

DSI

Die-Slide Injection

「in-mold build-up molding」

ダイスライド機構を利用した射出成形機による

The Japan Steel Works, Ltd.

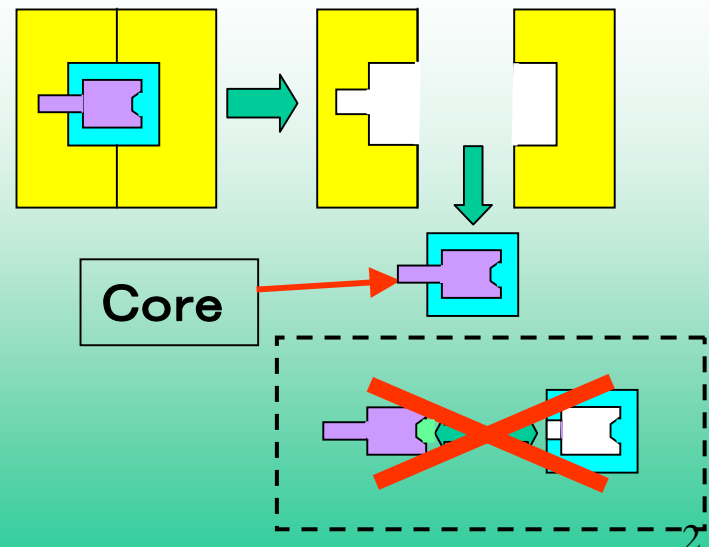
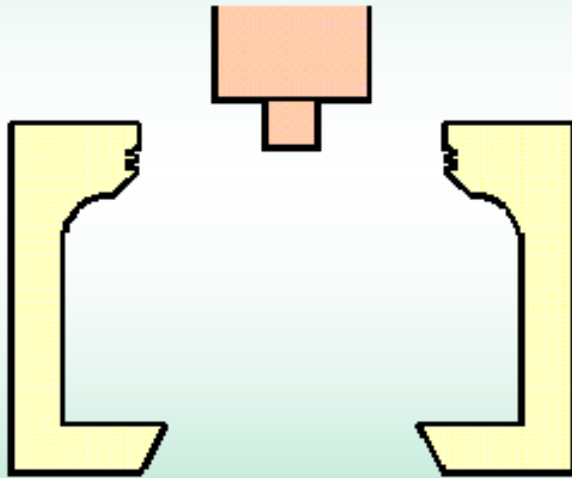
Application to Hollow Parts

Conventional method to produce hollow parts:

従来の・・

Gas injection, Parison blow molding,

Lost core, Welding, **but ...**

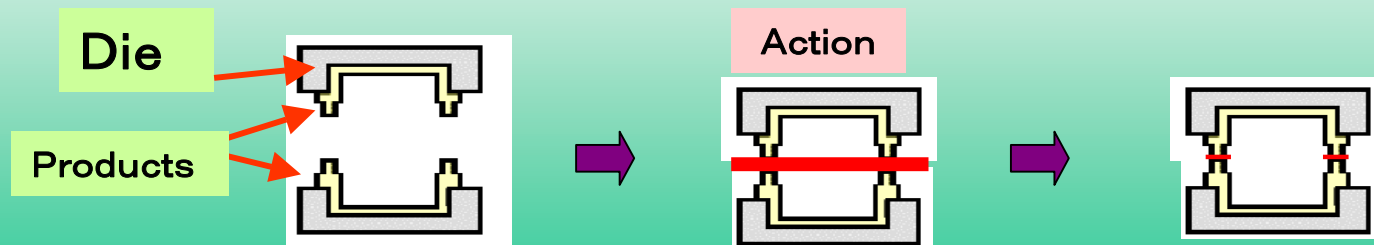


Gas Injection

- Compressed gas is introduced inside melt injected resin during / after injection.
- Uneven thickness.
- Limitation of controlling thickness.

Welding Method

- 2 pieces are molded and welded / adhered.
Ultrasonic welding, Vibration welding, ...
- Welding area should be flat.
- Difficult temperature control at welding.
- Long processing time.
- Large energy consumption.
- Multiple processes.



Application to Hollow Parts

Can they make such hollow parts?

- Rib and boss inside.
- Controlled thickness.
- Fully enclosed shape.
- Smooth inside surface

DSI can do !

DSI for Hollow Parts

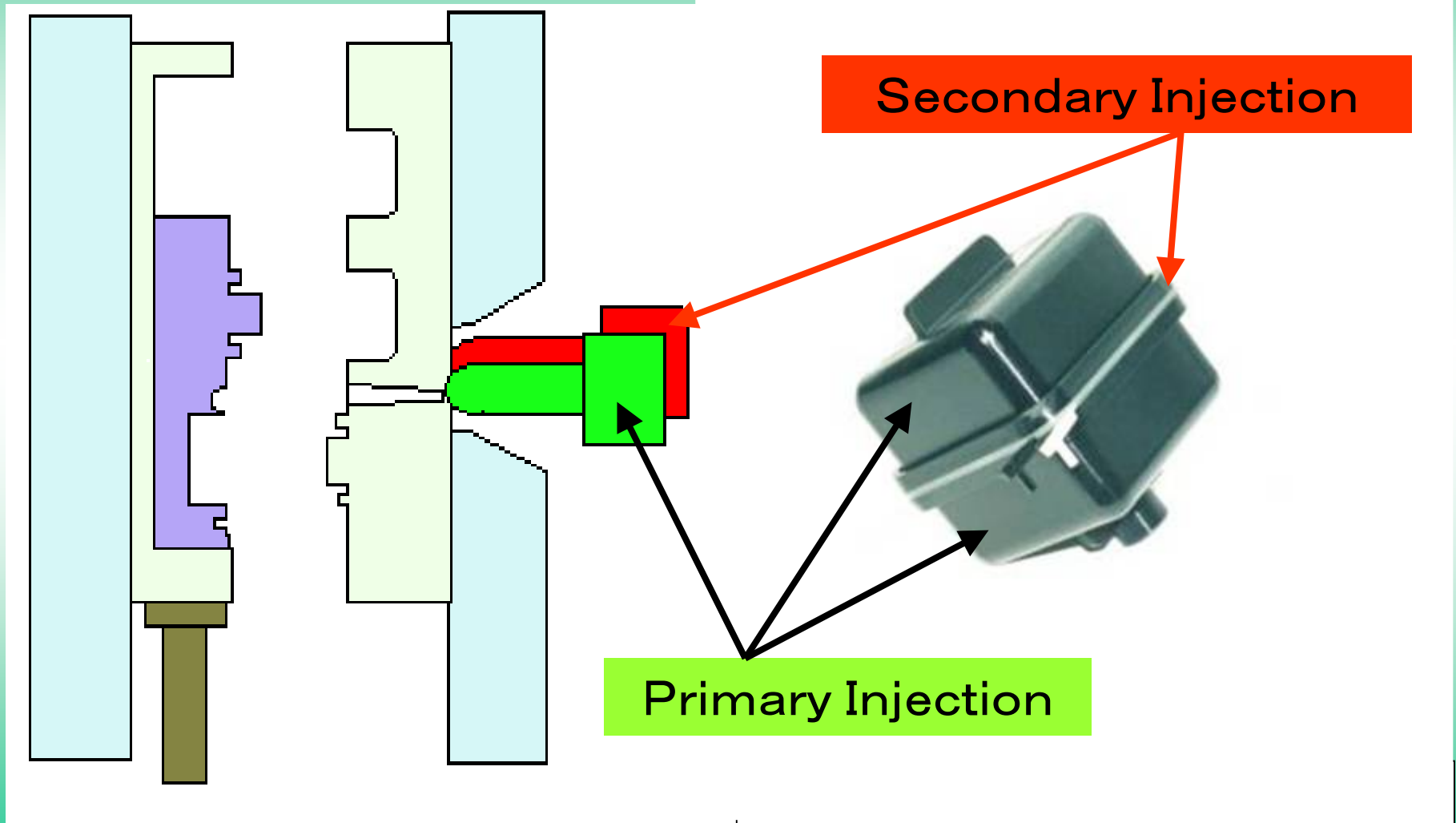
- One injection molding machine and one mold can make hollow molded parts.
- Complicated shape with rib and boss inside.
- Inserted & hollow parts.
- 50 to 100% higher joint strength than vibration welding.
- Precise parts, and moreover

DSI for Hollow Parts

- Less processing than lost core and blow.
- Molded without exposed outside until final parts.
- -- Clean molding such as filter insertion.
- Desirable thickness at any portion.
- 3 dimensional joint.

