Elastomeric Keypad Design Guidelines

Elastomeric keypads can provide maximum **tactile response** due to their full **travel** flow when it comes to data entry interfaces. They consist of an elastomeric cover that is typically used as an **actuator** over another switching technology, most commonly a **membrane switch**. They offer a lower unit cost than conventional switching products, and are resistant to temperature, moisture, chemicals, and abrasion, providing them with a long operating life.

Because every elastomeric keypad we create is designed custom for your unique application, certain specifications are required for each design. This set of design guidelines was created to assist you with the design and creation of your custom elastomeric keypad. Our highly skilled engineering team will carefully review your requirements to assist in designing the optimum keypad for your application.

Things to Consider when Designing your Elastomeric Keypad:

1. **Environmental conditions** *(indoor/outdoor, harsh environments, sunlight, etc.)*
2. **Mechanical requirements** *(material, actuations, tactile feedback, etc.)*
3. **Electronics requirements** *(conductive pills)*
4. **Appearance** *(colors, key caps, finishes, etc.)*
5. **Certifications** *(ISO, U.L., etc.)*

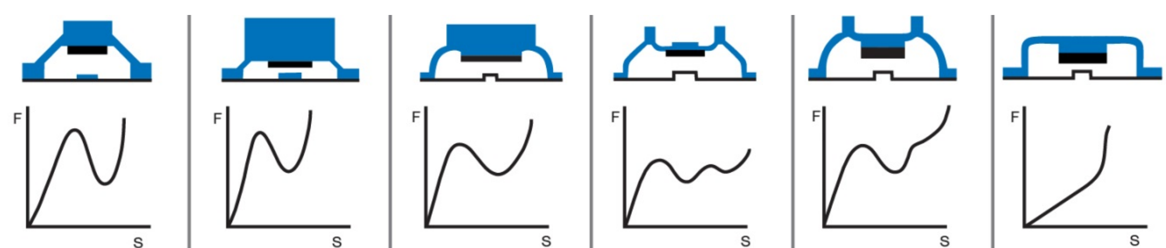
Elastomeric Keypad Construction:

Elastomeric keypads are manufactured from rubber, and are formed using molds. Most elastomeric keypads utilize the rubber as the top circuit or actuator when pressed, making contact with a lower switch circuit or **PCB**. Differing forces can be accomplished by using various key constructions as shown below in **Figure 1**.

Materials: Elastomeric keypads are manufactured out of **elastomers**, which are described as a **polymer** that contains **viscoelasticity**. The most common material used for graphic switches is **silicone rubber**; however **EPDM** is also a popular alternative. Silicone rubber is resistant to extreme temperatures, moisture, chemicals, and abrasion. **Fluorosilicone rubber** is also available, but primarily used for actuation and gaskets due to its superior characteristics and sealing capabilities. Additionally, fluorosilicone rubber is 3 to 5 times the cost of silicone rubber.

Figure 1

Type
Curve



Force Range	0-350g	30-250g	30-150g	30-80g	30-200g	20-80g
Stroke Range	0.5-3.0mm	0.7-1.5mm	0.5-3.0mm	2.0-4.0mm	1.5-2.5mm	0.2-1.0mm
Life Cycle(x10^3)	500-2,000	500-2,000	1,000-3,000	5,000-20,000	500-3,000	500-10,000
Typical Uses	Telephone, Remote Control, Automobile, Radio, Toys, Calculator	Telephone, Remote Control, Toys, Games, Calculator	Telephone, Remote Control, Toys, Measuring Instruments, Office Machine	Computer	Telephone, Test Instruments	Remote Control, Calculator, Computer

Colors: Wilson-Hurd most commonly uses the **Pantone Matching System** or **CMYK color model** to match custom colors. We can match to a specified or provided color. If you wish to submit a sample, we prefer that it be 2 x 2” in size. Elastomeric keypads are available with single or multi-colored surfaces.

Artwork: Please visit the Resources section on Wilson-Hurd’s website to submit artwork, or simply visit the link below.

www.wilsonhurd.com/submit-artwork

We accept the following types of artwork (listed in order of preference):

- AutoCAD (2D)*
- Solidworks (3D)*
- IGES (3D)
- STEP (3D)
- DXF (2D)
- Gerber (PCB) – include dimensional of your part in one of the other formats
- Adobe Illustrator (Graphics) – include dimensions of your part
- PDF (Graphics or Dimensional Support) – with embedded fonts (Graphics)
- Postscript (Graphics) – with embedded fonts

**Most preferred forms of artwork*

Graphics: Graphics can be applied to elastomeric keypads using **screen-printing**, **pad printing**, and **spraying and etching**. Spraying and etching is capable of producing the finest detail out of the three different techniques.

Over-coatings & Finishes: Over-coatings and finishes are recommended if you would like to increase the durability and operating life of your elastomeric keypad. **Epoxy** and **polyurethane** over-coatings are available to add additional protection against chemicals and abrasion, as well as increase the ink longevity of graphics. **Fluorescent** and **anti-microbial** finishes can also be applied.

Molds: Elastomeric keypads are formed using either **injection** or **compression molding**. Injection molding is ideal for manufacturing a product at high volumes, and the overall quality of the parts produced is greater than when made using compression molding. Compression molding is a lower cost molding method, however it is possible that each part produced will not have a consistent level of quality. Prototype molds can be completed in as little as 18 days. Hard molds can take up to 40 days and are more costly, however they are recommended for mass produced parts due to their increased operating life. Hard molds can be made out of hardened or pre-hardened steel, while their more cost-effective counterparts are typically made of either aluminum or a beryllium-copper alloy.

Key Caps: Plastic and stainless steel key caps are available to incorporate into your elastomeric keypad design for added tactile feedback.

