Middle-size models
Si-280-6 / Si-350-6 / Si-450-6

Fully Electric Injection Molding Machine

Si-6 series

Large-size models
Si-680-6 / Si-850-6 / Si-950-6

Customer’s Value Up

A Hitachi Group Company
SMART MOLDING
Powerful yet Simple Process Control

Si-6series

The Si-6 series provides a SMART solution to ever-complicated injection molding process.

New control SYSTEM 600
Easy-to-operate control system including an easy-to-see 15-inch LCD touch panel, high precision mold protection, and versatile trouble diagnosing function

Space-efficient design
Easy factory floor layout or machine replacement thanks to small footprint of the machine

Easy maintenance
Much easier maintenance work thanks to the nozzle-touch-rod-eliminated structure, one-touch connection of the nozzle heater and thermocouple, and light covers with fewer fixing bolts

Environmental friendliness
Reduced and digitally visualized power consumption boosts energy saving activity and evokes eco-consciousness.
Globally-uniformed specifications

Standardized multi-language screen and common safety specifications covering all the destinations of the machine

Japan (K1001: The Japan Society of Industrial Machinery Manufacturers)
China (GB22530: National Standard)
Europe (CE Mark)
North America (ANSI/SPI)
South Korea (KC Mark)
Brazil (NR-12)

Safety specifications are available to meet the safety standards for each country.

LINE UP

Six models in middle and large sizes

Actual appearance will differ depending upon the destination and specifications.

Middle-size models
Si-280-6 / Si-350-6 / Si-450-6

Large-size models
Si-680-6 / Si-850-6 / Si-950-6

Wide selection of injection units for your specific needs

<table>
<thead>
<tr>
<th>Injection unit construct</th>
<th>Injection unit</th>
<th>Screw diameter (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Si-280-6</td>
<td>J370D</td>
<td>50</td>
</tr>
<tr>
<td>Si-350-6</td>
<td>J450D</td>
<td>55</td>
</tr>
<tr>
<td>Si-450-6</td>
<td>K600D</td>
<td>60</td>
</tr>
<tr>
<td>Si-680-6</td>
<td>L750D</td>
<td>66</td>
</tr>
<tr>
<td>Si-850-6</td>
<td>M750D</td>
<td>83</td>
</tr>
<tr>
<td>Si-950-6</td>
<td>N1100D</td>
<td>110</td>
</tr>
</tbody>
</table>

Standard injection units and screw diameters
Totally new control system
New stage of high speed and high response operation

Equipped with an easy-to-operate large touch panel, the latest control system SYSTEM 600 provides a variety of enhanced functions including improved mold protection and operator-supporting functions such as mold condition analyzing and molding navigation.

15-inch touch panel

Having the same setting items and screen layout as before, the gray-tone touch panel has become larger for greater visibility and operability.

HSP mold protection system

High response of SYSTEM 600 control and specially set two torque monitoring areas combined, the HSP (High Sensitive Protection) mold protection system shows greater performance in protecting the mold from damage due to product pinching between mold halves. Mold protection accuracy has been much improved even in high cycle operation, so that cycle time can be shortened without concern for any damage to the mold.

Example of foreign object detection

In testing the effect of the HSP system, a 5.82 mm-thick molding was placed between the mold halves on the Sr-280-6.

Comparison of crush volume in foreign object detection test

The HSP system reduced the "crush volume" by 55% at maximum.
Trouble diagnosing support  NEW

For quick recovery, data necessary to diagnose a trouble are automatically stored.
The four graphs shown below are automatically stored when any alarm is issued in a certain cycle.
This function is particularly useful to solve a trouble at a unmanned night shift or a seldom-reproducible trouble.

Graphs:
- Injection graph
- Cycle graph
- Metering graph
- Cycle logic graph

These four graphs are automatically stored in a USB memory in a cycle where
the machine has stopped due to any alarm.

Molding condition analyzing function  NEW

By comparing operator-set molding parameters with the stored reference data*, this analyzing function finds out setting problems
and displays advice for correction, so that an operator can set proper molding conditions in a short time.

Automatic identification of setting problems
- Oversight in parameters setting
- Unintended machine motion

Corrective advice on the screen
- Problematic settings are displayed
- Problem visualization leads to quality molding

* Reference data has been established based on Toyo's long standing experience.

Molding navigation system

This system guides an operator step-by-step along the setting process of molding parameters based on the basic setting principle.
This function is helpful not only for novice operators not accustomed to Toyo molding machines but for molding experts to recall the basic setting method.

