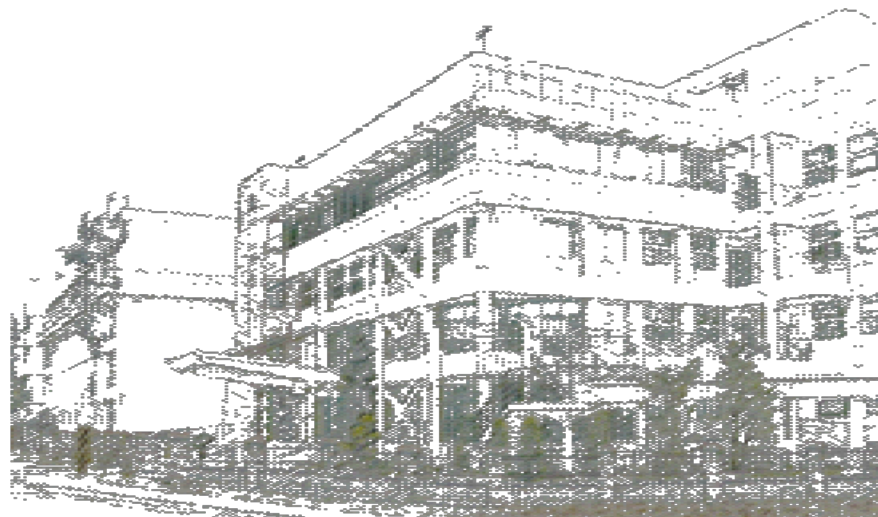


射出成形模具與機構



一、射出成型機-----P.03

◎射出成型機構造

◎射出成型作動情況

二、標準模座的介紹與選擇-----P.23

◎標準模座的種類

三、模具基本架構的設計&零件介紹-----P.38

◎標準模座以外的零件

◎模具各零件的尺寸規格設計&介紹

四、模具充填區域的設計-----P.62

◎澆口型式

◎熱流道系統

◎產品延伸至模具的設計

◎射出問題點&改善流程

◎模具加工

一、射出成型機

◎射出成型機構造

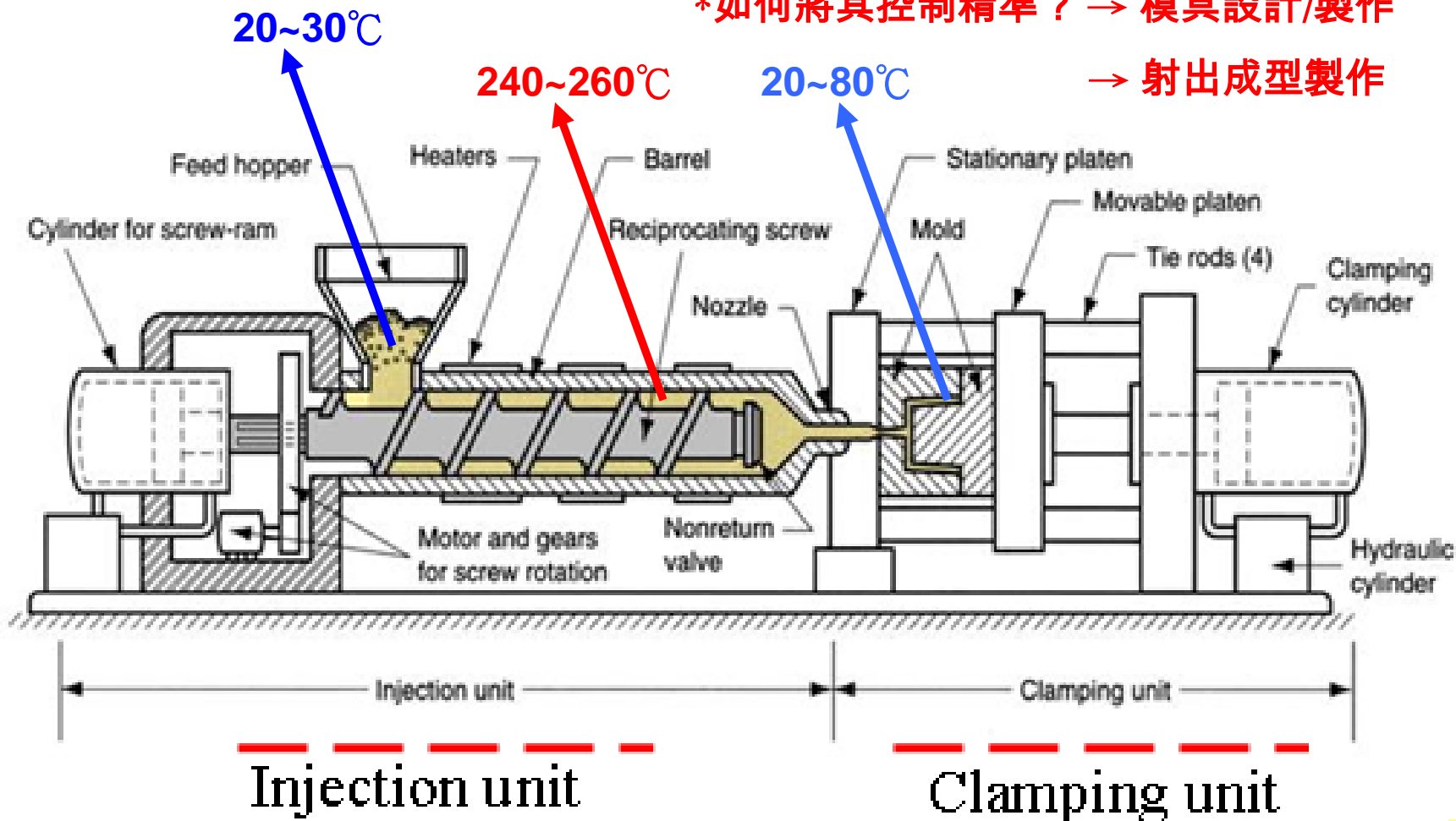
◎射出成型作動情況

◎射出成型機構造

*溫度反應十分劇烈的一種成型方式。

*如何將其控制精準？ → 模具設計/製作

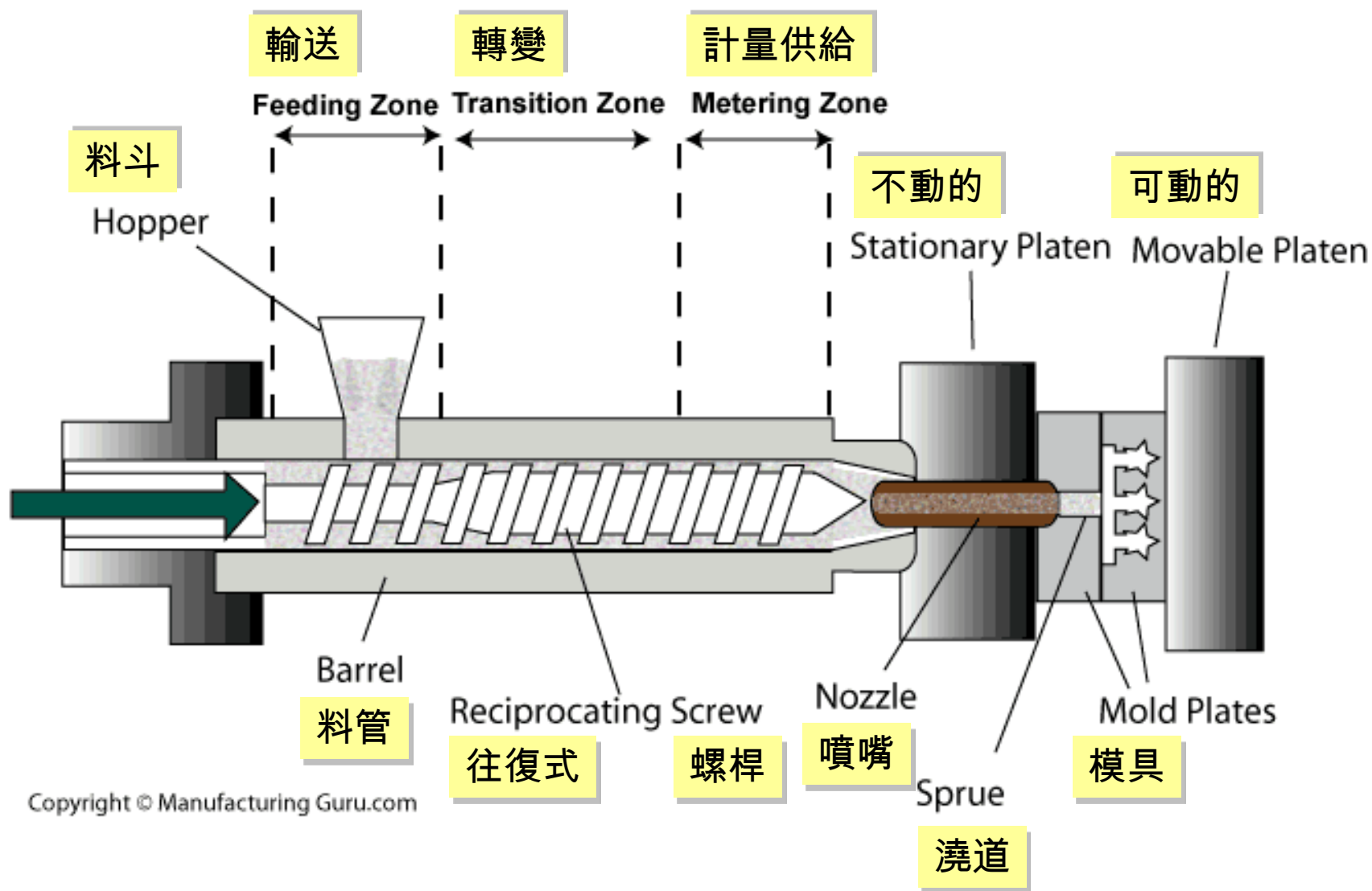
→ 射出成型製作



02-Introduction to Injection Molding - Molding Machine Components (excerpt).mp4



◎射出成型機構造



◎射出成型作動情況

⑦開模/產品頂出

opening the mold
part ejection

injection cycle
end start

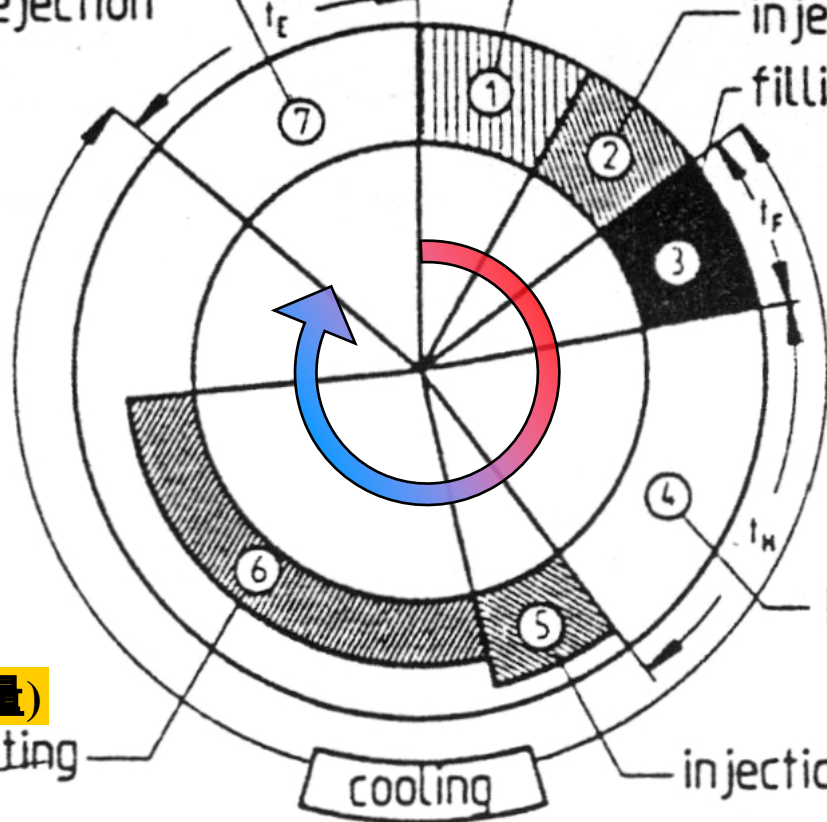
①關模

closing the mold
injection unit forward

②射座前進

filling

③射出



④保壓

holding pressure

⑤射座後退

injection unit backward

⑥塑化(計量)

