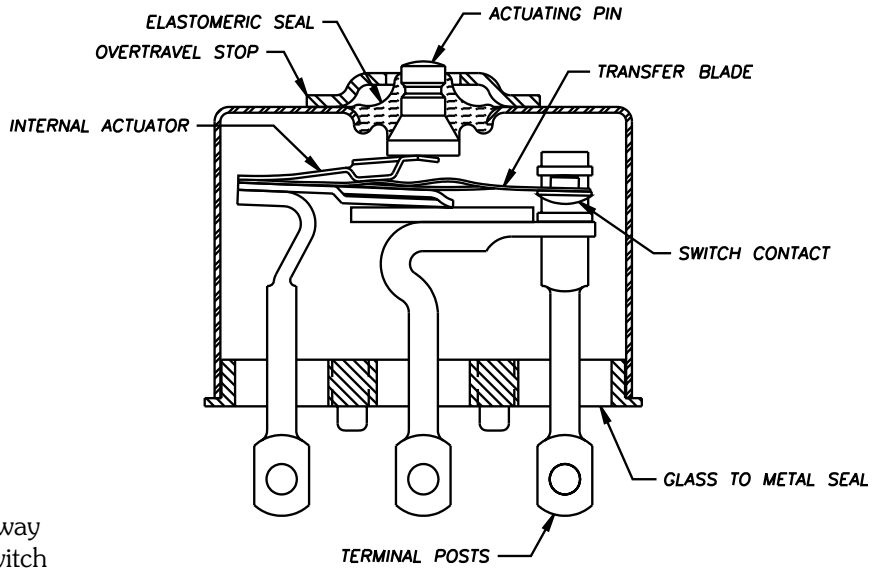


Figure S-2. Cut away of a typical basic switch

HSI Switch Features

One Piece Blade

Haydon's snap action switches utilize a patented one-piece switch blade. This design has the advantage of maximum cross sectional area for highest load carrying capacity. The one-piece blade also provides high contact pressure, even near the trip point, thereby enhancing vibration resistance and decreasing contact resistance. Blades are constructed of beryllium copper or Elgiloy. The specific blade configuration, material and thickness used depends on application parameters such as temperature, life requirements and vibration.

Switch Mechanism

The switch mechanism consists of the one-piece blade, internal actuator and contacts mounted directly on the terminal posts (figure S-2). This construction assures a reliable and rugged mechanism for long operating life.

Seal

Haydon produces switches which meet environmentally sealed and hermetically sealed classifications per MIL-PRF-8805 class 4 and 5. Environmentally sealed switches have a leak rate not exceeding $1x10^{-6}$ atm cc/sec. Hermetically sealed switches have a leak rate not exceeding $1x10^{-8}$ atm cc/sec.

Terminal poles are part of the glass-to-metal header assembly which is welded or soldered directly to the switch housing. The terminal seal does not depend on potting compound, plastics or organic material. This construction assures a reliable and rugged sealed assembly for long operating life.

Actuation of the internal switch mechanism must be accomplished through some type of seal. Haydon's hermetically sealed switches are actuated through a wobble diaphragm or metal bellows which insure seal integrity. Haydon's environmentally sealed switches incorporate a resilient elastomeric seal bonded to the housing and actuating pin. During construction Haydon's sealed switches are evacuated, filled with dry nitrogen, sealed and subjected to an altitude immersion leak test.

Contacts

Fine silver, gold alloy, platinum, or silver cadmium oxide contacts are available. Selection will depend on the current and temperature requirements of each application. Fine silver is typically used for applications requiring 1 amp to 5 amp ratings. For low level applications (<1 amp) gold alloy contacts are used. Platinum contacts are typically used for high temperature. Silver cadmium oxide contacts are used for applications up to 10 amperes, but life rating is reduced at high amperage.

Operation Techniques

Switches are designed, manufactured and adjusted for operation under extreme environments. Many switches are pretested under various environmental conditions prior to use to insure their reliability and stability.

There are basic operating characteristics, explained in this section, which affect switch reliability. If any of the operating characteristics are disregarded the reliability of the switch could be jeopardized. For these reasons some of the following suggestions in the design of the operator mechanism will be helpful.

Actuator position

When designing an external actuator mechanism it is important to study the time the switch is in the free position versus time in the actuated position. If possible, the actuator and the switch wiring should be arranged so that the basic switch actuator is in the free position longer than it is in the actuated position. If an application requires the switch be held in the operated overtraveled position, then a "helper leaf" should be used under the basic switch actuator.

In the free position the basic switch actuator must be free of the customer actuating means. This applies to any type of actuator including: leaf, lever, plunger, slide or cam types.

Overtravel control

The actuating mechanism must be designed to control overtravel. One method is to maintain the overtravel in accordance with the specification of the basic switch, usually .006 to .008 inches (.015 to .02 mm). Another means of controlling overtravel is the integration of a fixed overtravel stop. In both cases it is important to control the overtravel force on the switch actuator.

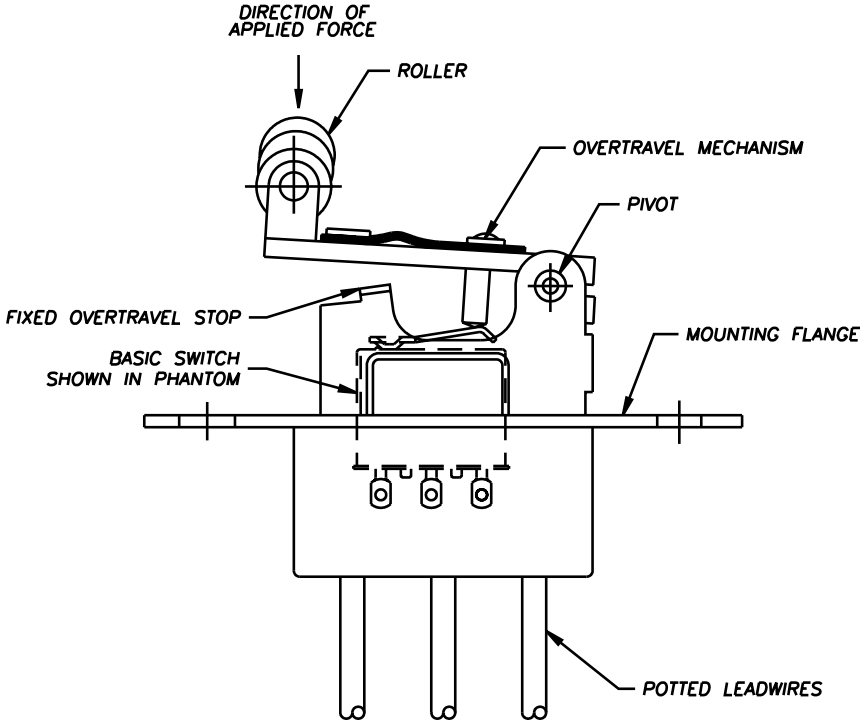


Figure S-3. Overtravel force controlled mechanism

Actuating force

During the operation of basic switches always apply the actuation force perpendicular to the switch actuator.

Cam operated switches

Switches should not be operated by cam directly on the switch actuator. This could shorten the switch life by distorting the diaphragm area. An auxiliary leaf should be used between the cam and switch actuator. The leaf will be subjected to the side motion while the switch actuator will only be subjected to vertical motion.

The cam rise for most applications is 45° and the dimension between high and low diameter of the cam should be the total distance from the free position to the minimum overtravel position. In addition, some means to adjust the switch overtravel must be provided. This could be accomplished by adjusting the basic switch location.

Lead wires

Care should be taken in soldering or brazing lead wires to switch terminals, not to overheat terminals and fracture glass seals. Do not bend or twist switch terminals. Where switches are subjected to high vibration, lead wires must be supported within a few inches from the switch terminals.

Mounting

When mounting a basic switch, series 6100, 6300 or 6700 through its housing, do not apply more than 5 in.-lbs. torque to the 2-56 screws.

When a basic switch is mounted to a threaded bushing, do not use the switch as a means of threading the bushing into the proper mounting position.

Terminology

Chatter: Rapid opening and closing of contacts, usually exhibited during extreme vibration and/or shock.

Contact resistance: The resistance offered to the flow of current from one contact to the other.

Differential motion: Distance between the operating point and release point. Usually specified as a maximum value.

Free position: Point at which plunger exists in the unoperated condition. There should be no force on the plunger at this position. Usually measured from the switch mounting holes and specified as a maximum value.

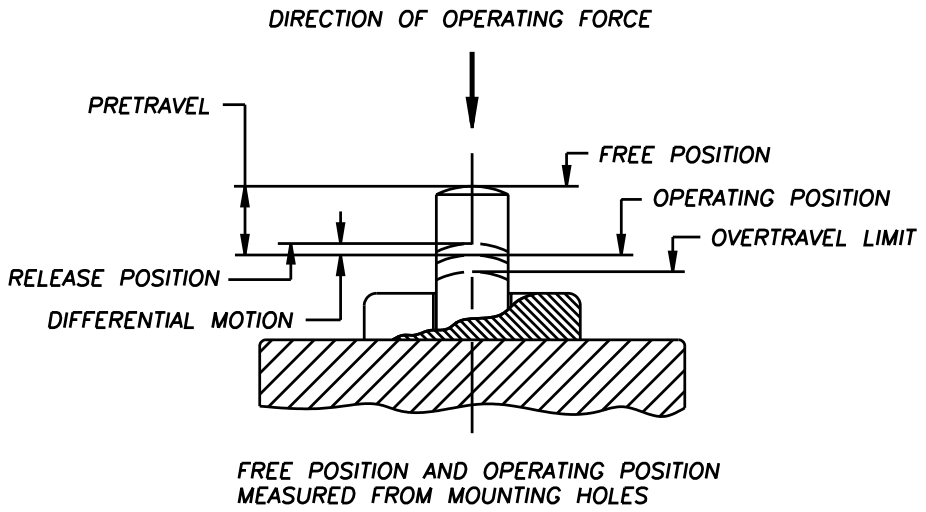


Figure S-4. Illustration of switch positions.
Note: free position and operating position measured from mounting holes.

Loop resistance: The resistance value at the point of measurement. If measured at the lead ends, this figure is the cumulative series resistance of contacts, blade, pins, leads, welds, solder, or riveted junctions.

Operating force: The force required at the actuator to cause the contacts to transfer from the normally closed contact to the normally open contact. Usually specified as a maximum value.

Operating point: Point at which contacts transfer from normally closed contact to the normally open contact. Usually measured from the switch mounting holes and specified with a ± tolerance.

Overtravel: Distance from the operating point to the end of plunger's travel. Usually specified as a minimum value.

Pretravel: Distance from free position to operating point. Usually specified as a maximum value.

Release force: Force at which contacts resume their normal position. Usually specified as a minimum value.

Release point: Point at which contacts resume their normal position. Usually not specified.

Snap action: The abrupt transfer of contacts from one position to another. This action is relatively independent of the speed of actuation travel.

Wiping action: Lateral travel of moveable contact over fixed contact while pressure between the two contacts exists. Occurs during plunger travel. This action helps clean the contacts to assure the lowest contact resistance.

Haydon Precision Switches

Overview

Haydon Switch and Instrument offers a complete range of design, engineering and manufacturing capabilities to meet a variety of precision switch applications. Our experience, knowledge and innovative engineering spirit have been recognized with over 50 patents covering blades, packages, actuator design and switch mechanisms. Our custom design, testing and manufacturing resources have been utilized in the development of over 1,000 new switches and actuators in accommodating user specifications. In addition, we combine custom capabilities with an extensive manufacturing facility to provide economical solutions to short run requirements as well as full run production needs.

Custom Designs

Throughout the years, Haydon has developed an extensive array of precision switches to match a wide range of size, function, environmental, and application requirements. This provides us with the ability to solve many new requirements with available products or by creating minor modifications to existing technology. This inventory of experience has made Haydon a leader in the design and production of precision switches for new or unique applications.

Haydon's qualified application engineers will work with you in developing cost effective solutions to meet your requirements. We also offer complete in-plant, tool-and-die making capabilities for the fabrication of prototypes, and we can provide in-depth testing to insure that your switch offers reliable performance.

Testing

Haydon's custom design and manufacturing services are supported with a full range of testing and quality control capabilities. Each test is conducted to insure that every precision switch manufactured performs to required specifications under extreme environmental conditions. In addition to an extensive quality engineering department complete with the latest dedicated testing equipment, Haydon test capabilities include:

- *Testing facilities for MIL. SPEC. 8805*
- *Random vibration*
- *Sinusoidal vibration*
- *Shock*
- *Altitude*
- *Leak Testing (gross and fine)*
- *Salt spray*
- *Particle impact noise detection (PIND)*
- *Centrifugal acceleration*
- *Mechanical endurance*
- *High/low temperature testing*
- *Humidity testing*
- *Cycling (mechanical & electrical)*

ORDERING INFORMATION

Every switch presented in the Haydon Switch catalog can be custom designed and manufactured according to customer specifications. When placing an order the following general information will be required.

- ❍ Intended application
- ❍ Quantities required
- ❍ Will engineering drawings be provided?

Electrical

- ❍ Voltage (28 VDC / 115 VAC @ 400 Hz) or other?
- ❍ Current: Inductive? Resistive?
- ❍ Number of poles needed per switch
- ❍ Throw: ❍ Single ❍ Double

Environmental

- ❍ General environment of application
- ❍ Temperature range
- ❍ Seal required: ❍ Environmental (Class 4) ❍ Hermetic (Class 5) ❍ Other

Mechanical Properties

- ❍ Free position (maximum)
- ❍ Pretravel (maximum)
- ❍ Operating point (±)
- ❍ Overtravel (minimum)
- ❍ Operation force (maximum)
- ❍ Release force (minimum)

Operating Requirements

- ❍ Required life cycle
- ❍ Shock (Sawtooth: 100 G's in 6 ms typical)
- ❍ Vibration: Sinusoidal (30 to 50 G's typical)? Random?

Actuator Types

- ❍ Pushbutton ❍ Leever ❍ Plunger ❍ Toggle ❍ Other
- ❍ Location on switch

Connection Type

- ❍ Potting with leads

Terminals ❍ Solder ❍ Braze ❍ Screw ❍ Other

- ❍ Location on switch

Testing Requirments

Miscellaneous other information

Series 6100 Environmentally Sealed Switch

Figure S-5

The series 6100 environmentally sealed switch is designed for applications where high reliability is required in a high or low temperature environment. Combining long life and precise action, this switch is used in a wide variety of commercial and military aircraft and space applications. These switches can perform such functions as indication for door locks, landing gear position, valve position and throttle control. Military applications include brake lights on military vehicles, gear shift indicator for tanks and other applications where a resiliently sealed, high reliability switch is required.

Incorporating an elastomer seal, which enables high sensitivity and low operating pressure, the switch has a maximum leak rate of $1x10^{-6}$ atm cc/sec. Fine silver contacts are standard and gold alloy or platinum contacts are also available. Electrical and mechanical life are conservatively rated at 100,000 operations.

Also available in the 6100 series is an ultra high temperature, non-sealed switch with a range of -65°F to +700°F (-54°C to +371°C).

