VACUUM & PRESSURE BAGGING TOOLS

VACUUM BAGGING HARDWARE

FOR AUTOCLAVE, OVEN, PRESS, & ROOM TEMP PROCESSES

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CATALOG NO. 5
Bonding and laminating are accomplished using a variety of methods, one of which is "vacuum bagging". Vacuum bagging surrounds the part being bonded with an airtight membrane or diaphragm and utilizes the surrounding pressure to force the membrane tight against the article being bonded, similar to a vacuum-packaged item. Once the article is vacuum bagged, it is allowed to cure for a specific amount of time. For articles comprising heat-activated (thermoset) or heat-formed (thermoplastic) resins and adhesives, the vacuum-bagged articles are cured in ovens or, when more pressure is required, in autoclaves and mechanical presses. These temperatures and pressures normally exceed 250°F and 50 psi. Vacuum bagging produces exceptionally strong parts with little, if any, air entrapment. Forming to every contour of the part, vacuum bagging, in many cases, eliminates the need for expensive matched-die molds and presses while producing higher-quality parts.

Taking advantage of the surrounding air or gas pressure to form and clamp items is a very efficient, effective way to bond or laminate a product. Torr's main objective is to provide you with high quality, easy-to-use tools and hardware for producing parts in this manner. Toward this end we offer the T7™ (pat. pend.) vacuum bagging system. It is the simplest, most effective, and efficient way to vacuum bag. Throughout this catalog are examples of T7 tools demonstrating their adaptability and diversity. Also presented are a variety of tools to apply vacuum and pressure to items which can't utilize the T7 seal. For vacuum bagging components, we design and manufacture our own vacuum hoses and probes, and offer a selection of quick-disconnects, elastomers, and vacuum pumps.

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Most of the products offered here are Torr originals; you won't find them anywhere except through Torr or one of its representatives. Our combined experience of more than 30 years in manufacturing vacuum bagging tools and hardware provides you with products and solutions that tackle your specific process requirements head-on so that the tools and hardware we provide do the job they were designed for.
An outdated, yet common method of vacuum bagging advanced composites and other types of laminates involves applying a thin strip of sealant tape or putty to the perimeter of the mold on which the part is laid up. Plastic film is placed over the laminate and pressed into the sealant. Once the air is removed and the part is cured, the sealant and film are thrown away and the sealant residue is cleaned off of the mold. The plastic film’s low elasticity creates low and high pressure areas and its tendency to wrinkle causes resin ridges on the laminate which may require extensive rework. These bags are labor-intensive, environmentally unsound, and create quality control problems. Torr replaces the “one shot, throw away” plastic-film-and-sealant bag with a vacuum bagging tool that can be used hundreds of times.

<table>
<thead>
<tr>
<th>TORR VACUUM/PRESSURE BAGGING TOOL</th>
<th>HAND-BUILT PLASTIC FILM BAG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bagging time (4’ x 6’ flat mold)</td>
<td>1 min</td>
</tr>
<tr>
<td>Prone to bagging errors?</td>
<td>No</td>
</tr>
<tr>
<td>Consistent, repeatable results?</td>
<td>Yes</td>
</tr>
<tr>
<td>Uniform pressure on complex shapes?</td>
<td>Yes</td>
</tr>
<tr>
<td>Bag wrinkles?</td>
<td>No</td>
</tr>
<tr>
<td>Clean-up of mold required?</td>
<td>No</td>
</tr>
<tr>
<td>Disposal costs?</td>
<td>No</td>
</tr>
<tr>
<td>Bagging material costs</td>
<td>One time initial cost</td>
</tr>
<tr>
<td>Integral vacuum and thermocouple connections?</td>
<td>Yes</td>
</tr>
</tbody>
</table>

By using a Torr System, you will:
1) Cut labor and material costs dramatically
2) Improve part surface and structural quality
3) Have a repeatable manufacturing process
4) Eliminate plastic film and sealant disposal costs
5) Reduce part rejection and secondary finishing
6) Increase productivity

In the production of advanced composite parts, compacting or debulking involves vacuum bagging a part at various stages in the lay-up process to reduce the amount of air trapped in the layers of pre-preg. It is not uncommon for a laminate to undergo compaction after placement of each ply. This can amount to more than 50 compaction cycles before the final cure. In such cases, a Torr vacuum bagging tool can pay for itself during the production of just one part.