plasticating

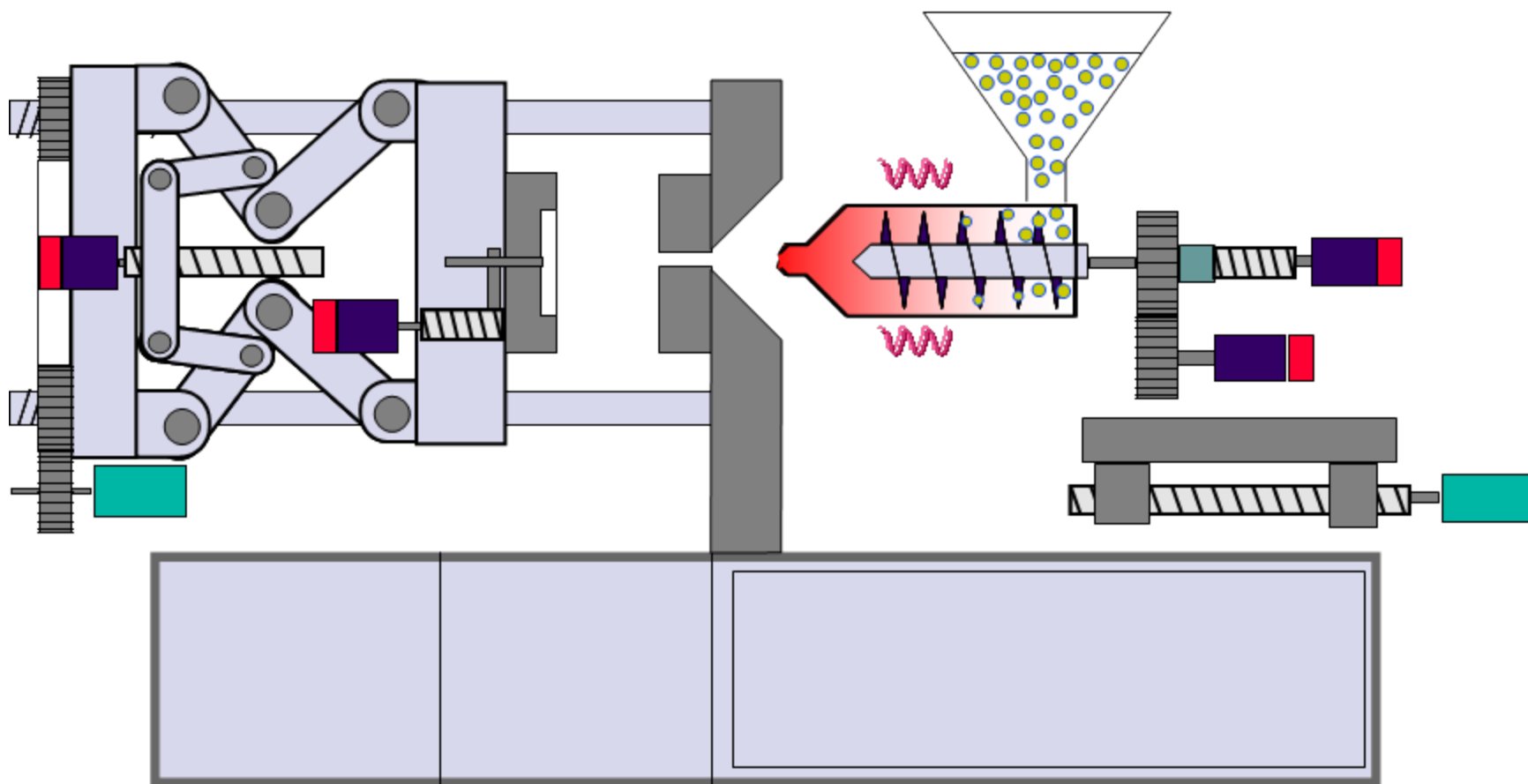
冷卻(從射出開始→開模)

Injection molding cycle

◎射出成型作動情況

①關模 → ②射座前進 → ③射出 → ④保壓 → ⑤射座後退 → ⑥塑化(計量) → ⑦開模/產品頂出

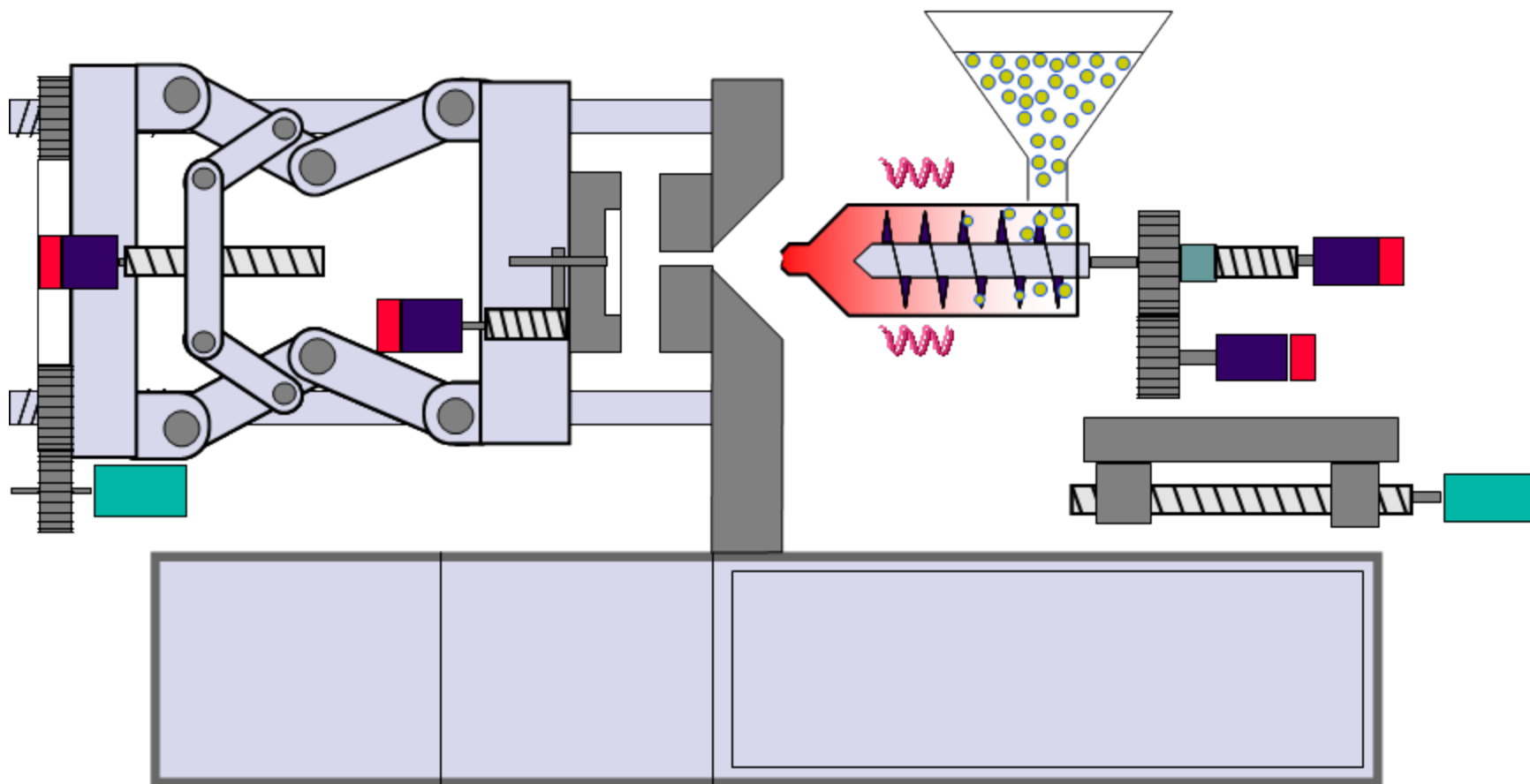
冷卻(從射出開始 → 開模)



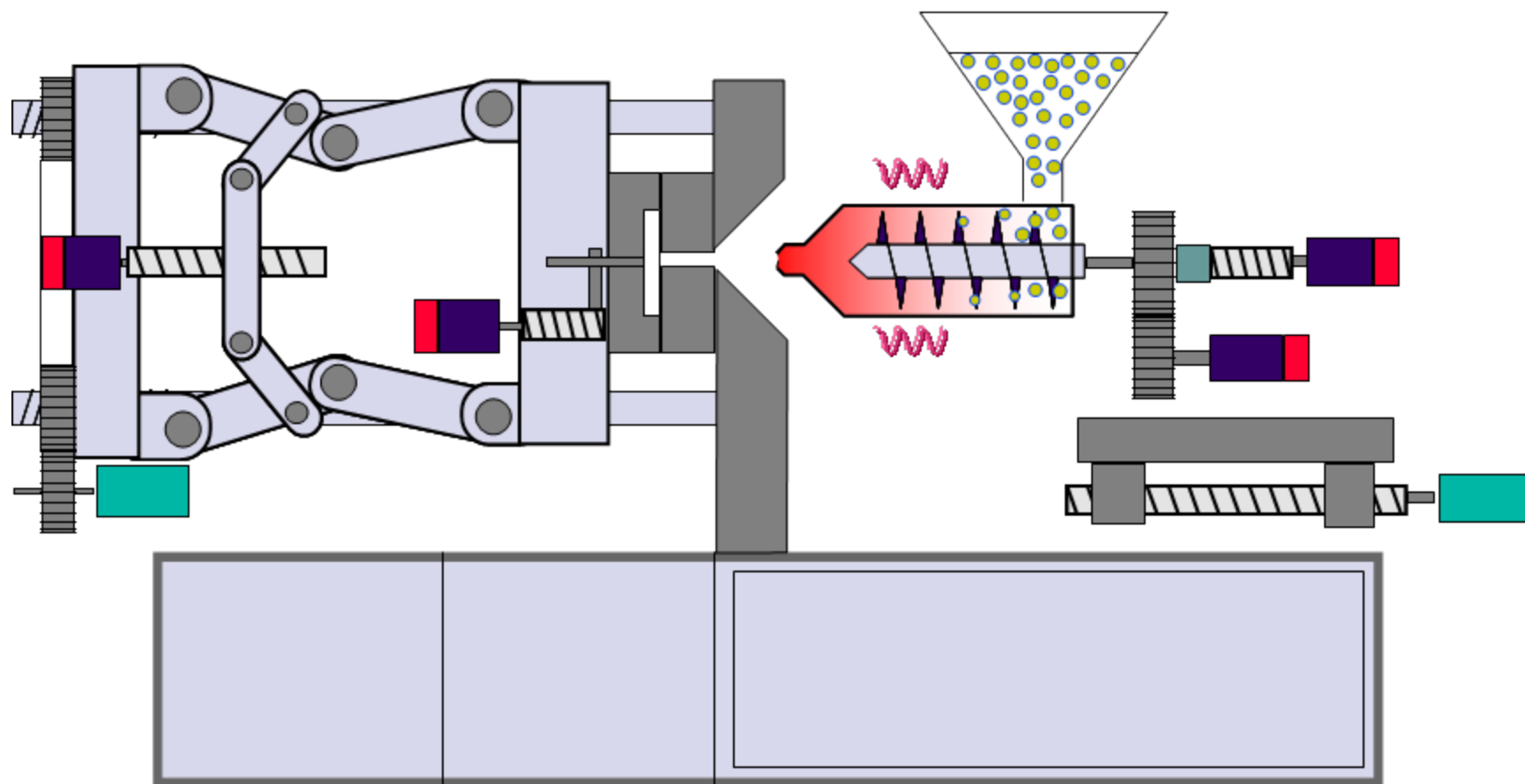
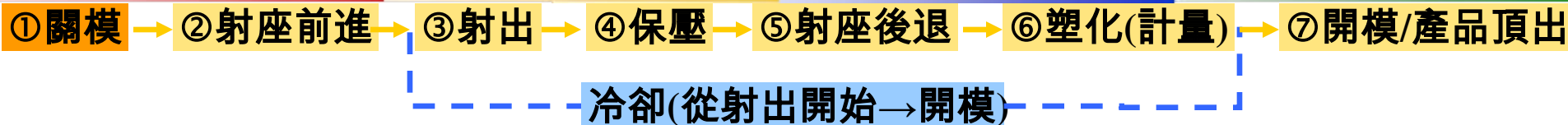
◎射出成型作動情況

①關模 → ②射座前進 → ③射出 → ④保壓 → ⑤射座後退 → ⑥塑化(計量) → ⑦開模/產品頂出

冷卻(從射出開始 → 開模)



