CEFIL’AIR®
Inflatable Seals
Meeting Your Critical Sealing Requirements.
INTRODUCTION

When faced with the problem of sealing between parts, which move in relation to one another and are capable of being connected and disconnected at will, the easiest, safest and most effective technique to use is pneumatic seals.

CEFIL'AIR® seals, which are expanded and retracted by a pneumatic process, have been designed to meet multiple applications. CEFIL'AIR® inflatable seals bring wider possibilities of use as a result of its patented design employing modern techniques and the most advanced elastomers.

These seals can satisfy the highest demands of temperatures from -60 °C to +220 °C, as well as higher temperatures during short periods. They can also withstand pressures from dynamic vacuum (1.33.10^-6 Bar) to several dozen Bars (10^2 Bar and more). CEFIL'AIR® inflatable seals can be used in all sectors of industry including advanced techniques and scientific research.

With know-how and expertise in the field of pneumatic seals, Technetics Group develops and markets CEFIL'AIR® products for diverse customer applications. Thanks to engineering studies, calculations and FEA, particularly within maestral® laboratory, Technetics Group is able to meet the challenges of today and tomorrow, including economic challenges with reactivity, anticipation and competitiveness, as well as challenges concerning safety and security to ultimately meet customer needs.

BIO-GUARDIAN® SEALS

Essential to the medical, pharmaceutical and food industries, the BIO-GUARDIAN® sealing solution prevents bacterial and microbial growth on equipment and materials. The BIO-GUARDIAN® solution can be used in CEFIL'AIR® inflatable seals to meet the needs of demanding hygienic applications.

As with the majority of elastomers produced by Technetics Group, BIO-GUARDIAN® seals can have an additional surface treatment to improve friction properties and gas impermeability. Laboratory results show that BIO-GUARDIAN® solutions treated with CEFIL'GLIS™ N°1 are certified FDA & USP Pharma Class VI and can be recommended for use in critical installations where the growth of microorganisms should be avoided.

APPLICATIONS

CEFIL'AIR® inflatable seals are fitted in the following cases where sealing, handling, or locking is required:

- movable cofferdam bulkheads
- storage containers
- transport containers
- leaktight panels (naval, aerospace industry)
- nuclear vessels (equipment or personnel chambers)
- isothermal chambers
- clean rooms
- sliding or quick-locking doors (autoclaves, sterilisers)
- centrifugal filters (access doors and drainage hoppers)
- aircraft access doors
- cockpit canopies
- portholes
- cofferdams
- pneumatic conveyors (bagging hoppers, valve gates)
- phonic isolation
OPERATION

CEFIL'AIR® seals have no textile reinforcement or expansion system. Their expansion, like their retraction, is obtained through the combined effects of the walls of the seal forming elastic arms. The seals, which are produced from elastomers with a high modulus of elasticity and considerable elongation and fitted in grooves, are restricted to low work rates. As a result, they are protected against risks of bursting, so it is necessary to observe the fitting dimensions (table, pages 4-5).

Comment: CEFIL'AIR® HP inflatable seals must be captive in slots or grooves closed on all four faces in accordance with the specified dimensions. You are strongly recommended not to pressurise or use the seals when one of the faces of the groove is open. On the other hand, CEFIL'AIR® LP seals can be secured by their base and work freely. However, the maximum pressure cannot be applied until their contact face (toothed side) is against the item to be sealed.