Idea of DSI Mold

DSI Operation

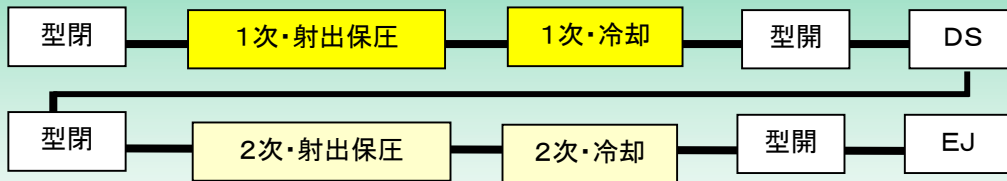


DSI of Operation

1 Unit / two setting Injection conditions molding

Two-Color Molding

DSI-1M動作

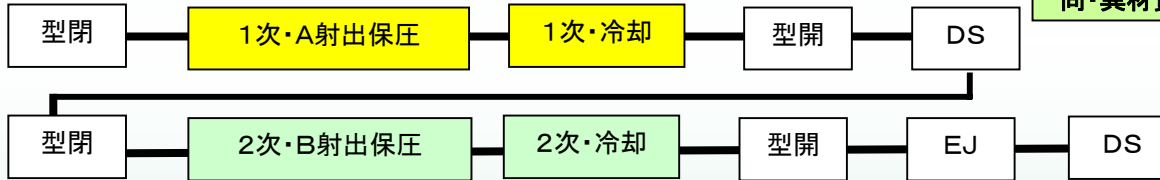


1つの射出ユニットによる2回成形
1ユニットの2条件制御
同材質の融着成形

事例1



DSI-2M動作

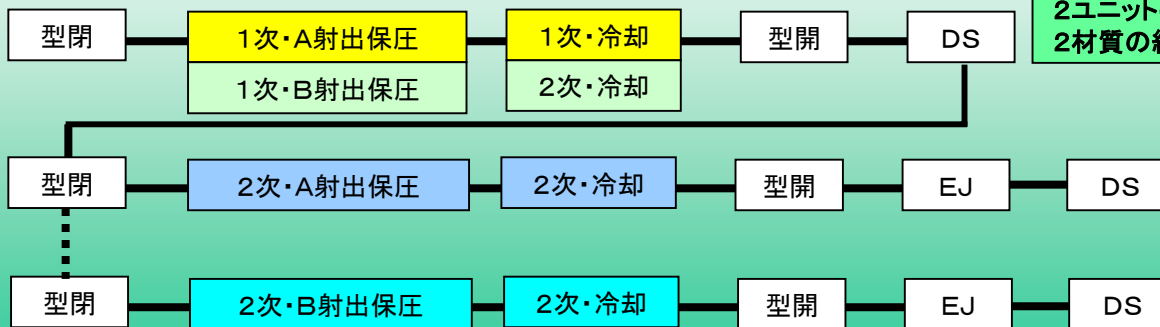


2つの射出ユニットによる各1回成形
1ユニットの1条件制御
同・異材質の融着成形

事例2



DSI-2M動作



2つの射出ユニットによる各2回成形
2ユニットの2条件制御
2材質の組立成形 & 同・異材質融着成形

事例3



Comparison of Hollow Molding

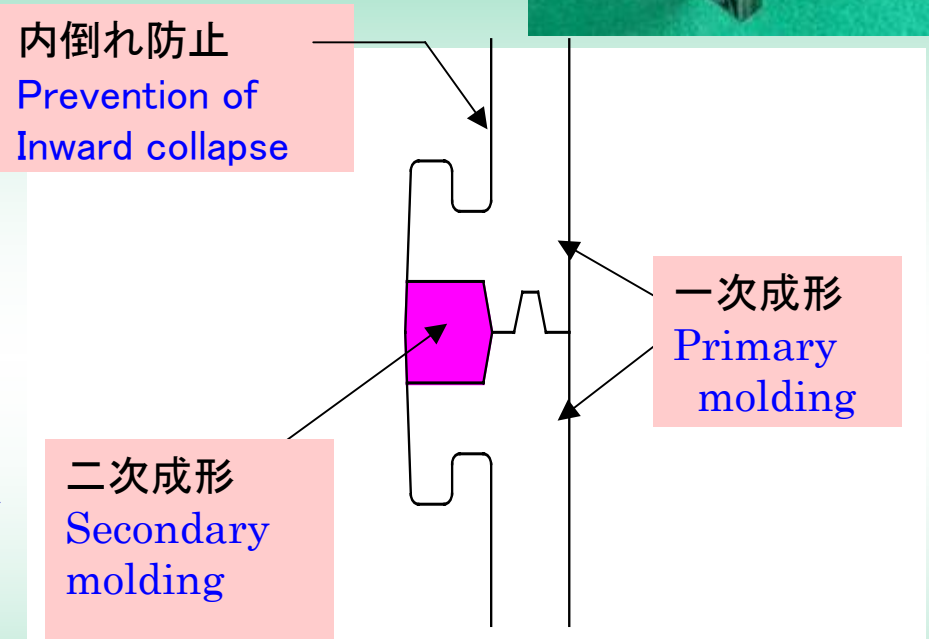
Molding method		Characteristics												
		Limitation of shape	Limitation of resin	Dimensional accuracy	Strength, property	Light weigh	Mold cost	Required equipment	Productivity	Eliminating post-process	Environmental problem	Material loss	Overall Cost	
Core	Lost core	A	B	B	B	C	B	D	D	D	D	C	D	
	Core slide	D	A	B	B	B	B	B	B	B	B	B	B	
Hollow molding	Blow	D	C	D	C	B	A	C	C	D	B	D	A	
	Gas inject	D	C	D	C	C	B	C	B	B	B	B	B	
Injection molding	DSI		B	B	A	B	A	B	B	B	A	B	B	A
	2 shell		C	B	B	C	C	B	C	D	B	B	B	B
	Welding	Vibration weld	C	B	B	C	B	A	B	A	D	B	B	A
		Friction weld	C	B	B	C	B	A	B	A	D	B	B	A
		Hot plate weld	C	B	B	C	B	A	B	A	D	B	B	A
		Ultrasonic weld	D	B	B	C	B	A	B	A	D	B	B	A
	Assembling	Welding	A	B	B	B	C	A	B	A	D	B	C	A
		Tightening	A	B	B	C	C	A	B	A	D	B	D	A

A: Excellent B: Good C: Fair D: Poor

Joint Shape (a)



- Typical shape with collapse holder.
- L shaped portion of primary molded pieces are faced each other to prevent inward collapse against secondary injection.



Basic Form
Applicable to joint at center of hollow article

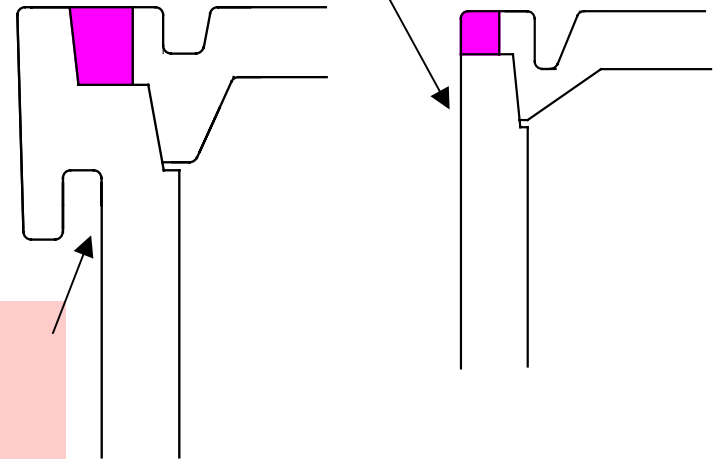
Joint Shape (b)

- This joint is located at edge without collapse holder.
- Limited shape and limited resin.