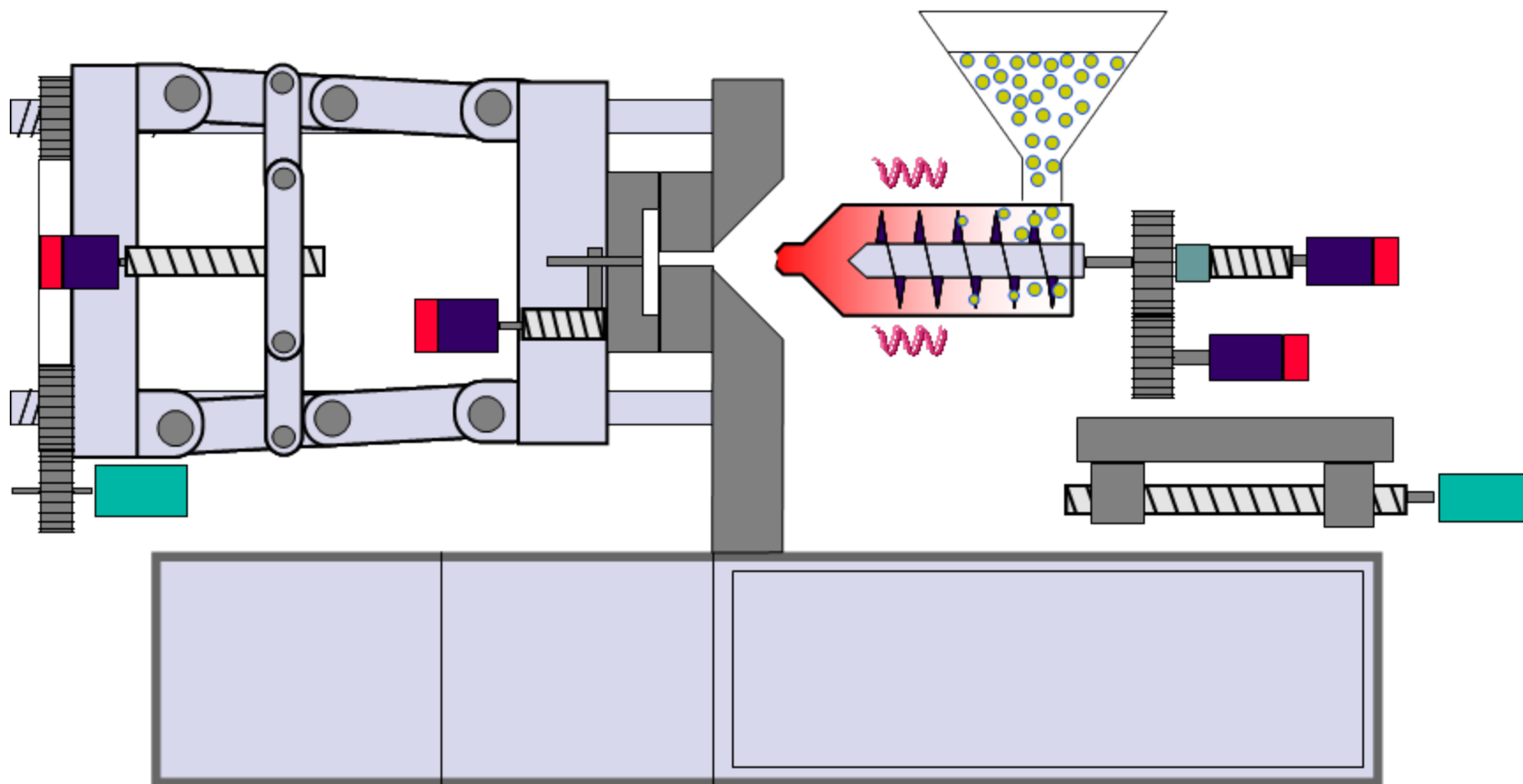
◎射出成型作動情況



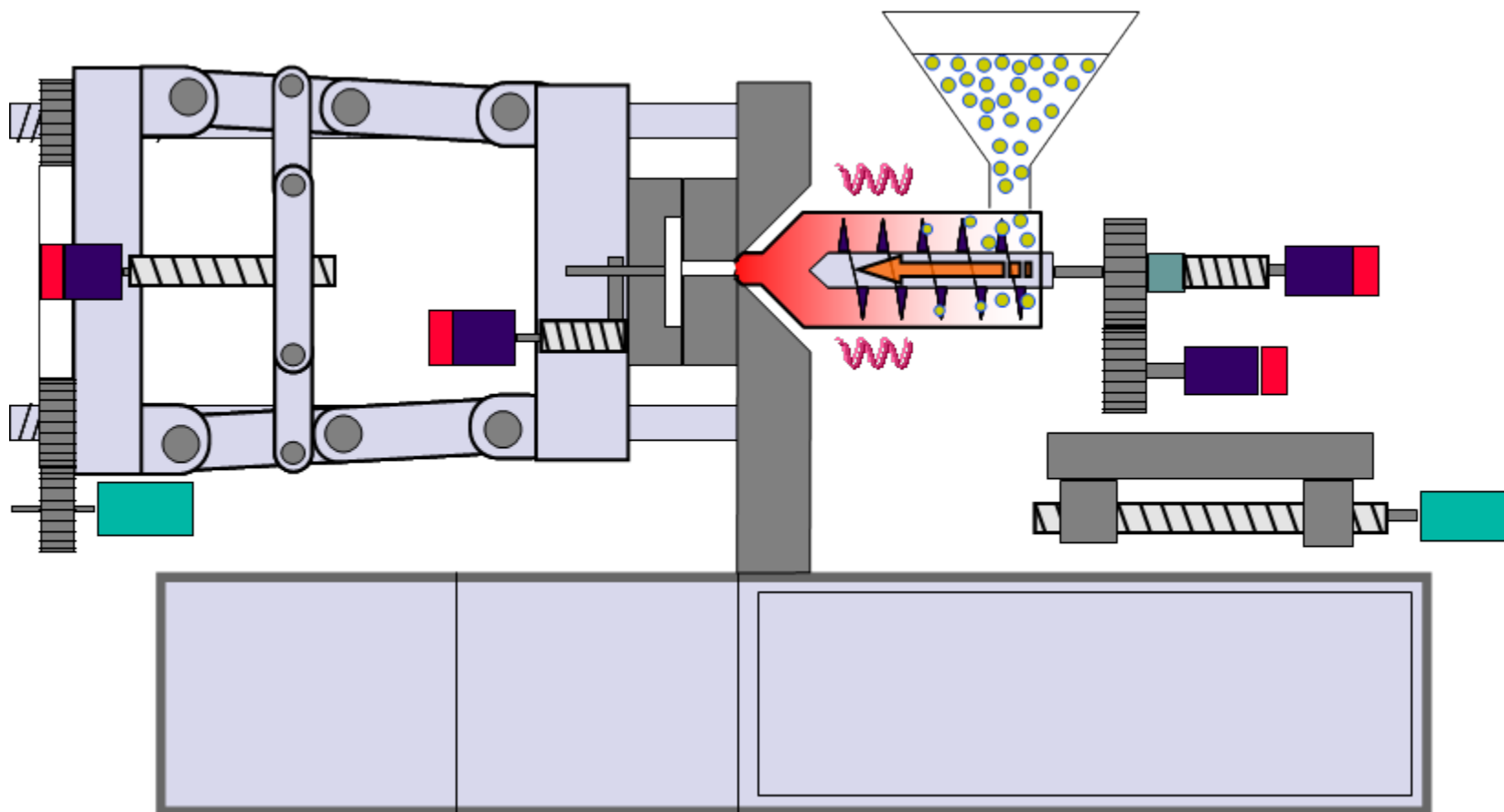
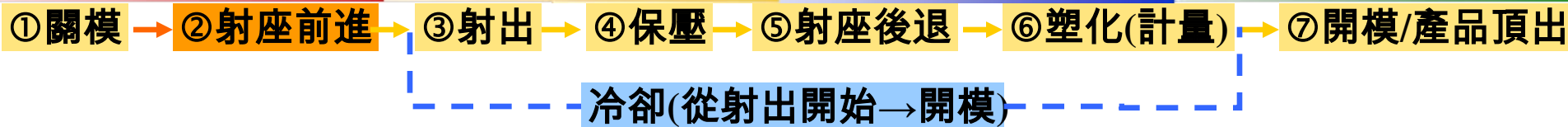
◎射出成型作動情況

①關模 → ②射座前進 → ③射出 → ④保壓 → ⑤射座後退 → ⑥塑化(計量) → ⑦開模/產品頂出

冷卻(從射出開始 → 開模)



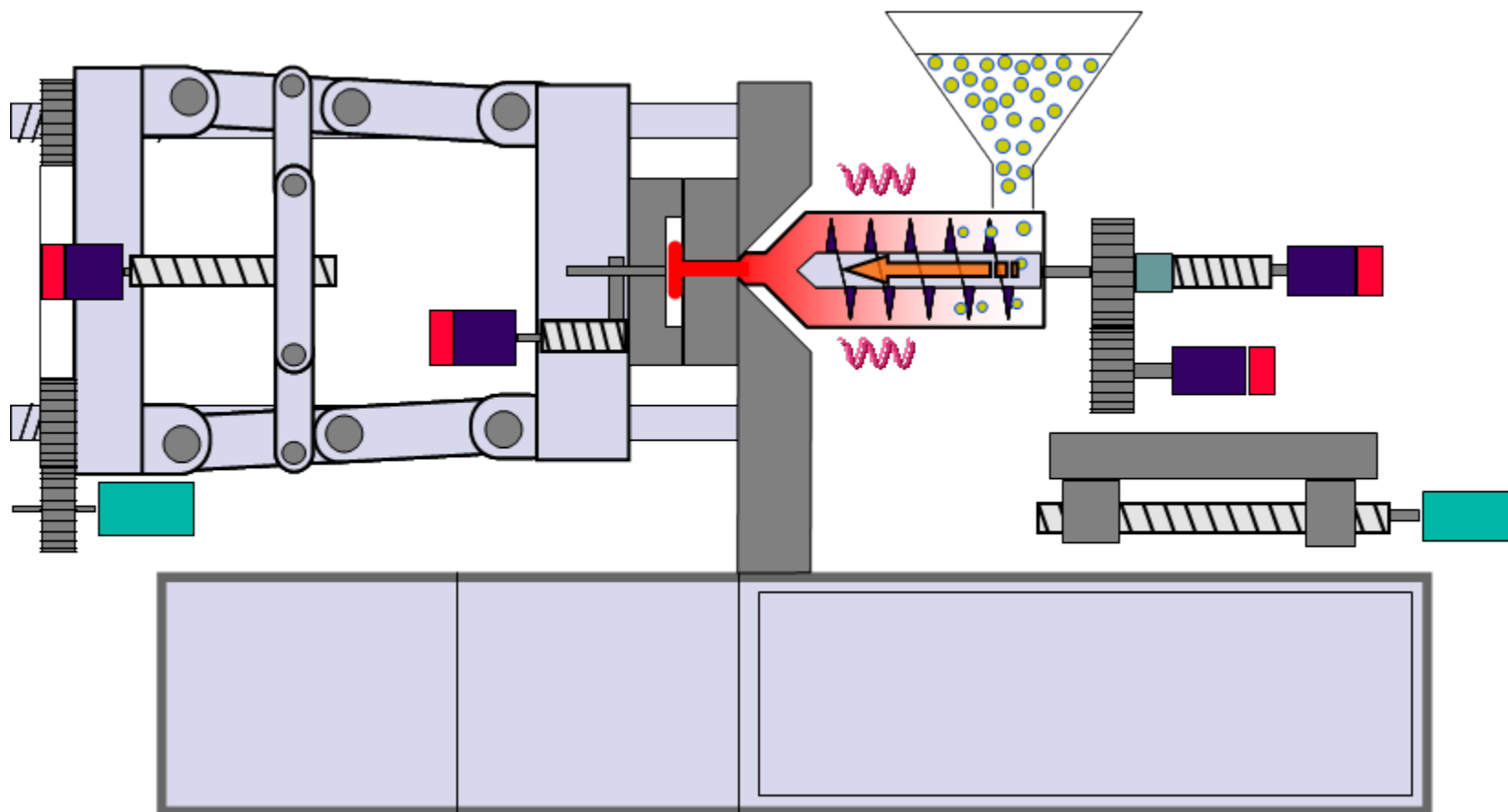
◎射出成型作動情況



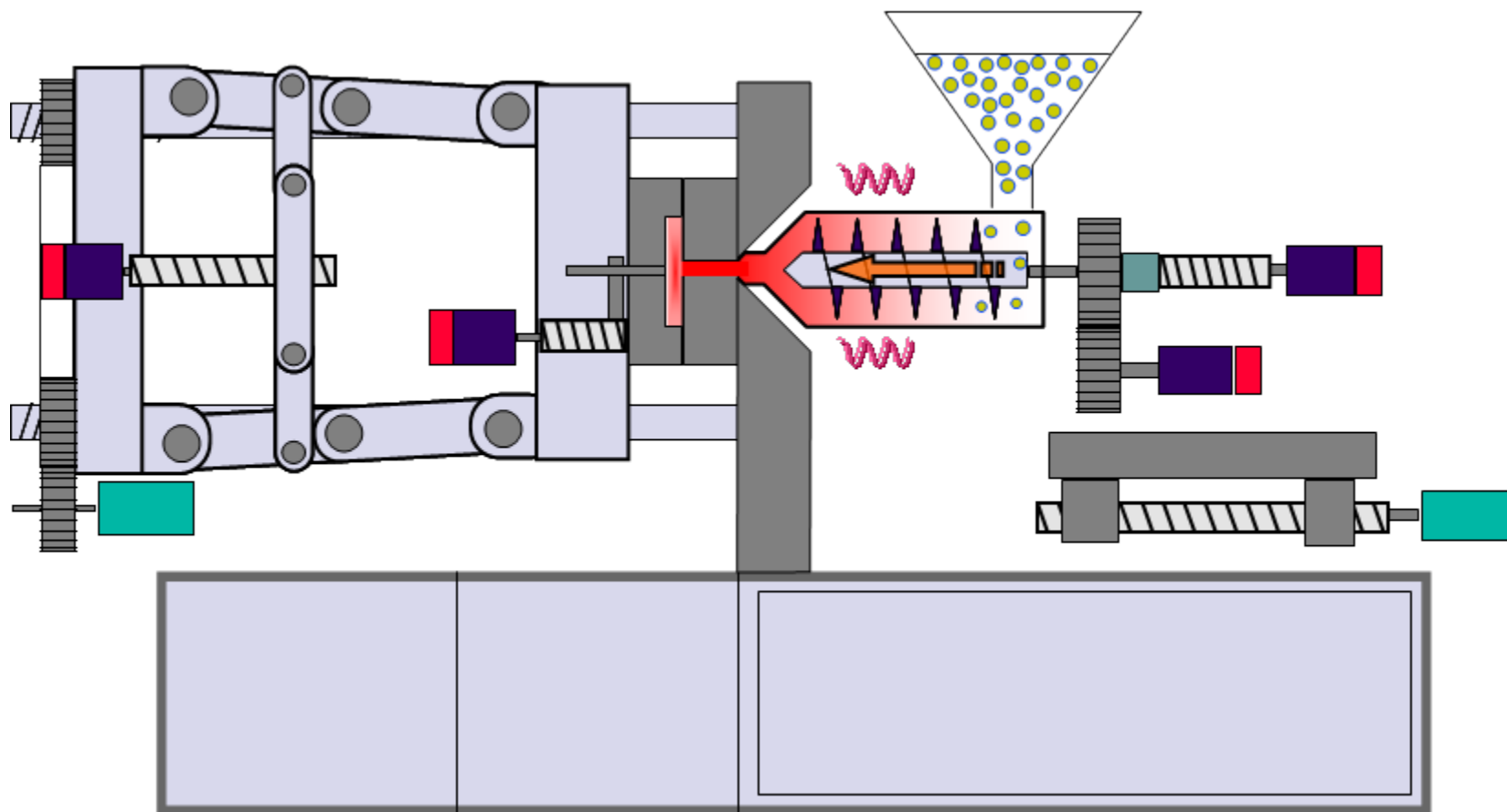
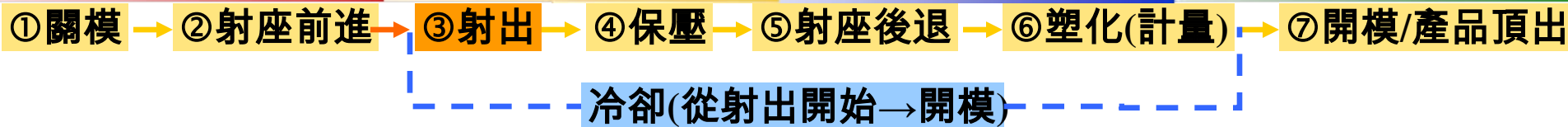
◎射出成型作動情況