When free, CEFIL'AIR® seals must not be inflated above ≥ 0,8 to 1,5 bar (according to the type of the profile). When fitted in a groove, they are perfectly leaktight for an inflation pressure of 1,25 to 1,45 times the pressure to seal (Ps). The maximum inflation pressure (Pi) which the seals can withstand depends on the clearance (J) between the supporting frame and the moving panel (see profiles on pages 4-5). The inflation pressure (Pi) can be higher if clearance is reduced. CEFIL'AIR® seals are designed to provide tightness on pressurised equipment. This creates a lateral force on the seal, which tends to force it either towards the outside (equipment under pressure) or towards the inside of the equipment (equipment under vacuum).

a) Equipment under vacuum (P₀-Pₛ>0)
The condition of the surfaces in contact, as well as the completion of the assembly operation, make it possible for CEFIL'AIR® seals to withstand a vacuum of 10⁻³ Torr (dynamic vacuum).

b) Equipment under pressure (P₀-Pₛ<0)
With an internal pressure created by gas or a controlled atmosphere, the strength is directly linked to the clearances, deformation of the contact faces and the pressurisation of the seal. In these applications, it is always necessary to reduce dimension (J) to a minimum, restricting the surface to which the pressure of the enclosure (Ps) will be applied, in order to reduce the radial component or, depending on the arrangement, the axial component, as far as possible as this tends to force the seal outwards. Generally, the ratio Ps-P₀/Pi is of 0,7 to 0,2 but with the limits laid down in the table concerning profiles (pages 4-5).

MANUFACTURE

CEFIL'AIR® inflatable seals are made by joining together extruded or moulded sections. This connection is made in our workshops, which ensures perfect continuity while at the same time reducing any stresses in the joint to a minimum.

This method provides substantial flexibility with regard to the geometry of the sections. There are two types of standard profiles and a series of special profiles that are used in numerous applications, i.e. sealing, locking or gripping during automatic handling have been created.

For specific uses which need reinforced manufacturing (textiles, high performance aramid fibers) or expanded profiles, see pages 12 and 13 and please contact our technical department.
TYPES OF ELASTOMERS

CEFIL'AIR® inflatable seals are produced with elastomers with high mechanical properties. Silicone, SBR and EPDM are the most commonly used. Although these are high performance materials, they are not suitable for all applications, and consequently, other elastomers should be used.

### Elastomers

<table>
<thead>
<tr>
<th>Elastomers</th>
<th>Ref.</th>
<th>Δ Sh A</th>
<th>Temp. range °C</th>
<th>Properties</th>
</tr>
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<tbody>
<tr>
<td>SBR Styrene Butadiene Rubber</td>
<td>1 A 60</td>
<td>60</td>
<td>-20 +100</td>
<td>Good resistance to:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- water</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- demineralised water</td>
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<tr>
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<td></td>
<td></td>
<td>- air</td>
</tr>
<tr>
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<td></td>
<td>- ketones</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Abrasion-resistant</td>
</tr>
<tr>
<td>CR* Chloroprene</td>
<td>4 B61K</td>
<td>60</td>
<td>-20 +110</td>
<td>Same as SBR, with better resistance to:</td>
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<td></td>
<td>- ultraviolet rays</td>
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<td>- ozone</td>
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<td></td>
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<td></td>
<td>Low resistance to grease</td>
</tr>
<tr>
<td>IIR* Butyl</td>
<td>5 B 60</td>
<td>65</td>
<td>-20 +120</td>
<td>Good resistance to:</td>
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<td>- diluted acids and bases</td>
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<td>- ketones</td>
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<td></td>
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<td>- very low permeability</td>
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<tr>
<td>EPDM* Ethylene Propylene</td>
<td>6 B 65</td>
<td>65</td>
<td>-30 +150</td>
<td>Good resistance to:</td>
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<td></td>
<td>- atmospheric conditions</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Low resistance to hydrocarbon</td>
</tr>
<tr>
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<td>C 65 M</td>
<td>60</td>
<td>-60 +220</td>
<td>Good resistance to:</td>
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<td>- dry and humid heat</td>
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<td>- very low oil resistance</td>
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<td></td>
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<td>- does not age</td>
</tr>
<tr>
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<td>-50 +200</td>
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<td></td>
<td>- chlorinated solvents</td>
</tr>
<tr>
<td>NBR* Nitrile Rubber</td>
<td>3 B</td>
<td>70</td>
<td>-30 +110</td>
<td>Good resistance to:</td>
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<td>- oils</td>
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<td></td>
<td>- fuels</td>
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<td></td>
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<td></td>
<td></td>
<td>- some solvents</td>
</tr>
<tr>
<td>HNBR* Hydrogebutated Nitrile Rubber</td>
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<td>70</td>
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<td></td>
<td>- ozone</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- high temperatures</td>
</tr>
<tr>
<td>FKM* (VITON®) Fluorocarbon Rubber</td>
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<td>65</td>
<td>-20 +180</td>
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<td></td>
<td>- aromatics</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- strong acids and bases</td>
</tr>
</tbody>
</table>