内倒れ防止
Prevention of
Inward collapse

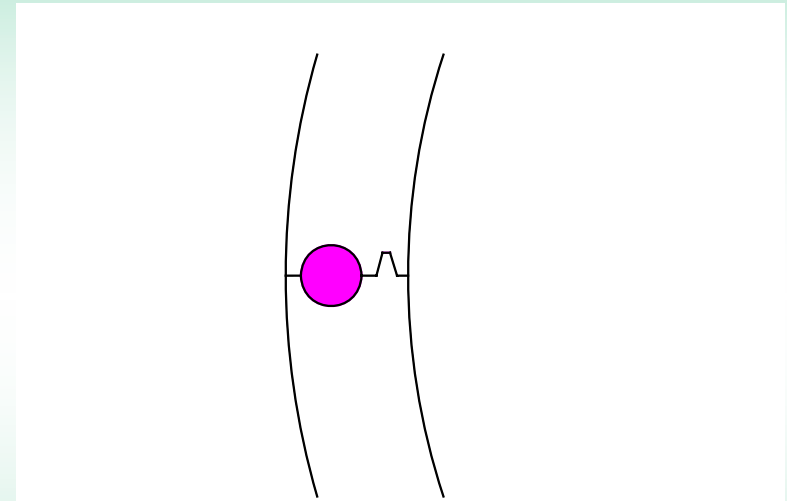
内倒れ防止排除
Release of prevention
Of inward collapse



角部で接合する場合に採用
Applicable to joint corner section

Joint Shape (c)

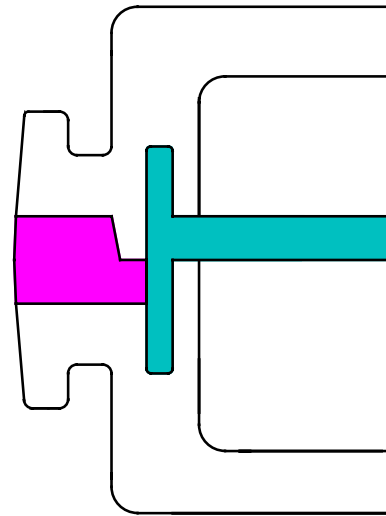
- This joint is hidden inside primary molded parts.
- Used for DSI demonstration parts at NPE2000.
- Limited shape and resin.



Releasing the inward collapse prevention and jointed at inner position
(Shape and material are limited)

Joint Shape (d)

- Joint with insert piece.
- Inner space of hollow parts is divided to 2 section by an insert.



Double-shell hollow article is made by DSI+insert

Example of DSI product

成形品 Product : 排水弁 (洗濯機部品)
Washing Machine Parts (Drain Valve)

樹脂 ; P P 製品重量 ; 1 3 0 g



Example of DSI product

成形品 Product : エアーインテーク
Automobile Parts (Air Intake)



Example of DSI product

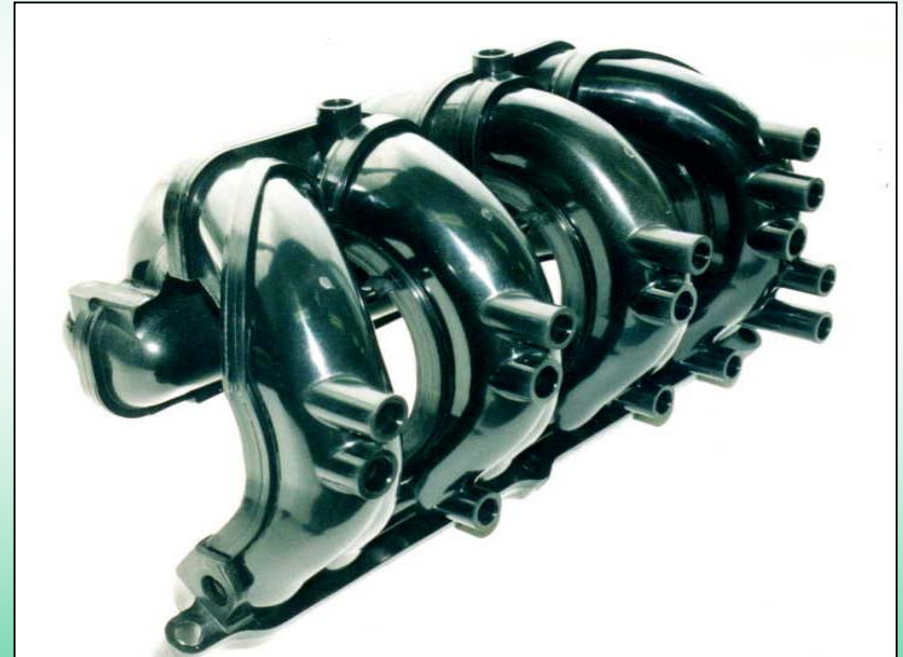
Product ; 製氷容器

Refrigerator Part (Chiller Tank)