①關模 → ②射座前進 → ③射出 → ④保壓 → ⑤射座後退 → ⑥塑化(計量) → ⑦開模/產品頂出

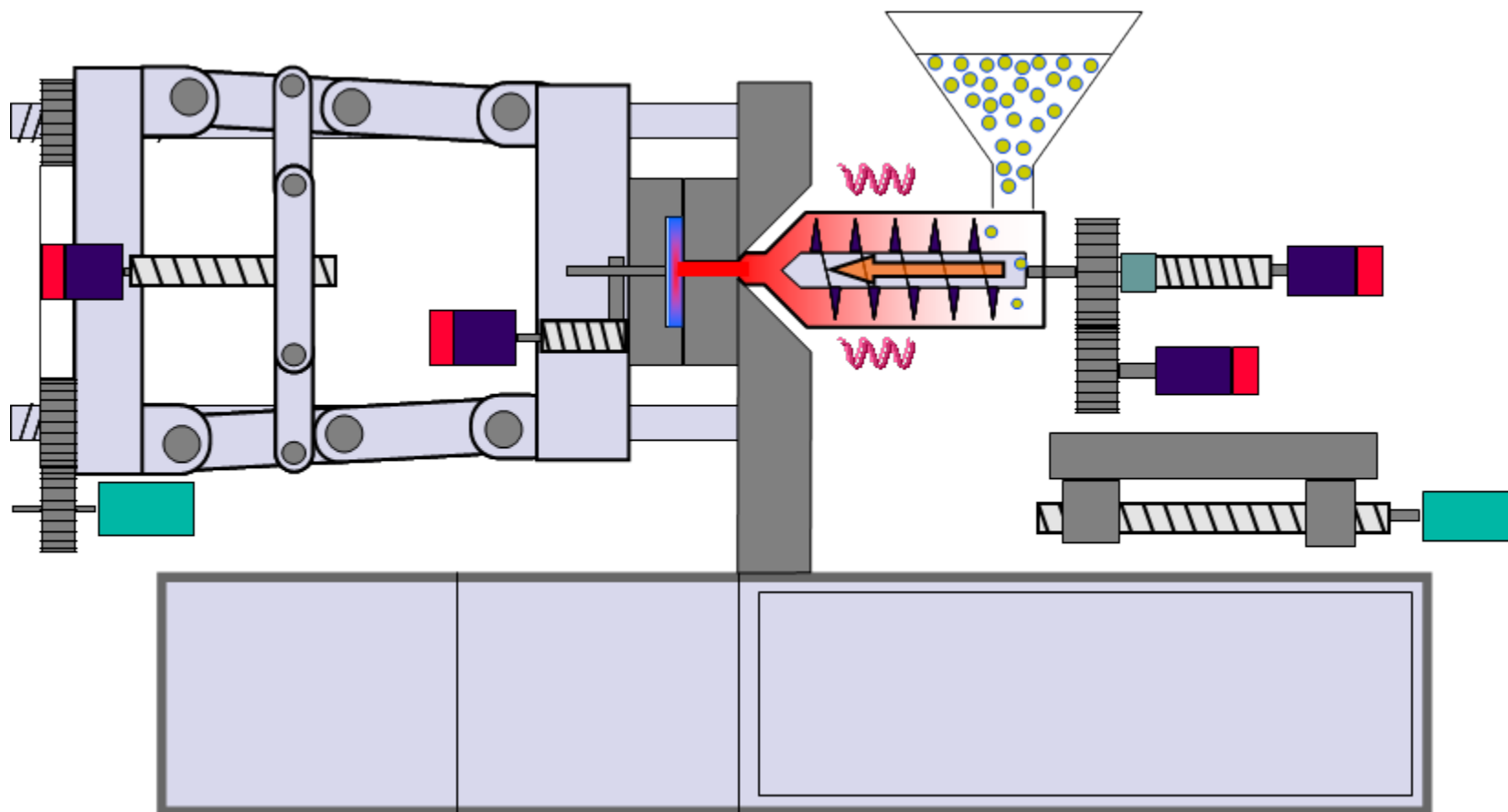
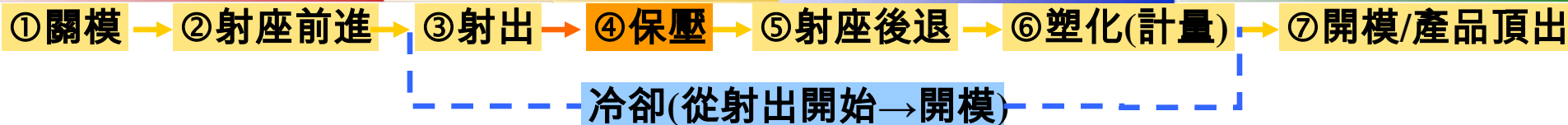
冷卻(從射出開始 → 開模)



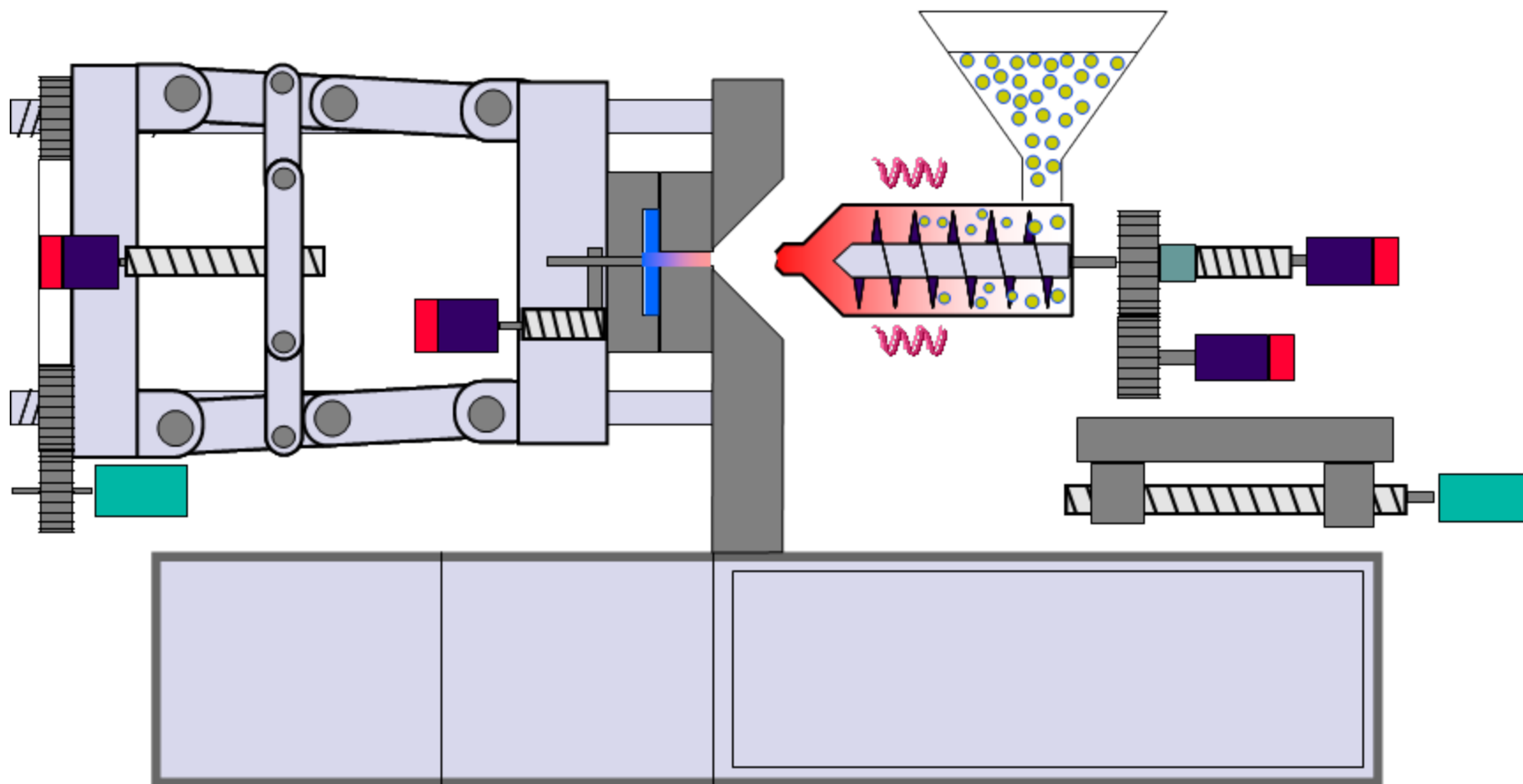
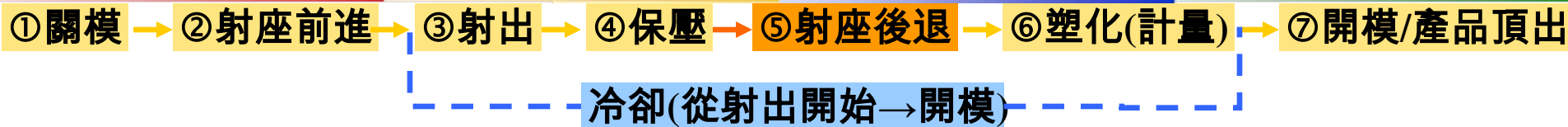
◎射出成型作動情況



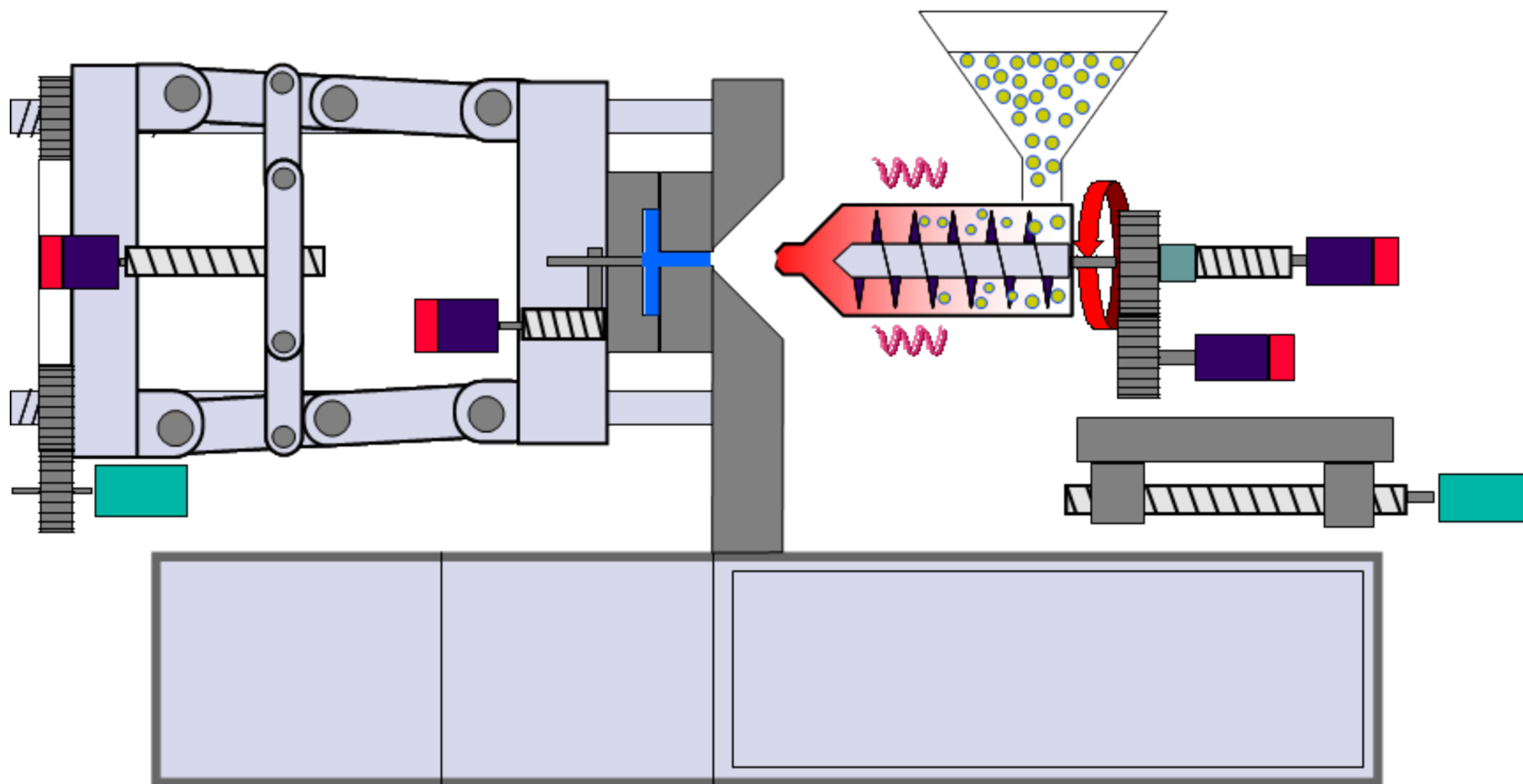
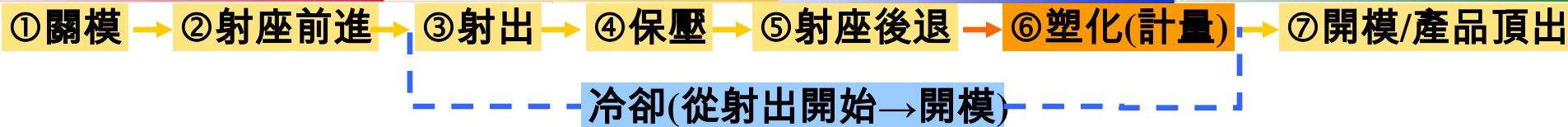
◎射出成型作動情況