*Profiles not kept in stock, produced on special request. (Please contact our technical department).

**Note:** This information represents broad outlines for use. For specific applications, please contact our technical department.
In order to obtain the full expansion and retraction of the seal, as well as guarantee its maximum efficiency, the minimum curve radii in the corners must be in accordance with the opposite table. The sketches define the reference line of the radius at the bottom of the groove according to the position of the curve in relation to the direction of the expansion.

Please consult our technical department for small sized circular seals.

* The housing width and expansion of the seal should be checked in accordance with the requirements on page 7.

In the retracted position, the seal is contracted and protected in its groove (B1 > B).

The clearance (J) can be reduced to zero when the two parts are in contact, without their movements being hindered by the seal (B1 = H).

* √ Ra 3,2 to 6,3, standard N8 (see page 9).

In order to obtain the full expansion and retraction of the seal, as well as guarantee its maximum efficiency, the minimum curve radii in the corners must be in accordance with the opposite table. The sketches define the reference line of the radius at the bottom of the groove according to the position of the curve in relation to the direction of the expansion.

* For profiles other than in silicone, increase the above values RgA/RgE/Rgl by a minimum of 20%.

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In order to obtain the full expansion and retraction of the seal, as well as guarantee its maximum efficiency, the minimum curve radii in the corners must be in accordance with the opposite table, which defines the value of the radius at the bottom of the groove according to the position of the curve in relation to the direction of the expansion.

* Other forms of seals can be produced (see page 13).
* The dimensions of the dies available may be supplied on request.

**ASSEMBLY**

This profile can be used with a groove (sketch 1) or without a groove (sketch 2). Dimension (B) corresponds to the seal in the idle position. When it is subjected to a pressure of 1.5 bar (seal in free position), (H1) (maximum height) is obtained. Dimension (H) is a normal working value, intermediate values can also be used between (B) and (H). The foot must be secured on each side when the seal is subjected to an external pressure acting on its side. Specifically, in the axial position, standard LP CEFILAIR® seals must be maintained in the radii by quadrants.

**Fixing Examples:**

![Fixing Examples](image)

Note: Other fixing systems can be considered, they are left up to the user’s initiative and are to be supplied by him.

**CURVE RADIi** (between 2 straight lengths).

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**STANDARD LP PROFILES**

![Table](table)

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For profiles other than silicone, increase the above values RgA/RgE/RgI by a minimum of 20%.

---

In order to obtain the full expansion and retraction of the seal, as well as guarantee its maximum efficiency, the minimum curve radii in the corners must be in accordance with the opposite table, which defines the value of the radius at the bottom of the groove according to the position of the curve in relation to the direction of the expansion.

Please consult our technical department for small sized circular seals.
END PLUGS

Linear seals may be manufactured with “solid” end plugs. In this case, the plugged areas are neutralised, as neither expansion nor contraction can occur.

Two constructions are possible: either by plugging the expanded seal or by plugging the retracted seal. When using either solution, it is necessary to provide flanges or end plates to hold the seal in order to prevent tearing caused by seal expansion (see flanges or retaining plates below).

