

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

# **ALM450**



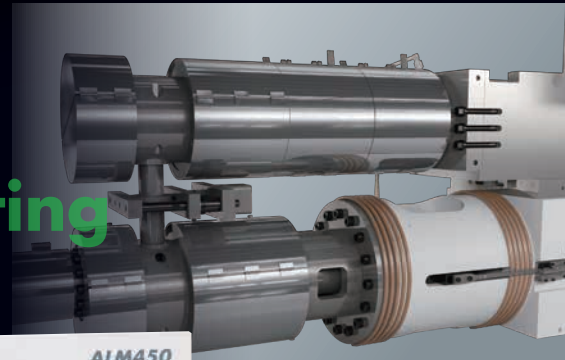
World's First\*\*

Released injection molding machine for aluminum alloy without

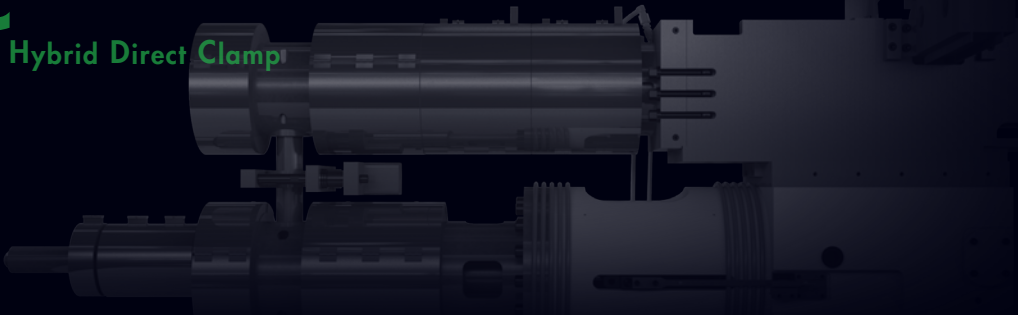
# Aluminum Molding Revolution

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



SHDC  
Sodick Hybrid Direct Clamp



## 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.



# a melting furnace and holding furnace\*1

# ALM450

\*1: Based on Sodick's research

## 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

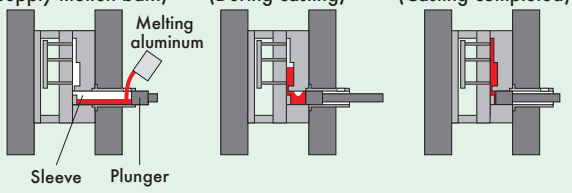
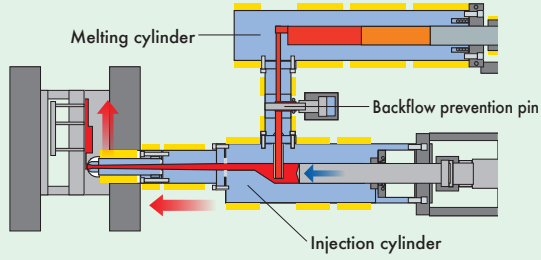
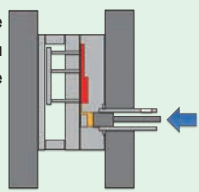
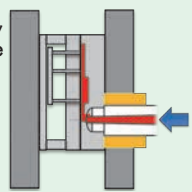
Holds the molten bath close to the product of the mold which improves the appearance quality of thin products, because the bath flows easily without cooling down. The reduced entrainment of air by low speed injection allows the pressure to be transmitted directly by the holding pressure effect, which 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