Every year, thousands of tons of petroleum-based plastic film and sealant tape are disposed of in our landfills. Just one 4’ x 8’ mold can produce more than 700 lbs of bagging waste annually. While reducing labor costs, material costs, and producing higher-quality parts more consistently, Torr tools take a gigantic step toward reducing your company’s impact on the environment. Also, nearly 100% of the small amount of metal and silicone rubber waste produced in the manufacturing of a Torr tool is recycled...and if you ever retire one of your Torr systems, most of the component materials are recycleable as well. Take a look at the processes which create the most waste and vacuum bagging with plastic film will be at or near the top of the list.
LOOK AT THE ADVANTAGES

ECONOMY - Bagging time is reduced by more than 90%! Bagging film and sealant costs, as well as the purchasing, inventory, and disposal of those items, are greatly reduced. Torr systems reduce, and in some cases eliminate, part rejection and rework. Manufacturers are discovering that bidding jobs using Torr vacuum bagging tools gives them a competitive edge over companies using outdated, inefficient bagging methods, including poorly designed reusable vacuum bags.

QUALITY - Our high-strength conformable elastomers distribute pressure more evenly and eliminate wrinkles so both physical and cosmetic properties of laminates are improved, resulting in a higher level of quality in your manufacturing process.

CONSISTENCY - The variables associated with plastic film bag construction are eliminated. Consistent, repeatable results are obtained every time you vacuum bag.

SERVICE - We provide our customers help and assistance through system care manuals, maintenance and repair manuals, repair kits, instructional videos, and our toll-free 800 number.

PLUS...

Torr considers many factors in designing and manufacturing tools for its customers. We look at the environment the tools will be used in and construct them accordingly. Factors such as:

CURE ENVIRONMENT - Whether it's autoclave, oven, press, or room temp, Torr matches the tool design and construction to the process.

LAY-UP ENVIRONMENT - Ceiling height, storage space, mold size, part height...every customer has their own particular requirements as to where and how parts are laid up and bagged. From hinges to integral pneumatic lift systems to simple frame-mounted handles, Torr constructs tools that fit into the environment they will be used in.

MOLD DESIGN - The design of the mold sealing area is extremely important for trouble-free, economical implementation of permanent vacuum bagging tools. By following the design guidelines on the opposite page, the vacuum bagging systems manufactured for the molds you construct will be the least costly, the longest lasting, and the easiest to use. Call Torr and we'll provide you with our recommendations for each specific mold you're working on.

Manufacturers looking to gain a competitive edge by modernizing their production facilities and processes are discovering that the quickest, most effective way to reduce costs and increase profits is to implement the use of Torr Vacuum Bagging Tools. With Torr, you eliminate the variables of labor-intensive, hand-built bags. The rewards are high process quality, consistent, repeatable bagging results, and dramatically lower production costs.
MOLD DESIGN GUIDELINES

When designing and constructing molds, there are a number of design criteria that will result in more efficient, less costly implementation of reusable vacuum bagging systems.

Allowances must be made for breather material, release film, vacuum and thermocouple connections, as well as the vacuum seal. Allow at least 5" beyond the edges of the layup for the sealing area. If the vacuum tool is to be hinged, allow an additional 2" along the hinge edge.

In this example, the sealing area of the middle and right molds has been increased. The right mold has gone a step further and eliminated the top horizontal flange.

Eliminate compound curves in the sealing area. Construct the mold so that the sealing area changes direction along 2 axes only, not 3. Compound curves will increase frame, seal, and diaphragm costs. If you need to follow the part contour more closely, change mold edge direction after or before the curve by at least 3", not in the middle as shown in the left hand mold.

For relatively small molds, truncate ribs or "hat-sections" and provide a flat sealing area whenever possible. The only other option would be to place the entire mold onto a larger baseplate for bagging. In this example, the upstanding portion of the mold has been truncated and tapered down to a flat sealing area. This minor design change will cut the cost of a reusable bagging system by at least 40% and allow the vacuum bagging tool to be hinged to the mold.