Other special functions

I Just Pack control  High precision holding pressure control
By precisely controlling the holding pressure right after the first
injection process, smoother melt filling can be made compared with
conventional control. This control suppresses burrs and minimizes
the residual stress that tends to cause warping.

I V-mode injection control  Response-speed adjusting function
This function automatically controls acceleration and deceleration in
injection and in mold opening and closing. Unlike conventional
system, ideal acceleration and deceleration patterns can be set
simply by choosing a desired mode.

Acceleration and deceleration in each mode

Example: Light guide plate

The graph shows the transition of the holding pressure with an upper line by conventional control and
a lower line by Just Pack control. The light blue area is excessive pressure by conventional control.

The graph shows acceleration and deceleration curves depending on the V-mode selection.
Downsizing

One of the most space-efficient machines in the industry*1

The newly designed injection mechanism and a new design concept have greatly reduced the machine size, which contributes to an efficient use of the factory floor.

Middle-size models  Si-280-6 / Si-350-6 / Si-450-6 (Clamping force : 280 ton / 350 ton / 450 ton)

The new injection mechanism has greatly reduced the machine length.

The newly designed injection mechanism has shortened the injection unit, eventually reducing the total machine length.

Machine length
Max. 740 mm shorter in 280 ton model

3-model average 6% or more shorter

Large-size models  Si-680-6 / Si-850-6 / Si-950-6 (Clamping force : 680 ton / 850 ton / 950 ton)

Machine length and footprint are greatly reduced from the previous equivalent model.

One-class greater clamping force is provided compared with each previous model with a clamping unit of an equivalent size. As clamping force is large enough, you can expect longer servicing life of the machine.

Machine length
Max. 1,234 mm shorter in 850 ton model

Footprint
Max. 20% smaller in 850 ton model

Clamping force and tie-bar clearance, Si-V vs. Si-6

<table>
<thead>
<tr>
<th>Clamping force (ton)</th>
<th>Previous series Si-V</th>
<th>New series Si-6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model</td>
<td>Tie-bar clearance (mm)</td>
</tr>
<tr>
<td>950</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>850</td>
<td>Si-850V</td>
<td>1320x1320</td>
</tr>
<tr>
<td>680</td>
<td>Si-680V</td>
<td>1145x1145</td>
</tr>
<tr>
<td>550</td>
<td>Si-550V</td>
<td>970x970</td>
</tr>
</tbody>
</table>

*1 According to our survey of Japan's major five manufacturers as of July, 2013

※ Comparison is made with Toyo's equivalent 2013 model in the Si-V series.
Easier maintenance and improved eco-efficiency

Reflecting desires from users, the Si-6 series is a practically easy machine to maintain. In addition, energy-efficiency and eco-friendliness are greatly increased.

Power consumption display
Visualization of power consumption promotes energy saving activity
Either integrated total power consumption or hourly consumption from a preset point can be displayed by switching. In addition, the consumed power can be displayed in the desired unit such as JPY, US$, or emitted amount of CO₂.

Toyo-developed food grade grease
In addition to Toyo’s own "PLASTAR GREASE B3 No.2", which is required only 1/10 the consumption of ordinary grease, a food-grade grease "PLASTAR GREASE H1-2" has been developed.

Having the same lubrication property as that of the "B3 No.2", the "H1-2" grease is certified by NSF International in the U.S. as grease that can be used for the machine that molds sanitary-controlled products such as food containers.

H1: Products that can be used at the place where products happen to touch with food.

One-touch connection of heater and thermocouple
The nozzle heater and thermocouple can be connected in one-touch operation, so that the heat barrel can be exchanged very quickly.

Nozzle touch rod-eliminated structure
Heat barrel-related maintenance work such as nozzle or screw replacement can be made easily.

Extended safety door opening stroke
The safety door-opening stroke is extended so that mold maintenance work can be made easily and safely.

<table>
<thead>
<tr>
<th>Model</th>
<th>Si-V At min. mold height</th>
<th>At max. mold height</th>
<th>Si-6 At min. mold height</th>
</tr>
</thead>
<tbody>
<tr>
<td>280 ton</td>
<td>755 mm</td>
<td>1105 mm</td>
<td>1250 mm</td>
</tr>
<tr>
<td>350 ton</td>
<td>733 mm</td>
<td>1103 mm</td>
<td>1265 mm</td>
</tr>
<tr>
<td>450 ton</td>
<td>1010 mm</td>
<td>1480 mm</td>
<td>1540 mm</td>
</tr>
</tbody>
</table>

Easily mountable and dismountable toggle cover
The toggle cover has been designed so that it can be easily mounted or dismounted to facilitate maintenance work. In addition to the cover structure itself, mounting method is changed and the number of fixing bolts is reduced.
High precision injection for constant molding of quality products

The injection unit is equipped with low-friction linear guides so that stable injecting performance can be achieved, eventually contributing to constant quality of the molding.