\*2: Separate vacuum equipment is required

### ❖ 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)

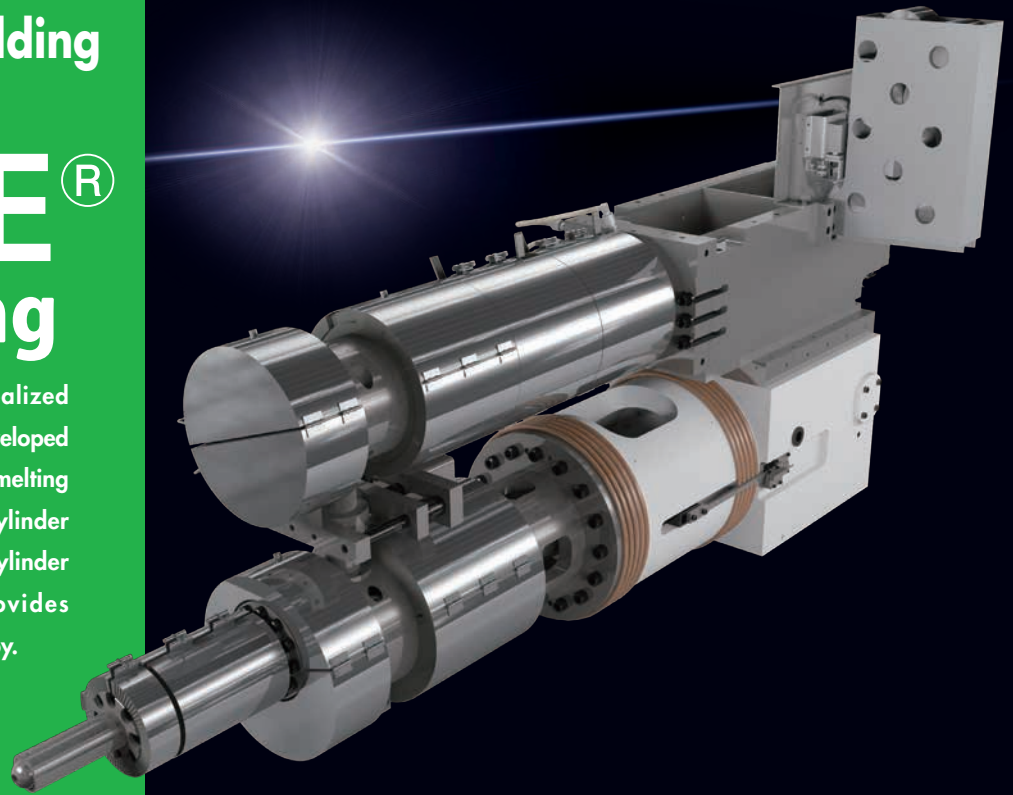
Name	Conventional method: Cold chamber method	Sodick: V-LINE® Direct Casting
Technological features	<p>Light metal die casting, particularly the main casting method of aluminum products*3</p> <ul style="list-style-type: none"> <li>● Equipped with a melting furnace and holding furnace</li> <li>● No pressure chamber in the molten bath</li> </ul>	<p>Sodick's uniquely developed injection molding of aluminum molded products</p> <ul style="list-style-type: none"> <li>● No melting furnace and holding furnace</li> <li>● Molten bath flows through the cylinder</li> </ul>
Yield and quality	<p>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.</p> <p>1. Mold clamping (Supply molten bath)    2. During injection (During casting)    3. Injection completed (Casting completed)</p>  <p>Sleeve Plunger Melting aluminum</p>	<p>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.</p>  <p>Melting cylinder Backflow prevention pin Injection cylinder</p>
Space	In addition to the die casting machine, peripheral equipment, such as a melting furnace, holding furnace, ladle and robot are required.	The installation space of the ALM450 (including heater power supply) is all that is required.
Melting temperature	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.	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.
Holding pressure	<p>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.</p> 	<p>Directly applying pressure to the molten bath, transfers the material to the fine portions of the product.</p> 

\*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.

