BELLOWS DESIGN GUIDE
INTRO TO BELLOWS & APPLICATION SPOTLIGHT
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**BELLOWS DESIGN GUIDE**

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WHAT PURPOSE DO BELLOWS SERVE?

BELLOWS FUNCTIONS, SHAPES AND SIZES

The most common function of a bellows is to extend the life of your valuable equipment by keeping out contaminants, such as abrasive particles and metal chips. Other purposes include:

- Covering pinch points
- Concealment of mechanical part for aesthetic purposes
- Air flow or ducting
- Flexible seal between two joints with relative movement

ANY SIZE, ANY SHAPE • CUSTOM-ENGINEERED BELLOWS SINCE 1960 • WIDE VARIETY OF MATERIALS

FLAT/BOX STYLE BELLOWS (LINEAR RAILS, WAY PROTECTION, SCREEN-TYPE BARRIERS, ETC.)

<table>
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<th>Box Shape/3-Sided</th>
<th>Peaked/Multi-Sided</th>
<th>Flat/Strip-Type</th>
<th>Stainless Steel Plated</th>
<th>Custom Stiffener Profile</th>
<th>Special Shape</th>
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ENCLOSED-SHAPE BELLOWS (SCREW COVERS, BOOTS, SEALS, MECHANICAL LIFT ENCLOSURES, DUCTING, ETC.)

<table>
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<th>Round</th>
<th>Oblong/Oval</th>
<th>Rectangular</th>
<th>Tapered</th>
<th>Wire Frame</th>
<th>Special Shape</th>
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BELLOWS APPLICATIONS
CUSTOMIZED PROTECTION FOR ALL INDUSTRIES

Dynatect’s line of custom-engineered bellows provides a wide choice of materials and manufacturing methods; a solution can be tailored to your particular application and requirements. Bellows have been used in countless applications, including:

- Machine way and ball screw protection
- Laser bellows
- Cameras, imaging equipment
- Tilt or medical lift table
- Lab and metrology equipment
- Shift/ joystick boots
- Transportation bellows
- Defense applications

Weld Spatter or Elevated Temperatures
Abrasives and Grinding Particles
Laser Beam Path (Light-Tight Bellows)
Chemical, Oil or Coolant Resistance
Air Duct (Exhaust, Ventilation)
Hydraulic Cylinders, Heavy Equipment

Outdoor Environments, Mass Transit
Medical Devices, Lab Equipment
Lift Platforms, Tables, Scissors Lifts
Camera and Imaging Equipment

Long Travel (Example: Vertical Machining Center)
High Speeds/Acceleration (Example: Water Jet CNC Cutting System)
BELLOWS DESIGN: INTRO TO MATERIALS
BASIC OVERVIEW & COMMON MATERIALS

Common Materials

- Fabric reinforced elastomers (most common)
  - Gorprene™ (Dynatect’s proprietary chloroprene)
  - Goralon® (Dynatect’s proprietary CSM)
- Elastomers (e.g. nitrile, chloroprene)
- Fabric-reinforced thermoplastics (e.g. PVC coated polyester)
- Thermoplastic elastomers (polyurethane)
- Ballistic nylon
- PTFE
- Aluminized fabrics
- PVC plastisol

Fabric-Reinforced Elastomers
Dynatect sources elastomer coated fabrics of the following common rubbers:

- Butyl
- Chloroprene
- Chlorosulfonated Polyethylene (CSM)
- EPDM
- FKM
- Nitrile / NBR /Buna-N
- Polyurethane
- Silicone
- Styrene-butadiene (SBR)

Typical Fabric Reinforcements

- Nylon, Polyester, Para-aramids, Fiberglass

Specialty Applications — Ask Dynatect about material options for these applications:

- Medical (microbial, cleaning, FR)
- FDA compliant materials
- Flame retardant (FR) requirements
- Regulatory requirements (e.g. Flame, Smoke, Toxicity)
- Concentrated chemical exposure
- Clean room / lab applications
- Extreme heat / laser beams

Outdoor/UV Resistance

- Goralon® / CSM coated fabrics
- Chloroprene coated fabrics
- Military Spec. materials

Fluid Resistance

- PTFE (harsh chemicals)
- Goralon® / CSM (acids)
- Nitrile (hydrocarbon based oils)
- Speak to your Dynatect Rep for specific chemical resistance

Abrasion-Resistance

- Ballistic nylon
- Goralon® / CSM coated fabrics
- Polyurethane coated fabrics

Heat /Spark Resistance

- Silicone coated fiberglass
- Aluminized fiberglass
- PTFE, PTFE coated fiberglass
- Polyurethane coated preox/aramid
- FKM
- EPDM, CSM (under 200° F)
BELLOWS DESIGN BASICS

KEY CONSIDERATIONS

Fabric bellows are the most flexible for adaptation to high speeds and smooth-gliding applications. They are available in varying shapes, size, and materials including elastomer coated fabrics, thermoplastics, and coated aramid fibers.

What factors should be considered when choosing a protective cover or bellows?
Be sure to tell your bellows manufacturer about your application requirements such as:

- Operating temperatures including ambient, temporary, and nearby heat sources
- Exposure to environmental threats such as dust, oils, acid, coolant, weld spatter, etc
- The speed (velocity and acceleration) of the cover and frequency of cycle
- Vacuum or pressure conditions - also consider how air enters and exits the bellows
- Load-support requirements (e.g., heavy chip load, or protection from dropped tools)
- Orientation of cover travel (horizontal, vertical, cross rail/frontal, ceiling/roof cover)

For help selecting the right cover, a local Dynatect Rep can assist in measuring the cover, making recommendations, showing samples, and assisting in your quote request. (Dynatect provides forms to simplify the process of receiving a quote.)
BELLOWS DESIGN - QUOTE REQUEST
SIMPLIFYING THE RFQ / DESIGN PROCESS

We have a questionnaire for each common shape! Request an RFQ form from your Dynatect Rep or access them online at: Dynatect.com/request-for-quote/bellows-quote-request/

• What is the overall shape?
• New design or a replacement bellows?
• Machine make and model?
• What are the environmental conditions? (temperature, exposure, liquids)
• What are the motion requirements?
• Extended/retracted or travel distance

• Direction of movement (horizontal/vertical)
• Speed, duty cycle
• Space obstructions
• Dimensions of the bellows (if replacing) or surface/part to be covered (if new)
• Finishing the bellows – what type of mounting do you need?