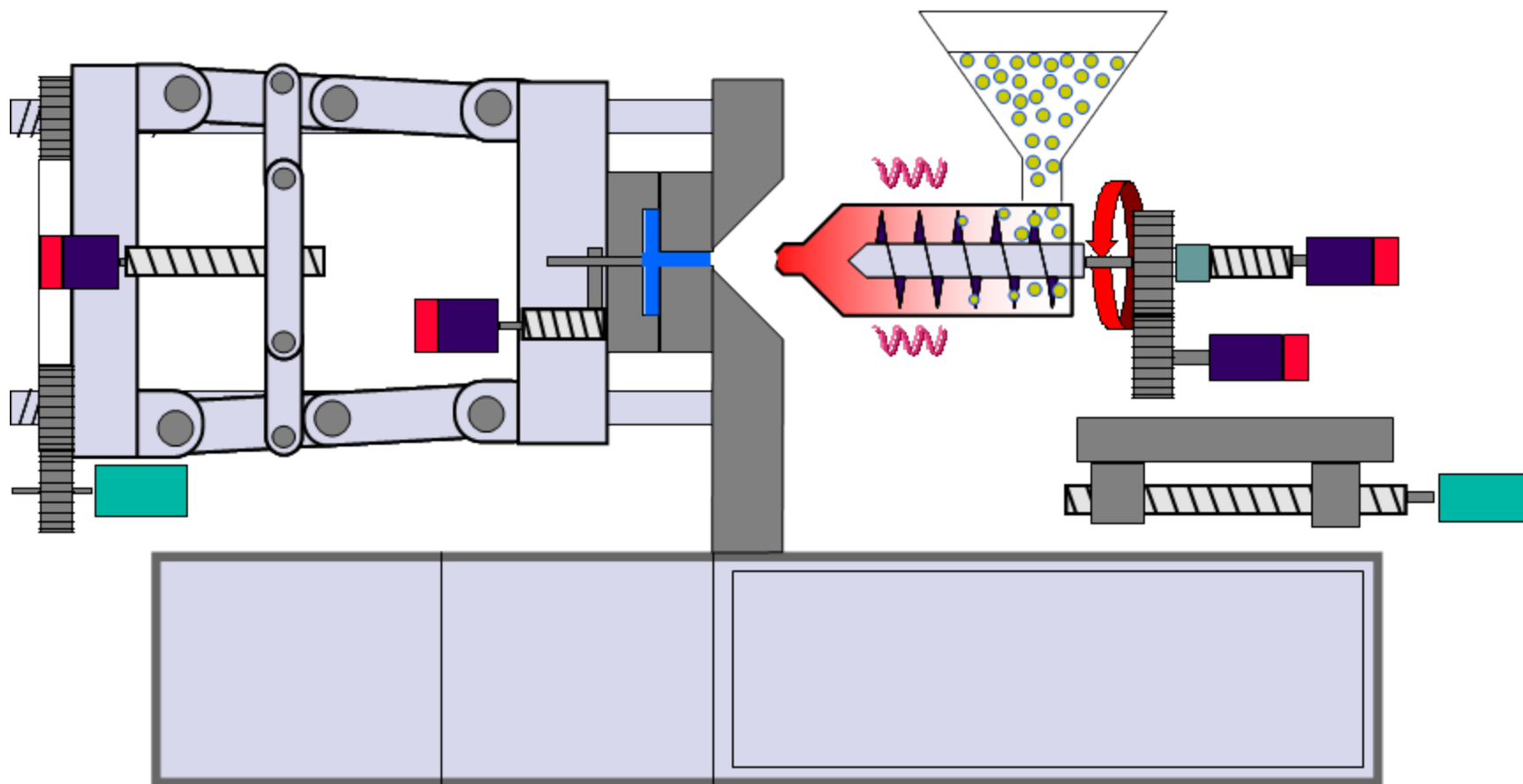
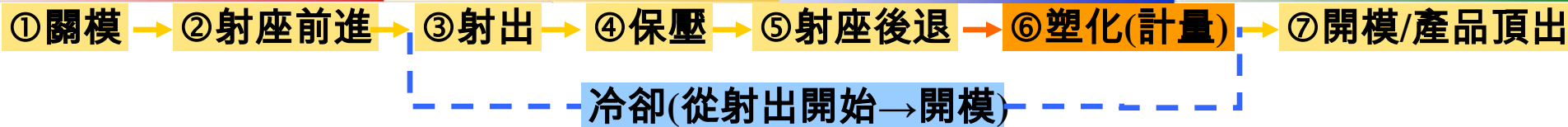
◎射出成型作動情況



◎射出成型作動情況



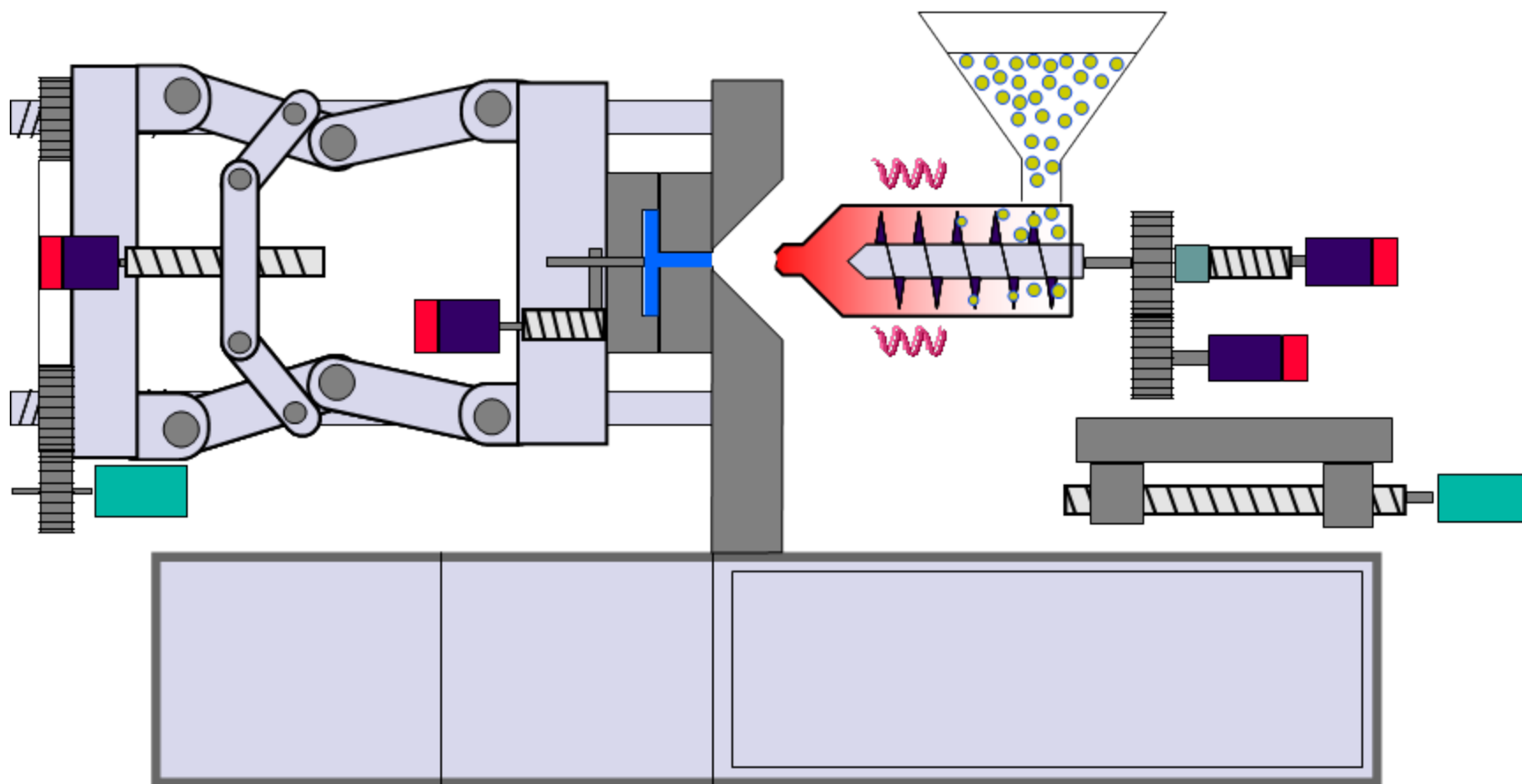
◎射出成型作動情況



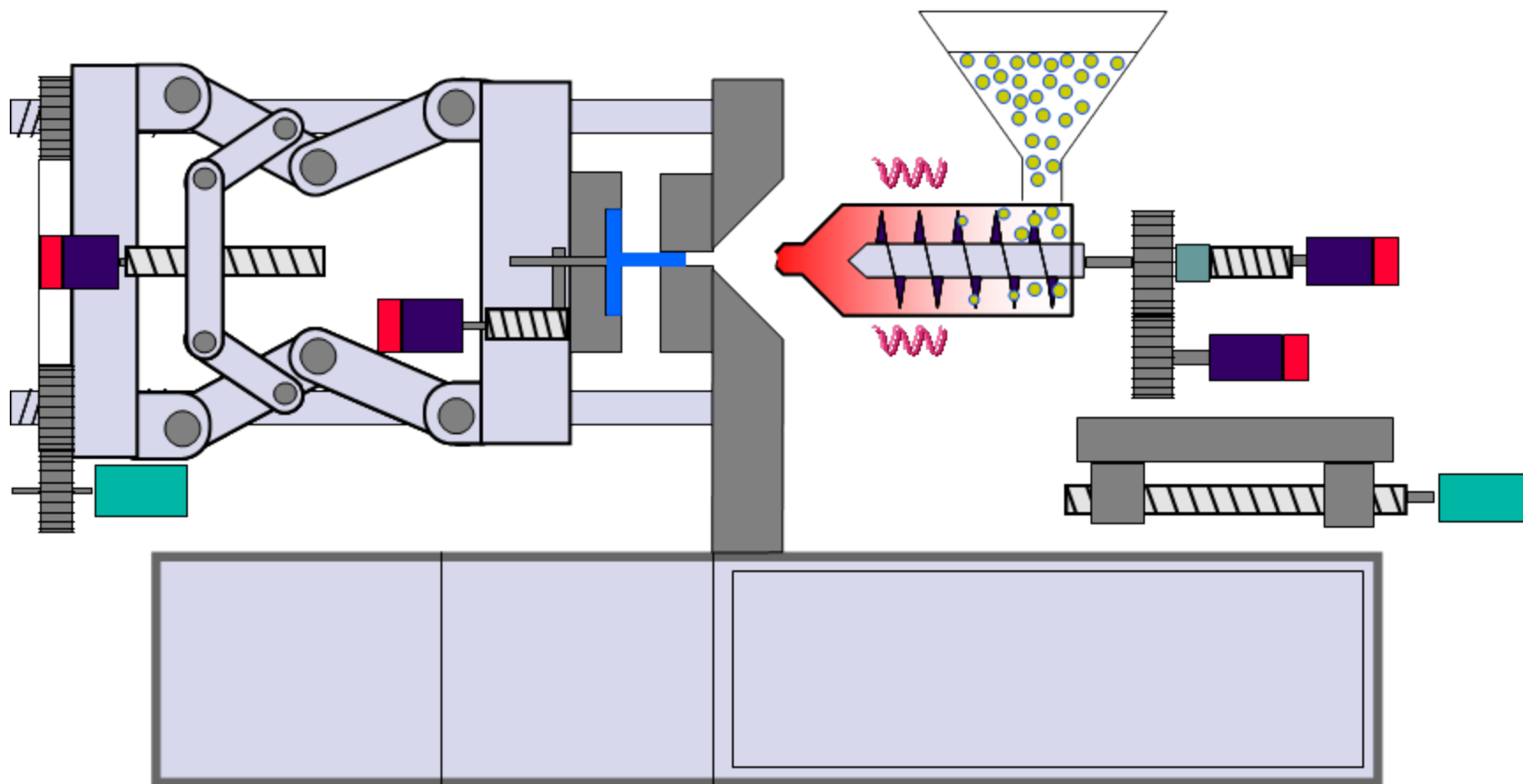
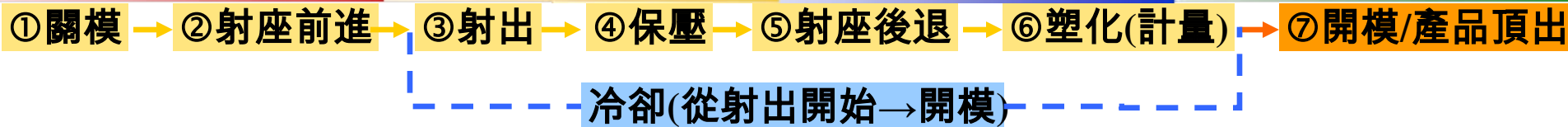
◎射出成型作動情況