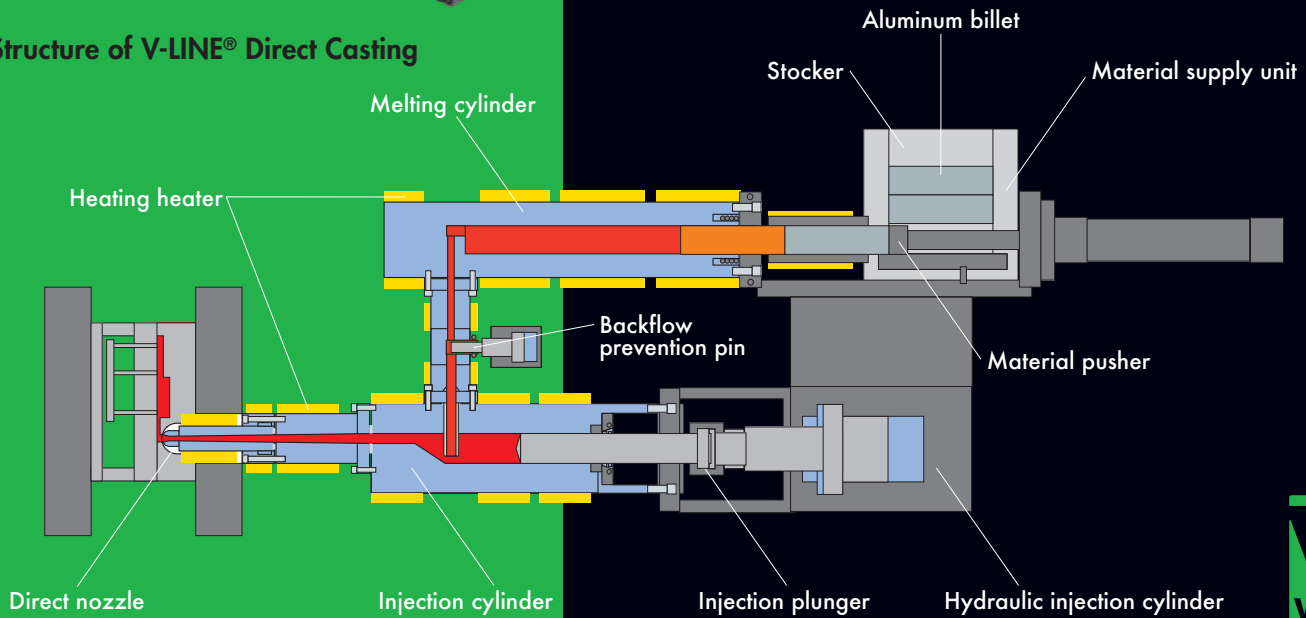
# Realized Injection Molding of Aluminum Alloy

# V-LINE<sup>®</sup> Direct Casting

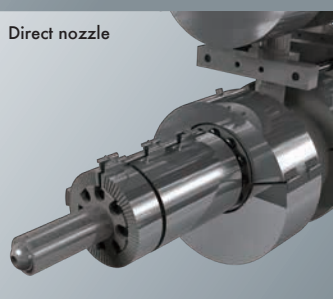
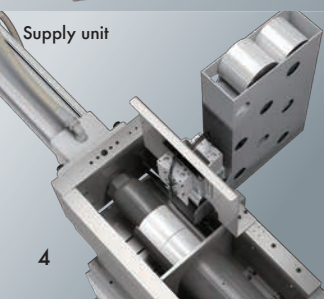
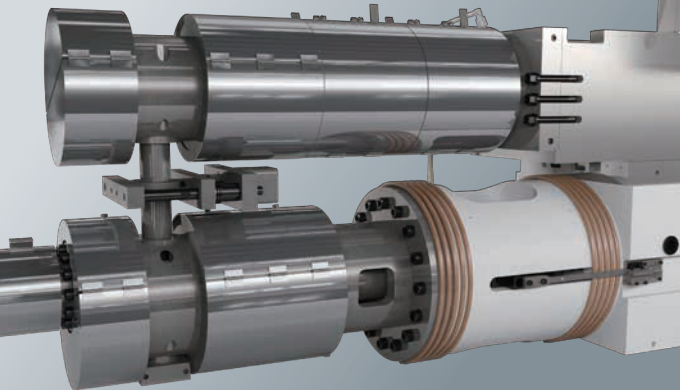
Sodick's unique V-LINE<sup>®</sup> Direct Casting realized through the application of independently developed materials that suppress the melting loss by melting aluminum to the flow path of the melting cylinder that melts the aluminum and the injection cylinder that injects the melted aluminum, provides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



## Structure of V-LINE<sup>®</sup> Direct Casting



V-LINE<sup>®</sup> Direct Casting



## Molding Material and Material Supply Unit

Aluminum with a diameter of  $\phi 90$  mm or  $\phi 120$  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.



