Where is vacuum used?

Precision Investment Casting (PIC) is a process carried out under vacuum to produce complex mechanical components such as turbine blades.

The ceramic mould is created by dipping the shaped wax into a ceramic slurry. The mould is then dewaxed by using a high pressure steam autoclave which rapidly flushes out the wax. The shell is then fired at high temperature to sinter the ceramic particles together. The metal is melted by induction and then poured into a ceramic mould with the component’s shape.

Typical precision investment casting systems

PIC furnaces usually have two chambers with two independent vacuum systems:

• First a Melting chamber, where alloy is melted / poured / allowed to solidify, is equipped with a high vacuum pump system with a diffusion pump.
• Second a Mould / load lock chamber for mould introduction is equipped with a medium vacuum pump / booster combination to pump down to typically less than 0.1 mbar in a maximum of 60 seconds to avoid any temperature drop in the mould.

Both melting and mould chambers collect large quantities of dust and particulate material that can reach vacuum systems especially during fast pump down.

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## Solutions

### Dry pumping systems - Recommended technology

<table>
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<tr>
<th>Dry pumps</th>
<th>MAXX vacuum systems</th>
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</thead>
<tbody>
<tr>
<td>GXS dry screw pumps and GMB booster combinations</td>
<td>GXS pump range is systemised with pXH mechanical boosters available in two models:</td>
</tr>
<tr>
<td>• GXS160, GXS160/1750</td>
<td>• pXH4500, displacement 6,766 m³/h</td>
</tr>
<tr>
<td>• GXS250, GXS250/2600</td>
<td>• pXH6000, displacement 8,358 m³/h</td>
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<tr>
<td>• GXS450, GXS450/2600, GXS450/4200</td>
<td></td>
</tr>
<tr>
<td>• GXS750, GXS750/2600, GXS750/4200</td>
<td></td>
</tr>
</tbody>
</table>

**Benefit:** Dry pump systems substantially reduce maintenance and operating costs.

- Increased tolerance to particles created by the melt
- Clean residual vacuum
- Elimination of oil back streaming which is a source of contamination and degassing in the furnace
- Large water vapour pumping capacity aids drying of the new chamber lining
- Elimination of oil mist at the exhaust and external oil leaks

### Oil Sealed pumping systems - Conventional technology

<table>
<thead>
<tr>
<th>Stokes microvac rotary piston pumps with EH and 6” Stokes booster combination</th>
<th>Diffusion pumps</th>
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<tr>
<td>• 212J</td>
<td>• HT10</td>
</tr>
<tr>
<td>• 412J</td>
<td>• HT16B</td>
</tr>
<tr>
<td>• 612J</td>
<td>• HT20B</td>
</tr>
</tbody>
</table>

**Benefit:** Generally, oil sealed pumps have high operating and maintenance costs. If oil sealed technology is to be used, piston pumps are the vacuum pump of choice.

- Rugged and less sensitive to dust and vapour handling
- Low rpm operation for the longest pipe life cycle
- Efficient, time proven design to deliver ease of maintenance

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Edwards’ Benefits

GXS dry screw pumps

160 m³/h - 750 m³/h primary pumps with pumping speeds up to 3,450 m³/h with vacuum boosters. Equipped with an intelligent on-board controller with extensive communication and automated control capabilities.

- Highly reliable
  Ability to handle harsh processes

- Low maintenance cost
  No unplanned down-time

- Increased productivity
  Longer intervals between services

- Safe operation, consistent output
  Automated control of your process

MAXX vacuum systems

The GXS pump range is complemented by the new generation of pXH large mechanical boosters for an integrated flexible modular skid design.

- Variety of pump combinations ensure optimized configurations
  Delivering the performance required by your processes

- Easy to upgrade
  Whenever you need more capacity
Diffusion pumps

Our Industrial, high throughput diffusion pumps are ideal for the precision investment casting application.

**Increased productivity**
High throughput pumping

**Stable performance**
High backing line pressure

**Better end product quality**
Low oil back streaming

Microvac rotary piston pumps

Packaged with EH range or 6” series of mechanical boosters.

**Value for investment**
Low rotational speed enables the longest pump life cycle

**Easy maintenance on site**
Robust simple mechanism for high reliability and ease of rebuild

**Proven, tested; peace of mind**
Over 80 years of time tested proven performance

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