The mold on the right has a narrow sealing area and the sharp radii of the part extend to the edges of the mold. Below left, the sealing area has been widened and the radii in the sealing area have been modified. Below right, a flat, planar sealing area has been created. If the part contour allows it, this is the most efficient design.

Do not extend small joggles and curves from the part area into the sealing area. This creates added costs because the frame and seal must be manufactured to extremely close tolerances and be indexed precisely to work correctly. Below, the sealing area margin is wider and lies in the same plane, again significantly reducing the cost and increasing the reliability of a vacuum bagging tool. It also allows hinging of the tool. You could also raise the part area instead of recessing it as shown.

Eliminate as many curves as possible. If 1 straight section causes the mold to be too large, break up the curve into 2 or 3 straight sections. If curves cannot be avoided, make them along one axis only, i.e. no compound curves. Every curve and angle built into the frame limits the option of hinging the vacuum bagging tool to the mold.
T-7™ VACUUM & PRESSURE BAGGING TOOLS

There are other types of vacuum bagging systems available but nothing comes close to the dependability and simplicity of the T7 system. It readily adapts to existing molds and provides the manufacturer with the most consistent, highest quality parts possible. T7 systems are not just vacuum bags, they’re invaluable production tools. Here’s why:

T7 tools combine a precision, custom-fit frame with the highest quality silicone elastomers and the T7 seal. With the frame, blanket, and seal being an integrated package, T7 tools do away with modification of the customer’s molds or tooling. There are no grooves to be machined or extrusions to be bonded. Since the surface of the mold is free and clear of all obstructions, you can lay-up, cure, and remove parts from the mold without damaging a critical seal component of the vacuum bagging system.

T7 tools don’t rely on diaphragm tension to initiate and hold vacuum as other types of systems do. Leaks caused by stress-induced diaphragm breakdown and tension set, common in other reusable systems, are eliminated. Since diaphragm looseness does not affect the T7 seal, laminates with high profiles near the edge of the mold can easily be accommodated. This also means that disastrous seal blow-outs caused by the thermal expansion of the silicone diaphragm at elevated temperatures are eliminated. Unlike other reusable systems, with the T7 tool, the seal integrity of the 500th cycle is as good as the first.

The precision welded frame coupled with the conformable T7 seal means not having numerous clamps and closure mechanisms lining the perimeter of the mold. The angled leg of the T7 seal flexes to follow the contour of the mold. The weight of the vacuum bagging tool is usually sufficient to initiate the seal; it’s simply a matter of placing the T7 tool onto the mold and applying vacuum. Once initiated, the seal is further enhanced by increased vacuum and autoclave pressure.
T7 tools readily adapt to existing molds or baseplates. In addition to the above features, T7 tools are available with a variety of baseplates, carts, heating systems, auxiliary vacuum pumps, thru-mold vacuum ports, and many other convenient options. When you call or fax for a quote, please provide us with an isometric or perspective drawing or sketch indicating part and mold dimensions, number and size of vacuum connections, number and type of thermocouple connections, cure temperature and pressure, and any limiting factors, such as oven or autoclave dimensions. For more ideas, please look over the tool examples on the following pages.
T7 tool built to fit existing leading edge mold.

T7 tool with integral pneumatic lift system installed on core-bonding cowl mold.

T7 tool hinged to existing epoxy-fiberglass mold.

Double-diaphragm Interflow T7 tool. Shape of part is defined by mold placed underneath lower diaphragm.

Form-fit T7 tools hinged to aluminum baseplates. Note how the T7 tools are not affected by high profile laminates located close to the seal area.

Large T7 tool for manufacturing curved laminates.
T7 forming tool using cured calendered EL78 silicone rubber sheet. Note the fairing bars along the base of the mold to reduce stress on the blanket. Part extends only 1” down from top of mold.

Tool on the left with vacuum applied. Note conformance of the diaphragm to the form contours. This is not recommended for repeated autoclave or high-temperature cures.

T7 tool with diaphragm molded from uncured EL80M elastomer.

Another example of a molded diaphragm, this time from EL78.