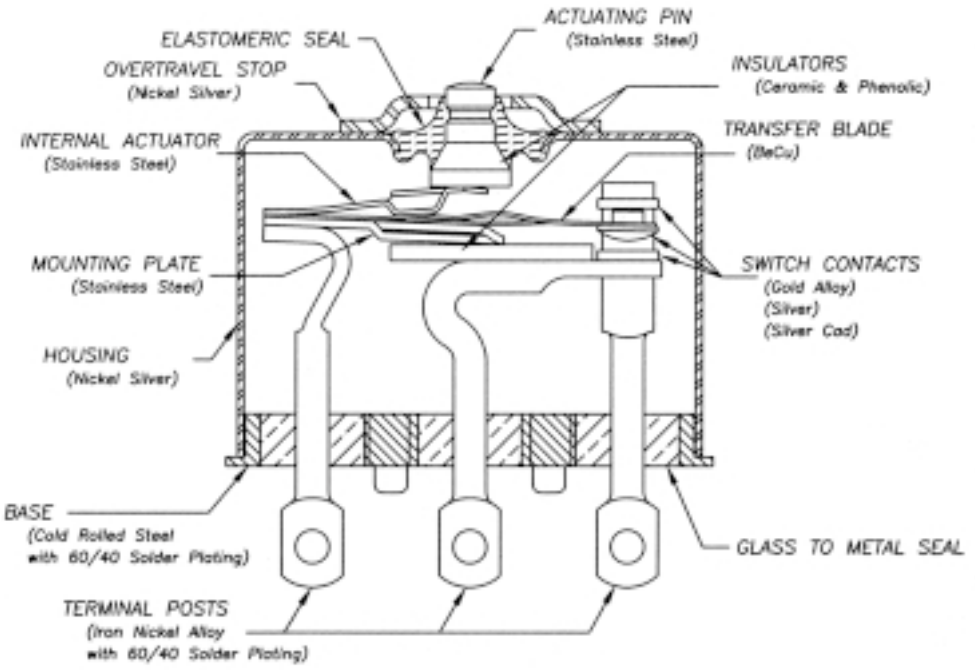
Assemblies

Series 6100 environmentally sealed switches are available in a wide variety of actuator assemblies. Typical assemblies include pushbutton, toggle, leaf actuators and roller leaf assemblies. Haydon can also provide custom assemblies to meet specific operational requirements.

Cut Away Diagram

Figure S-6

Patented and patent pending design and mechanism



Series 6100 Environmentally Sealed Switch

Mechanical Characteristics

Maximum Operating Force	Center Button 22 oz. (6.12 N) Offset Button 10 oz. (2.8 N)
Minimum Release Force	Center Button 6 oz. (1.67 N) Offset Button 2 oz. (0.56 N)
Movement Differential	.0005/.005" (0.0127/0.127 mm)
Weight	.32 oz. (9.07 g)
Overtravel Stop	.007" available (0.1778 mm)

Electrical Characteristics

Electrical Rating	28 VDC/115 VAC, 400 Hz
Resistive	5 A
Inductive	3 A
Dielectric Withstanding Voltage	1000 V rms at sea level for 1 minute or 1250 V rms for 1 second with maximum leakage current 0.5 mA. Can be supplied to meet 1500 V rms withstand voltage with reduction in life.
Contact Arrangement	SPDT

Environmental Characteristics

Temperature Range	-85°F to +300°F (-65°C to 149°C) *+400°F on special order [204°C]*
Shock	100g for 6 ± 1 ms
Vibration	10 - 2000 Hz 20g peak
Military Specification	MIL-PRF-8805

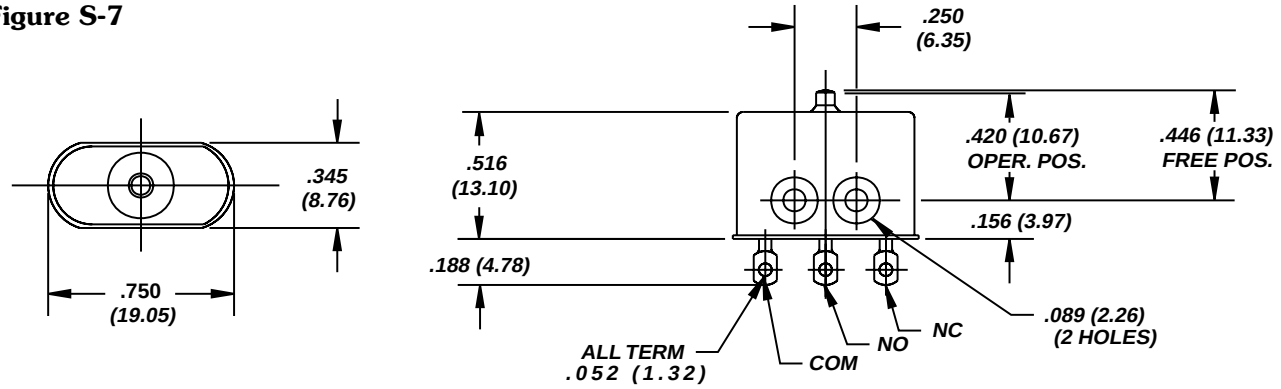
Series 6100 Selection

Part Number	Mil-Spec Part Number	Part Number	Mil-Spec Part Number
6106	**MS 27993-1**	**6130-2**	**MS 27992-3**
6106-1	**MS 27993-3**	**6130-3**	**MS 27992-4**
6107	**MS 27993-2**	**6146**	**MS 27993-7**
6107-1	**MS 27993-4**	**6146-2**	**MS 27993-8**
6130	**MS 27992-1**	**6146-3**	**MS 27993-5**
6130-1	**MS 27992-2**	**6146-4**	**MS 27993-6**

Series 6100 Dimensional Drawings

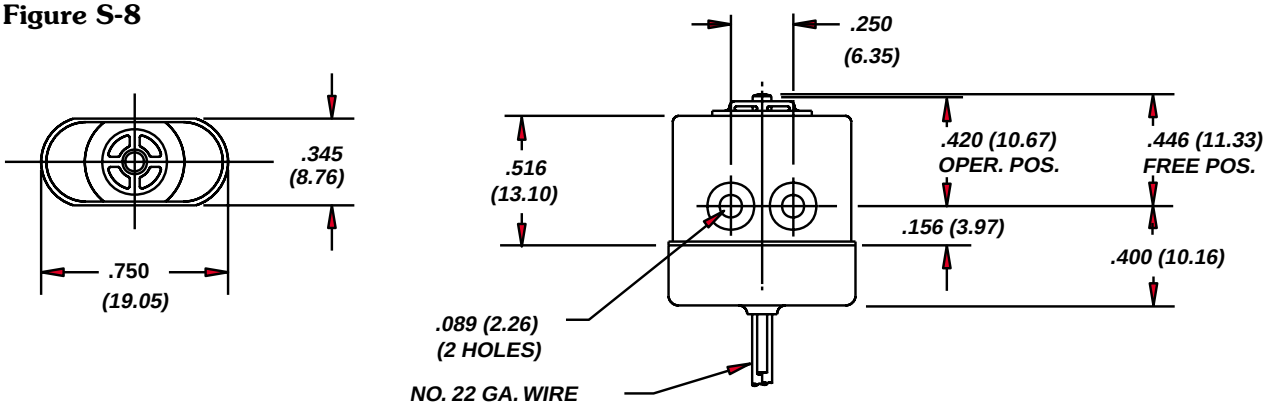
Basic Configuration

Figure S-7



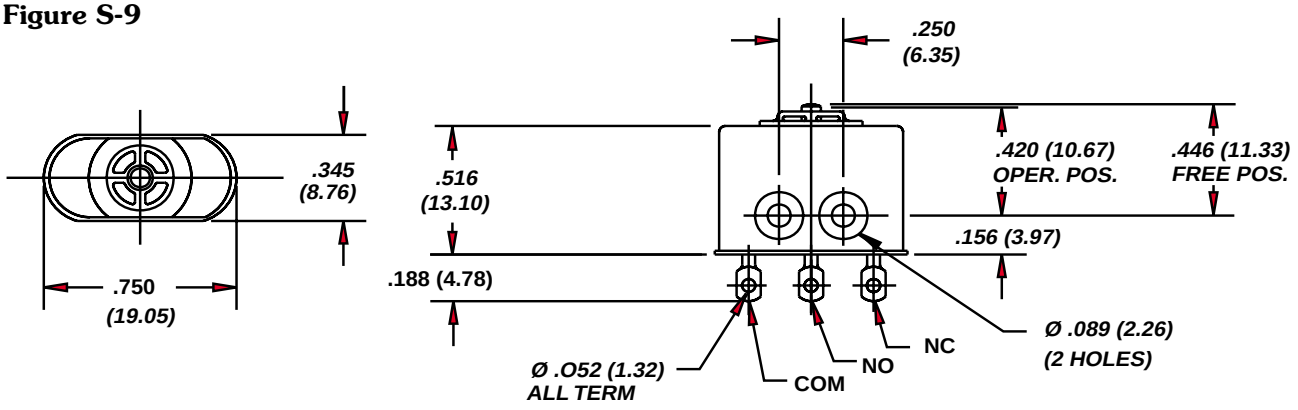
P/N 6106 • Mil Spec 27993-1

Figure S-8



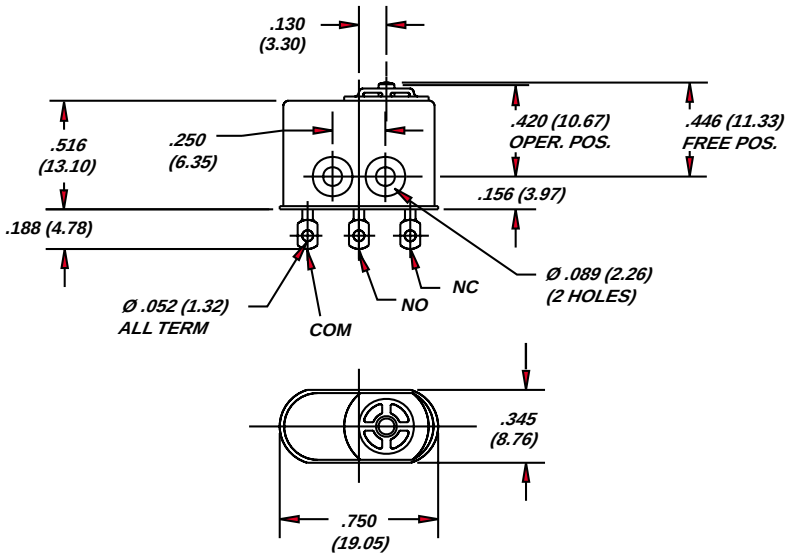
P/N 6107-1 • Mil Spec 27993-4

Figure S-9

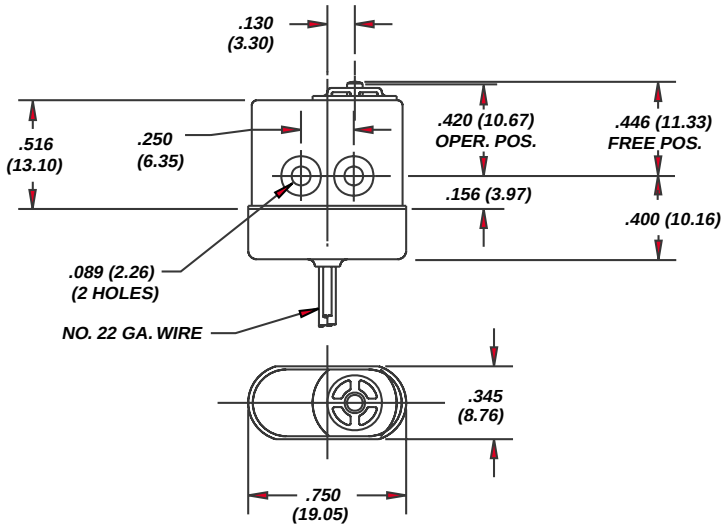


Series 6100 Dimensional Drawings

P/N 6130-1
Mil Spec 27993-4
Figure S-10



P/N 6130-3
Mil Spec 27993-4
Figure S-11



Series 6100 Ultra High Temperature, Non-sealed

This switch offers the high reliability and time proven performance of the Haydon 6100 Series switches with the added advantage of high temperature performance. The 61151 non-sealed switch offers an ambient temperature range of -65°F (-54°C) to +700°F (371°C).

Figure S-12

Mechanical Characteristics

Maximum Operating Force	20oz. (5.56 N)
Minimum Release Force	5 oz. (1.39 N)
Movement Differential	.005" (0.127 mm)
Weight	.32 oz. (9.07 g)
Overtravel Stop	.008" available (0.203 mm)

Electrical Characteristics

Electrical Rating	28VDC/115VAC, 400 Hz
Resistive	5 A
Inductive	3 A
Contact Arrangement	SPDT

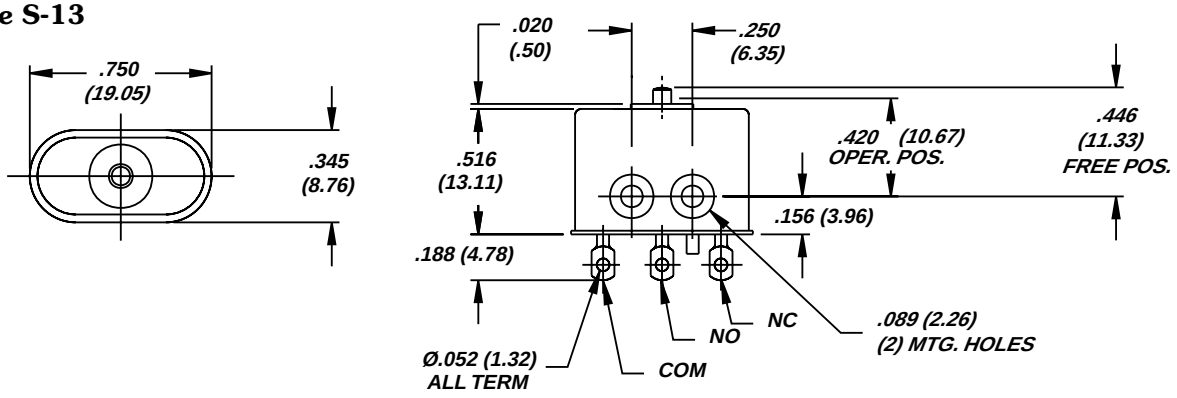
Environmental Characteristics

Temperature Range	-65°F to +700°F (-54°C to 371°C)
Vibration	10 - 2000 Hz 20g peak

Series 6100 Environmentally Sealed Dimensional Drawings

Basic Configuration

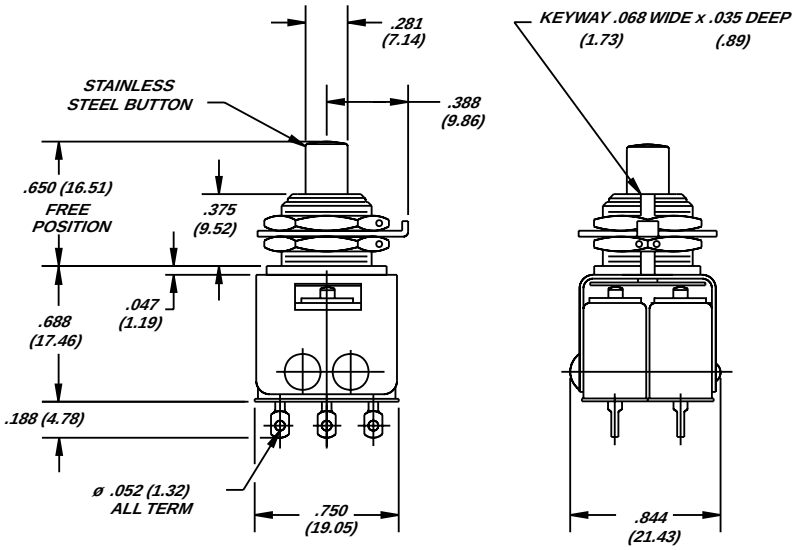
Figure S-13



Pushbutton, Double Pole, Double Throw

Figure S-14

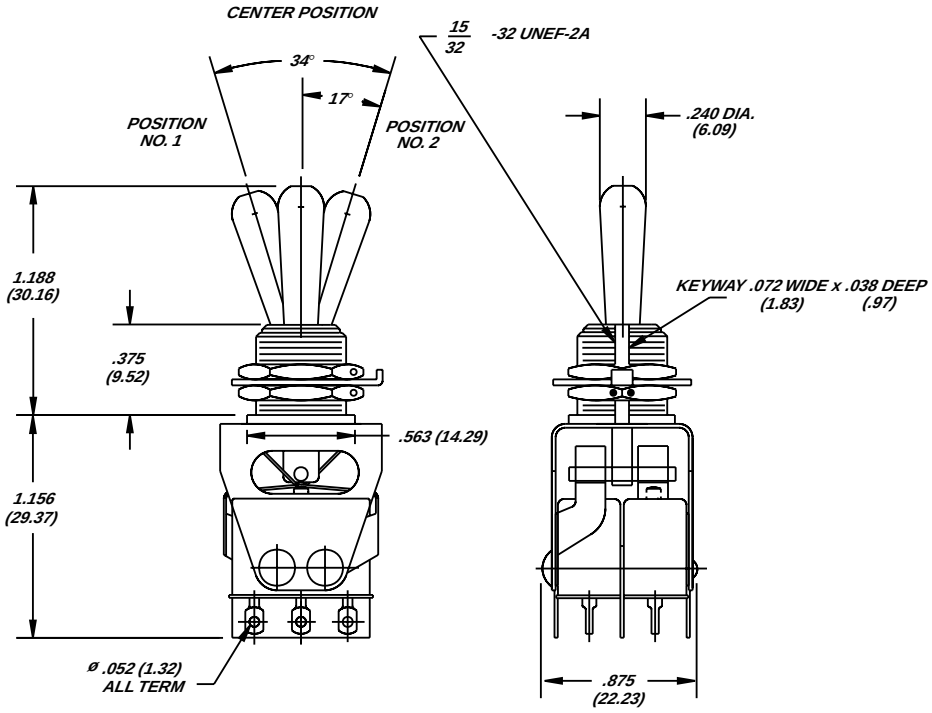
Double pole, double throw pushbutton switch assembly.