Conductive Pills: Electronic capabilities can be added to elastomeric keypads by including conductive pills on the base of the switch button. When the button is pressed, the conductive pills are then brought into contact with the PCB below.

Backlighting Options: We offer **LEDs**, **electro-luminescence**, **fiber optics**, and **light guide film** for backlighting options.

Integration: The design options for elastomeric keypads are incredibly flexible. They can easily be integrated into both **flex** and PCB-based membrane switch assemblies allowing for reduction in cost as well as assembly time. With elastomeric keypads you also have the ability to use an entire elastomeric overlay, or incorporate elastomeric keys into other overlay material designs.

Technical Details:

Type	Specification
Hardness	Shore 20A-80A
Conductive Pill Contact Resistance	<100 ohms with 100gr loading
Operating Temperature	-25°C (-13°F) to 70°C (158°F)
Storage Temperature	-30°C (-22°F) to 85°C (185°F)

GLOSSARY

Actuation: The process that causes a switch to change position, i.e. to open or close.

Actuation Force: The minimum force required to electrically close a switch contact.

Actuator: A formed or molded protrusion to make contact with the center of a switch location, improving tactile feedback.

Anti-Microbial Finish: An anti-bacterial coating that kills the biotic agents it comes into contact with.

Backlighting: Illumination originating from within or behind the switch panel which outlines or accents specific areas. Typical lights are LEDs, fiber optics, electro-luminescence, and light guide film.

CMYK Color Model: Also known as process color and four color, it is a color model used in color printing utilizing the four inks cyan, magenta, yellow, and key (black).

Color Matching: The physical creation of a color in the range of one-dimensional hues.

Compression Molding: A method of molding in which pre-heated molding material is placed into a heated mold cavity. After the mold is sealed, pressure is then applied to force the material into contact with the entire mold until it has been cured.

Conductive Pills: A small metal pill placed on the base of a key in an elastomeric keypad, typically made of either carbon or gold. Once the key is pressed, the conductive pill comes into contact with a PCB below.

Current (A or I) Unit, Amp: The flow of electricity, i.e., the characteristic drift movement of carriers such as ions, electrons, or holes. I=E/R

Elastomer: A polymer that displays viscoelastic traits.

Elastomeric Keypad: A keypad featuring an elastomeric cover used as an actuator over another switching technology, typically a membrane switch.

Electrical Actuation: Switch actuation produced by various electrical phenomena. In most cases, the switching action involves a change in state rather than a mechanical operation.

Electro-luminescent Lighting (EL): Light produced by charged phosphorous.

EPDM: Ethylene Propylene Diene Terpolymer

Epoxy Coating: A durable coating made using epoxy resins that increases a product’s durability and resistance to moisture and extreme temperatures.

Feedback: The mechanism by which the operator senses that a switch has been activated; audio, visual, or tactile.

Fiber Optic: Extruded materials, such as certain plastic filaments, which provide paths for light.

Finishes: The application of a coating to a material that alters the surface appearance.

Flexible Membrane Switch: A membrane switch that contains a flexible printed circuit.

Flexible Printed Circuit (FPC): A printed circuit using Kapton polyimide film as a substrate.

Fluorescent Finish: A coating of the electromagnetic spectrum.

Fluorosilicone Rubber: A rubber material occasionally used in elastomeric switches, comprised of silicones and fluorocarbons.

Injection Molding: A method of molding in which a pre-heated molding material is injected into a mold cavity where it cools and hardens, taking on the shape of the mold.

Insulation Resistance: The alternating current resistance between two electrical conductors, or two systems of conductors separated by an insulating material.

Key Caps: Caps made out of plastic or stainless steel that cover elastomeric keys.

LED: Light-Emitting Diode

Light Guide Film: A more recently developed backlighting technology that uses LEDs to create a solid film of light.

Membrane Switch: An electronic switch that consists of printed circuits and acts as a user-interface, allowing the communication of commands from users to electronic devices and machinery.

Momentary Contact: When the actuator returns from its operating position to its free position after an actuating force is removed.

Operating Force: The force required to transfer the switch from one position to another.

Over-Coatings: A coating added to an elastomeric keypad to increase durability and resistance against chemicals, moisture, and extreme temperatures.

Pad Printing: A printing process that transfers a 2D image onto a 3D object using a silicone pad.

Pantone Matching System (PMS): An ink color designation system commonly used in a variety of industries, including printing as well as the manufacturing of paint, fabric, and plastics.

Polymer: A substance that is composed of macromolecules.

Polyurethane Coating: A coating derived from polyester and urethane resins.

Printed Circuit Board (PCB): A circuit board comprised of conductive tracks, pads, and other features that have been etched and laminated onto a non-conductive substrate.

Resistance: Opposition that a material or electrical circuit offers to the flow of electric current. It is the property of a circuit that transforms electrical energy into heat energy as it opposes the flow of current.

Resistance Units – Ohms: The common unit of electrical resistance. One ohm is equal to one volt per amp.

Screen-Printing: Ink is forced through a photographically created mesh stencil (screen) using a rubber squeegee, allowing heavy ink deposits with a minimal number of passes.

Silicone Rubber: An elastomer composed of silicone containing silicon, carbon, hydrogen, and oxygen.

Spraying & Etching: Alternative method to producing graphics utilizing spray etching.

Tactile Feedback: Operator perception through their sense of touch that switch actuation has taken place.

Travel: The downward movement of a key or the distance between the upper and lower contacts.

User-Interface: A device used so that two or more independent systems can meet and act on or communicate with one another.

Viscoelasticity: Having both viscosity and elasticity.

Voltage (V or E): Electromotive force, or difference of potential; E=IR, where I is current and R is resistance.