Example of DSI product

Intake manifold



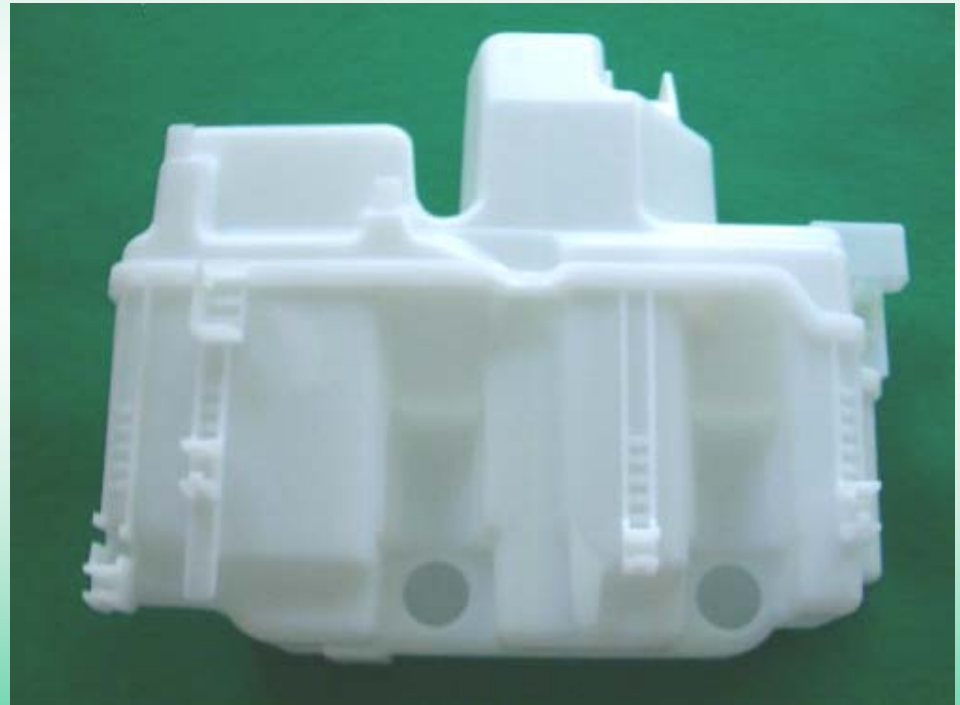
Example of DSI product

Intake manifold

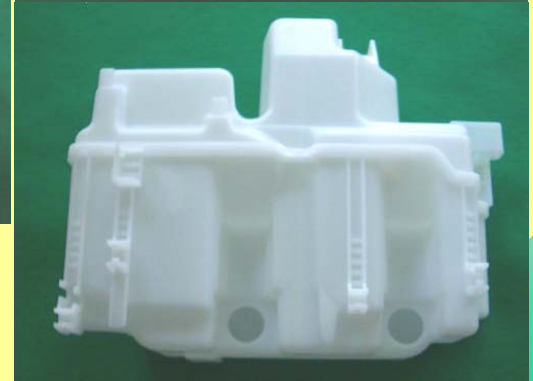


Example of DSI product

Washer Tank

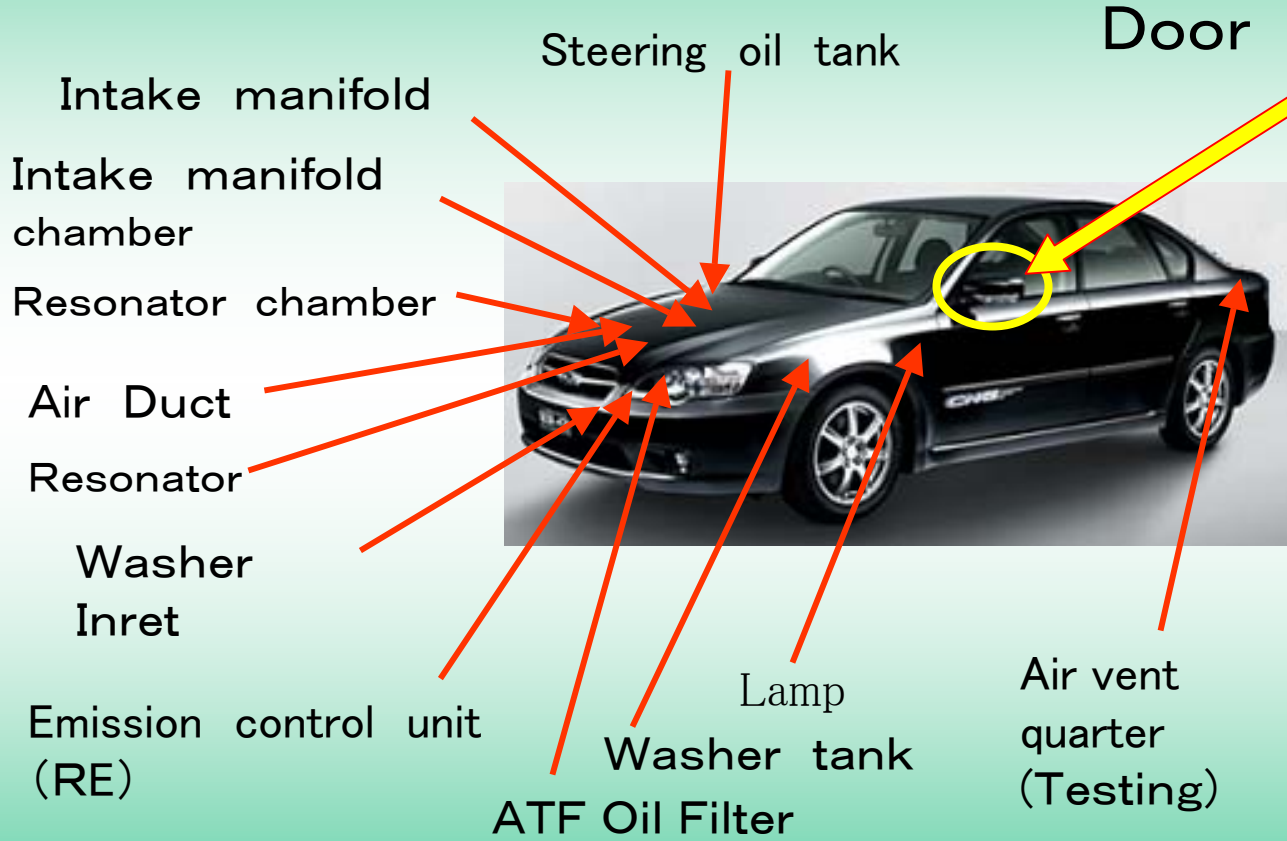


Example of DSI product



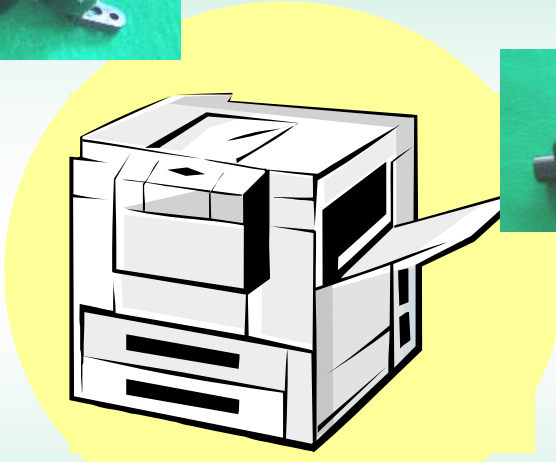
The Japan Steel Works, Ltd.

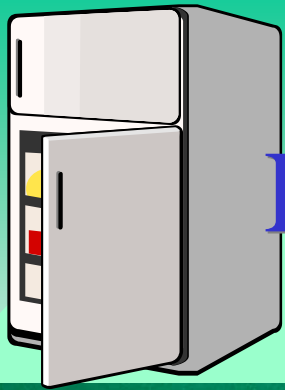
Example of DSI product



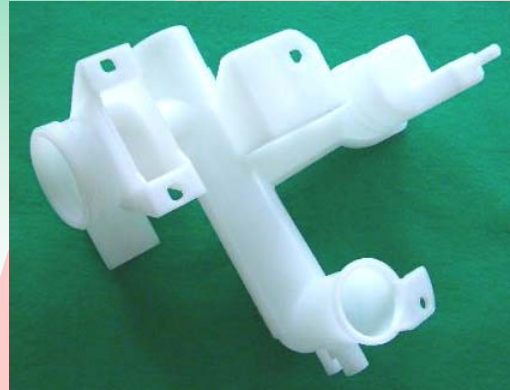
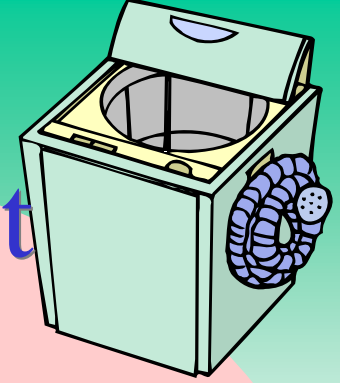
DSI automobile parts have been adopted by 8 Japanese major car makers TOYOTA · NISSAN · HONDA · MAZDA · MITSUBISHI · DAIHATSU and SUBARU for Their 37 car model