Toggle, Double Pole, Three Position

Figure S-15

Three position, two pole switch assembly. Switch is maintained in all positions. Available with potted leads.

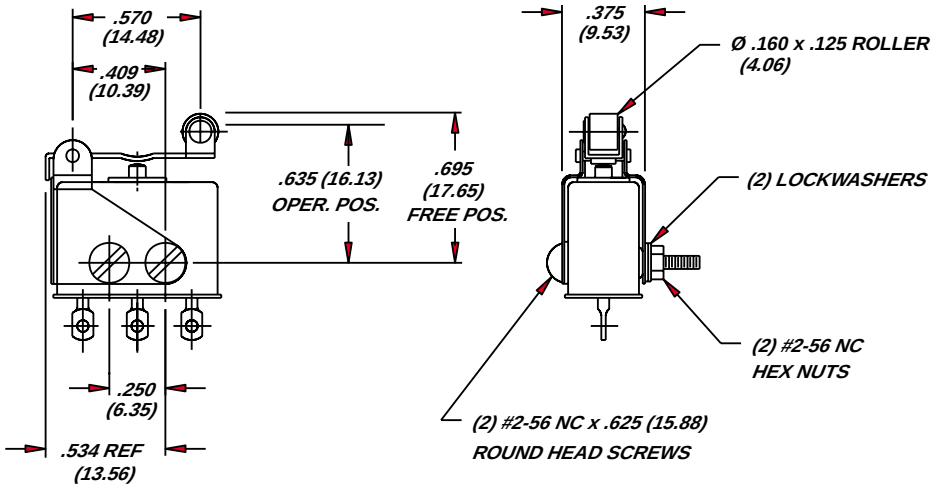


Series 6100 Environmentally Sealed Actuator Styles

Roller Lever Actuator

Figure S-16

Roller lever actuated for single pole assembly. Available with potted leads.



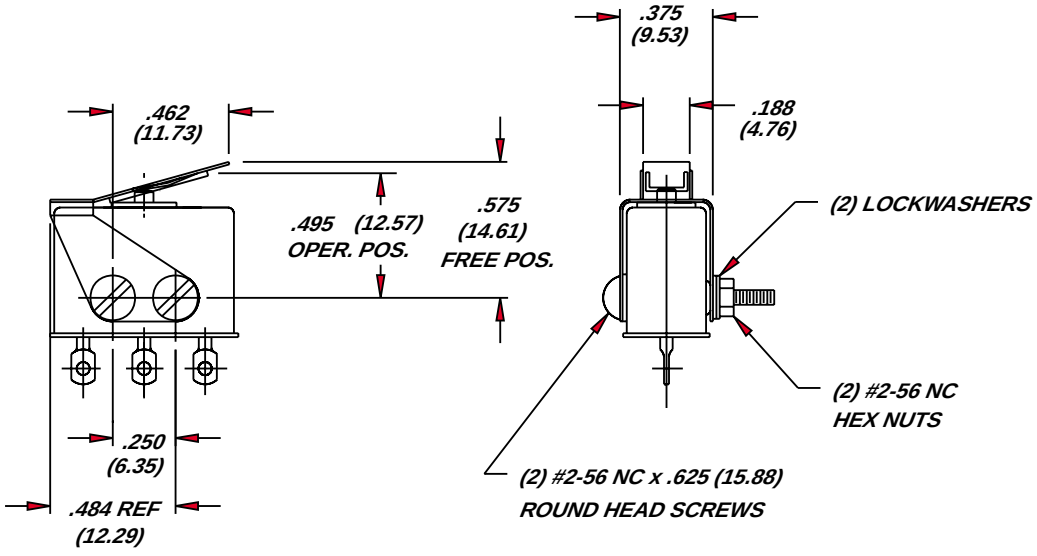
Mechanical Characteristics

Max. Movement Differential	.015" (0.38 mm)
Max. Operating Force	15 oz. (4.17 N)
Minimum Release Force	3 oz. (0.83 N)
Total Overtravel	.020" (0.51 mm)

Leaf Actuator

Figure S-17

Leaf actuator with overtravel for single pole assembly. Also available with potted leads.



Mechanical Characteristics

Max. Movement Differential	.030" (0.76 mm)
Max. Operating Force	13 oz. (3.61 N)
Minimum Release Force	1 oz. (0.28 N)
Total Overtravel	.040" (1.02 mm)

Series 6200 Hermetically Sealed, High Temperature

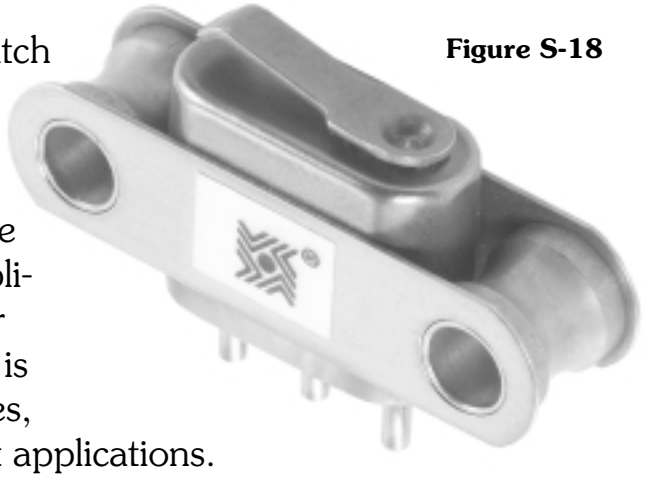


Figure S-18

The series 6200 hermetically sealed switch is ideal for high temperature applications or anywhere extremely severe environmental conditions are encountered. Most commonly used on commercial and military aircraft, these switches can also be found in some space applications. Originally designed and developed for use on Mach 2 supersonic aircraft, the switch is currently being used in high temperature valves, thrust reversers and other severe environment applications.

The 6200 series switches are highly resistant to vibration, shock and other environmental conditions typical of aerospace applications. The corrosion resistant metal and glass sealed enclosure is accomplished by using a heat treated stainless steel housing and a glass metal header. The Haydon wobble diaphragm is an integral part of the housing, not a separate piece welded or brazed in place therefore the mechanical life is significantly longer than life at rated load. The glass to metal header uses materials rated to 600°F (316°C). In addition, the glass has excellent dielectric and insulation resistance, particularly important at high temperatures which degrade insulation qualities. True hermetic sealing integrity is maintained per Category 5 of MIL-PRF-8805 i.e. 1 x 10^{-8} atm cc/sec.

In high temperature low current operation the slightest contamination can generate film on the contacts. Since the low current cannot penetrate even the thinnest film, the result is an intermittent signal. Haydon technology solves the contamination problem and prevents failure. Switches are assembled and sealed in our class 10,000 clean room environment. All metal and glass components are used in this design. Cleaning and inspection operations, to prevent contamination, are performed as a regular part of the manufacturing process. The cover is heliarc welded to the glass to metal header and the housing is backfilled with inert nitrogen gas. This provides a controlled environment for the switch contacts which makes maximum electrical life possible.

The actuator design limits overtravel to acceptable limits and will withstand up to 10 lbs. (4.54 Kg) of force exerted on the actuator at its operation point.

Assemblies

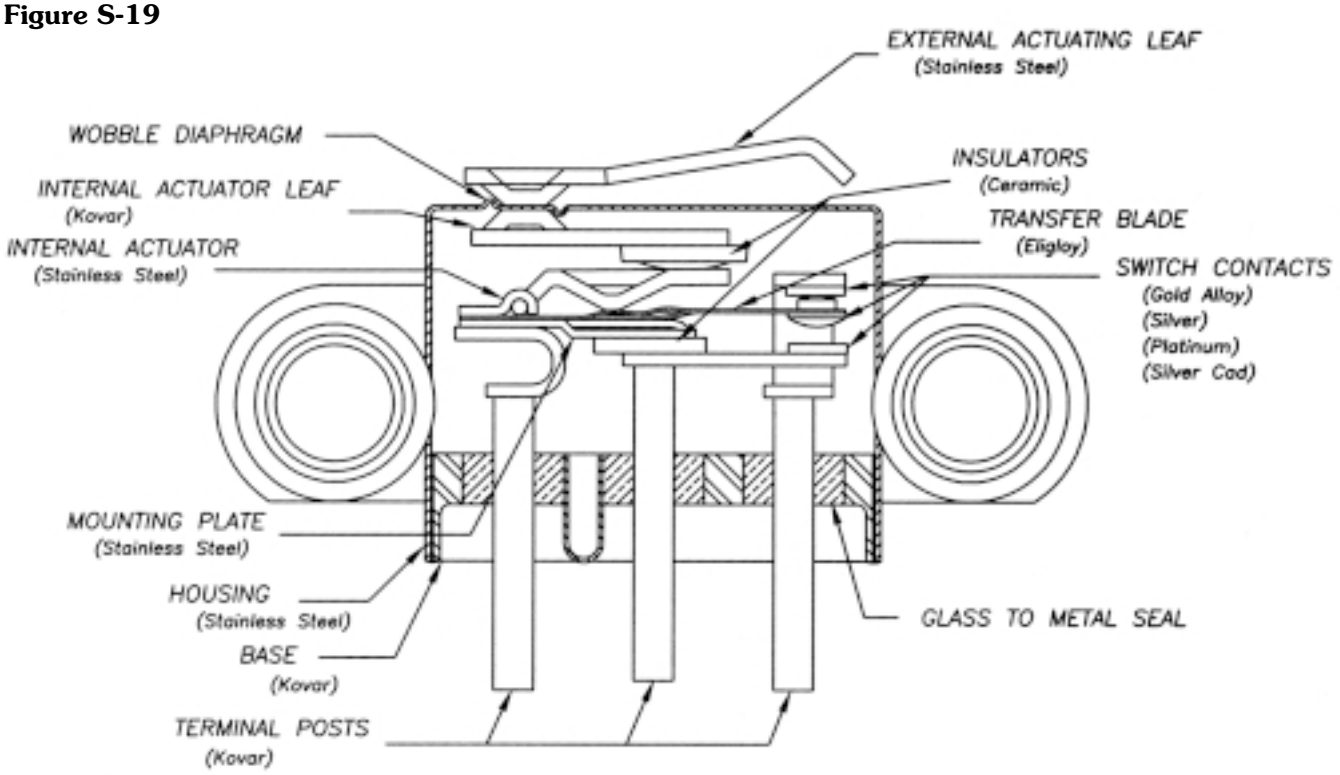
A variety of standard assemblies are available for use with Series 6200 switches including assemblies rated up to +660°F (315°C) continuous operation and up to +800°F (427°C) intermittent operation. Haydon can also design custom assemblies and provide electrical terminations to meet specific application requirements.

Series 6200 Hermetically Sealed, High Temperature

Cut Away Diagram

Patented and patent pending design and mechanism

Figure S-19



Series 6200 Ultra High Temperature

The series 6200 is also available in an ultra high temperature version. The switch incorporates an elgiloy blade and platinum contacts to withstand operating temperatures to 900°F (482°C). Note: Hermiticity may be lost when operating at 900°F (482°C). Contact Haydon for complete specifications.

Series 6200 Milli-amp Switch

The 6200 series is also available in a low current version. This switch is designed to operate below 5 mA at 5 VDC in temperatures as high as 600°F (315°C).

Series 6200 Hermetically Sealed, High Temperature

Mechanical Characteristics

Maximum Operating Force	26 oz. (7.23 N)
Minimum Release Force	6 oz. (1.68 N)
Movement Differential	.020" (0.508 mm)
Weight	.48 oz. (13.61 g)
Overtravel Stop	.010" available (0.254 mm)

Electrical Characteristics

Electrical Rating	28 VDC/115 VAC, 400 Hz
Resistive	5 A
Inductive	3 A
Dielectric Withstanding Voltage	1000 V rms at sea level for 1 minute or 1250 V rms for 1 second with maximum leakage current 0.5 mA. Can be supplied to meet 1500 V rms withstand voltage with reduction in life.
Contact Arrangement	SPDT

Environmental Characteristics

Temperature Range	-65°F to 660°F (-54°C to 349°C) / 800°F (427°C) intermittent -320°F to 800°F (-195°C to 427°C) intermittent*
Shock	100g for 6 ± 1 ms
Vibration	10 - 2000 Hz 20g peak
Ambient Pressure	High vacuum (negative) to 50 PSI (positive) 3.5 atmospheres
Military Specification	MIL-PRF-8805

** Special order, all others standard*

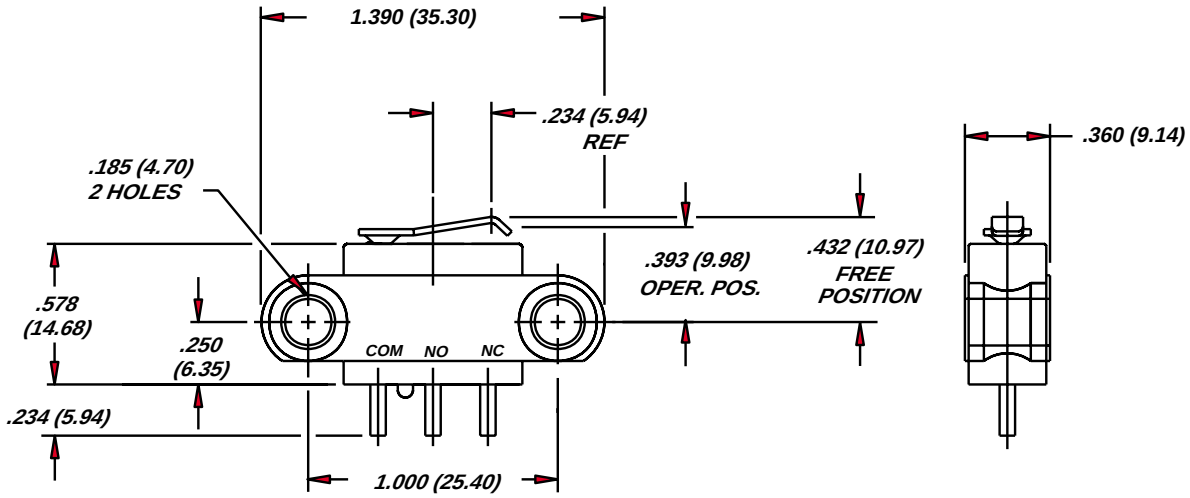
Series 6200 Selection

Part Number	Mil-Spec Part Number
6214-14	**MS 8805/82-004**
6214-15	**MS 8805/82-005**
6214-16	**MS 8805/82-006**