FILLABLE PDF  ONLINE RFQ  CALL (800) 298-2066  HOW-TO VIDEOS

For tapered bellows, provide the height and width information for both ends.
Dynatect’s Gortiflex® molded bellows are used in various loading applications. In this example, the bellows is extended to a tanker truck, is locked down, then filled with water from the holding raceway. This allows the salmon to be transported upstream past the river dams. (To learn more about how salmon get a free taxi ride, search “Baker River Upstream Fish Trap” on Youtube.)

Gortiflex® molded bellows have fabric reinforcement options, which make them more durable than regular molded bellows. Additionally, wire reinforcements can be added to withstand pressure. Tooling required to produce Gortiflex bellows, if not in stock, is significantly less expensive than traditional molded bellows tooling. This allows for fast, customized, low volume production and prototypes with small upfront costs. Learn more about Gortiflex® bellows at Dynatect.com
BELLOWS IN SUB-ZERO TEMPERATURES
APPLICATION SPOTLIGHT

A defense contractor requested bellows covers for the hydraulic cylinders that open the split clamshell silo hatches for the ground based interceptor missiles in Fort Greely, Alaska. Due to the location, there were extreme low temperature requirements for operation of the bellows. Other requirements prevented the use of silicone based materials which are usually the standard elastomer for low temperature applications. The silo hatches must operate flawlessly when a launch is required. Protection of the actuating cylinders and the ability to perform routine maintenance are vital to dependable operation. The operation is checked routinely in all weather conditions. Since Fort Greely can get to below -40° F, the bellows must function at very low temperatures without failure or damage. Through testing, Dynatect was able to determine the combination of elastomer and bellows design that provided the necessary function for this application.

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Photo ©2018 Tim Holoday
SNOW MACHINE BELLOWS
APPLICATION SPOTLIGHT

A special bellows improves the aesthetics of snowmaking machines while also protecting their components and retaining heat to keep the components thawed. The bellows is used exclusively on the Puma® snowmaker, made by Snow Machines, Inc. (SMI), a global supplier of cutting-edge snow machines, snowmaking equipment and construction and engineering services.

Without a bellows, the area between the machine's rotating barrel and the components would be unprotected, leaving the components exposed to the elements. Dynatect designed and manufactured a bellows that would enhance the machine's aesthetics while also protecting the components while the barrel rotates from 0-45 degrees.

It combines a blend of bellows and cone covers to fit the machine and protect against freezing temperatures and intense UV exposure. By retaining heat from the machine's on-board compressor and heaters, it keeps the components thawed. It's made from a special elastomer-coated material that is color-coordinated to match the machine's housing.

The Puma was one of the machines SMI supplied for the 2014 Russian Winter Olympics. The Puma was designed with a goal of maximizing snow production over a wide range of conditions, especially in marginal temperatures.
MEDICAL BELLOWS (IMAGING EQUIPMENT)
APPLICATION SPOTLIGHT

Dynatect supplies bellows for concealing mechanical parts and covering pinch points. In this application, a Vulca Seal® bellows covers the vertical adjustment mechanism on a mammography system. The bellows material was chosen to compliment the equipment, and the bellows construction (Vulca Seal) was chosen for aesthetics.

Vulca Seal® bellows have high durability, a neat appearance, and do not have stitching. Learn more about these bellows at Dynatect.com
BELLOWS FOR MEDICAL DEVICES
APPLICATION SPOTLIGHT

Dynatect has worked with many OEMs to develop flexible covers for medical devices and is prepared to address the common requirements in medical equipment applications. Some common concerns cited are aesthetics, bacterial growth, and flame test specifications. (Read more below.)

Application Examples:
- Breathing apparatus
- Dental milling equipment
- Imaging machines
- Lift table & seat covers

Aesthetics
The cover must look very good since the patient often sees the cover in operation. Dynatect’s Vulca Seal®, Thermiseal™ and Gortiflex® are popular in medical applications.

Bacteria Growth
Stitched bellows are generally avoided since bacteria may grow in crevices formed by stitches. The surface texture of the cover is also critical. A smooth surface is easier to wash or wipe down compared to a textured surface. The material must resistant disinfectants that use alcohol or bleach.

UL94 V0
This standard becomes a concern when the cover is part of an electrical assembly. The material must meet this standard for flame testing so an electrical fire will not be propagated by the cover. Dynatect offers a selection of materials lab-tested to the VTM (Very Thin Material) test, however, many material suppliers do not test to this UL standard. Customers are encouraged to conduct independent testing.
CONTAINMENT OF DUST OR FLYING DEBRIS

APPLICATION SPOTLIGHT

Large CNC machining centers require special effort to minimize the impact of dust and sound (and sometimes flying debris!) on surrounding work areas. Machine roof covers were developed to contain debris and airborne contamination without creating interference or obstructions in the machining center’s travel.

Dynatect's **machine roof bellows** consist of large, self-supporting bellows equipped to glide on a rail system. Learn more at Dynatect.com