Precision Gas Nitriding Using The ZeroFlow® Method

Gas nitriding and ferritic nitrocarburizing require ammonia gas. The ZeroFlow® method was developed by SECO/WARWICK to simplify the nitriding process through the economical use of only raw ammonia (NH₃). The control of the nitriding atmosphere chemical composition, and therefore the control of nitriding potential (Np), is performed automatically via the ZeroFlow software and hardware controls.
To develop the ZeroFlow gas nitriding process, SECO/WARWICK worked with world-renowned, gas nitriding expert Professor Leszek Małdziński from the Institute of Work Machines and Vehicles of the Technical University in Poznan, Poland.

**Typical Gas Nitriding Applications:**
- Aluminum extrusion dies (H13)
- Nitriding of molds for aluminum pressure die casting
- Nitriding of crankshafts for engines of racing cars (4340)
- Nitriding of gears (4140, for various power transmission, like wind energy and turbines)
- Nitrocarburizing and post-oxidation of shafts (wear and corrosion resistance)
- Nitrocarburizing of gears for diesel engines and transmissions
SECO/VACUUM uses two basic types of furnaces for precision gas nitriding. One is a horizontal, front-loading retort furnace (Type HRN). The second is a vertically loaded (via crane) retort pit furnace (Type VRN).

The table shows the most standard sizes of each, with other various sizes offered as required on a semi-custom basis. These multi-process furnaces are excellent for precision gas nitriding, but can also be used for other processes including nitrocarburizing, post-oxidation (black), stress relief, precipitation hardening, tempering, and annealing, all in nitrogen. Coupled with vacuum purge, even cleaner finishes are possible. Uniformity is excellent.

**Benefits:**
- Lowest consumption of gases among competing nitriding processes
- Simplified gas system
- Proper safety controls
- Options of nitrocarburizing and post-oxidation, sulfonitriding, and oxy-nitriding
- Highly accurate formation of the nitrided layer due to precise control and equilibrium character of the process
- Activation options for various materials used in precision gas nitriding
- Vacuum purging of the retort minimizes nitrogen gas use
- Quick and precise atmosphere analysis, automatically and in-situ (no sampling lines needed)
- Low operational and ownership costs

**Features:**
- Well over 100 retort units installed over many years
- Special sealing system for the cover, atmosphere motor and retort (as in vacuum furnaces)
- Vacuum purge system removes air at beginning of cycle [or mid-cycle for pre-oxidation (up to 700°F)]. Vacuum can also be used for end of cycle
- Standard cooling via cold air blower on retort. Accelerated cooling with optional atmosphere “turbo” cooler (water cooled heat exchanger)
- Precise nitriding potential control and extensive data documentation via advanced controls
- Atmosphere exhaust burner
### Standard Sizes:

<table>
<thead>
<tr>
<th>Horizontal Model #</th>
<th>Useful Dimensions in (mm)</th>
<th>Gross Load Lbs (kg)</th>
<th>Working Temperature °F (°C)</th>
<th>Temperature Uniformity °F (°C)</th>
<th>Number of Heating Zones</th>
</tr>
</thead>
<tbody>
<tr>
<td>HRNe*--60.60.90-750-6-ZF</td>
<td>24x24x36 (600x600x900)</td>
<td>1320 (600)</td>
<td>300-1380 (150-750)</td>
<td>±9° (±5°)</td>
<td>one</td>
</tr>
<tr>
<td>HRNe*--90.90.120-750-15-ZF</td>
<td>36x36x48 (900x900x1200)</td>
<td>3300 (1500)</td>
<td>300-1380 (150-750)</td>
<td>±9° (±5°)</td>
<td>three</td>
</tr>
<tr>
<td>HRNe*--100.100.150-750-25-ZF</td>
<td>40x40x60 (1000x1000x1500)</td>
<td>5500 (2500)</td>
<td>300-1380 (150-750)</td>
<td>±9° (±5°)</td>
<td>three</td>
</tr>
</tbody>
</table>

*HRNe - Horizontal Retort Nitrider - Electrically Heated
Note: HRNg natural gas heated models also available

<table>
<thead>
<tr>
<th>Vertical Model #</th>
<th>Diameter in (mm)</th>
<th>Height in (mm)</th>
<th>Gross Load Lbs (kg)</th>
<th>Working Temperature °F (°C)</th>
<th>Temperature Uniformity °F (°C)</th>
<th>Number of Heating Zones</th>
</tr>
</thead>
<tbody>
<tr>
<td>VRNe--100.200-650-25-ZF</td>
<td>39 (1000)</td>
<td>78 (2000)</td>
<td>5500 (2500)</td>
<td>300-1200 (150-650)</td>
<td>±9° (±5°)</td>
<td>three</td>
</tr>
<tr>
<td>VRNe--120.300-650-50-ZF</td>
<td>47 (1200)</td>
<td>118 (3000)</td>
<td>11000 (5000)</td>
<td>300-1200 (150-650)</td>
<td>±9° (±5°)</td>
<td>three</td>
</tr>
</tbody>
</table>

*VRNe - Vertical Retort Nitrider - Electrically Heated