Series 6200 Dimensional Drawings

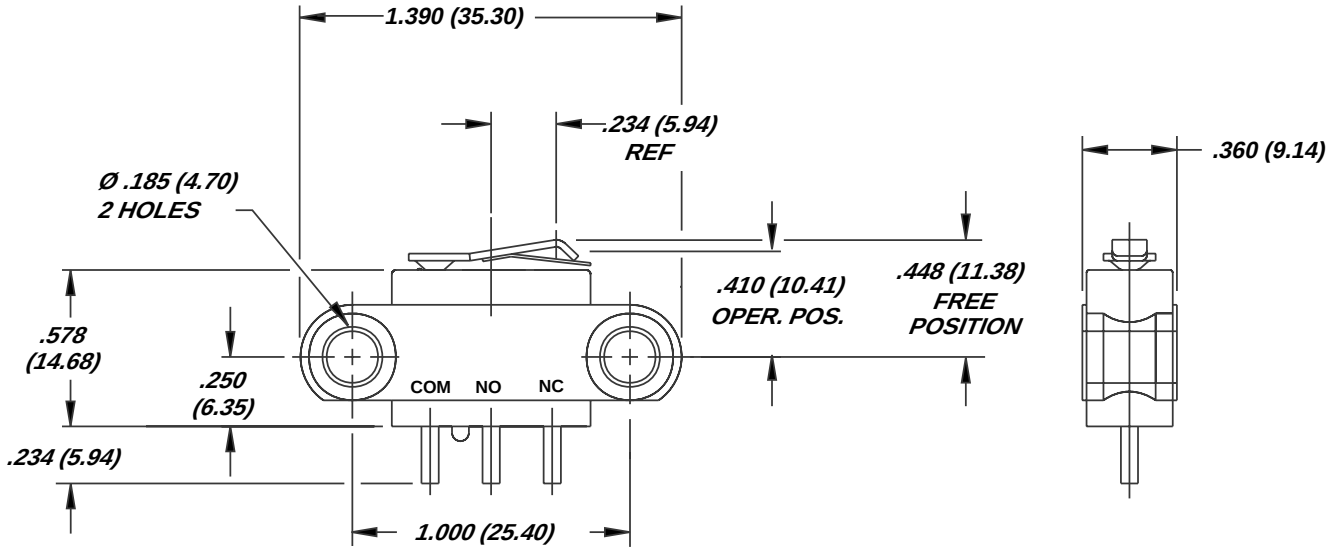
Basic Configuration

Figure S-20



Configuration with Helper Leaf Spring on Actuator

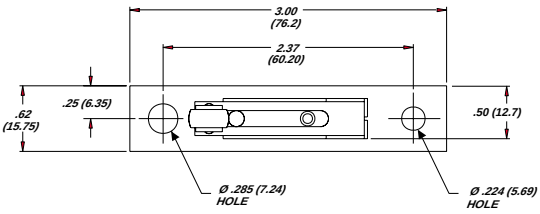
Figure S-21



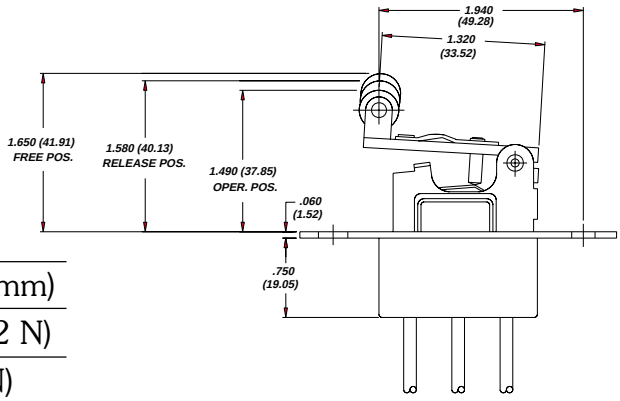
Series 6200 Typical Assemblies

Roller Lever with Potted Connectors

Figure S-22



Roller lever actuated assembly with leads welded and potted to the switch elements. Rated for 600°F (316°C) operation. Used in jet aircraft thrust reversal systems.

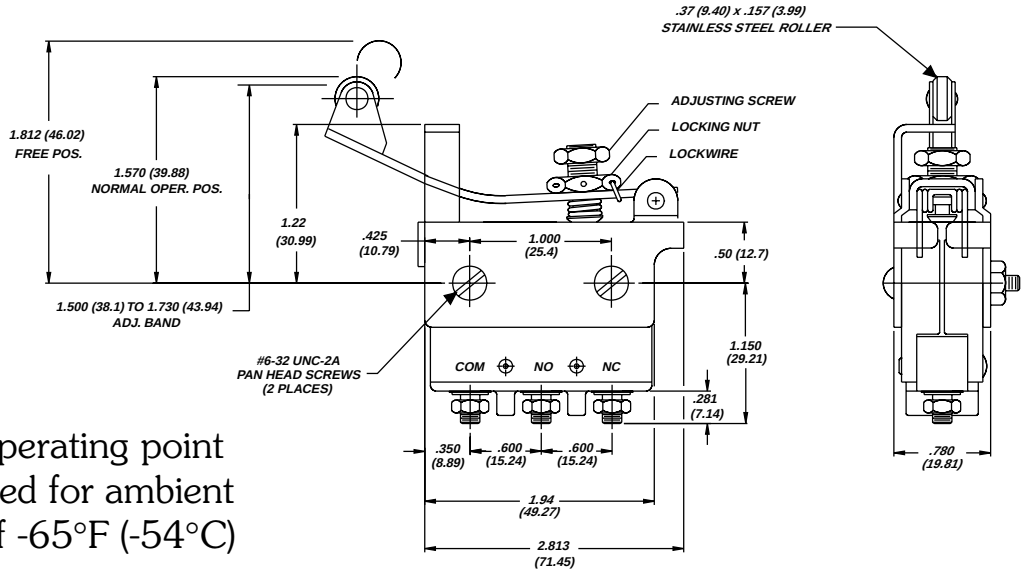


Mechanical Characteristics

Max. Movement Differential	.050" (0.32 mm)
Max. Operating Force	40 oz. (11.12 N)
Minimum Release Force	6 oz. (1.67 N)
Max. Overtravel	.300" (7.62 mm)
Max. Pretravel	.180" (4.57 mm)

Roller Lever with 8-32 Studded Connectors

Figure S-23



Roller lever actuated assembly with 8-32 studs for electrical connection. Offers high overtravel and means of adjusting operating point over wide range. Rated for ambient temperature range of -65°F (-54°C) to +800°F (427°C).

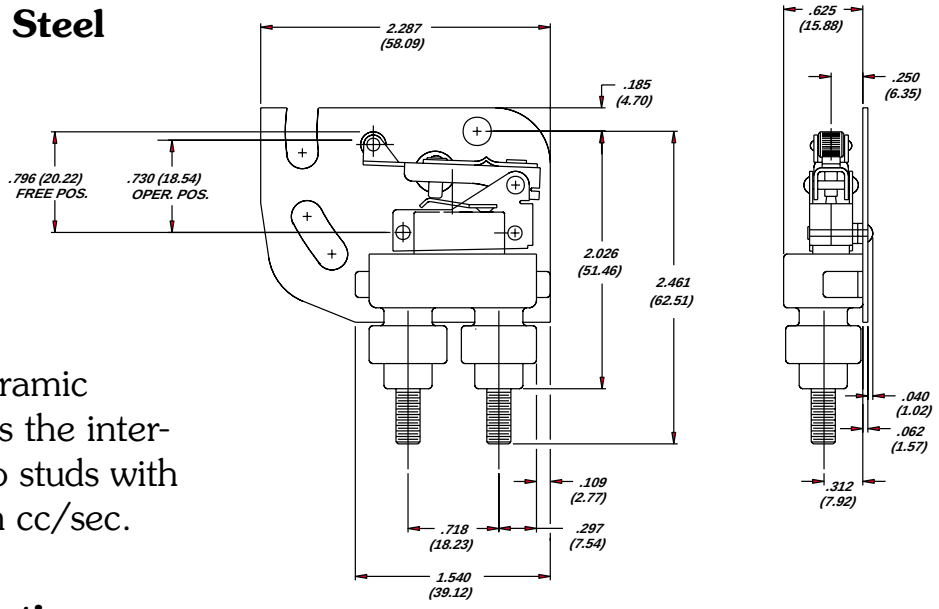
Mechanical Characteristics

Max. Movement Differential	.050" (0.32 mm)
Max. Operating Force	28 oz. (7.78 N)
Minimum Release Force	2 oz. (0.56 N)
Max. Overtravel	.250" (6.35 mm)
Nominal Pretravel	.242" (6.15 mm)

Series 6200 Typical Assemblies

Roller Lever, Stainless Steel and Ceramic

Figure S-24



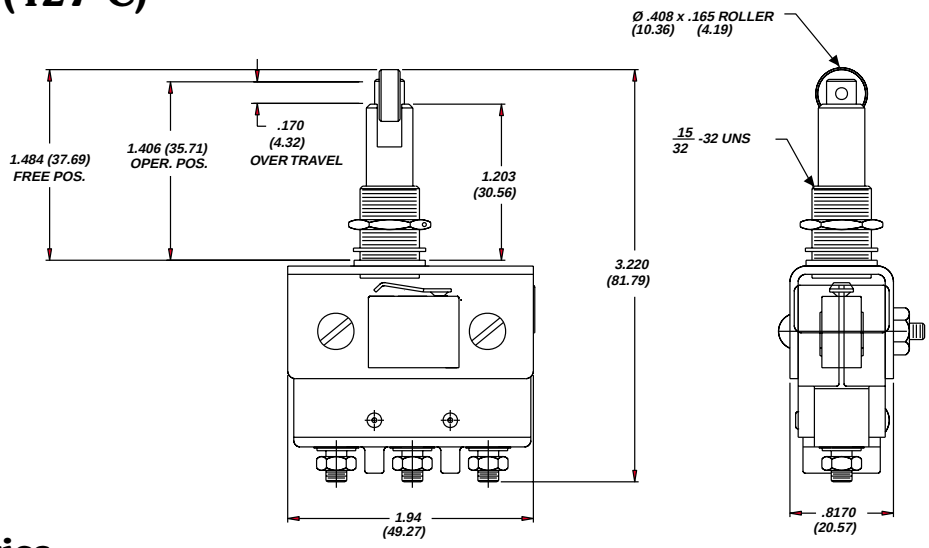
Roller lever actuated assembly with ceramic insulated 10-32 studs. The stainless steel enclosure to which the ceramic insulaters are brazed, seals the interconnection from switch to studs with a leak rate of 1 x 10^{-8} atm cc/sec. maximum.

Mechanical Characteristics

Max. Movement Differential	.030" (0.76 mm)
Max. Operating Force	26 oz. (7.23 N)
Max. Overtravel	.040" (1.02 mm)

Roller, Rated for 800°F (427°C)

Figure S-25



Roller actuator rated for 800°F (427°C) intermittent, 600°F (316°C) continuous operation.

Mechanical Characteristics

Max. Movement Differential	.050" (1.27 mm)
Max. Operating Force	40 oz. (11.12 N)
Min. Overtravel	.170" (4.32 mm)
Nominal Pretravel	.078" (1.98 mm)

Series 6300 Hermetically Sealed, Basic Switch

Figure S-26

The series 6300 hermetically sealed switch is designed for high reliability in extreme environments. This switch is used on military and commercial aircraft and in aerospace including the NASA shuttle program. Applications include valve limit switches, engine starters, over-speed switches, pressure switch and thrust reverser limit switches.

The metal corrosion resistant housing withstands most media and allows immersion of the switch in fluids such as synthetic hydraulic oils and jet fuels. The switch may be used in applications where external pressures are as high as 50 PSI (3.4 atmospheres). The 6300 series switch features an extremely low leak rate of $1x10^{-8}$ atm cc/sec. The switch enclosure can experience extremes of temperature pressure and media while the internal switch mechanism operates in a contaminant free environment of inert gas.

Contacts can be made of fine silver, gold alloy or platinum depending upon the application. Typically silver contacts are used up to 300°F (149°C) and platinum contacts are used for up to 500°F (260°C). Gold alloys are used for low level applications which range from 10 mA at 30 mV up to 500 mA at 30 VDC.

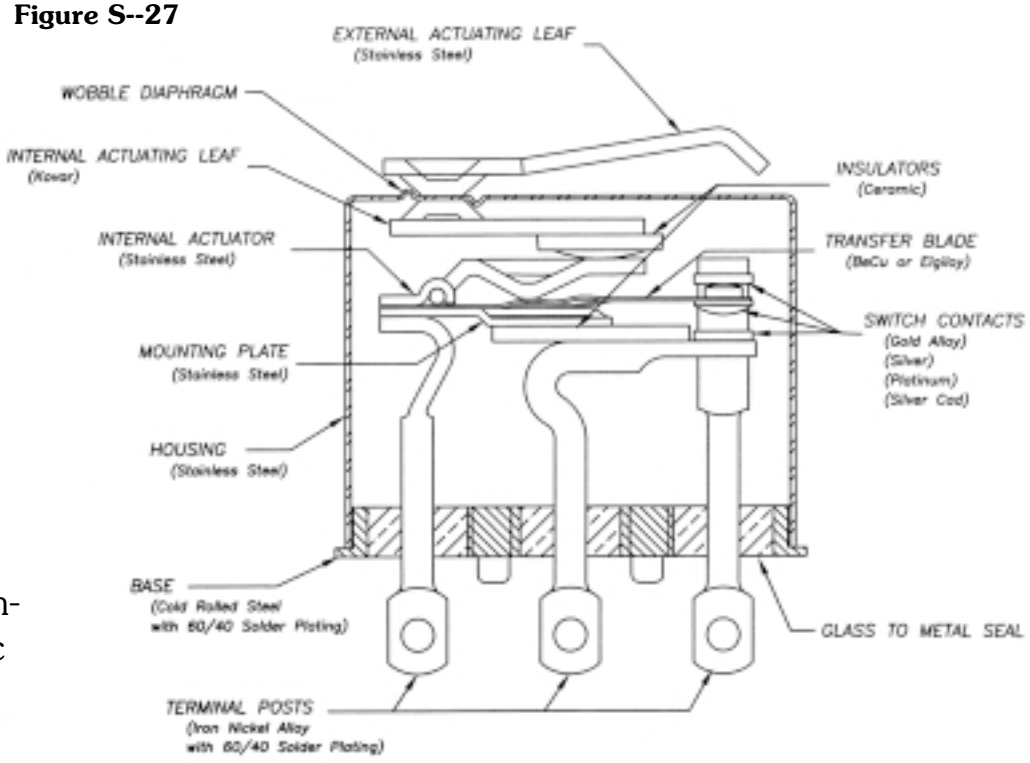
Assemblies

Series 6300 hermetically sealed switches may be actuated with a variety of assemblies. Typical assemblies include pushbutton, leaf, roller leaf and toggle. Standard assemblies may be modified to meet special mounting requirements. Haydon can also design custom assemblies to meet specific application requirements.