Molding material: Aluminum billets

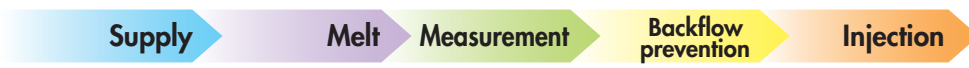
## Structure of V-LINE<sup>®</sup> Direct Casting

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

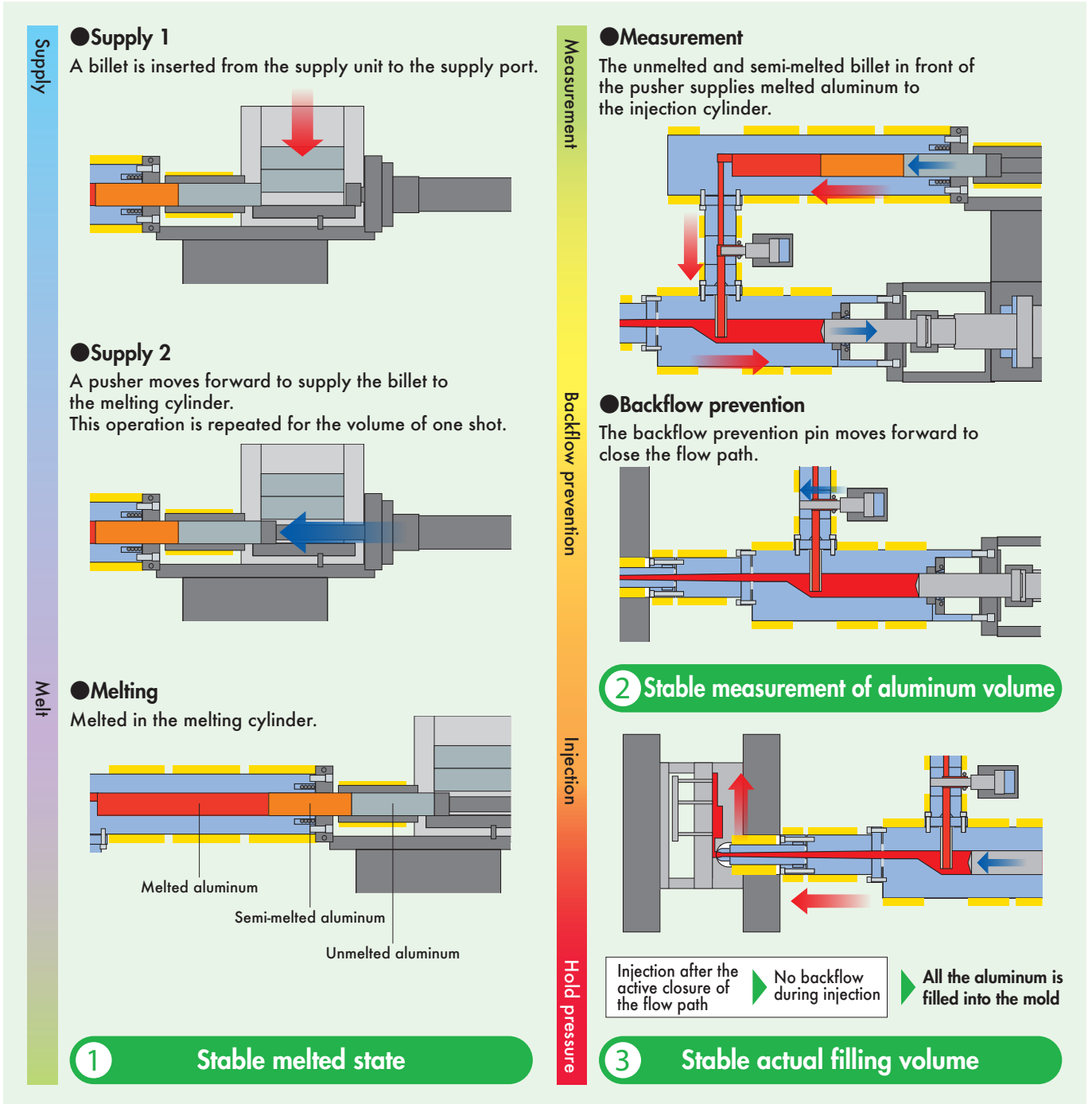
The direct nozzle which directly contacts the mold realizes a stable molding quality.