Type with expanded end

![Diagram of Type with expanded end]

Type with retracted end

![Diagram of Type with retracted end]

<table>
<thead>
<tr>
<th>Ref. Nr. silicone</th>
<th>Ref. Nr. SBR</th>
<th>A x B</th>
<th>H₂</th>
<th>H₃</th>
<th>L</th>
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<td>42</td>
<td>54</td>
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<thead>
<tr>
<th>Ref. Nr. silicone</th>
<th>Ref. Nr. SBR</th>
<th>A x B</th>
<th>H₂</th>
<th>H₃</th>
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<td>10170</td>
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<td>110</td>
<td>90</td>
<td>100</td>
<td>80</td>
</tr>
</tbody>
</table>

**Note:** The dimension N represents the intermediate part between the active seal and the end plug which cannot come into contact with the face to be sealed. The efficiency of the seal is only obtained beyond L + N.

These parts must not be outside of the support face seals under any circumstances.

Flange or retaining plate

![Flange or retaining plate]
**DEFINITION OF SEAL ACCORDING TO DIRECTION**

**AXIAL EXPANSION (LAYOUT I)**
The working pressure $P_i$ is normal.

**INTERNAL RADIAL EXPANSION (LAYOUT II)**
The working pressure $P_i$ is 20 to 30% greater than the normal pressure.

**EXTERNAL RADIAL EXPANSION (LAYOUT III)**
The working pressure $P_i$ is normal or 15 to 25% higher.

The circular layouts I, II and III are also applicable for formed seals if the radius $R_gA$, $R_gE$ and $R_gI$ are followed (see pages 4 & 5).

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**END PLUGS**

For specific applications requiring expansion nearly all along the seal, EXPANDABLE end plugs are available upon request.

**Examples:**

![Diagram of end plugs]

**PLEASE CONSULT OUR TECHNICAL DEPARTMENT**
FITTNGS AND VALVES

Our standard fittings and valves are manufactured in brass. We also produce fittings in any other material, such as bronze, stainless steel and elastomers.

STANDARD FITTINGS

<table>
<thead>
<tr>
<th>Ø E</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>10</th>
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<td>M6</td>
<td>M8</td>
<td>M10</td>
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<table>
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<table>
<thead>
<tr>
<th>L</th>
<th>30/35</th>
<th>30/35/40</th>
<th>40/45/50</th>
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<td>60/70/80</td>
<td>70/80/90</td>
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<table>
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| Ø M  | M4  | M6  | 7,65x0,79 | M8  | 1/8 G  | M10 | 1/8 NPT | M12 | 1/4 G  | M14 | M16 |

| Ø J  | 1,2 | 3   | 3   | 5   | 6   | 6   | 6   | 6   | 6   | 8   |

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Notes:
- during the assembly of RJO fitting, it is important to secure the O-ring (chamfers 30°, smooth edges, etc.).
- RES fitting is only available in rubber.

STANDARD VALVES

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<tr>
<td>M</td>
<td>M6</td>
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</table>

<table>
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<tr>
<th>Ø J</th>
<th>1,5</th>
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<tr>
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<th>10x8</th>
<th>11x8</th>
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</table>

| Ø M  | M4  | M6  | 7,65x0,79 | M8  | 1/8 G  | M10 | 1/8 NPT | M12 | 1/4 G  | M14 | M16 |

| Ø J  | 1,2 | 3   | 3   | 5   | 6   | 6   | 6   | 6   | 6   | 8   |

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Notes:
- during the assembly of RJO fitting, it is important to secure the O-ring (chamfers 30°, smooth edges, etc.).
- RES fitting is only available in rubber.

SPECIAL FITTINGS

We offer a wide range of solutions. Please contact our Technical Department for more information.
POSITION OF FITTINGS AND VALVES

CEFIL’AIR® inflatable seals conception requires that connections be located at the bottom of the grooves or at the end of the seals (straight length). When seals have curves radii it is preferable to avoid connections located in the curved area. If the equipment around the seal for assembly or other reasons requires a lateral supply, it is possible to use elbow fittings or special constructions (please consult our technical department).