Cut Away Diagram

Patented and patent pending design and mechanism

Figure S--27



Series 6300 Hermetically Sealed, Basic Switch

Mechanical Characteristics

Maximum Operating Force	26 oz. (7.23 N)
Minimum Release Force	6 oz. (1.67 N)
Movement Differential	.020" (0.508 mm)
Weight	.32 oz. (9.07 g)
Overtravel Stop	.010" available (0.254 mm)

Electrical Characteristics

Electrical Rating	28 VDC/115 VAC, 400 Hz
Resistive	5 A
Inductive	3 A
Dielectric Withstanding Voltage	1000 V rms at sea level for 1 minute or 1250 V rms for 1 second with maximum leakage current 0.5 mA. Can be supplied to meet 1500 V rms withstand voltage with reduction in life.
Contact Arrangement	SPDT

Environmental Characteristics

Temperature Range	-85°F to 300°F (-65°C to 149°C) -85°F to 500°F (-65°C to 260°C) / -320°F (-196°C)*
Shock	100g for 6 ± 1 ms
Vibration	10 - 2000 Hz 20g peak (50g on special order)
Ambient Pressure	High vacuum (negative) to 50 PSI (positive) 3.4 atmospheres
Military Specification	MIL-PRF-8805

** Special order, all others standard*

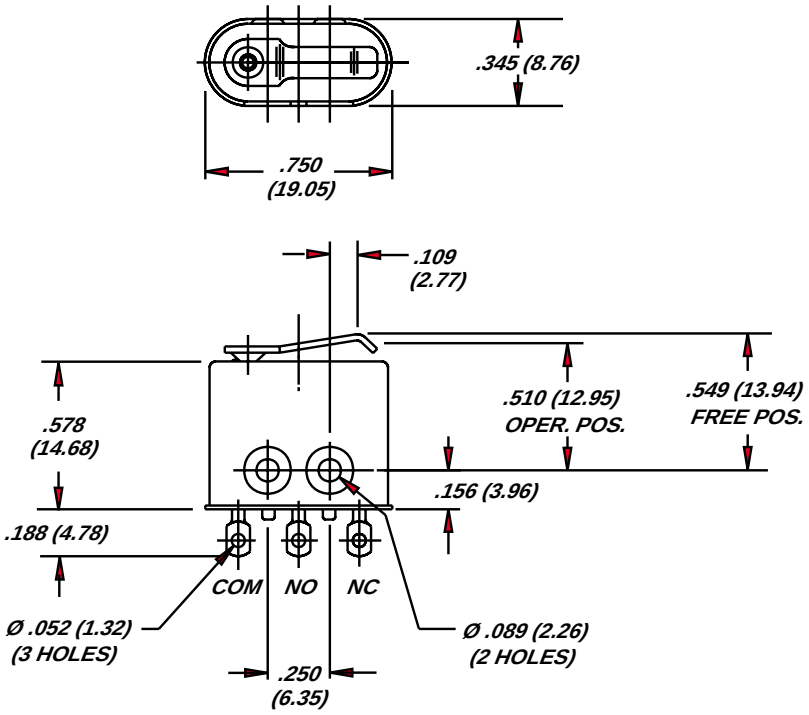
Series 6300 Selection

Part Number	Mil-Spec Part Number
6302-14	**MS 8805/46-001**
6302-15	**MS 8805/46-002**
6302-16	**MS 8805/46-003**

Series 6300 Dimensional Drawings

Basic Configuration

Figure S-28

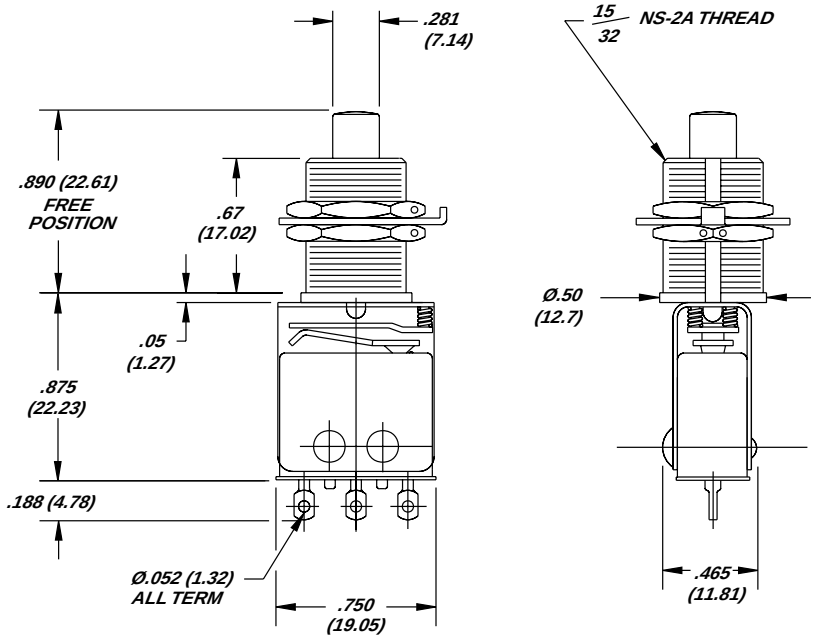


Series 6300 Typical Assemblies

Pushbutton, Single/Double Pole, Double Throw

Figure S-29

Single pole, double throw with pushbutton actuator. Also available in Double Pole Double Throw configuration. Also available with potted leads.



Mechanical Characteristics

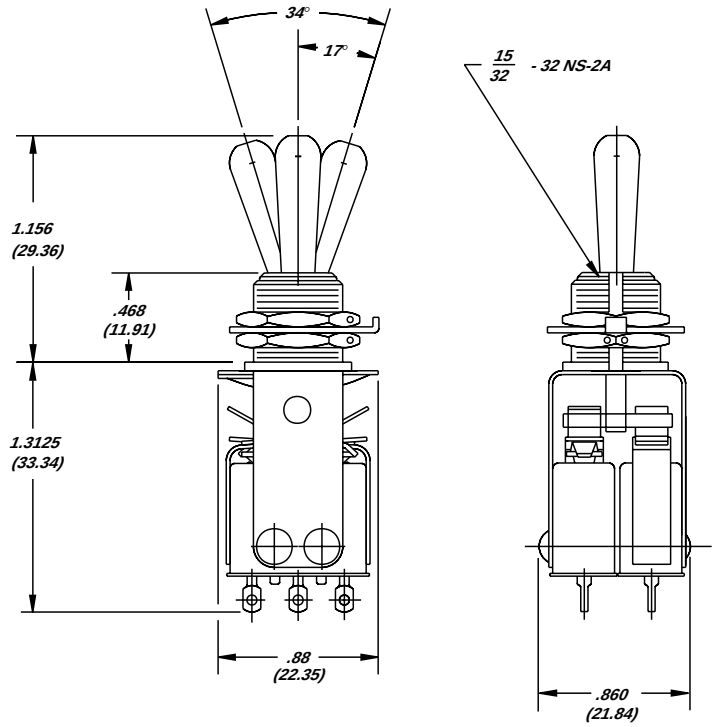
Max. Operating Force	5 to 8 lbs. (22.2 to 35.6 N)
Max. Overtravel	.100" (2.54 mm)

Series 6300 Typical Assemblies

Toggle, Two or Three Position, Double Pole

Figure S-30

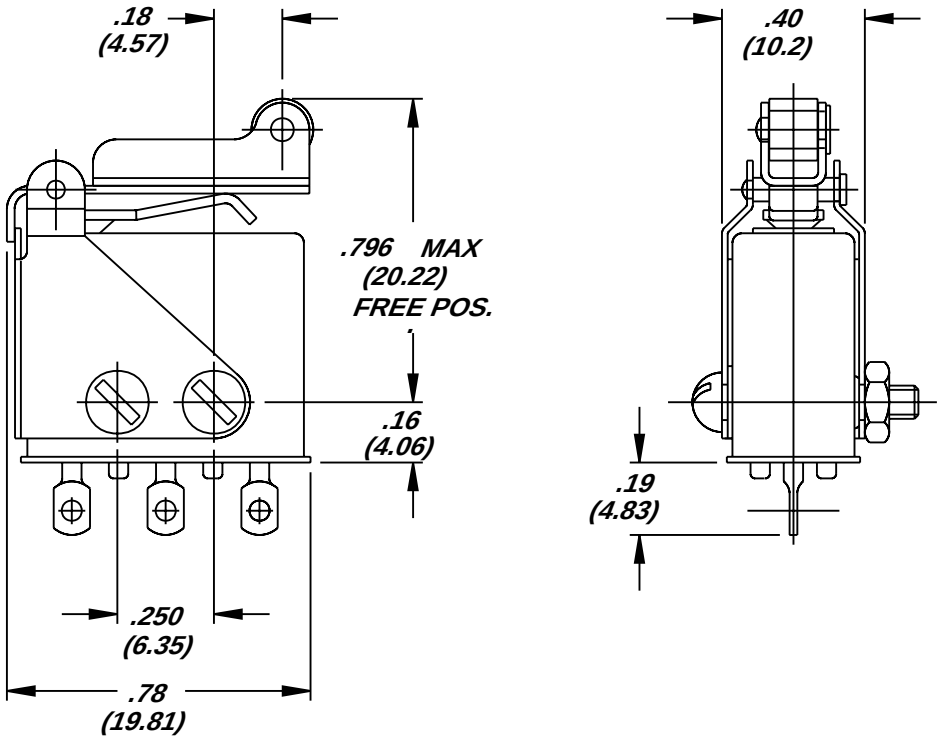
Two Position Double Pole Toggle Switch. Also available as a Three Position Double Pole Toggle Switch.



Roller Lever with Electrical Connections

Figure S-31

Roller lever actuated switch with leads for electrical connections. 24" (61 cm) potted lead wire standard.

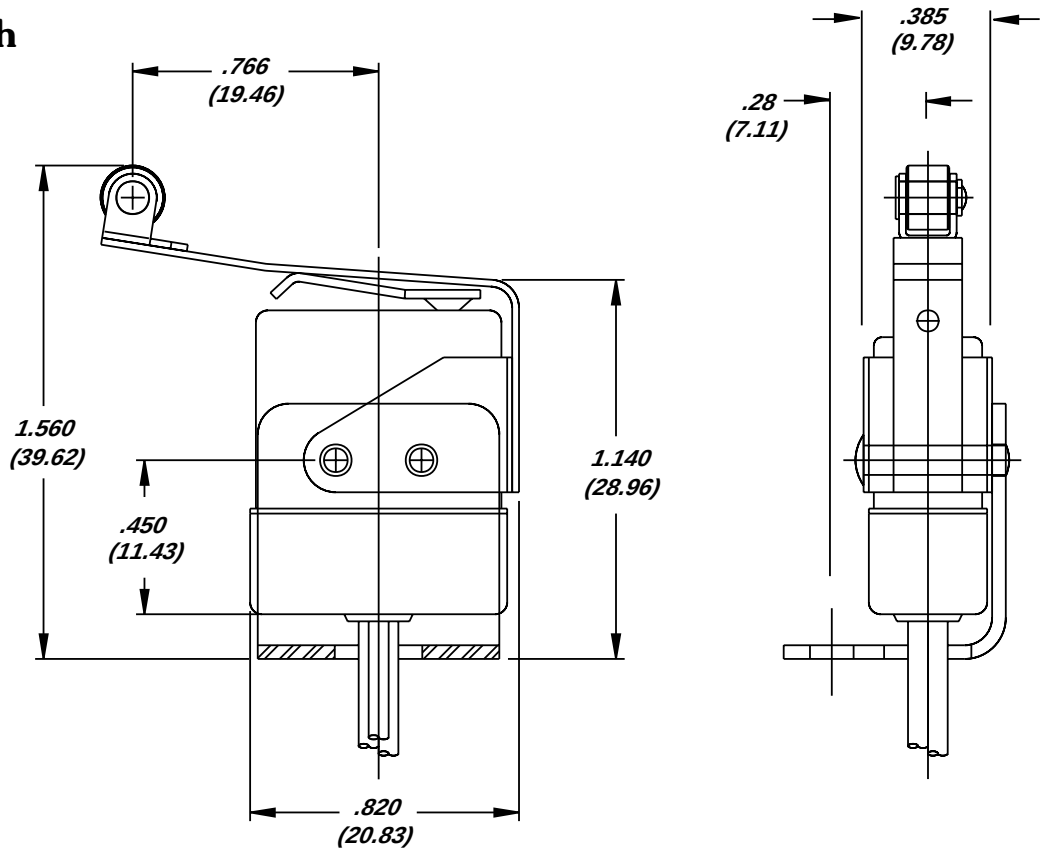


Series 6300 Typical Assemblies

Roller Lever with Potted Leads

Figure S-32

Roller lever actuated switch with potted leads.



Series 6600 Hermetically Sealed, Long Life

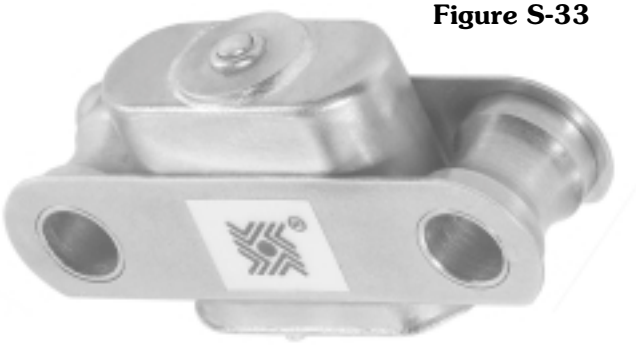


Figure S-33

The 6600 Series switch is designed for harsh environments where long life hermetic seal integrity of the switch is critical. The 130,000 cycle minimum hermetic life of the switch equates to life of aircraft reliability for many applications.

The rugged design and construction incorporates a metal bellows to insure durability of the actuation mechanism. The switch housing is backfilled with inert Nitrogen gas and sealed. Hermetic sealing is maintained per category 5 of MIL-PRF-8805 i.e. $1x10^{-8}$ atm cc/sec. The corrosion resistant housing withstands most media and allows exposure of the switch to fluids such as synthetic hydraulic oils and jet fuels.

The switch has been designed to operate below 5 mA at 28 VDC in temperatures as high as 400° F (204°C). By changing contact material the switch can be configured for 5 A operation.

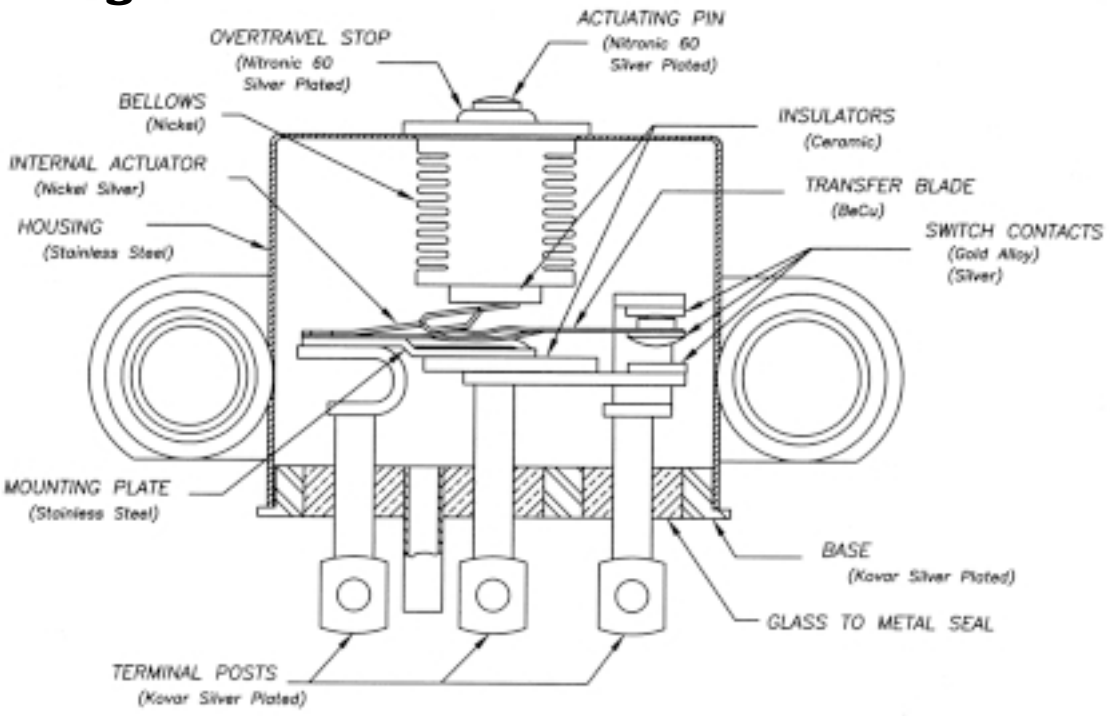
Assemblies

The 6600 series switches are available in a wide variety of actuator assemblies. Typical assemblies include leaf actuators, roller leaf assemblies and plunger actuators. HSI can also provide customization assemblies to meet specific operational requirements.

