V-LINE® Direct Casting
Injection Molding Machine for Aluminum Alloy

ALM450
Released injection molding machine for aluminum alloy without a melting furnace and holding furnace*

**Aluminum Molding Revolution**

The “ALM450” enables excellent injection molding of aluminum alloy without a melting furnace and holding furnace, by Sodick’s unique technology based on space-saving and safe design.

The development of this revolutionary molding accelerates the replacement of materials from steel to aluminum, thinner, more complicated and refinement of existing aluminum molded products, which brings an energy saving effect to automobile related and other related fields by weight reduction.

---

**V-LINE® Direct Casting**

Adopted the V-LINE® Direct Casting structure equipped with a melting cylinder which melts the aluminum, and an injection cylinder that injects the material into the mold. The separated melting and injection processes enable accurate and efficient molding.

---

**Features of “ALM450”**

- **V-LINE® Direct Casting**
  - Adopted the V-LINE® Direct Casting structure equipped with a melting cylinder which melts the aluminum, and an injection cylinder that injects the material into the mold. The separated melting and injection processes enable accurate and efficient molding.

- **Sodick’s Hybrid Direct Pressure Mold Clamping (SHDC)**
  - Smooth mold opening/closing is possible while maintaining accurate parallelism of the platens and high straightness of operation, which realizes excellent molding quality and reduces the maintenance frequency by preventing damage to the mold.
ALM450

Superiority of "ALM450"

No melting furnace and holding furnace
This machine is designed so that peripheral equipment, including a melting furnace that melts the aluminum, holding furnace that maintains the melted aluminum state, ladle that supplies the melted aluminum to the sleeve of the die casting machine, and a robot are not required which reduces the space to install this equipment, and improves safety because maintenance is not necessary.

Capable of various types of molding
Holds the molten bath close to the product of the mold which improves the appearance quality of thin products, because the bath flows easily without cooling down. The reduced entrainment of air by low speed injection allows the pressure to be transmitted directly by the holding pressure effect, which reduces the internal defect phenomena of thick products. It also allows injection at a high vacuum realm, which reduces the cavities in the casting. "2"

Excellent usability
The environment-friendly structure demonstrates efficient energy savings, because the amount of aluminum only required per molding cycle is melted. In addition to space-saving, improvements in safety and reduction of maintenance, the molding machine can be stopped and restarted easily, because it is not necessary to remove the molten bath that remains in the cylinder.

Features of V-LINE® Direct Casting: Comparison with conventional method (Die casting method)

<table>
<thead>
<tr>
<th>Name</th>
<th>Conventional method: Cold chamber method</th>
<th>Sodick: V-LINE® Direct Casting</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Technological features</strong></td>
<td>light metal die casting, particularly the main casting method of aluminum products*3</td>
<td>Sodick’s uniquely developed injection molding of aluminum molded products</td>
</tr>
<tr>
<td></td>
<td>equiped with a melting furnace and holding furnace</td>
<td>*No melting furnace and holding furnace</td>
</tr>
<tr>
<td></td>
<td>No pressure chamber in the molten bath</td>
<td>*Molten bath flows through the cylinder</td>
</tr>
<tr>
<td><strong>Yield and quality</strong></td>
<td>After the molten bath is supplied to the sleeve, a plunger is pushed in to supply the molten bath into the mold. Low stability of the quality and yield, because the start of solidification of the melted aluminum and entrainment of air cannot be avoided.</td>
<td>The aluminum is melted in the melting cylinder, measured by the injection cylinder, and after back flow prevention is applied it is injected. The quality and yield can be improved because it holds the melted state of the aluminum without entrainment of air.</td>
</tr>
<tr>
<td>1. Mold clamping</td>
<td>(Supply molten bath)</td>
<td><strong>Melting cylinder</strong></td>
</tr>
<tr>
<td>2. During injection</td>
<td>(During casting)</td>
<td><strong>Injection cylinder</strong></td>
</tr>
<tr>
<td>3. Injection completed</td>
<td>(Casting completed)</td>
<td><strong>Backflow prevention pin</strong></td>
</tr>
<tr>
<td><strong>Space</strong></td>
<td>In addition to the die casting machine, peripheral equipment, such as a melting furnace, holding furnace, ladle and robot are required.</td>
<td>The installation space of the ALM450 (including heater power supply) is all that is required.</td>
</tr>
<tr>
<td><strong>Melting temperature</strong></td>
<td>Although the melting temperature of aluminum for die casting is 600 °C, the melting and holding is controlled from 720 °C to 750 °C in the melting furnace and holding furnace to prevent solidification of the aluminum to be supplied.</td>
<td>Since the melted aluminum is always held in the flow path without contacting ambient air, only the melting temperature is required which contributes to energy saving.</td>
</tr>
<tr>
<td><strong>Holding pressure</strong></td>
<td>A high pressure force is required because the almost hardened biscuit is pressed at a high pressure, which generates a pressure loss even on the inside.</td>
<td>Directly applying pressure to the molten bath, transfers the material to the fine portions of the product.</td>
</tr>
</tbody>
</table>

*1: Based on Sodick’s research

*2: Separate vacuum equipment is required

*3: Hot chamber method: The casting method of light metals except for aluminum. This method is not yet ready for aluminum.
A pressure chamber is provided in the molten bath without a melting furnace and holding furnace.
Realized Injection Molding of Aluminum Alloy

V-LINE® Direct Casting

Sodick’s unique V-LINE® Direct Casting realized through the application of independently developed materials that suppress the melting loss by melting aluminum to the flow path of the melting cylinder that melts the aluminum and the injection cylinder that injects the melted aluminum, provides innovated injection molding of aluminum alloy.