**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.



**Effectiveness of V-LINE® Direct Casting**

<p>Effectiveness</p> <p><b>1</b></p> <p><b>Low speed</b></p> <p>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.</p>	<p>Effectiveness</p> <p><b>2</b></p> <p><b>Low pressure</b></p> <p>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.</p>	<p>Effectiveness</p> <p><b>3</b></p> <p><b>Low temperature</b></p> <p>The temperature is controlled to the nozzle at a relatively low temperature, which suppresses the occurrence of hydrogen.</p>
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# Reproduces accurate and uniform mold clamping force

Sodick's Hybrid Direct Pressure Mold Clamping

# SHDC

Sodick Hybrid Direct Clamp

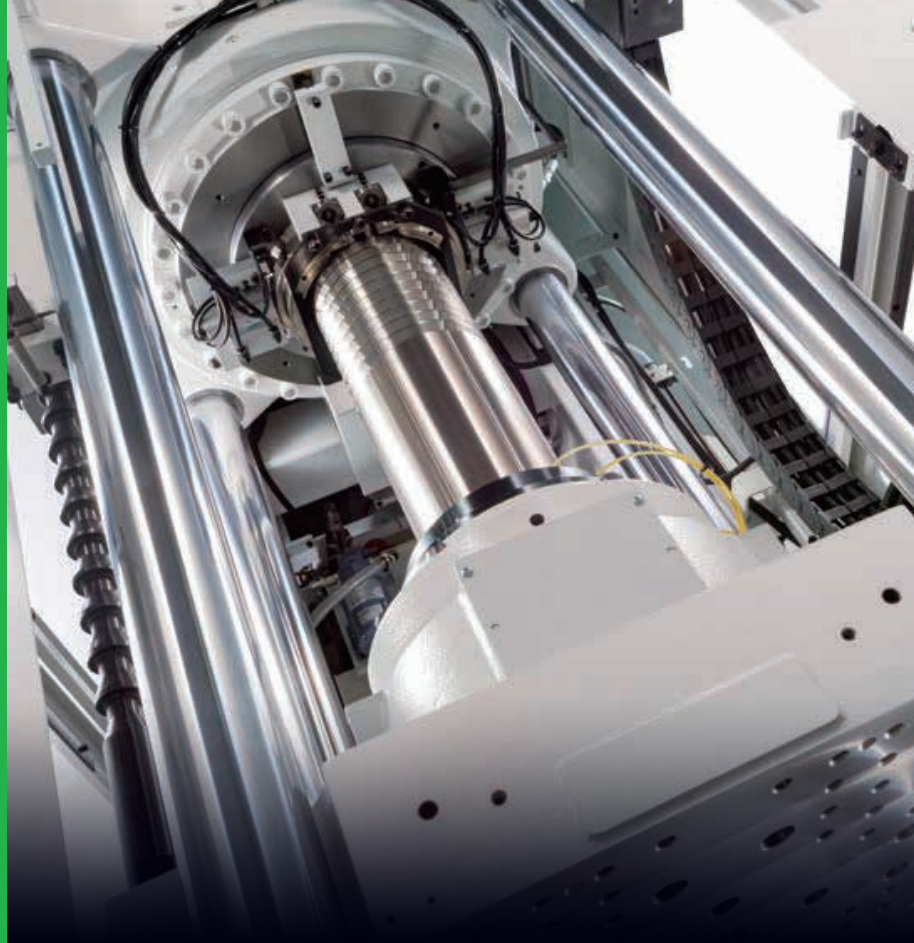
The "ALM450" is equipped with Sodick's unique hybrid direct pressure mold clamping (SHDC).

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.