Cut Away Diagram

Figure S-34

Patented and patent pending design and mechanism



Series 6600 Hermetically Sealed, Long Life

Mechanical Characteristics

Maximum Operating Force	22 oz. (6.12 N)
Minimum Release Force	3 oz. (.835 N)
Max. Movement Differential	.005" (0.13 mm)
Hermetic Life	130,000
Weight	.5 oz. (14.2 g)
Overtravel Minimum	.006" available (0.15 mm)

Electrical Characteristics

Electrical Rating	28 VDC/115 VAC, 400 Hz
Resistive	5 mA
Dielectric Withstanding Voltage	1000 V rms at sea level for 1 minute or 1250 V rms for 1 second with maximum leakage current 0.5 mA. Can be supplied to meet 1500 V rms withstand voltage with reduction in life.
Contact Gap	.015" (.381 mm) minimum
Contact Arrangement	SPDT

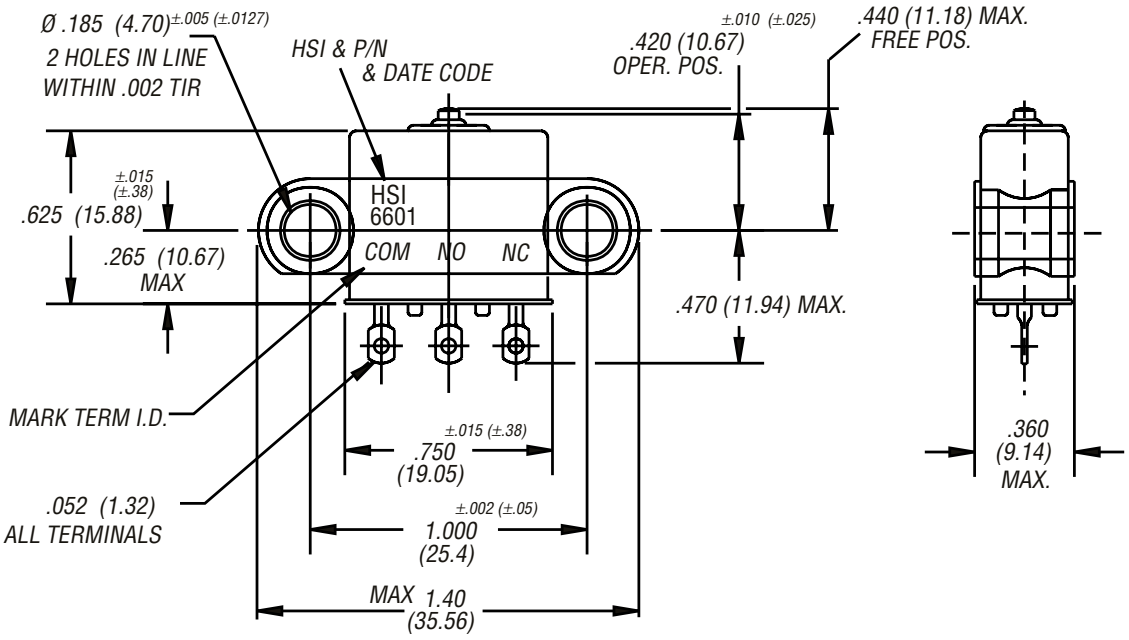
Environmental Characteristics

Temperature Range	-65°F to 400°F (-54°C to 204°C) continuous
Shock (sawtooth)	100g for 6 ± 1 ms
Vibration	10 - 2000 Hz 20g peak

Series 6600 Dimensional Drawings

Basic Configuration

Figure S-35



Series 66700: Switches for Extreme Environments

Electrical Characteristics

Electrical Rating	28VDC/115VAC, 400Hz
Resistive	5 A
Inductive	3 A
Dielectric Withstanding Voltage	1000V rms at sea level for 1 minute or 1250V rms for 1 second with maximum leakage current 0.5 mA. Can be supplied to meet 1500V rms withstand voltage with reduction in life.
Contact Arrangement	SPDT

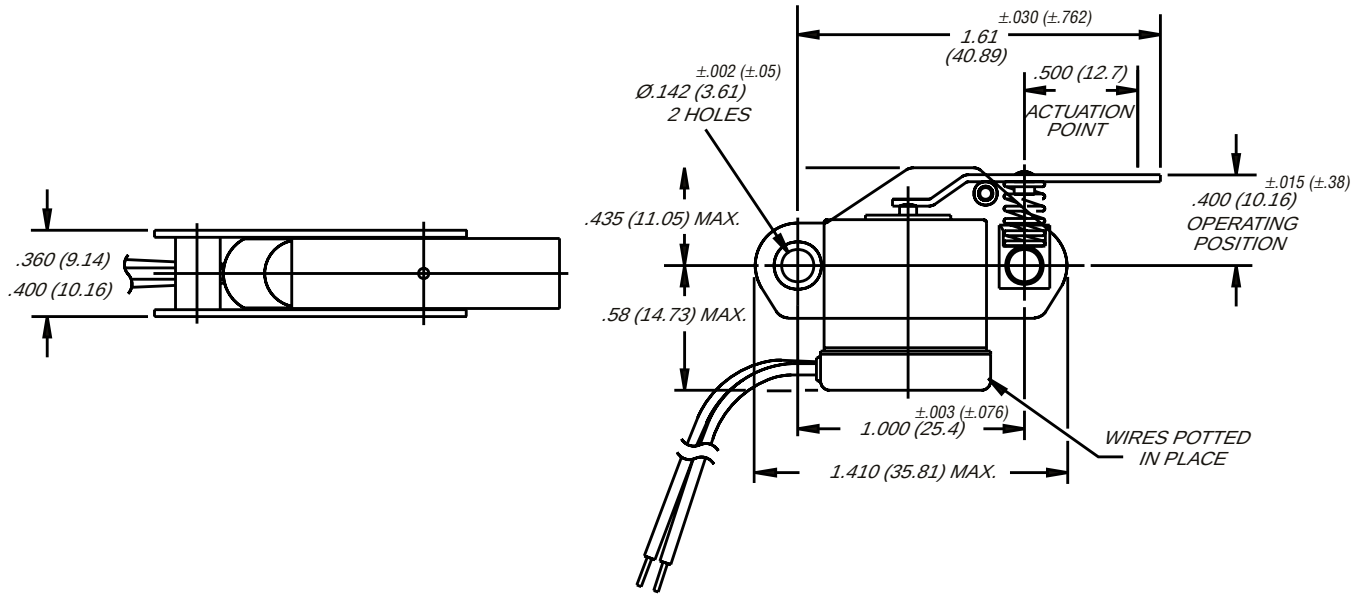
Environmental Characteristics

Temperature Range	-65°F to +400°F (-54°C to 204°C)
Shock (sawtooth)	100g for 6 ± 1 ms
Vibration	10 - 2000 Hz 20g
Ambient Pressure	High vacuum (Negative) to 50 PSI (Positive) (3.4 atmospheres)

Series 66700 Typical Assemblies

Leaf/Spring Actuator

Figure S-36



Series 6700 Environmentally Sealed, One Million Cycle

Figure S-37

The 6700 Series environmentally sealed switch is rated for one million cycles. The 6700 was developed for high cycle harsh environment applications. The need for high cycle limit switches has developed as aerospace and industrial systems have evolved from manual control and feedback to computer controlled mechanisms. The 6700 meets the high life cycle requirements of modern computer controlled systems.

Based on the proven design of HSI's 6100 series switch, the 6700 incorporates material and process changes to achieve reliable 1 million cycle life. Internal blade material thickness, temper and surface treatment have been optimized in the new design. The metal housing and operating pin are permanently bonded to a resilient elastomer seal. This ensures environmental seal integrity of 1×10^{-6} Atm cc/sec. The switch is configured for operation in the milliamp range. Operating temperature is -85° F to +300° F (-65°C to +148°C).

Assemblies

The 6700 series switches are available in a wide variety of actuator assemblies. Typical assemblies include leaf actuators, roller leaf assemblies and plunger actuators. HSI can also provide customization assemblies to meet specific operational requirements

Series 6700 Environmentally Sealed, One Million Cycle

Mechanical Characteristics

Maximum Operating Force	10 oz. (2.8 N)
Minimum Release Force	3 oz. (.84 N)
Max. Movement Differential	.0005/.005" (0.0127/0.127 mm)
Mechanical Life	1,000,000 cycles
Weight	Less leads – .02 lbs. (0.57 g)
Overtravel Stop	.007" available (0.1778 mm)

Electrical Characteristics

Electrical Rating	28 VDC/115 VAC, 400 Hz
Resistive	120 mA
Dielectric Withstanding Voltage	1000 V rms at sea level for 1 minute or 1250 V rms for 1 second with maximum leakage current 0.5 milliamperes. Can be supplied to meet 1500 V rms withstand voltage with reduction in life.

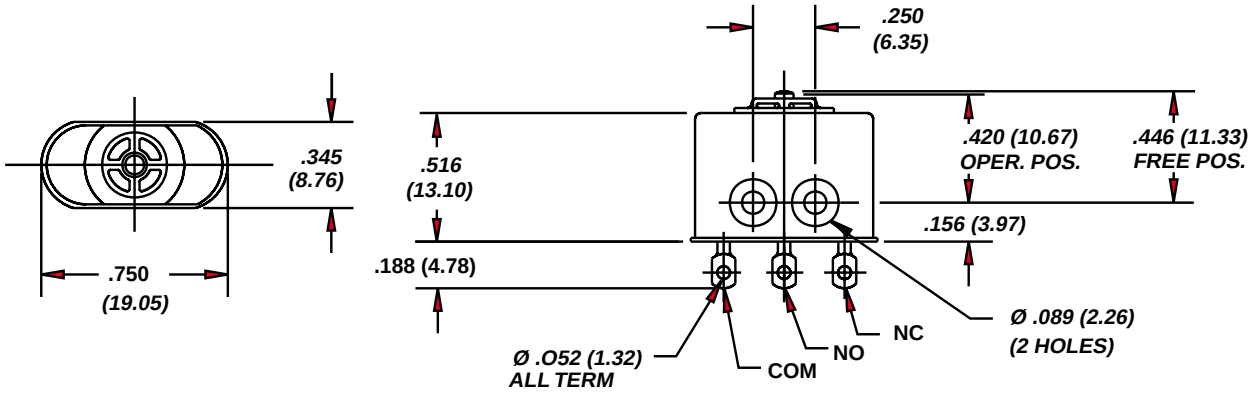
Environmental Characteristics

Temperature Range	-65°F to 300°F (-54°C to 148°C) continuous
Shock (sawtooth)	100g for 6 ± 1 ms
Vibration	10 - 2000 Hz 20g peak

Series 6700 Dimensional Drawings

Basic Configuration

Figure S-38



LC Series: Switches for Extreme Environments

The LC series switch assembly is designed to provide reliable operation in extreme environments. This switch is used in various applications on commercial jetliners. Available in leaf and roller leaf configurations these assemblies incorporate HSI's 6300 series hermetically sealed switch.

The switch has an extremely low leak rate of $1x10^{-8}$ atm. cc/sec., assuring a controlled environment for maximum electrical life. The metal corrosion resistant housing withstands most media and allows immersion of the switch in fluids such as synthetic hydraulic oils and jet fuels. Even when the assembly is operated in extreme temperatures and pressures the switch mechanism operates in a contaminant free environment filled with inert gas.

Fine silver, platinum and gold contacts are available to meet various temperature and current requirements. HSI's engineering group is ready to assist you with your application requirements including customized assemblies.

Figure S-39

Mechanical Characteristics

	SPDT	DPDT
Maximum Operating Force	24 oz. (6.67 N)	48 oz. (13.34 N)
Minimum Release Force	4 oz. (1.11 N)	8 oz. (2.22 N)
Pre-travel (max.)	.040" (1.02 mm)	.040" (1.02 mm)
Weight	.75 oz. (21.26 g)	1.50 oz. (42.52 g)
Overtravel (max.)	.125" (3.18 mm)	.125" (3.18 mm)

Electrical Characteristics

Electrical Rating	28 VDC/115 VAC, 400Hz
Resistive	5 A
Inductive	3 A
Dielectric Withstanding Voltage	1000 V rms at sea level for 1 minute or 1250 V rms for 1 second with maximum leakage current 0.5 mA. Can be supplied to meet 1500 V rms withstand voltage with reduction in life.
Contact Arrangement	SPDT/DPDT

LC Series: Switches for Extreme Environments

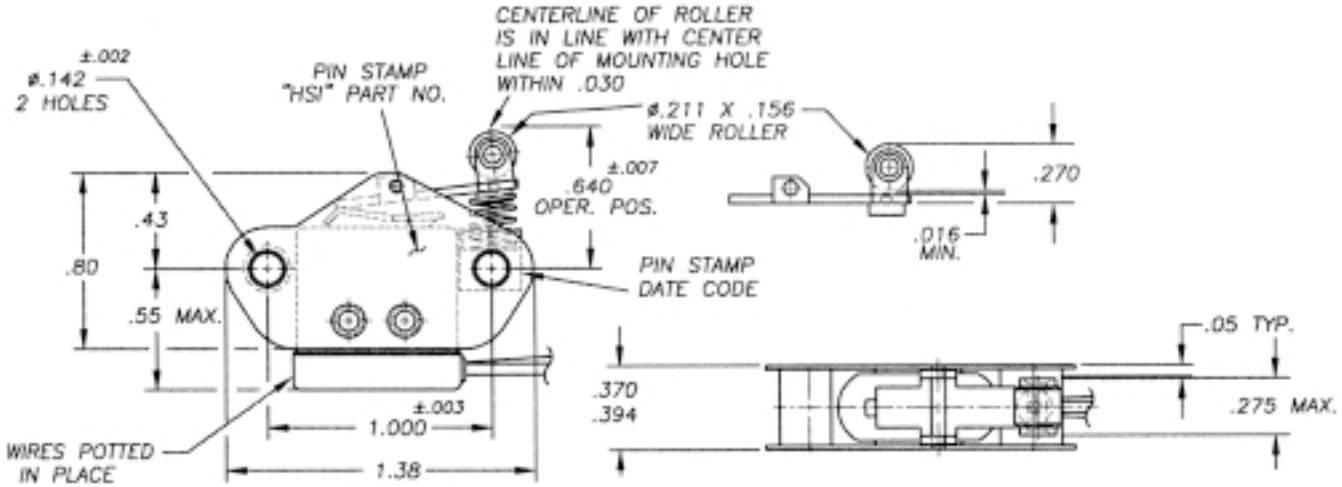
Environmental Characteristics

Temperature Range	-65°F to +275°F (-54°C to 135°C)
	-65°F to +500°F (-54°C to 260°C) Special
Shock (sawtooth)	100g for 6 ± 1 ms
Vibration	10 - 2000 Hz 20g
Ambient Pressure	High vacuum (Negative) to 50 PSI (Positive) (3.4 atmospheres)

LC Series Dimensional Drawings

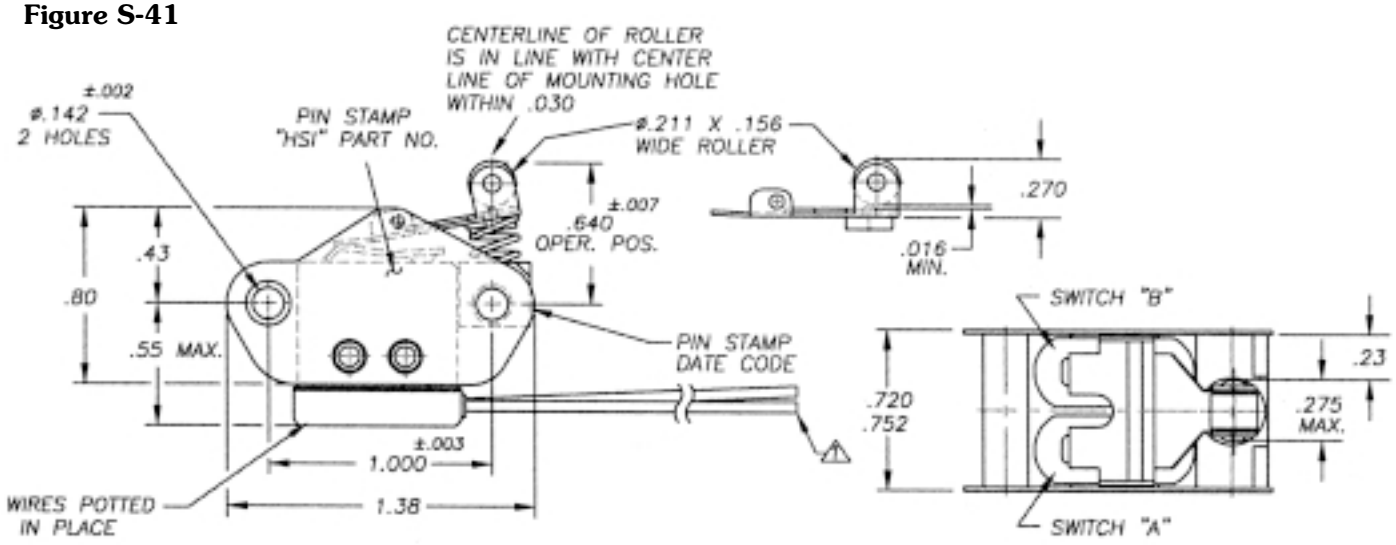
Single Pole, Double Throw Configuration

Figure S-40



Double Pole, Double Throw Configuration

Figure S-41



HSI Interlock Switch

The HSI interlock switch is a rugged pushbutton type switch used in heavy-duty applications. HSI constructs this switch under rigorous quality specifications using high-tolerance materials that provide reliable performance even in harsh environments. The key component of this switch is the industry-proven electrical switching mechanism which is hermetically sealed in a highly protective assembly made of stainless steel.