Example of DSI product





Example of DSI product



Example of DSI product

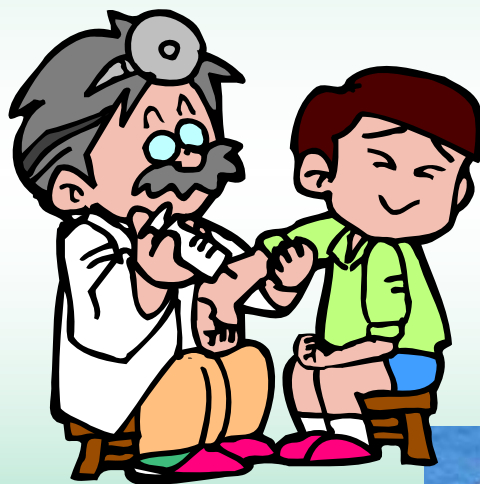


Example of DSI product

点滴用たこ管



血液フィルター

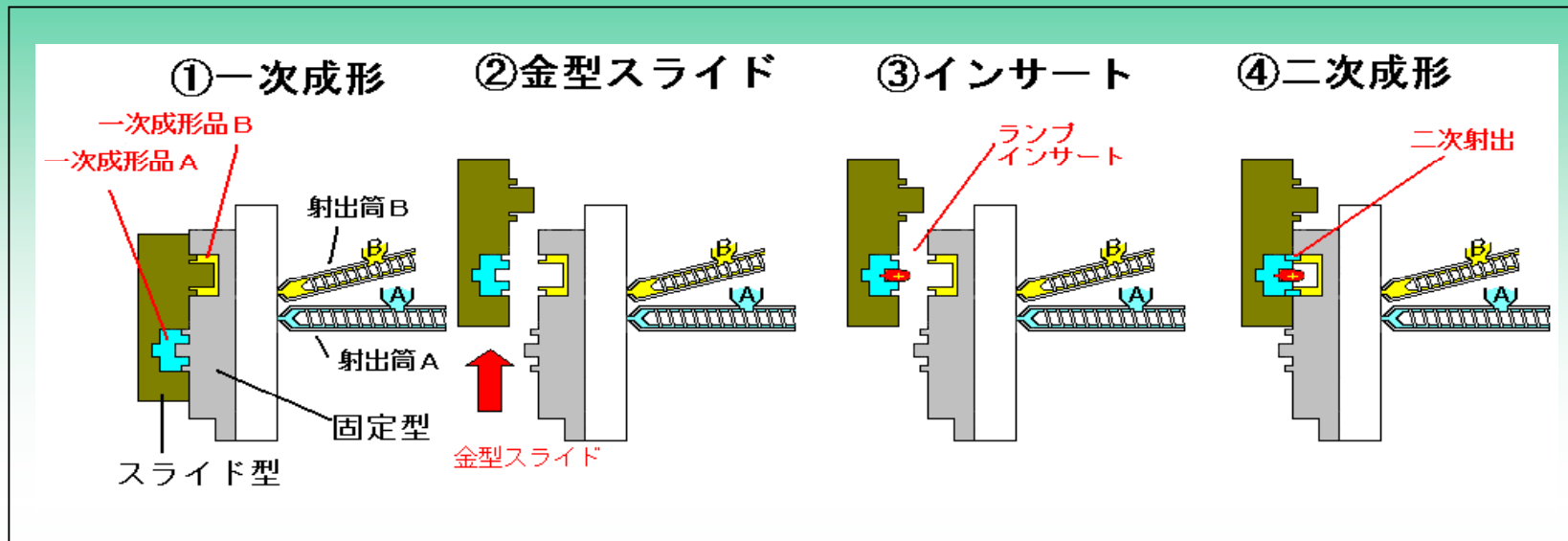


人工透析ユニット

リングルキャップ



Example of DSI product



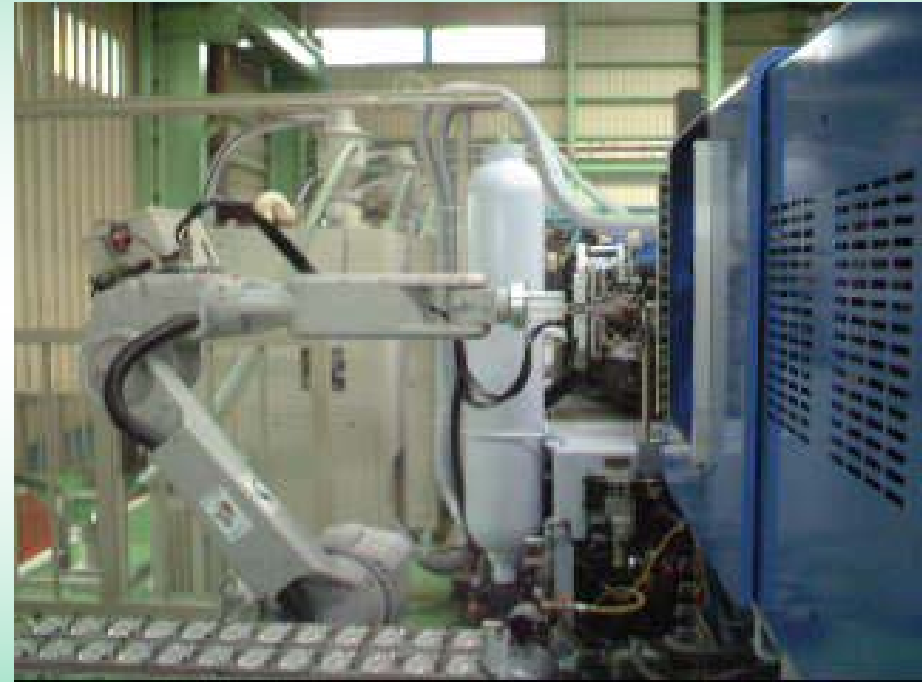
Example of DSI product

DSI molding

Lamp inspection



(動画データ)



(動画データ)

Stookless lamp inspection is conducted every molding cycle without conveying from injection area to other

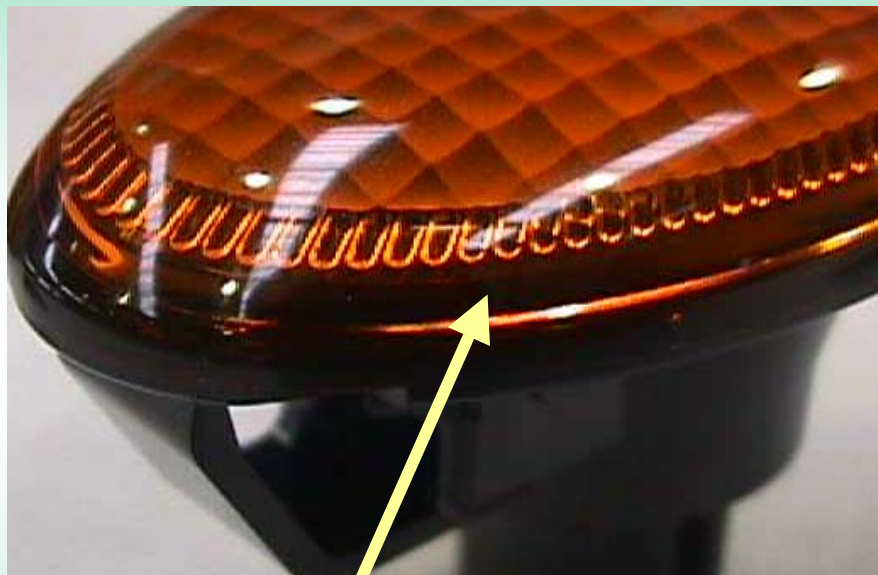
Example of DSI product features

Vibration welding



NO GOOD

DSI (Injection welding)