OVERMOLDED CONES

OVERMOLDED CONES (standard sizes)

For a maximum binding (metal/rubber), the fitting valves are equipped with an overmoulded rubber cone in accordance to their diameters (see table below).

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</tbody>
</table>

Note: For REC, REF, REP fittings, and CVL valves, please consider the size of the thread part (M) as the connection diameter (see sketches on page 7). In case of intermediate value (dimensions in inches), take the next larger cone. (For other sizes, please contact our technical department).

ASSEMBLY CONDITIONS

SURFACE FINISH

The mean roughness obtained by machining (lathe, mill, etc.) must not be less than the value of 0,8 to 1,6 microns Ra (L.C.A. Rugotest, standard N6 - N7). Applications where high performances are not required, 3,2 microns Ra are permissible (standard N8, L.C.A. Rugotest). Transverse scratches and local damage to the bearing surfaces to be sealed are prohibited.

PREPARATION OF GROOVES AND CONTACT FACE

Before installation, it must be verified that the groove taking the seal is free from roughness (grit or weld spatter, flash or projections sharp edges). If roughness occurs, this must be taken off before the installation, followed by degreasing with a suitable solvent.

INSTALLATION

1/ - The seal must be absolutely free from internal pressure at the time of fitting. If the valve is equipped with its mechanism, this must be removed during installation.

2/ - The installation of the seal in the groove must start, by positioning the pressure connexion (fittings or valves) in the (in) housings, then, the mechanical fixing is operated. It is important to make sure that splice vulcanisation is located far from the curve area.

3/ In order to fit the seal correctly, it is necessary to pressurise it immediately after positioning it in the glued groove, while observing the operation recommendations, i.e. perfectly captive on its four faces.

4/ It is possible to leave the CEFIL’AIR® seal pressurised throughout the time necessary for drying or vulcanizing the adhesives; it is also possible, after a short drying time, to retract it in order to complete the setting operation. However, it must only be moved after the bond is completely fixed.
ASSEMBLY CONDITIONS

FIXING THE SEALS

Although CEFIL’AIR® inflatable HP seals can be fitted in grooves without any form of retention, it is preferable to glue them to the bottom of the grooves. For this operation, it is recommended to use our general-purpose adhesive CEFIL’GRIP®, which can be applied directly to the metal when it has been thoroughly degreased and is free from rust or scale. For intensive utilizations of CEFIL’AIR® inflatable seals, we advise to prepare the support by a sanding process and to use the sticking primary (i.e. PM 820) and the silicone (RTV). If a different product than the one recommended is used, please check the instructions manual.

HP seals must be secured by the part opposite that of the seal (bottom of groove only), avoiding the use of adhesives on the lateral parts.

LP seals will preferably be fixed mechanically, but, if an adhesive is necessary, the gluing must be limited to the foot of the profile.

FIXING THE PRESSURE CONNECTION

The housing hole needs to have a conical part according to indications on page 9, to receive the overmoulded rubber cone of the seal. In the case of threaded connections (REC, REF, REP, CVL) tightening must be moderate and during this operation it is absolutely necessary to maintain the connection in order to avoid damaging the link between metal and rubber. It is important not to apply any torque to the fitting.
CALCULATIONS AND SUPPLY

APPLICATION FORCE (CALCULATIONS)

CEFIL’AIR® seals are retracted even with a residual internal pressure. Their expansion occurs above the latter and brings the contact and sealing face against for the moving part. The pressure necessary for expansion varies a little over a whole range of arrangements and depending on the profiles used. In the majority of cases, the minimum operating pressure is 1,5 bar. The inflation of the CEFIL’AIR® seal provides an application force proportional to a unit contact surface. The total applied load \((F_j)\) for the seal on the moving panel will be determined by:

\[
F_j = (P_i \times K_j) \times \mu \times D
\]

Where:
- \(P_i\) = Internal pressure of the seal in bar
- \(K_j\) = Coefficient of unit contact surface
- \(LD\) = Expanded length of the seal in cm