Provided with accurate drawings, fairly complex tools, like this one for a radome, can be constructed in our facility without the mold.

An example of a large nose cone tool seamed from cured, calendered EL80 sheet.
Envelope bags are another way to bond and laminate parts.

Used to manufacture printed circuit boards, Torr Vacuum Frames turn ordinary hydraulic presses into vacuum presses. Please call for more information.

This heated T7 tool utilizes forced hot air for temperature accuracy. It has two heat zones, is extremely economical to run, and has an integral pneumatic opening system.

Tube bonders are used to manufacture wrinkle-free laminated tubular shapes.

Inflatable or pressure bags are another way to bond and laminate parts. Torr machined the tooling and molded this 5' diameter donut.

These inflatables bond liners in wheel hubs and incorporate pressure relief valves for safety.

1-800-845-4424

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This molded EL80M bag fits the extremely complex inner contour of this multi-piece mold and seals using conventional sealant tape and a unique snap system.

2’ x 20’ T7 compacting tables shown in the open position.

This is actually an inflatable. It is installed inside a large pressure housing.

A fairly complex T7 double-diaphragm tool seamed from cured calendered EL80.

Left: T7 compacting table with counter-balance cylinders and integral rotary-vane vacuum pump. Right: Vacuum pump station.

The molded shape on this T7 tool is expanded and placed over the mold to produce wrinkle-free parts.

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Torr offers a wide variety of high quality, economical vacuum bagging hardware for virtually every oven, autoclave, and room-temp process. Because we manufacture much of our own hardware and sell direct, the savings to you are substantial. Since we get direct feedback from the customer, high quality and efficient, innovative products are assured. Compare our products with the competition's. We think you'll find the design, construction, and value to be superior. Please call us if you have any questions or need specialized hardware for your particular process.

### VACUUM HOSE FOR AUTOCLAVE, OVEN, AND ROOM TEMP PROCESSES

<table>
<thead>
<tr>
<th>Model</th>
<th>Maximum Temperature</th>
<th>Max. Autoclave Pressure</th>
<th>Characteristics</th>
<th>End Fittings</th>
<th>Notes</th>
</tr>
</thead>
</table>
| VH22  | 400°F (232°C)       | 250 psi                 | q High flow 3/8" ID  
q Aramid fiber-reinforced silicone rubber  
q Crush-resistant stainless steel core  
q Extremely flexible | Straight and 90°, 1/4, 3/8, & 1/2 npt male  
1/4 npt male std at no extra charge | To order, please specify length and required end fittings |
| VH23  | 1000°F (538°C)      | 200 psi                 | q High flow 3/8" ID  
q 100% stainless steel construction  
q Flexible and extremely durable | 1/4 npt male, 1/4, 3/8, & 1/2 female JIC  
1/4 npt male std at no extra charge | To order, please specify length and required end fittings |
| VH24  | 1000°F (538°C)      | 1000 psi                | q High flow 3/8" ID  
q 100% stainless steel construction  
q Extremely flexible and extremely durable | 1/4 npt male, 1/4, 3/8, & 1/2 female JIC  
1/4 npt male std at no extra charge | To order, please specify length and required end fittings |

All vacuum hose models are easily repaired. Torr provides complete repair & testing services.
VACUUM PROBES FOR AUTOCLAVE, OVEN, AND ROOM TEMP PROCESSES

VACUUM PROBES PROVIDE THE MOST EFFICIENT WAY TO APPLY VACUUM THROUGH BAGGING MATERIALS

**STANDARD**

- **Max. Temperature:** 500°F (260°C)
- Simple, efficient 1/4 turn installation
- All machined aluminum construction
- Unique "breathable" base design
- Wrench flats for fitting installation and removal
- Available in 1/4 or 1/2 npt
- The best value of any probe available

The Standard vacuum probe provides a high integrity seal through all types of bagging materials with just a quarter turn. It is extremely durable and inexpensive.