GOOD

Look actual parts ! サンプルをご確認下さい

Processes in the DSI in-mold sputtering molding Process

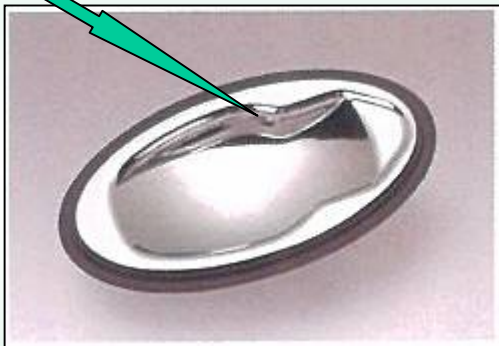
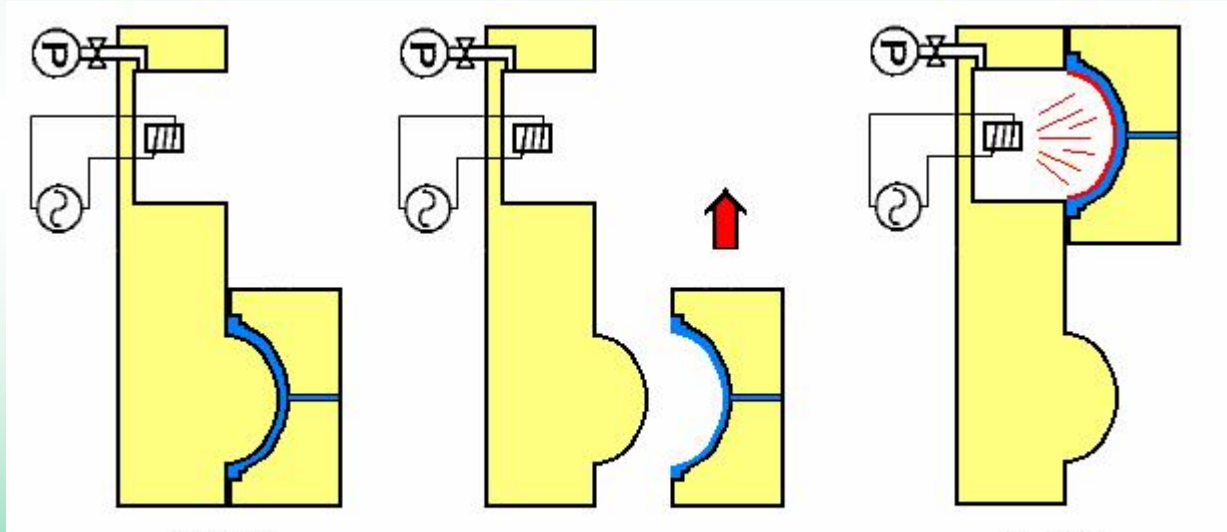
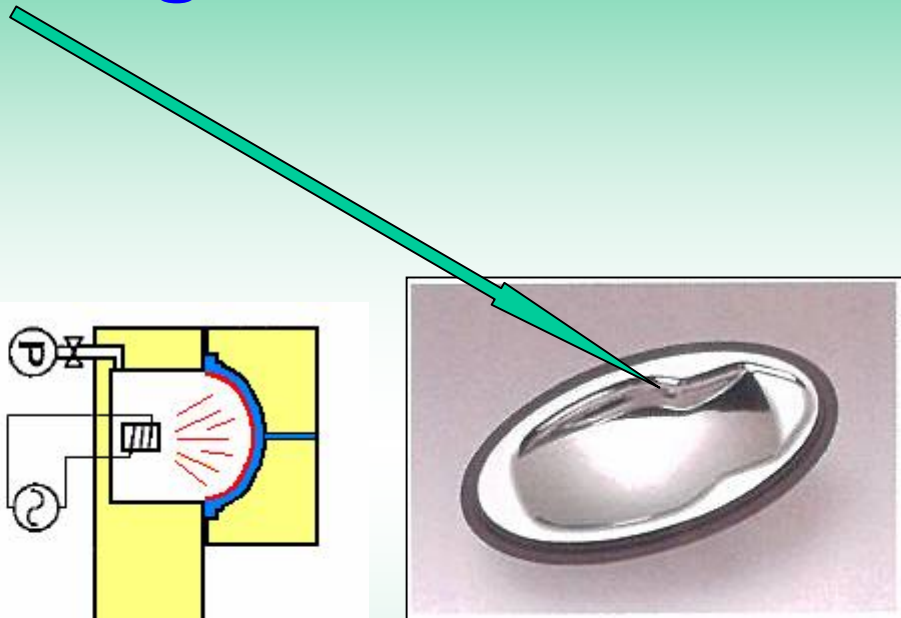
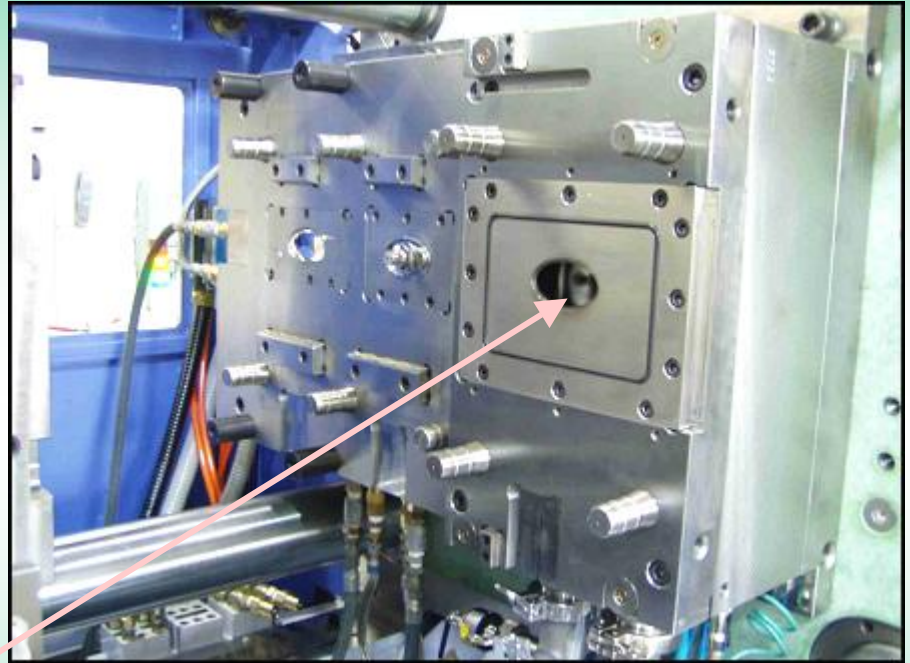


Image sample

Injection Molding ⇒ Die Slide ⇒ Sputter film

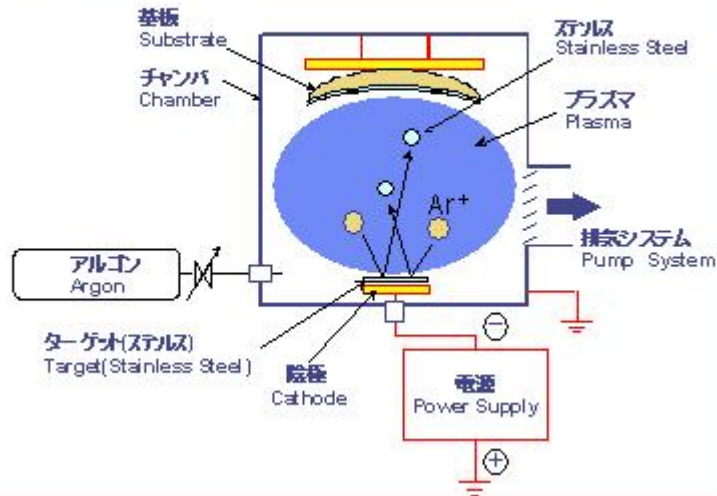
Processes in the DSI in-mold sputtering molding system