The HSI interlock switch also features a unique, flexible design which allows the operator to adjust the plunger to a specific switch activation point. With a 1/8" pre-travel - 1/2" total travel, the interlock switch gives engineers flexibility, latitude and desirable mechanical options. The HSI interlock switch is available with various mounting configurations and a variety of contact ratings ranging from 5 amperes at 28 VDC to 10 milliamps at 30 mV.

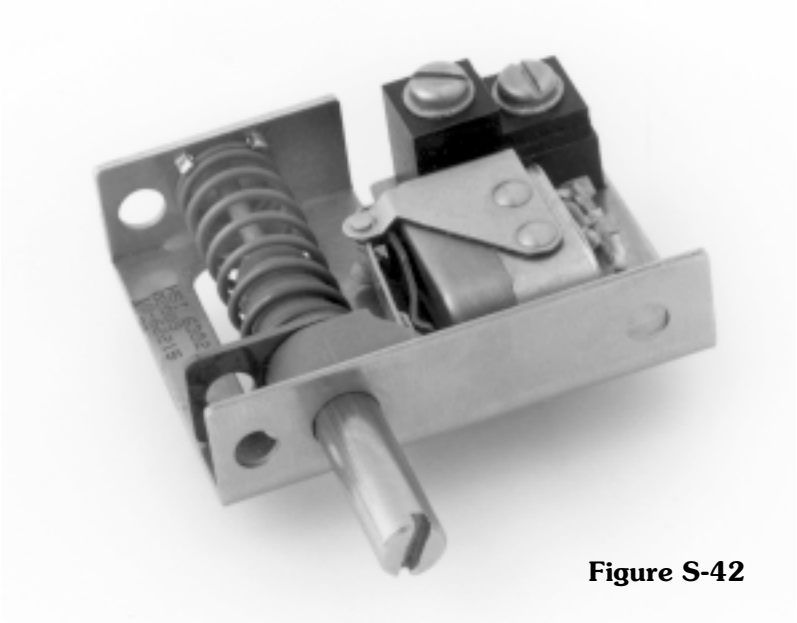


Figure S-42

The switches are tested under severe conditions including humidity, moisture, rain, icing, high/low temperature, vibration and shock. Applications include heavy cargo doors used by aircraft, water or land transport vehicles and/or industries that require heavy-duty door or hatch switching capability.

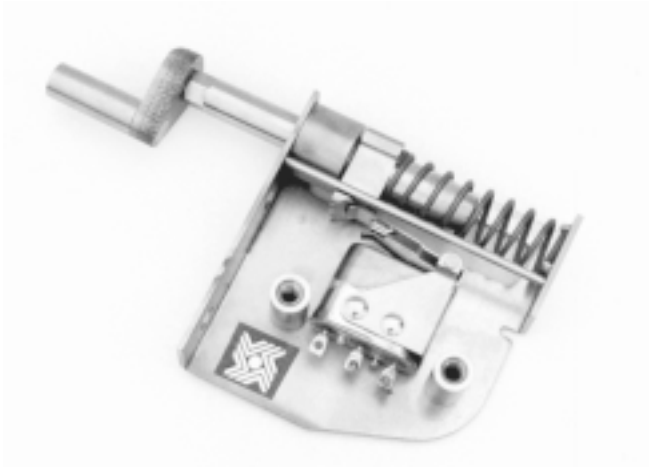


Figure S-43 Emergency interlock switch

HSI Interlock Switch

Mechanical Characteristics

Maximum Operating Force	7 lbs. (31.14 N)
Minimum Release Force	1 lb. (4.45 N)
Pretravel	.125" (3.18 mm)
Total Travel	.55" (14 mm)
Weight	3 oz. (85 g)

Electrical Characteristics

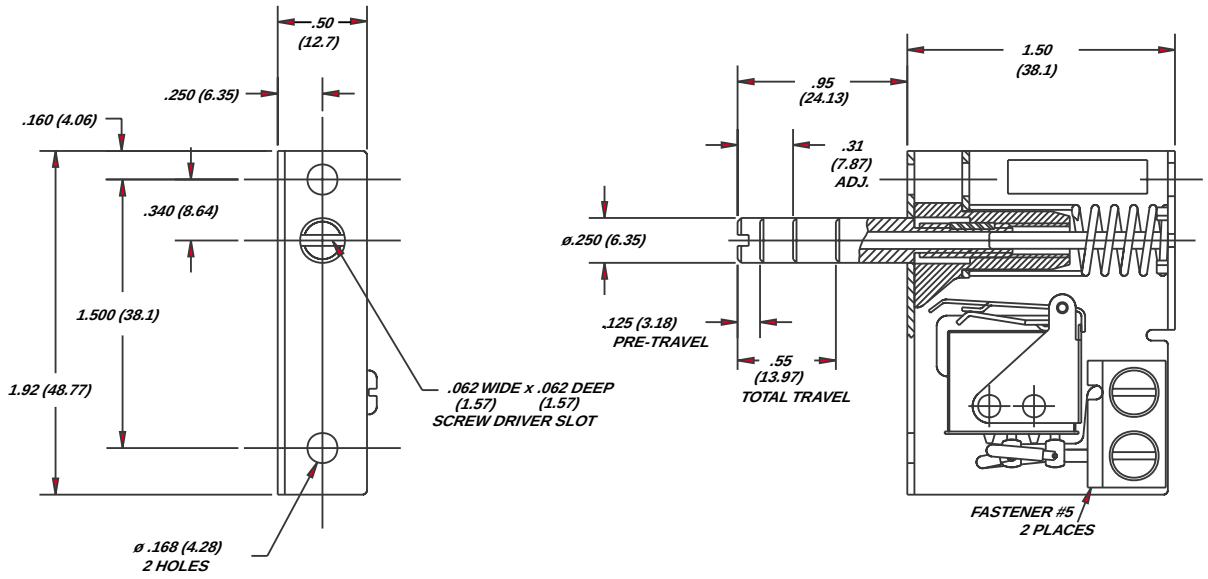
Electrical Rating	28 VDC/115 VAC, 400 Hz
Inductive	.25 A
Dielectric Withstanding Voltage	1000 V rms at sea level for 1 minute or 1250 V rms for 1 second with maximum leakage current 0.5 mA.
Contact Arrangement	SPST (N.O.)

Environmental Characteristics

Temperature Range	-65°F to 250°F (-54°C to 121°C) continuous
Ambient Pressure	Sea Level to +50,000 ft (15 Km) altitude
Shock	100g for 6 ± 1 ms
Vibration	10 - 2000 Hz 20g peak

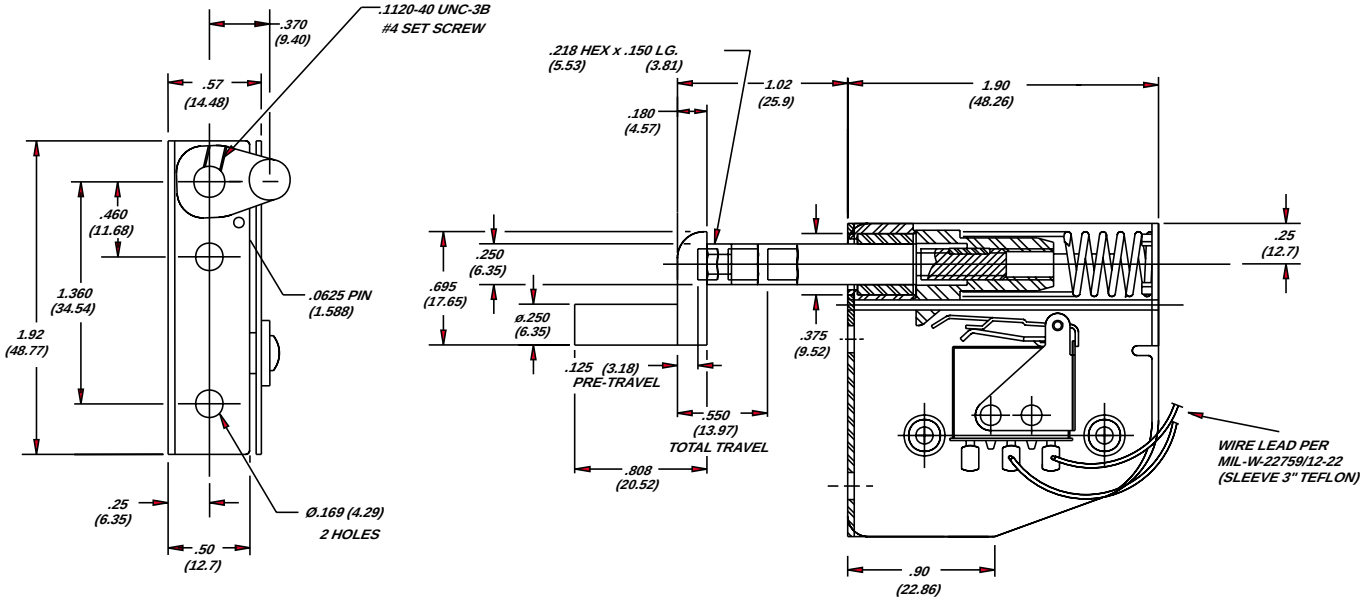
Interlock Configuration A

Figure S-44



Interlock Configuration B

Figure S-45



Series 62100 Explosion Proof Switch

The 62100 series is an explosion proof single pole single throw push-button switch available in normally closed or normally open versions. It is FM approved for Class 1 Division 1 Group D and nonicendive Class 1 Division 2 Group A, B, C, and D. It also carries an EExdIICT3 rating by DEMKO showing compliance with European standards for explosion proof areas. The robust design incorporates a heavy duty stainless steel housing and high temperature 18 gage wire leads per MIL-W-25038.

The switch is ideal for industrial applications requiring an explosion proof assembly.

Mechanical Characteristics

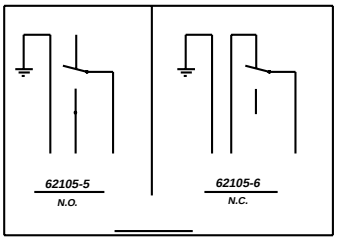
Maximum Operating Force	6 lbs. (26.68 N)
Minimum Release Force	2 lbs. (8.89 N)
Pretravel (Minimum)	.010" (0.254 mm)
Overtravel (Minimum)	.080" (2.03 mm)

Electrical Characteristics

Electrical Rating	28 VDC/125 VAC
Resistive	2 mA to 2 A / 2 mA to 400 mA
Dielectric Withstanding Voltage	1000 V rms at sea level for 1 minute or 1250 V rms for 1 second with maximum leakage current 0.5 mA.
Contact Arrangement	SPST NC or NO

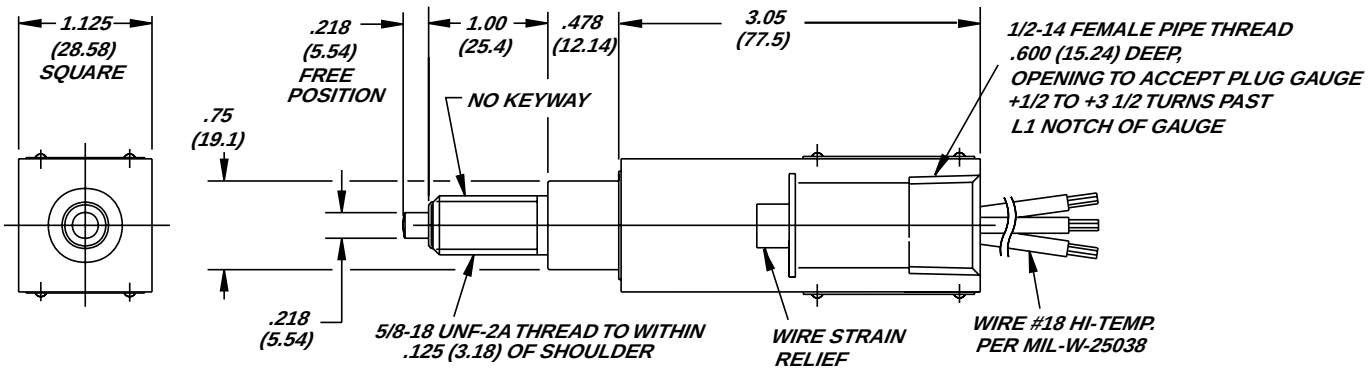
Wiring Diagram

Figure S-46



Dimensional Drawing

Figure S-47



Series 40100 Flap/Slat Switches

The 40100 series is a rotary style switch designed to operate at specific angles. The switch assembly contains two to four single pole double throw switches in an environmentally sealed housing. Selection of the basic SPDT switches governs the electrical characteristics. Optional external arm designs allow for flexibility of installation.

Designed for use as a flap and slat position indicating switch for commercial aircraft the 40100 series has seen countless hours of inflight service. Its rugged construction, resistance to temperature extremes, jet fuel, hydraulic fluid and de-icing fluid makes the switch ideal for aerospace and other harsh environment applications.