Linear guides provided to the sliding area
Low-friction linear guides realize stable injection performance at any injecting speed.

Improved stability in the low speed range
The linear guides can reduce speed variation even in the low injection speed range where variation tends to become large otherwise.

Molding's weight variation reduced by 10%.*
In comparison with Toyo's former models, the Si-IV series (started in 2007) and the Si-V series (started in 2010), the Si-6 series proves greater stability in molded products, which is realized by highly stable injecting motion and the new control SYSTEM 600.

Comparison of molding's weight variation

<table>
<thead>
<tr>
<th>Item</th>
<th>Si-280IV</th>
<th>Si-280V</th>
<th>Si-286</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screw diameter</td>
<td>Φ60</td>
<td>Φ60</td>
<td>Φ60</td>
</tr>
<tr>
<td>Product weight</td>
<td>311.00-</td>
<td>310.79-</td>
<td>310.58-</td>
</tr>
<tr>
<td></td>
<td>311.16 g</td>
<td>310.98 g</td>
<td>310.73 g</td>
</tr>
<tr>
<td>R (max-min)</td>
<td>0.16</td>
<td>0.19</td>
<td>0.15</td>
</tr>
<tr>
<td>X (average)</td>
<td>311.09 g</td>
<td>310.91 g</td>
<td>310.67 g</td>
</tr>
<tr>
<td>(standard deviation)</td>
<td>0.0460</td>
<td>0.0392</td>
<td>0.0350</td>
</tr>
<tr>
<td>R / X</td>
<td>0.0514</td>
<td>0.0511</td>
<td>0.0480</td>
</tr>
<tr>
<td>3σ / X</td>
<td>0.0444</td>
<td>0.0378</td>
<td>0.0340</td>
</tr>
</tbody>
</table>

Molding weight (3σ / X)

* Comparison is made against the Si-280V (2009 model) and the Si-280V (2013 model) in equivalent specifications.
The Si-6 adopts fruits of collaboration with academy

The clamping unit of the Si-6 series is equipped with various technologies such as "V-clamp" developed in collaboration with Kyoto University, and basic specifications such as tie-bar clearance and ejector stroke are enhanced.

The V-Clamp mold clamping structure realizes ideal clamping

The mold-clamping unit employs the V-shaped toggle mechanism, the V-clamp, and die-plates, both of which have been developed in collaboration with Kyoto University. Owing to the center-press effect, the V-clamp provides well-balanced and uniformed surface pressure over the mold, realizing ideal mold clamping. The die-plates are optimally designed so that they can be slim but have high rigidity.

One of the largest tie-bar clearances in the industry*  

Employed to the Si-280-6, Si-350-6 and Si-450-6, the largest-class tie-bar clearances in the industry facilitate mold replacement work and gives high flexibility in designing molds.

<table>
<thead>
<tr>
<th>Model</th>
<th>Industry average* Tie-bar clearance</th>
<th>Si-6 Tie-bar clearance</th>
</tr>
</thead>
<tbody>
<tr>
<td>280 ton</td>
<td>690×670 mm</td>
<td>730×730 mm</td>
</tr>
<tr>
<td>350 ton</td>
<td>780×750 mm</td>
<td>810×810 mm</td>
</tr>
<tr>
<td>450 ton</td>
<td>850×820 mm</td>
<td>870×870 mm</td>
</tr>
</tbody>
</table>

* Average of Japan's five major makers based on Toyo's survey in January, 2013

Extended ejector stroke

Employed to the Si-880-6 and Si-950-6, the extended ejector stroke is effective in molding deep products such as containers.

<table>
<thead>
<tr>
<th>Previous Si-V models</th>
<th>New Si-6 models</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>Ejector stroke (mm)</td>
</tr>
<tr>
<td>SI-280W</td>
<td>200 mm</td>
</tr>
<tr>
<td>SI-350W</td>
<td>200 mm</td>
</tr>
<tr>
<td>SI-450W</td>
<td>180 mm</td>
</tr>
</tbody>
</table>

Extended ejector stroke

High speed V-Clamp toggle mechanism

High cycle by reduced mold opening and closing time

The V-Clamp toggle mechanism is also adopted to large models, Si-680-6, Si-850-6 and Si-950-6, so that the mold opening and closing time is reduced by about 6% on an average compared with three previous equivalent models.
Toyo's own technologies make otherwise complicated molding process simple

Gas suppression screw
SAG (Screw Against Gas)

Gas-caused defects account for a large part of molding defects.
- Mold defects: silver, discoloring, burn, short shot, flash
- Affects to mold: sticking of grime, clogging of vent

The SAG screw reduces above defects and troubles and increases yield rate.