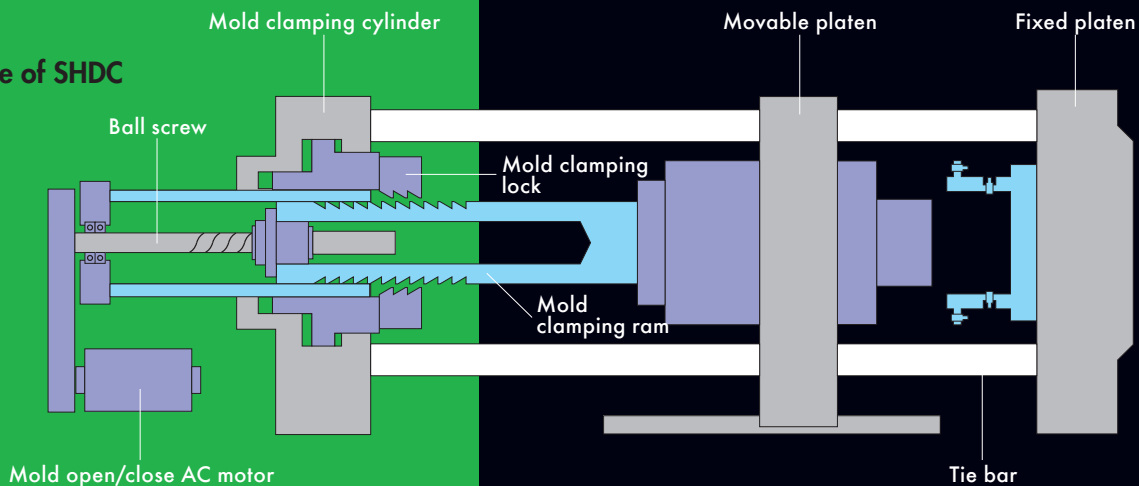
Electric servo motor mechanism which accurately controls the position during the mold opening/closing



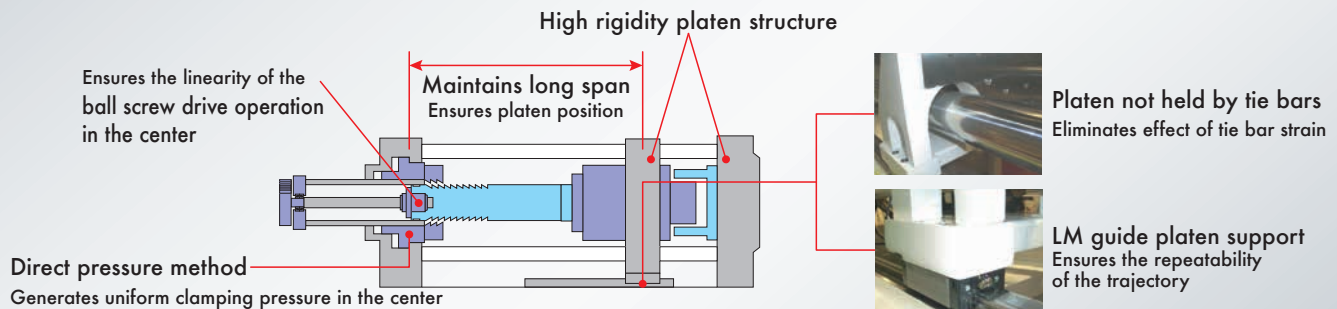
Hydraulic cylinder mechanism which reproduces a uniform mold clamping force during the mold clamping



## Structure of SHDC



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



1

### Operation accuracy

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.

2

### Effect from disturbances

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

3

### Load distribution

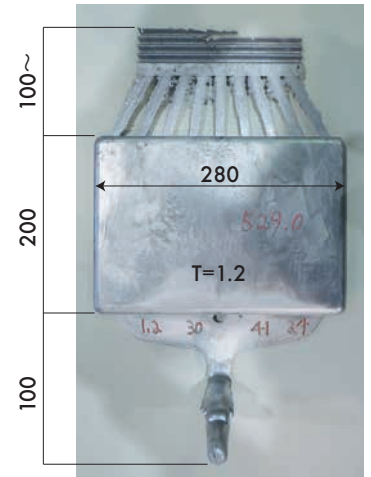
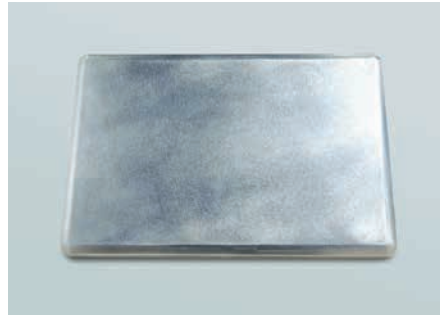
An unbalanced load does not occur with the ball screw drive in the center.