Mechanical Characteristics

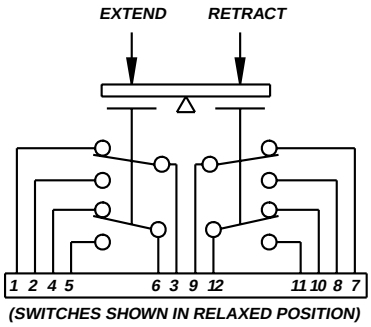
Operating Torque	4 to 8 in.-lbs. (.45 N-M to .90 N-M)
Overtravel Torque	5 to 11 in.-lbs. (.57 N-M to 1.24 N-M)
Centering Torque	2 in.-lbs. min. (.23 N-M)
Weight	10 oz. (284 g)

Electrical Characteristics

Electrical Rating	28 VDC
Resistive	5 A
Dielectric Withstanding Voltage	1000 V rms at sea level for 1 minute or 1250 V rms for 1 second with maximum leakage current 0.5 mA.
Contact Arrangement	2 DPDT Circuits (NC or NO)

Wiring Diagram

Figure S-48



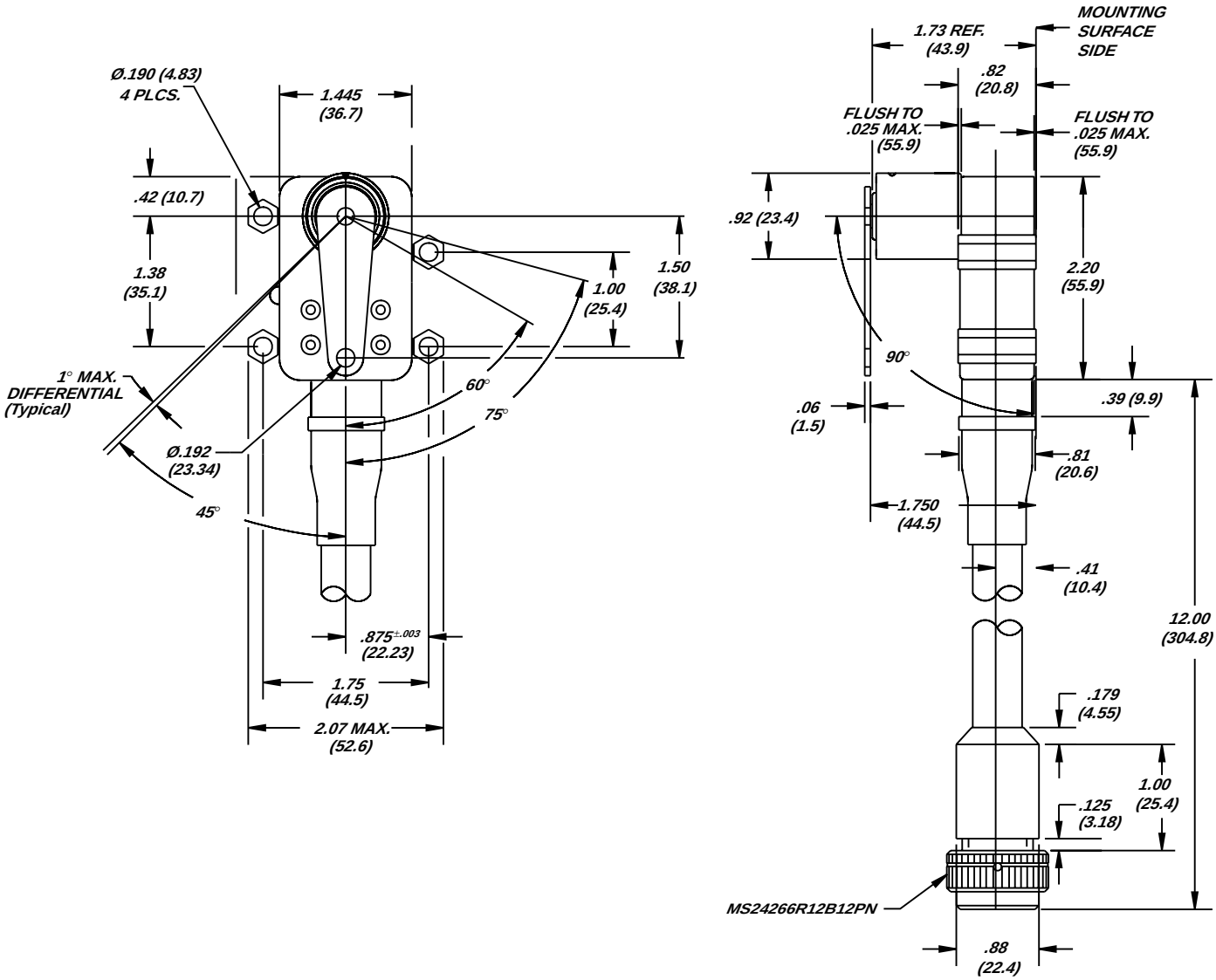
Environmental Characteristics

Temperature Range	-65° F to 400° F (-54° C to 205° C)
Vibration	25 G's RMS
Shock	15 g 11 ±1 ms

Series 40100 Dimensional Drawings

Basic Configuration

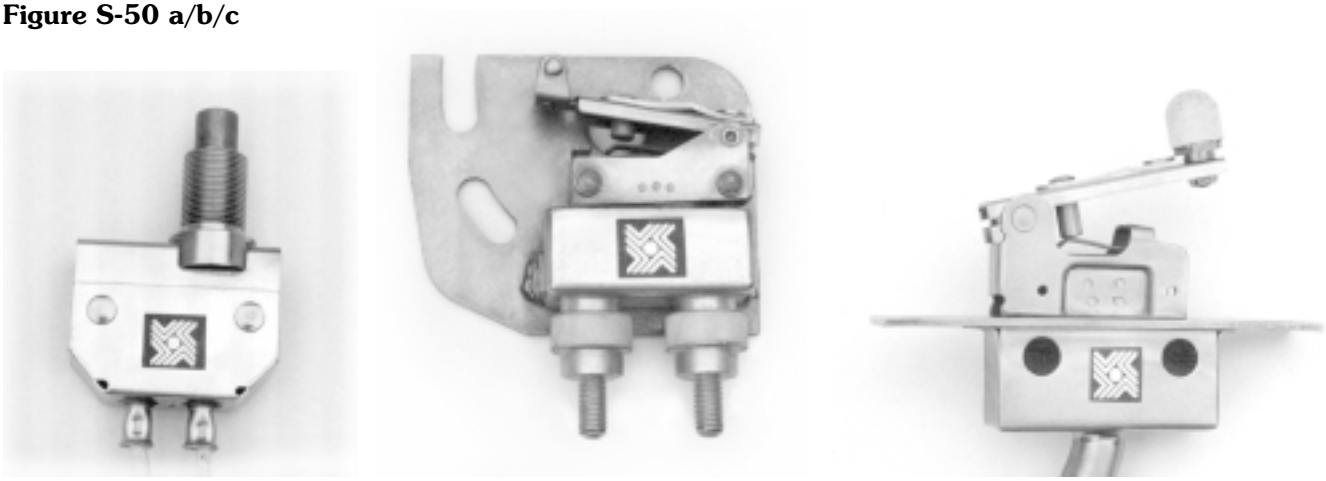
Figure S-49



Additional Customized Assemblies

In addition to our standard switches described in this catalog HSI can provide a range of customized assemblies. Our engineering and manufacturing teams have developed a broad range of innovative solutions to our customers' switching problems. The following examples illustrate some of the customized switches we produce. If your application requires something not shown, give us a call and we will be happy to work with you to develop a customized solution.

Figure S-50 a/b/c



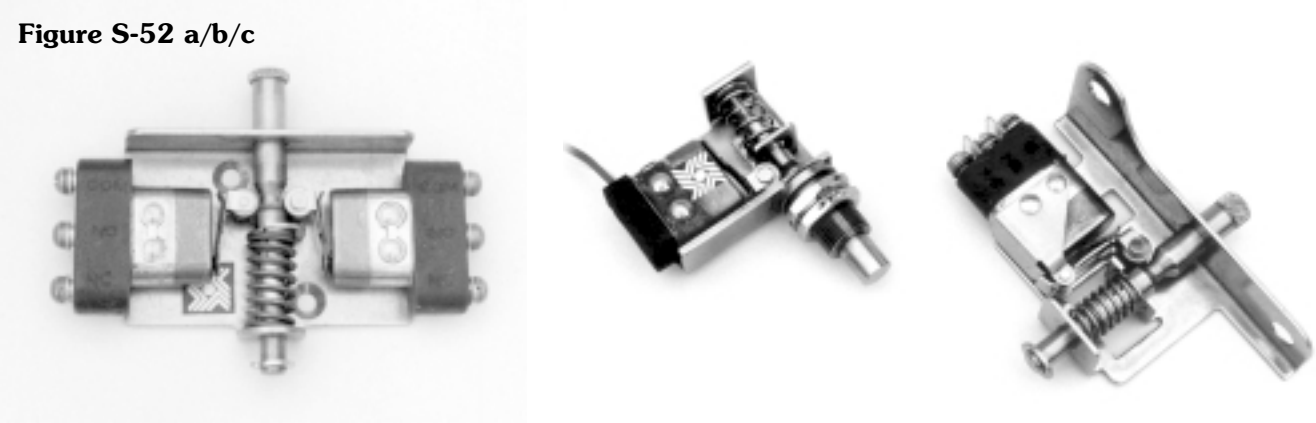
Example 1: Hermetically sealed high temperature (700° F) assemblies. Plunger, lever arm and roller actuated lever arm are shown, all feature built in overtravel protection. Options include wiring harness with MS connector, shielded armor cabling and ceramic insulated terminal studs. Applications: Jet engine bypass air valves, thrust reversers and environmental control valves.

Figure S-51

Example 2: Hermetically sealed, high temperature (700° F), two SPDT circuits, actuated with built in overtravel and integral MS connector. Switch is used on jet engines.

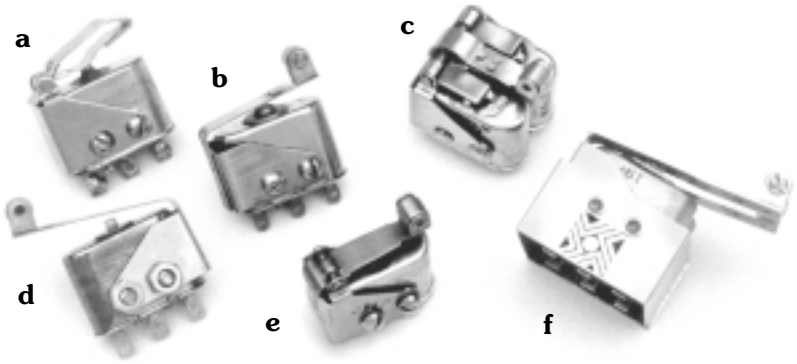
Additional Customized Assemblies

Figure S-52 a/b/c



Example 3: Hermetically sealed plunger assemblies shown in SPDT and two SPDT configurations. Options shown include reverse interlock features, screw terminals and potted leads. Applications: Door and panel interlock.

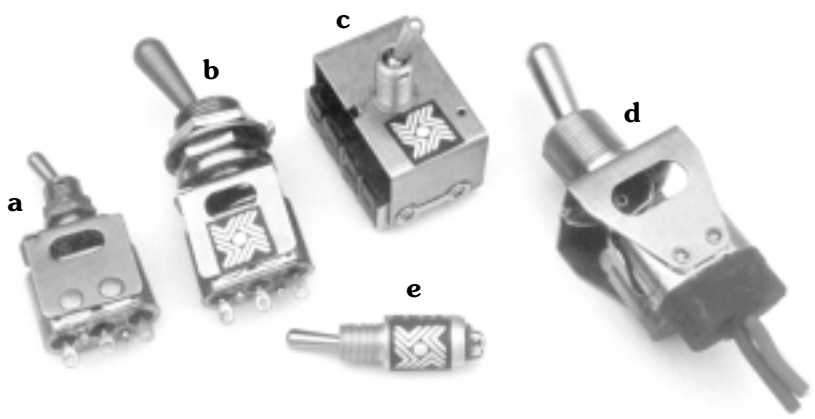
Figure S-53



Example 4: Leaf and roller leaf actuators for basic switches shown in SPDT and two SPDT configurations. Actuators can be supplied for environmentally sealed and hermetically sealed switches. Various lead and potting options available.

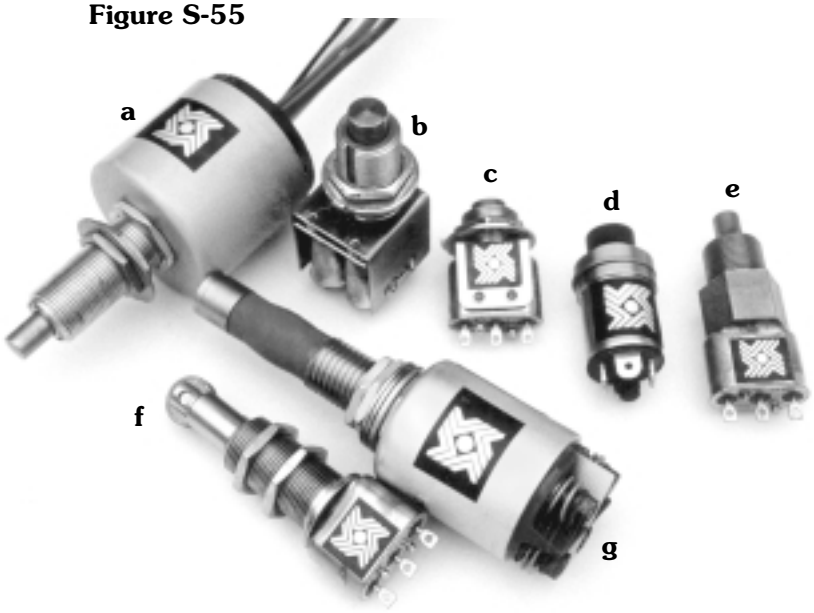
Additional Customized Assemblies

Figure S-54



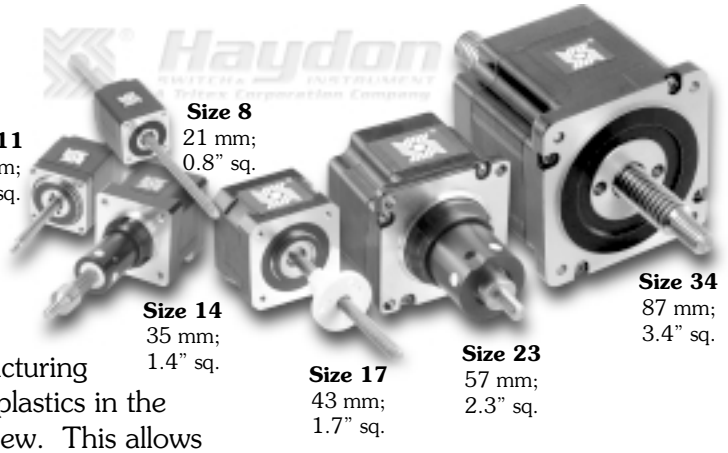
Example 5: Toggle assemblies shown in single and multi-switch configurations with momentary, locking and tease proof operation. Available for hermetically sealed, environmentally sealed and non-sealed switches. Various leads and potting available.

Figure S-55



Example 6: Push button and roller plunger actuated switches shown in single and multi-switch configurations. Options include threaded bushings for mounting, potted leads and threaded terminal studs.

Other HSI Products



Hybrid Linear Actuators: Size 8, 11, 14, 17, 23 & 34

HSI's line of hybrid linear actuators open new avenues for equipment designers who require high performance and exceptional endurance in a very small package. The various patent pending designs use a proprietary manufacturing process, which incorporates engineering thermoplastics in the rotor drive nut and a stainless steel acme lead screw. This allows the motor to be much quieter, more efficient and more durable than the v-thread and bronze nut configuration commonly used in other actuators. Motor life is improved more than 10 times over the traditional bronze nut style – and it requires no maintenance and does not affect the cost. An additional feature is the bearing pre-load adjustment which, unlike other designs, does not protrude from the motor configuration commonly used in other actuators.

The HSI hybrid actuators come in six sizes, from 21 mm square to 87 mm square. All are available in captive, non-captive and external linear versions.

There is a wide range of travels per step available and micro stepping can be used for even finer resolution. Our 87 mm actuator delivers up to 500 pounds (227 Kg) of force.

Dual Motion Hybrid Actuators: Size 14, 17 & 23

HSI's line of dual motion actuators provides independent linear and rotary motion from a compact package. Another feature of this design is to provide an electric motor in which linear and rotary motions are controllable independently of one another.

Can-Stack Linear Motors
HSI offers a complete family of linear actuators with both a broader range and, for a given size, significantly higher thrust than previously available. Five basic frame sizes are available, Ø 15 mm (.59"), Ø 20 mm (.79"), Ø 26 mm (1"), Ø 36 mm (1.4") and Ø 46 mm (1.8"). Rare earth magnets are available for higher thrust requirements. All units are built with dual ball bearings for greater motion control, precise step accuracy and long life.

Other Motors

HSI's **rotary motors** are built to provide exceptionally high torque-to-size ratios. By utilizing a patented enlarged rotor with low inductance coils, the motors provide superior torque and continuous, reliable high performance.

The **Big Inch® Series gear-train** motors produce higher torque than many twice their size, with power input as low as 1 watt. Their integral heavy duty gear train/motor assembly and basic simplicity provide for custom manufactured reliability at mass production prices.

The HSI **Pancake Series** stepper motors are designed for applications where accurate positioning, high torque and very thin packaging are desirable characteristics.

Other Products

HSI's support products include **drivers, proximity sensors, built-in home position switches, Teflon lead screws,** and **high temperature motors.**

On-site Engineering to Meet Customer Specifications

The diversity or our customers' linear motor applications have required our engineering and manufacturing teams to develop innovative designs that go beyond our standard lines. If your application requires something not shown, give us a call and we will be happy to work with you to develop a custom solution.

For More Information About HSI Motors or Switches

Detailed descriptions are available in the **Motors Product Catalogs** or on-line at **www.hsi-inc.com**.