①關模 → ②射座前進 → ③射出 → ④保壓 → ⑤射座後退 → ⑥塑化(計量) → ⑦開模/產品頂出

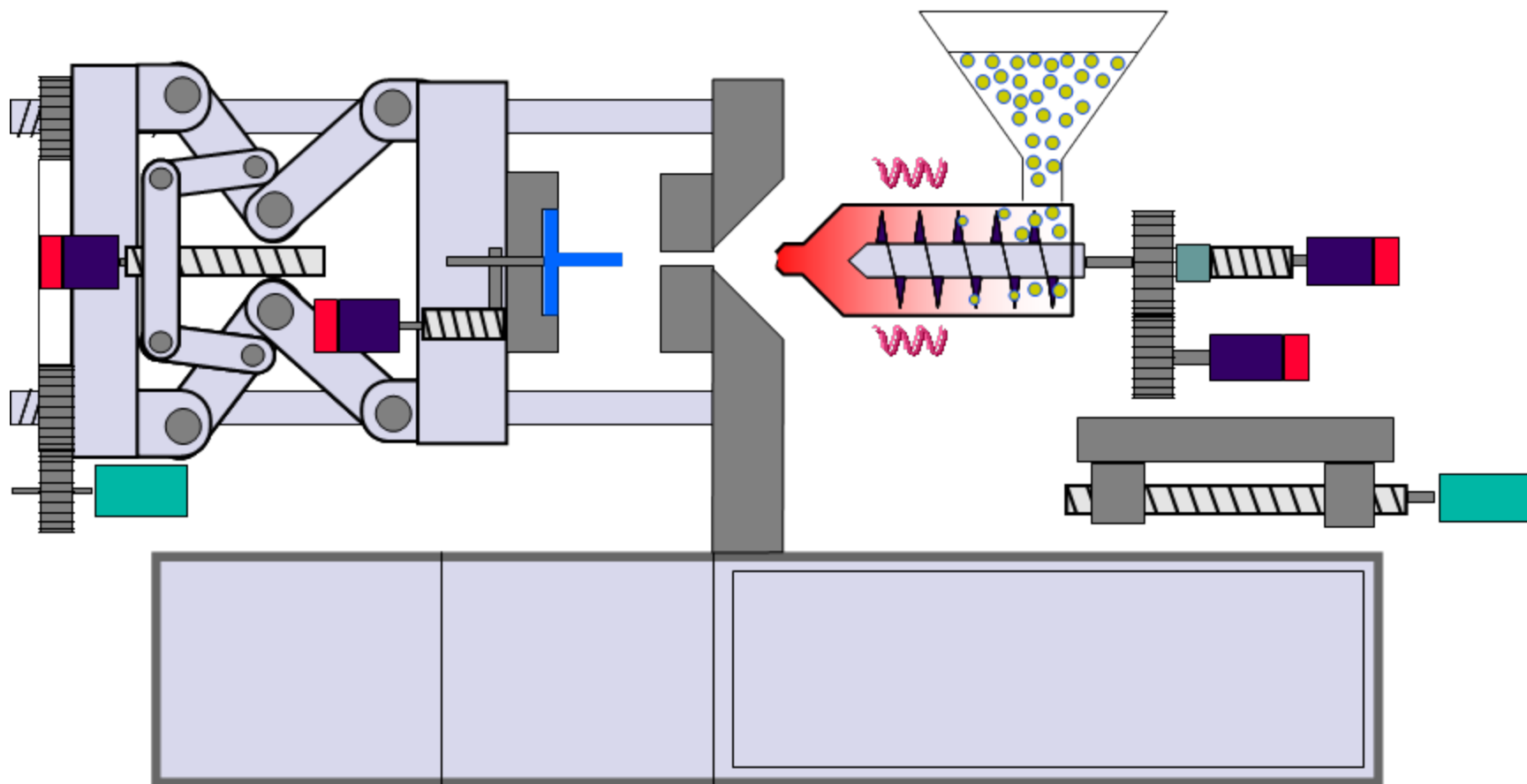
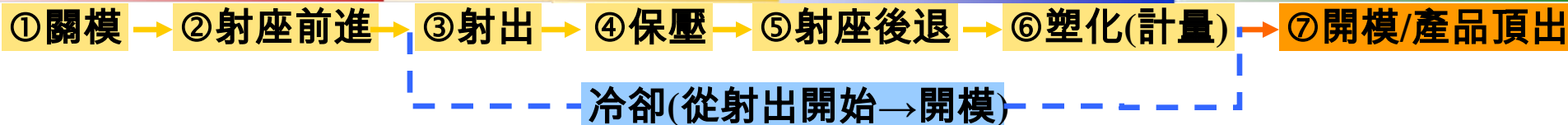
冷卻(從射出開始 → 開模)



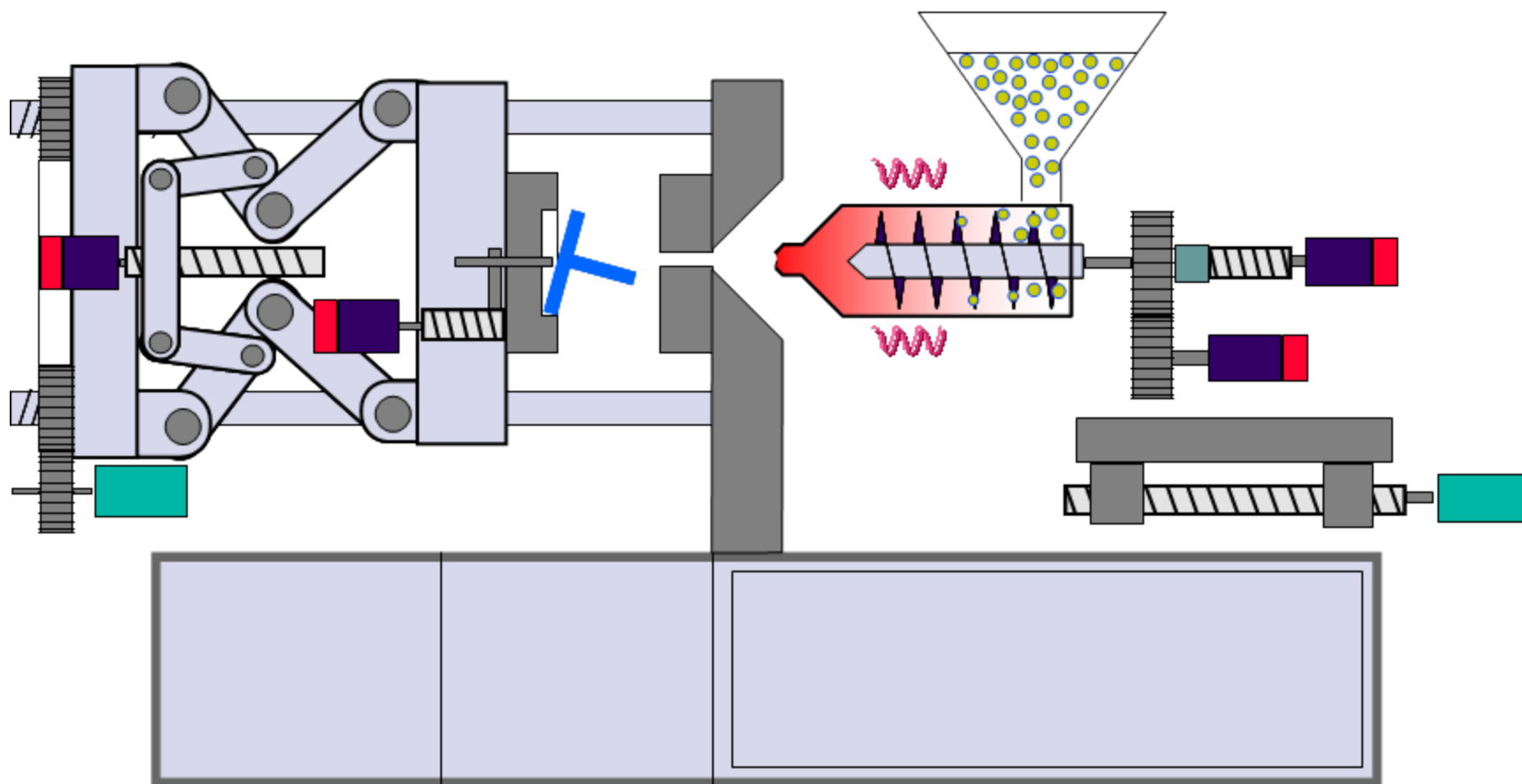
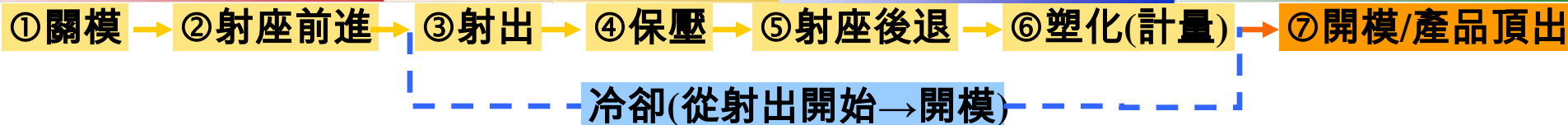
◎射出成型作動情況



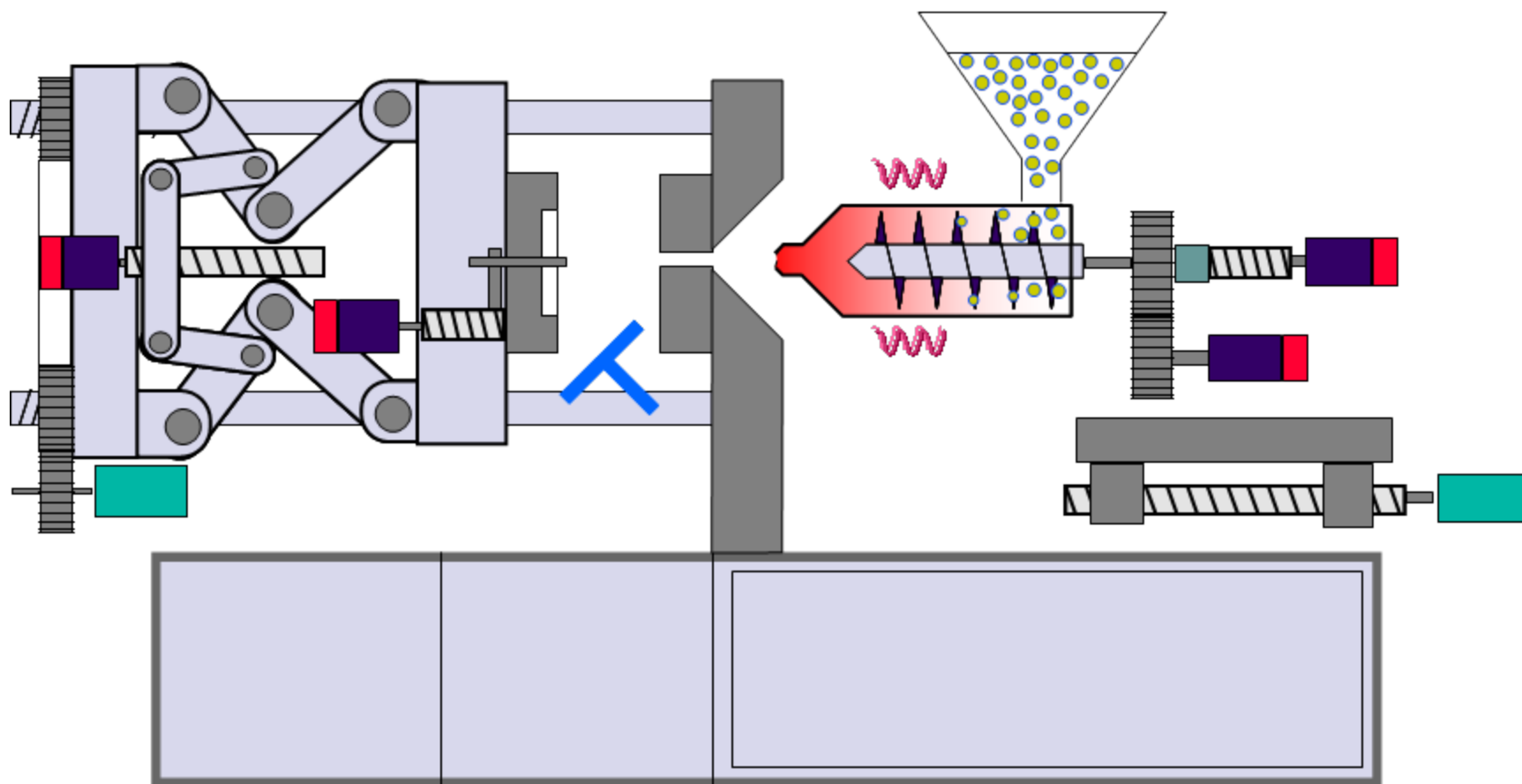
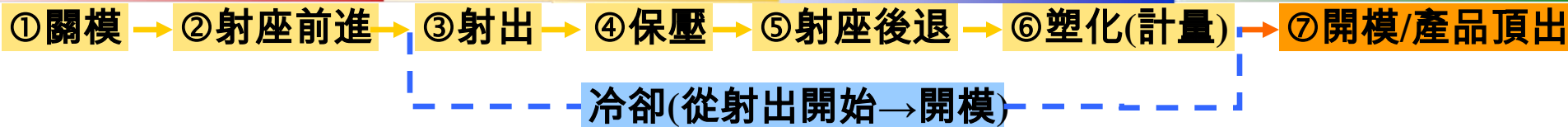
◎射出成型作動情況