Sliding die

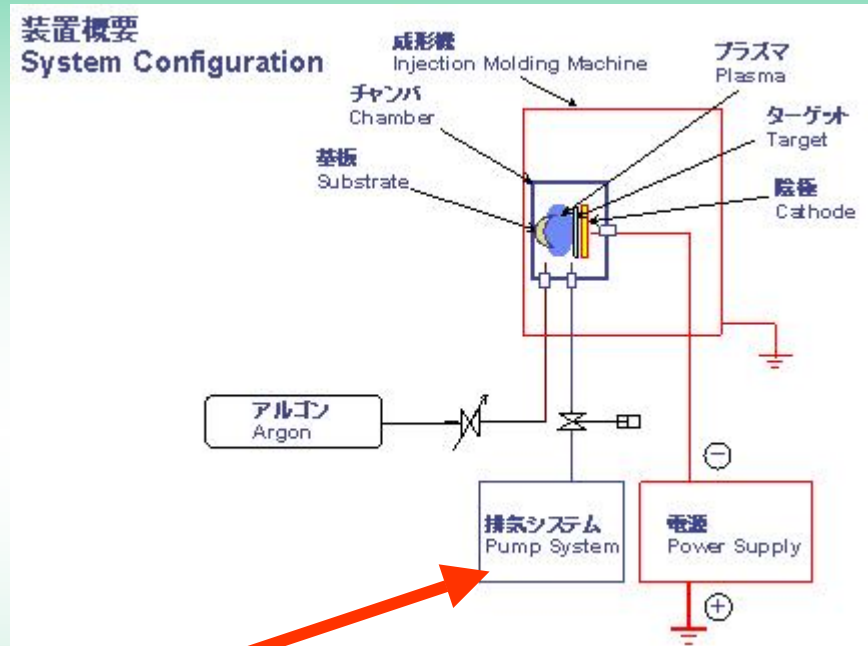


Fixed die

スパッタ装置
Sputtering System



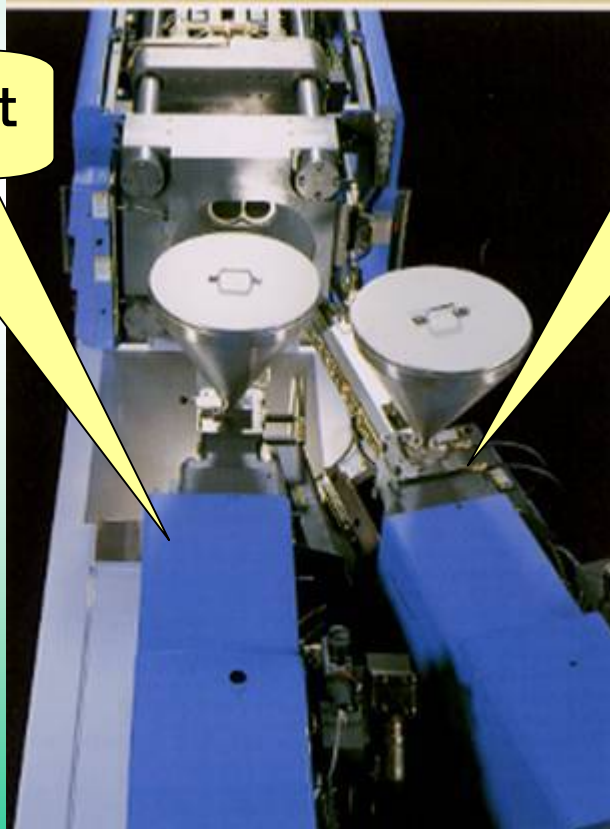
Processes in the DSI in-mold sputtering molding system



Machine of M-DSI

- 2 injection units for co-injection, ranging from 120 tons to 950 tons.

Main unit



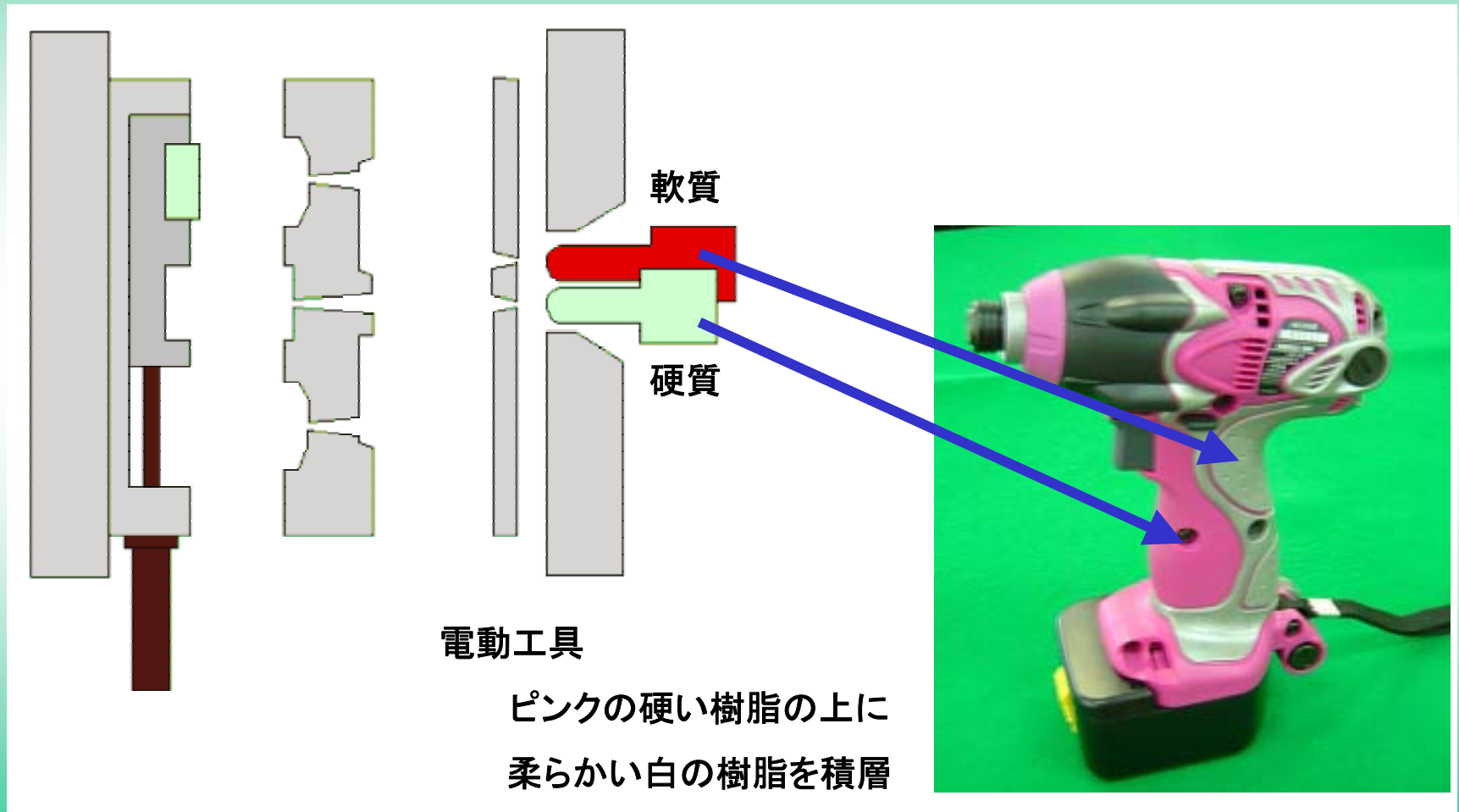
Auxiliary unit



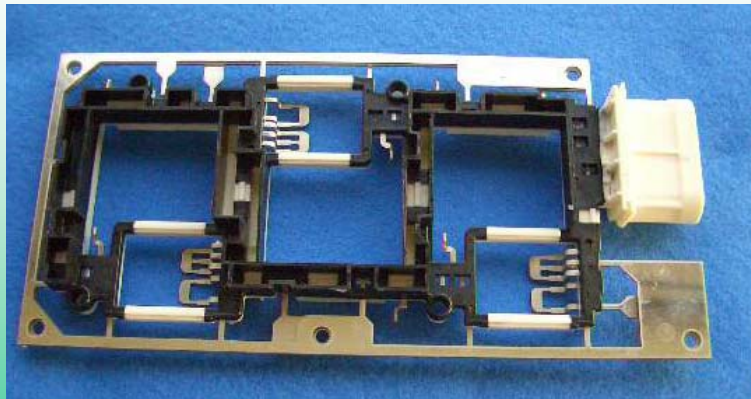
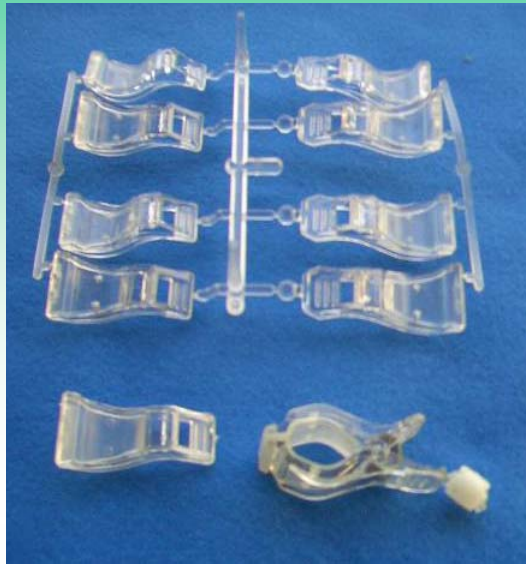
J220EL III - 2M

2 Color Molding M-DSI process

Multi layer Die Slide Injection (M-DSI)