**Molding Example**

Tablet PC Case

■ **Conditions**

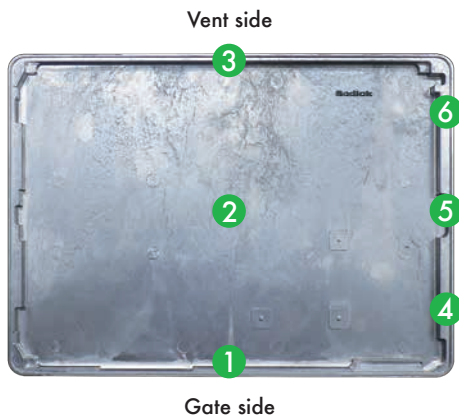
- Material : Al-Si (4,000 series)
- Product size : 280×200×10mm
- Thinnest portion : 1.2 mm (Almost entire surface)
- Nozzle cross-section : 2.5 cm<sup>2</sup> = Gate cross-section area
- Injection speed : 1.2 m/sec (No low speed area)
- Holding pressure : 40MPa-0.1sec
- Mold temperature : 200 °C, water cooling for sprue and vent portions
- Mold lubricant : Oil
- Vacuum : None



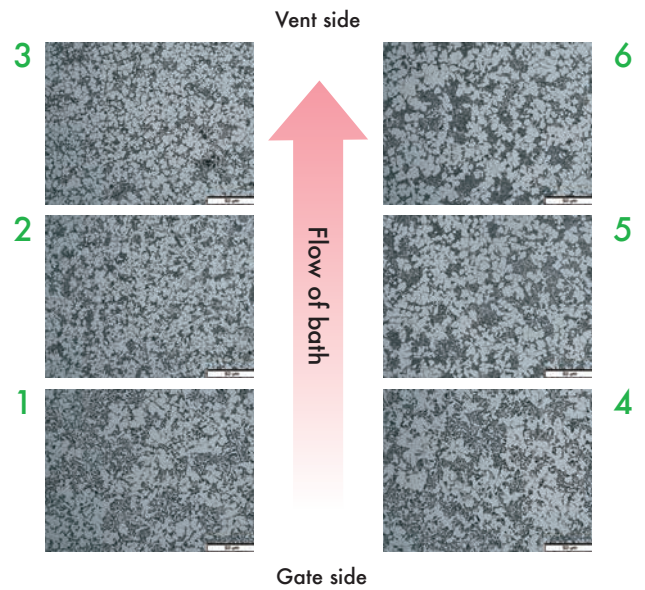
**Evaluation of Molded Product**

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

**Clamping Unit**

Max. clamping force	kN	4,410
Tie bar distance	mm	820 × 820
Open daylight (Min. mold thickness + Max. stroke)	mm	1,240
Min./Max. mold thickness	mm	340 / 900
Mold open/close force	Rated/Instantaneous kN	24.7/49.4
Ejector projection force	kN	252
Ejector stroke	mm	100

**Injection unit**

Al material diameter	mm	90	120
Plunger diameter	mm	90	120
Max. injection pressure	MPa	50	40
Theoretical injection volume	cm <sup>3</sup>	826	1810
Injection rate	cm <sup>3</sup> /s	31,808	33,929
Max. injection speed	mm/s	5,000	3,000