Cause of gas generation
Main cause: Unbalance between pellets feeding and melting in the heat barrel
- Over-heating due to excessive feeding of pellets
- Local heating due to variation of feed volume or melt adhesion to heat barrel

Advantage of SAG screw
The SAG screw alone can solve the problem.
Thanks to its unique screw design, the SAG screw controls shearing heat during plasticization process so that gas generation can be suppressed. You do not need any other equipment to solve the gas-caused problems.

Automatic melt viscosity control program
meltcon

Melt condition of resin varies when following factors are changed:
- Production lots of resin, drying conditions, contents of ground material, molding machines, plasticizing components
- The meltcon automatically controls melt viscosity so that the machine can keep producing quality products despite the changes of above factors.

Feature of meltcon
You set the base melt density at first to produce products with desired quality. After that, the meltcon automatically controls the heat barrel temperature to maintain the preset melt density. Condition adjustment by an operator is not necessary.

Sample case of SAG's effect
Extended span of mold maintenance
Greatly reduced grime adhered to the mold

Material: PC / Product: Battery case / Machine: 100-tonner with φ 24 screw / Cycle: 24 s (24 hours/day)

Conventional screw
- Mold condition after one-month operation:
- Mold maintenance scan:
  - Every two days

SAG screw
- Operation for 90 days
- No maintenance needed even after

Many other effective cases have been reported in processing LCP, PAST, PAB, PPS, PVC, etc.

Sample case of meltcon's performance
Product: Spiral flow / Material: PC / Comparison method: The flow length was measured before and after changing material lots without changing any molding parameters.

With meltcon OFF:
- The flow length was changed
- You need to change molding conditions to maintain the same flow length

With meltcon ON:
- Before changing material lots
- After changing material lots
- You do not need to adjust molding conditions.
A great variety of plasticizing components to support SMART MOLDING

**Special screw lineup**
- **SAT design**
  - High-mixing sub-flight screw
  - For high-mixing and high cycle molding
- **LOT design**
  - Screw for high viscosity resin
  - For molding optical products of PMMA, PC, etc.
- **MIT design**
  - High-mixing screw
  - For low-density Master Batch use

**Nozzle lineup**
- **Small diameter**
  - (Heater CD: φ26)
  - Standard: up to φ26
- **Separate type nozzle**
  - Standard: φ24 to φ36
- **One-piece type nozzle**
  - Standard: φ40 and up

**Screw check triplet**
- **Screw check triplet (non-rotation)**

**Specifications on plasticizing components**

<table>
<thead>
<tr>
<th>Material</th>
<th>Standard</th>
<th>Wear-resistant I</th>
<th>Wear-resistant II</th>
<th>Wear-resistant III</th>
<th>Fluorine-resistant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat barrel</td>
<td>Nitriding</td>
<td>Wear-resistant I</td>
<td>Wear-resistant II</td>
<td>Wear-resistant III</td>
<td>Fluorine-resistant material</td>
</tr>
<tr>
<td>Screw</td>
<td>Plating</td>
<td>Wear-resistant I</td>
<td>Wear-resistant II</td>
<td>Wear-resistant III</td>
<td>Fluorine-resistant material</td>
</tr>
<tr>
<td>Check triplet</td>
<td>Wear-resistant I</td>
<td>Wear-resistant II</td>
<td>Wear-resistant III</td>
<td>Fluorine-resistant material</td>
<td></td>
</tr>
<tr>
<td>Available surface treatment</td>
<td>Nitriding</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Plating</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>C/N</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>C-TIN</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Applicable resin</td>
<td>With no GF</td>
<td>GF: 30% or less</td>
<td>GF: 50% or more</td>
<td>Fluorine resin</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GF: 30% or less</td>
<td>Inflammability HB−V1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrosion resistance</td>
<td>More sigm show greater performance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Other special options

The SRC-III metering system (PAT.) prevents melt back flow [PAT. No. 3432776, No. 3432782]

Expansion of temperature control circuit

The SRC-III eliminates an unstable factor of the check ring

Evaluation of melt density stability by SRC-III metering

**Conventional metering system**
- X = 203.3 mm
- R = 1.67 mm
- d = 0.346 mm
- R/X = 0.829%

**SRC-III metering system**
- X = 202.8 mm
- R = 0.21 mm
- d = 0.0511 mm
- R/X = 1.04%

ATC board for heater control