Structure of V-LINE® Direct Casting

Molding Material and Material Supply Unit

Aluminum with a diameter of φ90 mm or φ120 mm and length of 200 mm is used as the molding material. Several aluminum billets are supplied to the stocker, and are automatically supplied to the melting cylinder one at a time. The material can be controlled more safely.

Structure of V-LINE® Direct Casting

The aluminum billets supplied from the supply unit are inserted into the melting cylinder, and are melted by a heater. This system is designed so that the aluminum required for one shot is supplied to the injection cylinder.

Direct Nozzle

The direct nozzle which directly contacts the mold realizes a stable molding quality.
V-LINE® Direct Casting Injection Molding Machine for Aluminum Alloy

Molding Process of V-LINE® Direct Casting

By independently controlling the entire process from injection to melting, the V-LINE® Direct Casting realizes three stability factors; 1) melted state of the aluminum, 2) measurement of the aluminum volume, and 3) actual filling volume.

1. Supply 1
   A billet is inserted from the supply unit to the supply port.

2. Supply 2
   A pusher moves forward to supply the billet to the melting cylinder. This operation is repeated for the volume of one shot.

3. Melting
   Melted in the melting cylinder.

4. Measurement
   The unmelted and semi-melted billet in front of the pusher supplies melted aluminum to the injection cylinder.

5. Backflow prevention
   The backflow prevention pin moves forward to close the flow path.

6. Stable measurement of aluminum volume
   The temperature is controlled to the nozzle at a relatively low temperature, which suppresses the occurrence of hydrogen.

7. Stable melted state
   The pressure spreads into the fine portions at a low pressure, because the holding pressure directly applies pressure on the bath, which is effective in reducing internal defects.

8. Stable actual filling volume
   There are almost no factors that would accelerate the solidification during injection, because the distance between the molten bath in the nozzle and the mold is very close.

Effectiveness of V-LINE® Direct Casting
Reproduces accurate and uniform mold clamping force  
Sodick's Hybrid Direct Pressure Mold Clamping  

**SHDC**  
Sodick Hybrid Direct Clamp  
The "ALM450" is equipped with Sodick’s unique hybrid direct pressure mold clamping (SHDC). The perfect repeatability of the trajectory required for opening and closing of the mold, and the high level of uniformity and reproducibility required for the mold clamping force, demonstrates an excellent sense of stability of the V-LINE® Direct Casting.

**Structure of SHDC**

- Electric servo motor mechanism which accurately controls the position during the mold opening/closing
- Hydraulic cylinder mechanism which reproduces a uniform mold clamping force during the mold clamping

**SHDC mechanism which supports V-LINE® Direct Casting**

- High rigidity platen structure
- Maintains long span
- Ensures platen position
- Direct pressure method: Generates uniform clamping pressure in the center
- Platen not held by tie bars: Eliminates effect of tie bar strain
- LM guide platen support: Ensures the repeatability of the trajectory

**Operation accuracy**

1. The repeatability of the trajectory is high with the support of the LM guide and mold clamping ram, which makes it easy to maintain the position of the movable platen.

**Effect from disturbances**

2. The mold clamping force by hydraulic pressure is not affected by disturbances, such as the temperature.

**Load distribution**

3. An unbalanced load does not occur with the ball screw drive in the center.
Molding Example
Tablet PC Case

- **Conditions**
  - Material: Al-Si (4,000 series)
  - Product size: 280×200×10mm
  - Thinnest portion: 1.2 mm (Almost entire surface)
  - Nozzle cross-section: 2.5 cm² = Gate crosssection area
  - Injection speed: 1.2 m/sec (No low speed area)
  - Holding pressure: 40MPa-0.1sec
  - Mold temperature: 200 °C, water cooling for sprue and vent portions
  - Mold lubricant: Oil
  - Vacuum: None

Evaluation of Molded Product
As a result of a micro observation of a fractured surface, there were almost no cavities in the microstructure with excellent flowability, and a stable molding quality by the effectiveness of the holding pressure could be confirmed.

- **Fractured surface structure observation**
- **Fractured surface microstructure observation**

---

### ALM450

---

#### Specifications

<table>
<thead>
<tr>
<th>Clamping Unit</th>
<th>Injection unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. clamping force</td>
<td>Al material diameter mm</td>
</tr>
<tr>
<td>Tie bar distance</td>
<td>90</td>
</tr>
<tr>
<td>Open daylight</td>
<td>Plunger diameter mm</td>
</tr>
<tr>
<td>Min./Max. mold thickness</td>
<td>Max. injection pressure MPa</td>
</tr>
<tr>
<td>Mold open/clos force</td>
<td>Theoretical injection volume cm³</td>
</tr>
<tr>
<td>Ejector projection force kN</td>
<td>Injection rate cm³/s</td>
</tr>
<tr>
<td>Ejector stroke mm</td>
<td>Max. injection speed mm/s</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Machine dimensions / Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine dimensions (L x W x H) mm</td>
</tr>
<tr>
<td>Machine weight kg</td>
</tr>
</tbody>
</table>
Machine Dimensions & Installation Drawing

Mold Installation Dimensions Drawing

Unit: mm

Sodick Co., Ltd.

3-12-1, Nakamachidai, Tsuzuki-ku, Yokohama, Kanagawa
224-8522 Japan
TEL: 81-45-942-3111  FAX: 81-45-943-7880
http://www.sodick.jp