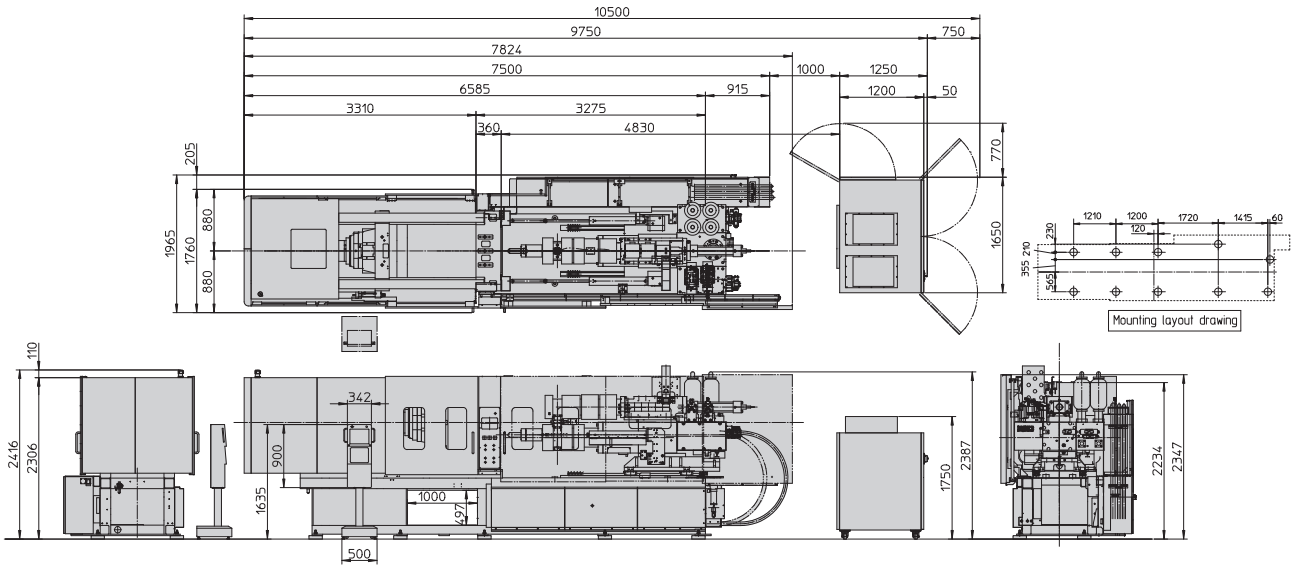
**Machine dimensions / Weight**

Machine dimensions (L x W x H)	mm	9,750 × 1,965 × 2,386
Machine weight	kg	21,000    22,000

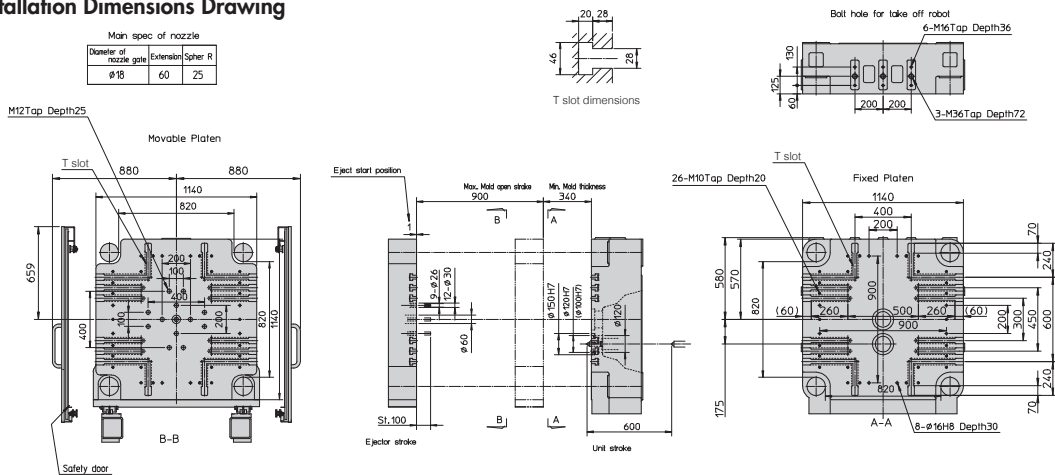
# ALM450



## Machine Dimensions & Installation Drawing



## Mold Installation Dimensions Drawing



Unit: mm

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