### EXAMPLE OF CALCULATION

For a CEFIL’AIR® seal with profile N° 347, with a diameter of 1500 mm and used at an internal pressure \(P_i\) of 2 bars

\[
F_j = (2 \times 1.2) \times (3.14 \times 150 \text{ cm}) = 1.130 \text{ da.N}
\]

(1) mean diameter

### PRESSURE SUPPLY

CEFIL’AIR® inflatable seals can be supplied either with gas or fluids. However, it is necessary to provide a constant supply, which must be guaranteed by a pressure regulator to avoid overpressure. Due to the relative permeability of elastomers (when inflated with air or gas) notably for silicone, it is necessary to provide pressure regulation for this type of inflation. It is also possible to use fluids (water, oil, etc.) to prevent elastomer gas permeability. (Please contact our technical department).

A Air collector  
B Pressure relief valve filter  
C Non return valve  
D Pressure gauge  
E Valve
EXAMPLES OF APPLICATION: “Sealing”

MOBILE BULKHEAD SEALING
WITH PROFILE REF. 514

STERILISER DOOR SEALING
WITH PROFILE REF. 369

NUCLEAR POWER STATION SEALING DOOR
WITH PROFILE REF. 10093

SEAL ON ISOTHERMAL BULKHEAD SEALING
WITH PROFILE REF. 369

COFFERDAM SEALING
WITH PROFILE REF. 10094

EXAMPLES OF APPLICATIONS: “Handling”

CEFIL’AIR® inflatable seals can also be used for the moving, handling, holding or clamping, particularly for fragile or complex geometry objects. (see following sketch).

TO LIFT
TO HOLD
TO CLAMP
TO PRESS

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Fax: +33 (0) 4 77 43 51 51
france@technetics.com
technetics.com
OTHER EXAMPLES OF PROFILES

2051  2190  1856  372  1406  2239

1812  1263  10266  10410  811  2104

OTHER EXAMPLES OF APPLICATIONS

SMALL DIAMETER

 Principle

 Locking on shaft
 Application: Handling of cylindrical pieces

Examples:
Locking on shaft
(cartridge mounting “minimum height occupied”)

Hole tightening
Application:
Handling hollow pieces (tube, bottle, etc.)

END PLUGS FOR TUBE
Example: “Mechanical expansion”

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COMPANY: TEL:  
CONTACT: EMAIL:  
ADDRESS: DATE:  
END USER: INSTALLATION LOCATION:  
REF: ACTIVITIES FIELD:  

N° CLIENT:  

WORKING CONDITIONS (Information requested for any enquiry)

New assembly or modifiable conception or  or  Existent not be change*  

Assembly position  Hoizontal  Under cover  Vertical  Slanting  
Function Needed  Sealing  or  Handling  
Pressure to seal*  Bars  or  Global Load Expected*  
Vacuum  Atmosphere  daN  
Working temperature*  (°C)  
Media*  Gas  Liquid  Vacuum  

Working cycles  

Inflating duration  per Hr. or  per Days or  per Months  
Deflating duration  per Hr. or  per Days or  per Months or  Year  

CONFIGURATION (Information requested for any enquiry) - dimensions in millimeter. Please provide drawing

Bottom groove cotation (Ag, …g, …)  
Face to seal cotation (A0, …0, …)  

Circular  
Axial expansion  
Mean Diameter D0 / Dg  
Clearance J  
Circular  
Internal radial expansion  
Diameter D0 / Dg  
Clearance J  
Circular  
External radial expansion  
Diameter D0 / Dg  
Clearance J  
Square right angle corners  
Axial expansion  
Mean length A0  
Mean width B0  
Valve position C0  
Clearance J  

Valve (Information requested for any enquiry)

Material: Stainless Steel  Brass  Rubber (RES only)  Other:  
Type:  Size: Diameter:  

ADDITIONAL DETAILS

Quantities:  
Spot Order:  
Yearly Order:
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