◎射出成型作動情況



◎射出成型作動情況



二、標準模座的介紹與選擇

◎標準模座的種類

FUTABA	http://www.futabahk.com.hk/ http://www.futaba.co.jp/
MISUMI	http://www.misumi-tw.com.tw/index.html http://jp.misumi-ec.com/
HASCO	http://www.hasco.com/de
DME	http://www.shuan-shin.com.tw/ http://www.dme.net/dme/index.html

◎標準模座的種類



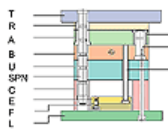
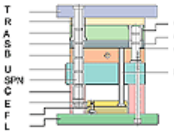
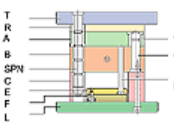
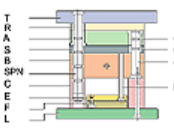
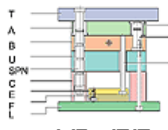

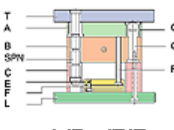
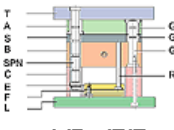
二板模模座-大水口模座

三板模模座-小水口模座

大水口模座

<p>SA 型</p>  <p>介紹 選擇</p>	<p>SB 型</p>  <p>介紹 選擇</p>	<p>SC 型</p>  <p>介紹 選擇</p>	<p>SD 型</p>  <p>介紹 選擇</p>
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小水口模座

<p>DA 型</p>  <p>介紹 選擇</p>	<p>DB 型</p>  <p>介紹 選擇</p>	<p>DC 型</p>  <p>介紹 選擇</p>	<p>DD 型</p>  <p>介紹 選擇</p>
<p>EA 型</p>  <p>介紹 選擇</p>	<p>EB 型</p>  <p>介紹 選擇</p>	<p>EC 型</p>  <p>介紹 選擇</p>	<p>ED 型</p>  <p>介紹 選擇</p>

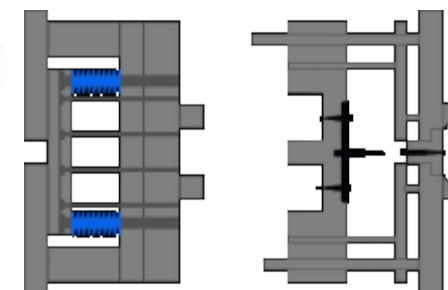
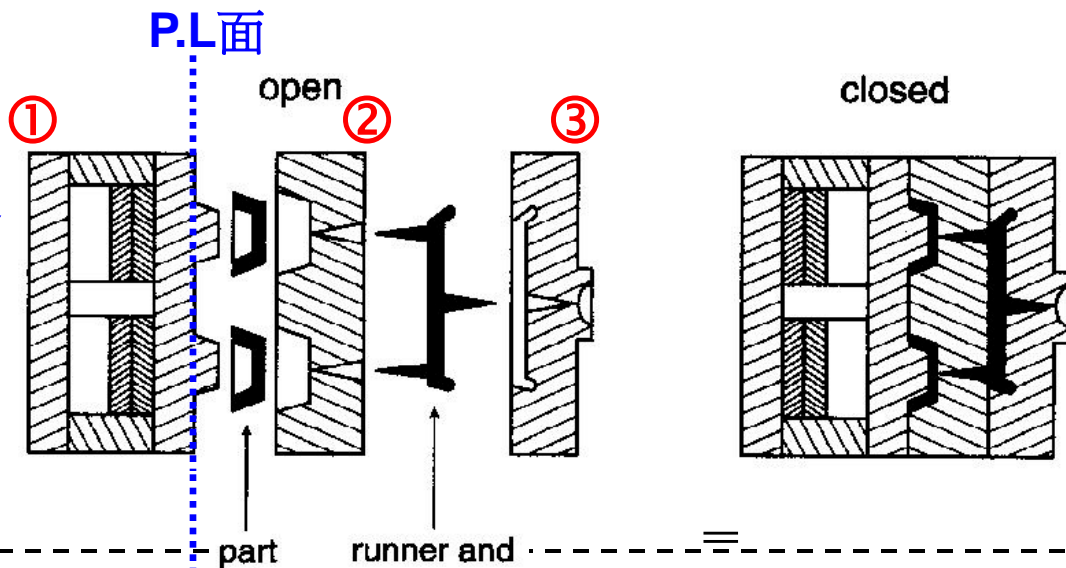
簡易水口模座

<p>FA 型</p>  <p>介紹 選擇</p>	<p>GA 型</p>  <p>介紹 選擇</p>	<p>FC 型</p>  <p>介紹 選擇</p>	<p>GC 型</p>  <p>介紹 選擇</p>
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◎標準模座的種類

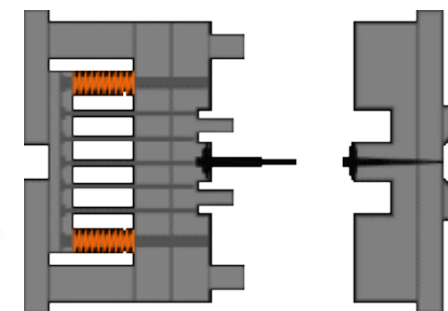
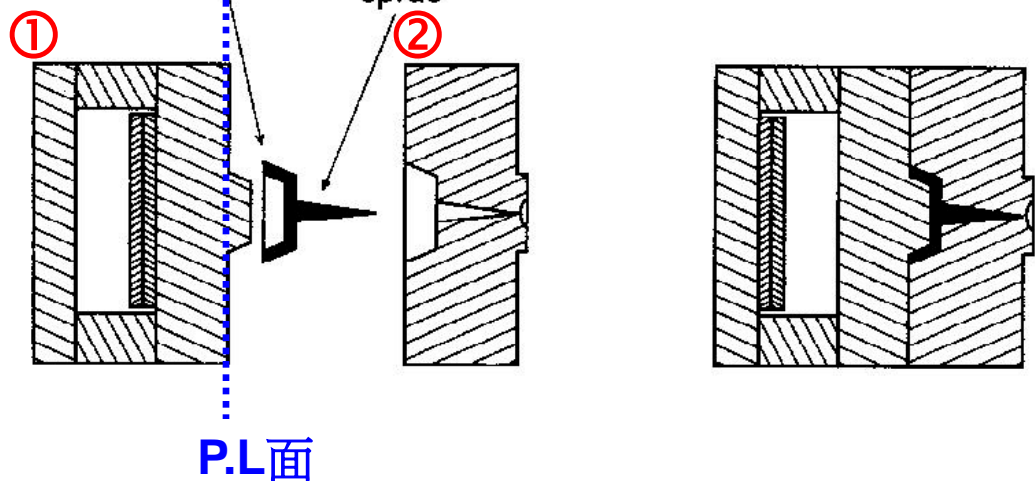
三板模

three plate mold



二板模

two plate mold



◎標準模座的種類

二板模(大水口)模座

上固定板(固定側固定板)

Top Clamping Plate

母模板(固定側模板)

Cavity Plate

活動板(剝料板)

Stripper Plate

公模板(可動側模板)

Core Plate

承板

Support Plate

間隔塊(模腳)

Spacer Block

上頂針板(頂出銷定位板)

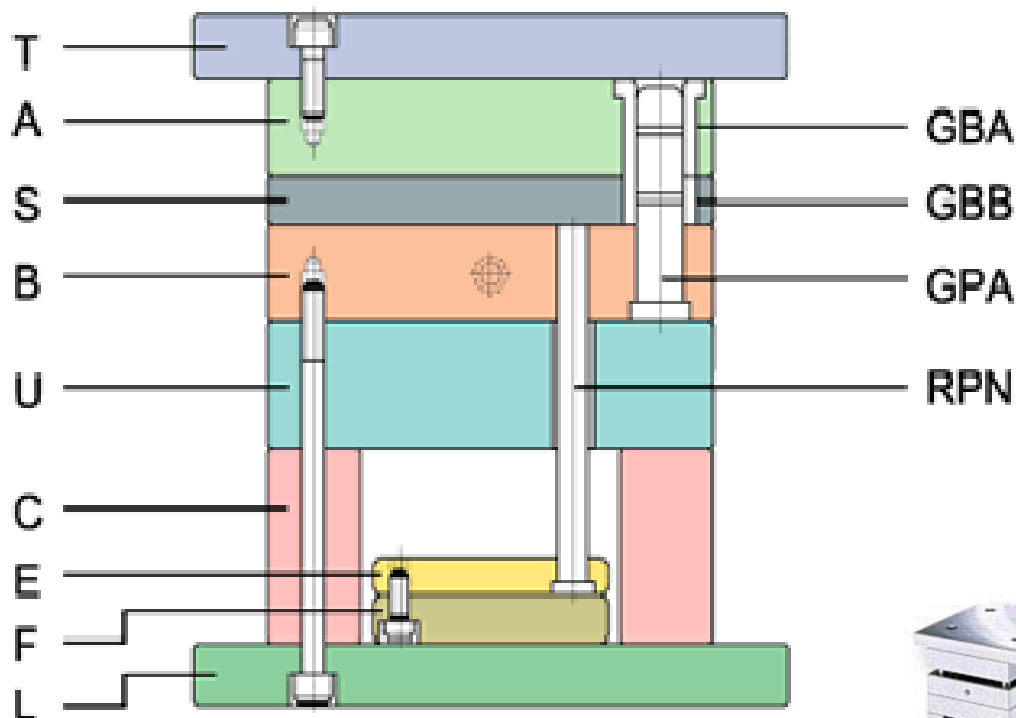
Ejector Locating Plate

下頂針板(頂出銷固定板)

Ejector Clamping Plate

下固定板(可動側固定板)

Bottom Clamping Plate



導套A型(導銷襯套)

Guide Bush

導套B型(導銷襯套)

Guide Bush

導銷(導針)

Guide Pin

回位銷(回針)

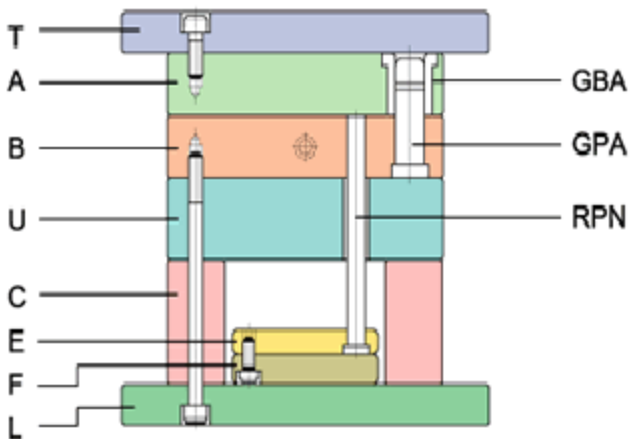
Return Pin



◎標準模座的種類

大水口模座

SA 型

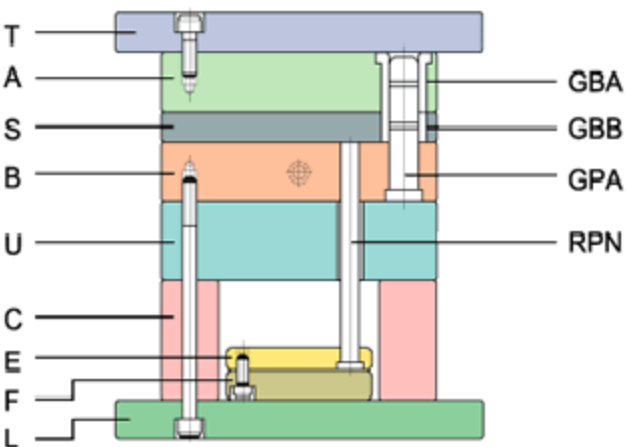


- ✗ 活動板(剝料板)
Stripper Plate
- ✓ 承板
Support Plate

無 活動版(剝料板) → **A** 導套(導銷襯套)

有 活動版(剝料板) → **A+B** 導套(導銷襯套)

SB 型



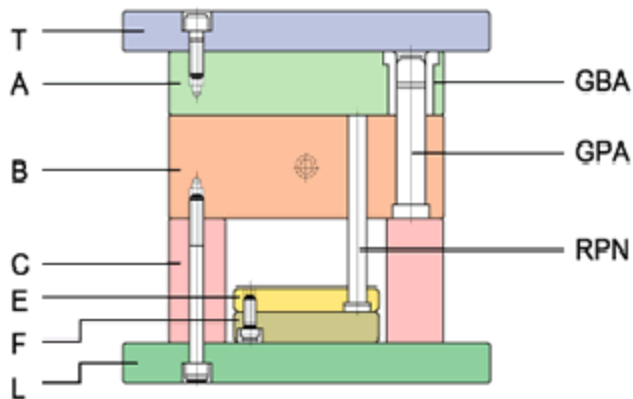
- ✓ 活動板(剝料板)
Stripper Plate
- ✓ 承板
Support Plate



◎標準模座的種類

大水口模座

SC 型

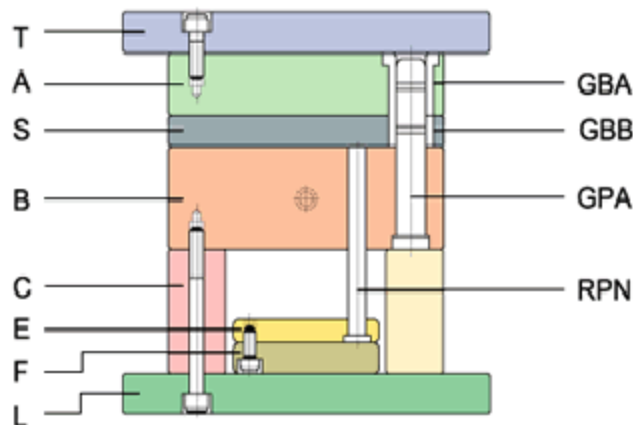


- ✗ 活動板(剝料板)
Stripper Plate
- ✗ 承板
Support Plate

無 活動版(剝料板) → **A** 導套(導銷襯套)