Example of M—DSI product



Other multi layer molding

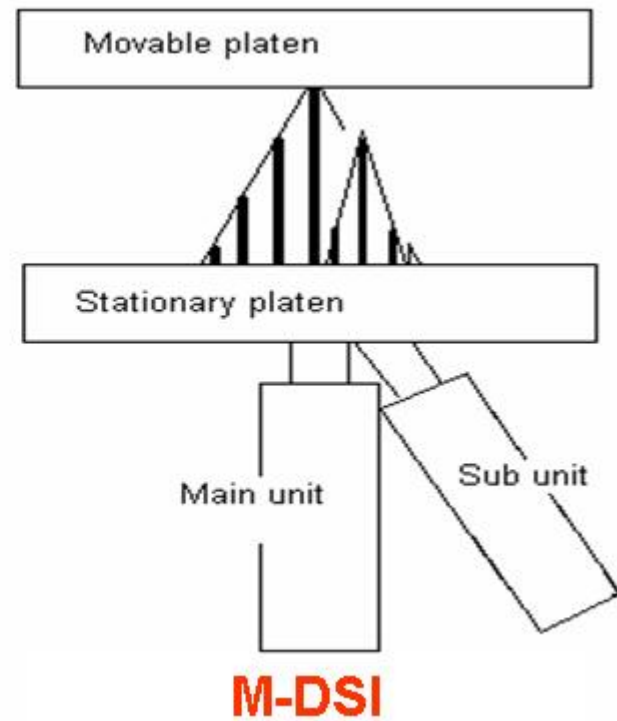
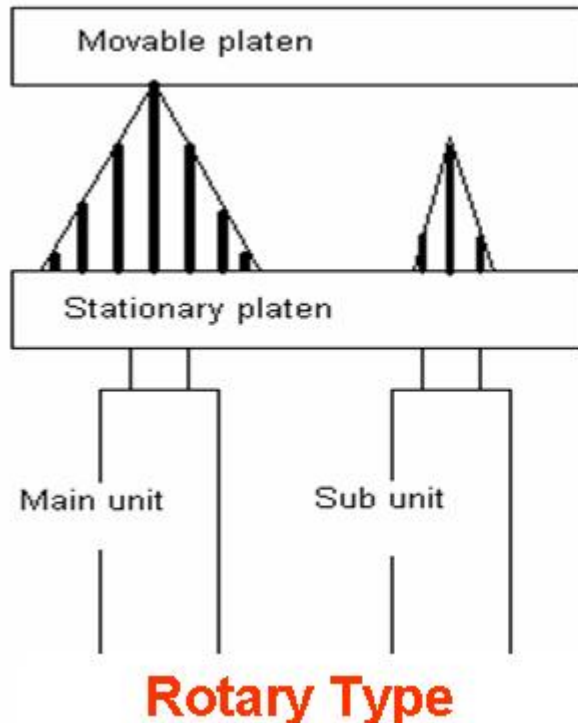
- After 1st shot mold is turned to change cavities, then 2nd shot (mold table turns on movable platen : rotary type, or movable platen faces to the other side : opposite type).
- Difficult for complicated (need core puller) product.
- Machine requires a larger platens due to mold mounting space.
- Unbalanced force on platen.

Unbalanced Force

- Mold can't be located at center so that unbalanced force occurs on platen.

金型を型盤中央に位置不可・1次成形が偏心・反転によりコアプラー対応困難複雑形状対応不可・アンバランス

金型が型盤中央に位置する。1次成形が中央にある。バランスが良い。大型製品対応可能。高効率成形



M-DSI System

- Cavity slides after 1st shot for 2nd shot.
- 3 cavities on stationary side, and 2 on movable, switching runner (Double M-DSI).
- 2 cavities on stationary side and 1 on movable (Single M-DSI).

Example of Double M-DSI Product



Primary Mold (PA6-30GF)

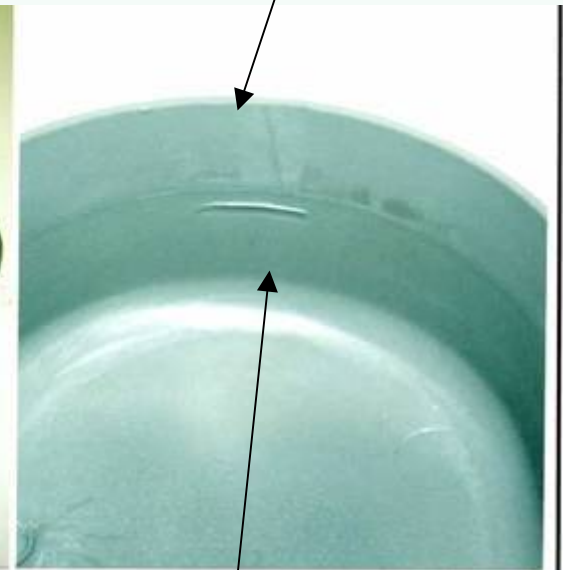
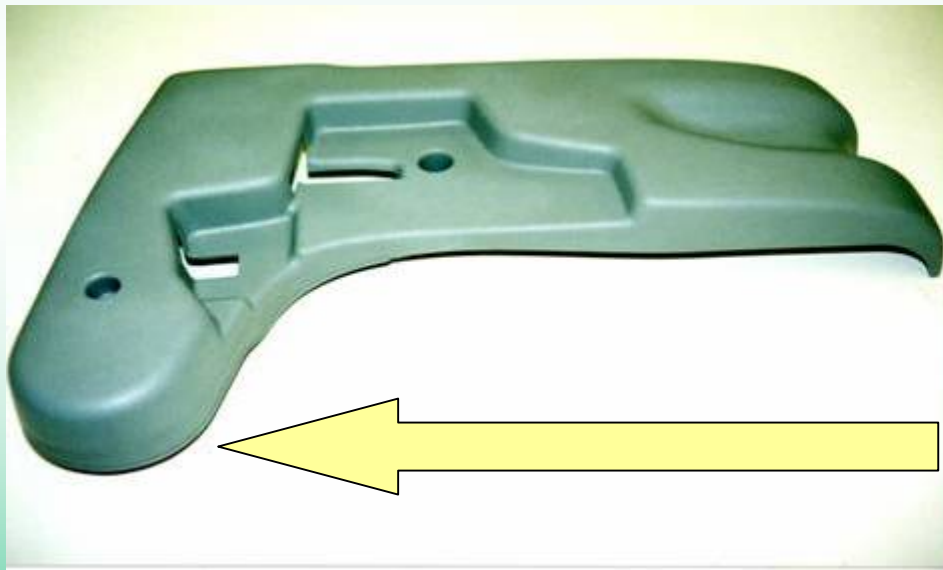
Secondary Mold (TPU)



Example of Single M-DSI Product

Automobile Part (Seat Part)

Primary Mold (TPO)

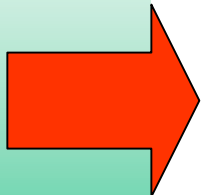


Secondary Mold (PP)

Comparison of 2 Color Molding

Method \ Items	Limitation of product shape	Generality	Mold set up time	Productivity	Manufacturing cost of mold	Application of automation	Total cost
Rotary type	B	C	D	C	C	C	C
Opposite platen type	A	D	D	C	C	C	D
Core back type	D	A	A	B	C	B	B
M-DSI	A	A	A	A	B	B	A

A: Excellent B: Good C: Fair D: Poor



DSI history

- 1986 : DSI method was planed and its patent was applied.
- 1990 : A controller for 2 molding condition started to be developed.
- 1990 : First mold (check valve) was made and DSI method has been studied and developed.
- 1990 : Test mold (pressure container) was built to examine joint strength.
- 1991 : DSI patent registered in Japan.
- 1992 : Study of burst test started.
- 1992 : Development of 2 color DSI machine started. Also larger size machine in line up.
- 1994 : Study of DSI joint shape was settled. Pressure resistent of PA66 achieved 170psi.
- 1995 : Mold to evaluate application to intake manifolds was built and study started.
- 1996 : USA patent pending
- 2000 : Debut at NPE2000.

DSI

Die-Slide Injection

Thank You Very much

The Japan Steel Works