**Part No.**

- 304114 Std 1/4 npt aluminum probe w/500°F gasket
- 308228 Std 1/2 npt aluminum probe w/500°F gasket

**CINCH**

- **Max. Temperature:**
  - Aluminum 500°F (260°C)
  - Stainless Steel 1000°F (538°C)
- Compound action for an unbeatable seal
- Matched grooves allow gasket-less seal
- All machined aluminum or stainless steel construction
- Unique "breathable" base design
- Wrench flats for fitting installation and removal

The Cinch probe readily seals through various bagging material thicknesses with a 1/4 to 3/4 turn. It provides the most sealing pressure of all the probes.

**Part No.**

- 324114 Cinch 1/4 npt aluminum probe w/500°F gasket
- 334664 Cinch 1/4 npt stainless steel probe w/500°F gasket

**VP36**

- **Max. Temperature:** 500°F (260°C)
- Threaded design for elastomeric materials
- All machined aluminum construction
- Compact for more usable layup area
- Wrench flats for fitting installation and removal
- Available in 1/4 npt

The VP36 provides a more permanent 1/4 npt male connection through elastomeric materials than other types of probes. It is ideal for use in permanent or reusable vacuum & pressure bagging tools.

**Part No.**

- 364000 VP36 1/4 npt aluminum probe

**VP37**

- **Max. Temperature:** 500°F (260°C)
- Nickel-plated machined steel
- Simple, positive o-ring seal
- For baseplate thicknesses from .25" to 1.13"
- Wrench flats for easy installation
- Flush installation
- Available in 1/4 npt only

VP37 probes are ideal for plumbing vacuum through metal baseplates or tooling and its design withstands the thermal expansion and contraction of heated processes.

**Part No.**

- 374000 VP37 1/4 npt probe (Aluminum block not included)
The QD10, common in room temperature and high temperature vacuum and pressure applications, is available in a variety of configurations making it readily adaptable to many processes.

**Max. Temperature:** 500°F (260°C)
- Heat-treated zinc dichromate-plated steel
- Viton seals
- High flow
- Valved
- Available in 1/4 or 1/2 npt male and female threads

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
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<tbody>
<tr>
<td>100504</td>
<td>Plug, fem 1/4 npt thrs</td>
</tr>
<tr>
<td>100514</td>
<td>Plug, male 1/4 npt thrs</td>
</tr>
<tr>
<td>100508</td>
<td>Plug, fem 1/2 npt thrs</td>
</tr>
<tr>
<td>100518</td>
<td>Plug, male 1/2 npt thrs</td>
</tr>
</tbody>
</table>

**Part No.**
- 101504 Coupler, fem 1/4 npt thrs
- 101514 Coupler, male 1/4 npt thrs
- 101508 Coupler, fem 1/2 npt thrs
- 101518 Coupler, male 1/2 npt thrs

The QD11 is a valved quick-disconnect common throughout the aerospace/composites industry. It is a high-quality, economical fitting suitable for most vacuum and pressure applications.

**Max. Temperature:** 500°F (260°C)
- Heat-treated zinc dichromate-plated steel
- Viton seals
- High flow
- Valved
- Industrial interchange
- Available in 1/4, 3/8, or 1/2 fem npt threads

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
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<tbody>
<tr>
<td>110504</td>
<td>Plug, fem 1/4 npt thrs</td>
</tr>
<tr>
<td>110508</td>
<td>Plug, fem 1/2 npt thrs</td>
</tr>
</tbody>
</table>

**Part No.**
- 111504 Coupler, fem 1/4 npt thrs
- 111508 Coupler, fem 1/2 npt thrs

SEE PRICE LIST FOR A COMPLETE LISTING OF COMPONENTS & PRODUCTS

**VACUUM PUMPS**

Torr offers its customers a complete line of rotary vane vacuum pumps. These quality pumps are quiet (around 65 dB(A)) and offer unsurpassed performance for the money. They can be supplied alone or incorporated into vacuum stands and compacting tables. Please call with your requirements.

For economy, Torr offers a lightweight, portable 110 VAC diaphragm vacuum pump. This amazingly quiet pump pulls 25.5" Hg vacuum and comes complete with gauge, side-mounted on/off switch, and suction feet.
Torr offers a complete selection of cured and uncured calendered silicone rubber sheeting. Our high-strength compounds, available with a light fabric finish, are unsurpassed in vacuum and pressure bagging performance. Commercial-grade compounds, available in a wide selection of hardnesses and thicknesses, are used in pressure-intensifier and gasket applications not requiring high strength properties. Please call with your requirements.

Torr's patent-pending Interflow™ breather pattern rubber utilizes our high-strength compounds and must be special-ordered unless over-run stock is available.

Finally, Torr stocks a number of extruded silicone rubber shapes used for seals, pressure intensifiers, and tube-bonding bladders.

### HIGH-STRENGTH COMPOUNDS

#### EL78 LOW MODULUS HIGH-STRENGTH SILICONE RUBBER
- High-strength elastomer formulated specifically for vacuum bagging
- Incredible elasticity & conformance
- 400°F (204°C) rated continuous
- Available cured & uncured
- Clear formulation available for low-temperature processes (special order)

#### EL80 HIGH-STRENGTH SILICONE RUBBER
- High-strength elastomer formulated specifically for vacuum bagging
- Exceptional elongation and tear strength properties
- 400°F (204°C) rated continuous
- Available cured & uncured

#### EL80M HIGH-STRENGTH SILICONE RUBBER
- High-strength elastomer formulated specifically for vacuum bagging
- Exceptional elongation and tear strength properties
- 400°F (204°C) rated continuous
- Outstanding low compression set properties
- Available cured & uncured

#### EL81 TRANSLUCENT HIGH-STRENGTH SILICONE RUBBER
- High-strength translucent compound formulated specifically for vacuum bagging
- Exceptional elongation and tear strength properties
- 375°F (191°C) rated continuous
- Available cured & uncured

### SPECIFICATIONS

<table>
<thead>
<tr>
<th></th>
<th>EL78</th>
<th>EL80</th>
<th>EL80M</th>
<th>EL81</th>
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<tr>
<td>Hardness (Shore A)</td>
<td>30</td>
<td>50</td>
<td>51</td>
<td>48</td>
</tr>
<tr>
<td>Tensile strength (psi)</td>
<td>1500</td>
<td>1660</td>
<td>1178</td>
<td></td>
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<tr>
<td>Tear strength (ppi)</td>
<td>207</td>
<td>1400</td>
<td>295</td>
<td>230</td>
</tr>
<tr>
<td>Modulus (psi)</td>
<td>290</td>
<td>250</td>
<td>600</td>
<td>419</td>
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<tr>
<td>(300% elongation)</td>
<td></td>
<td></td>
<td>600</td>
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<tr>
<td>Elongation at break (%)</td>
<td>900</td>
<td>630</td>
<td>800</td>
<td></td>
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<tr>
<td>Specific gravity</td>
<td>1.10</td>
<td>1.65</td>
<td>1.17</td>
<td>1.13</td>
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<tr>
<td>Compression set (%)</td>
<td>17</td>
<td>1.15</td>
<td>15</td>
<td>49</td>
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<tr>
<td>(22 hrs @ 350°F)</td>
<td></td>
<td></td>
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</tbody>
</table>

To order, please specify thickness, width, & length

Stock thicknesses: .030" .063" .085" .125"
Stock widths: 36" 48" 54"

For non-stock items, minimum order is 50 lin. ft.
Seamed blankets available in any width
Sold per square ft.

### INTERFLOW™ BREATHER PATTERN RUBBER

For vacuum bagging metal-bond assemblies, pre-cured skins, glass, wood, thermoplastics, or for compacting or debulking pre-preg laminates without breather material, Interflow's the answer. There are other types of patterned rubber available to remove air without breather material but they all incorporate a coarse pattern over the entire surface and they don't breathe very well. Interflow can be applied to all of our high strength elastomers. Because the surface of the rubber has a molded grid pattern, more than 70% of the contact area is flat, providing better pressure distribution and superior breathing characteristics. Compared with other breather pattern silicone sheet, Interflow costs less. See photo on page 7.

### EXTRUSIONS

Torr stocks a variety of high-strength and commercial grade extruded silicone rubber shapes used for seals, pressure intensifiers, fairing bars, and tube bonding bladders. Please refer to our price list for a complete listing of stock sizes.

CUSTOM EXTRUSIONS AVAILABLE