有 活動版(剝料板) → **A+B** 導套(導銷襯套)

SD 型



- ✓ 活動板(剝料板)
Stripper Plate
- ✗ 承板
Support Plate



◎標準模座的種類

三板模(小水口)模座

上固定板(固定側固定板)

Top Clamping Plate

脫料板(流道剝料板)

Runner Stripper Plate

母模板(固定側模板)

Cavity Plate

活動板(剝料板)

Stripper Plate

公模板(可動側模板)

Core Plate

承板

Support Plate

拉桿

Support Pin

間隔塊

Spacer Block

上頂針板(頂出銷定位板)

Ejector Locating Plate

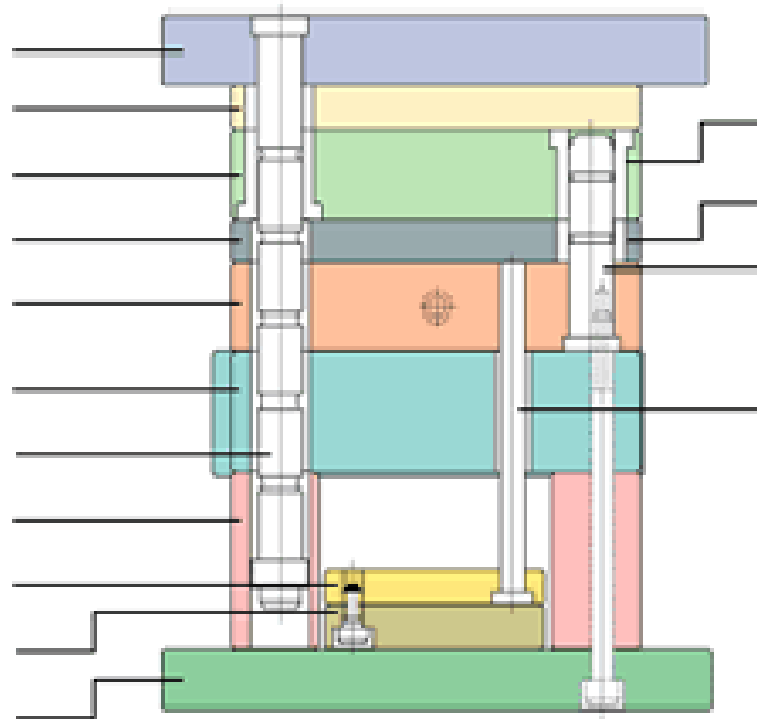
下頂針板(頂出銷固定板)

Ejector Clamping Plate

下固定板(可動側固定板)

Bottom Clamping Plate

T
R
A
S
B
U
S
P
N
C
E
F
L



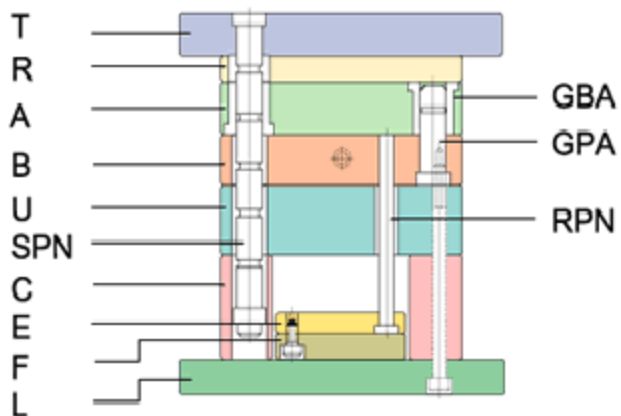
GBA 導套A型(導銷襯套)
Guide Bush
GBB 導套B型(導銷襯套)
Guide Bush
GPA 導銷(導針)
Guide Pin
RPN 回位銷(回針)
Return Pin



◎標準模座的種類

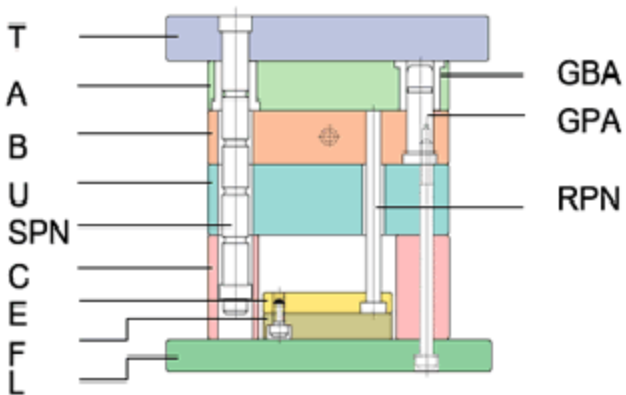
小水口模座

DA 型



- ✓ 脫料板(流道剝料板)
Runner Stripper Plate
- ✗ 活動板(剝料板)
Stripper Plate
- ✓ 承板
Support Plate

EA 型



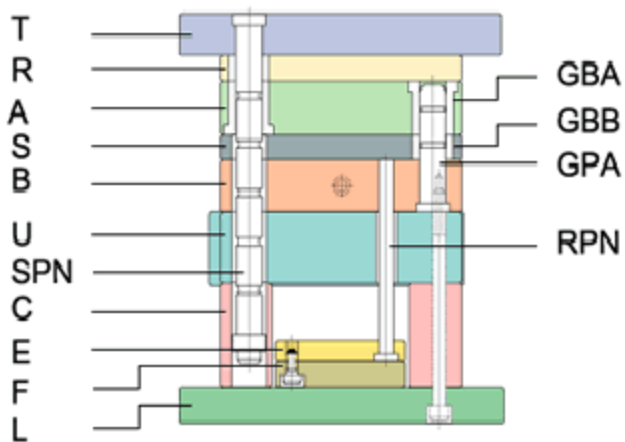
- ✗ 脫料板(流道剝料板)
Runner Stripper Plate
- ✗ 活動板(剝料板)
Stripper Plate
- ✓ 承板
Support Plate



◎標準模座的種類

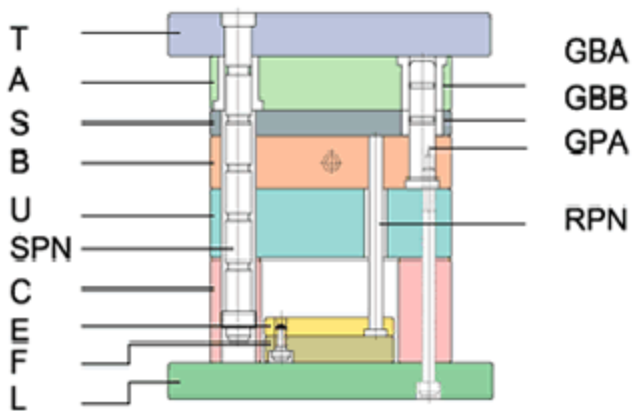
小水口模座

DB 型



- ✓ 脫料板(流道剝料板)
Runner Stripper Plate
- ✓ 活動板(剝料板)
Stripper Plate
- ✓ 承板
Support Plate

EB 型



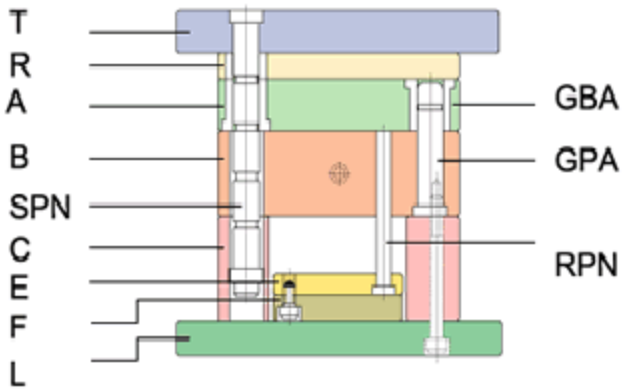
- ✗ 脫料板(流道剝料板)
Runner Stripper Plate
- ✓ 活動板(剝料板)
Stripper Plate
- ✓ 承板
Support Plate



◎標準模座的種類

小水口模座

DC 型



脫料板(流道剝料板)
Runner Stripper Plate

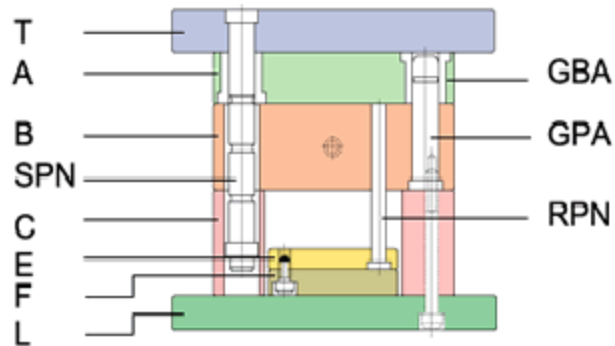


活動板(剝料板)
Stripper Plate



承板
Support Plate

EC 型



脫料板(流道剝料板)
Runner Stripper Plate



活動板(剝料板)
Stripper Plate



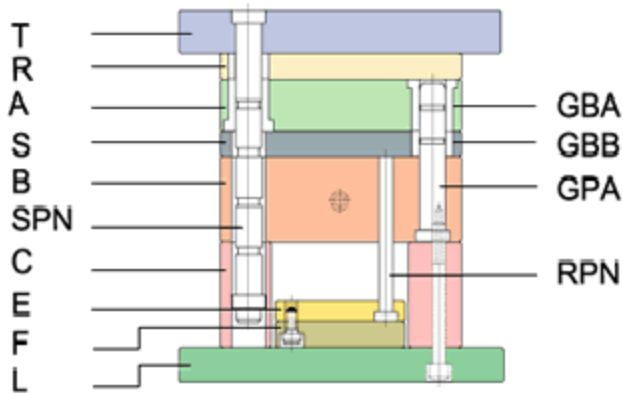
承板
Support Plate



◎標準模座的種類

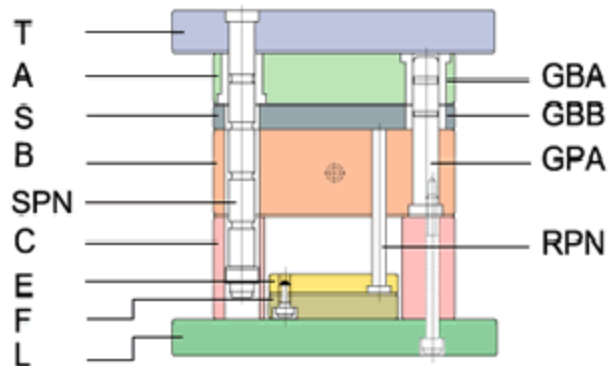
小水口模座

DD 型



- ✓ 脫料板(流道剝料板)
Runner Stripper Plate
- ✓ 活動板(剝料板)
Stripper Plate
- ✗ 承板
Support Plate

ED 型



- ✗ 脫料板(流道剝料板)
Runner Stripper Plate
- ✓ 活動板(剝料板)
Stripper Plate
- ✗ 承板
Support Plate

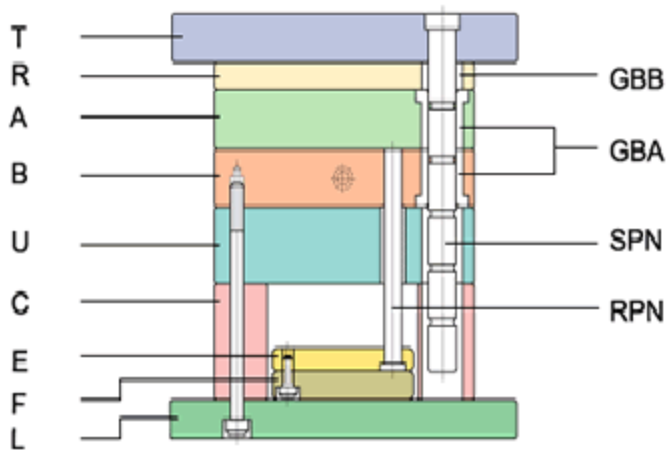


◎標準模座的種類

簡易小水口模座

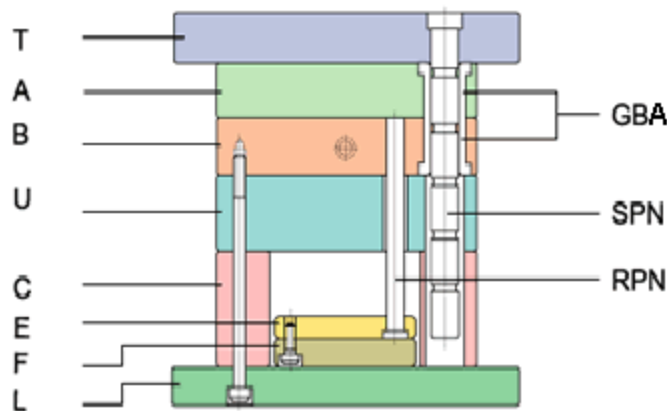
沒有導銷→拉杆兼具導銷功能

FA 型



- ✓ 脫料板(流道剝料板)
Runner Stripper Plate
- ✗ 活動板(剝料板)
Stripper Plate
- ✓ 承板
Support Plate

GA 型



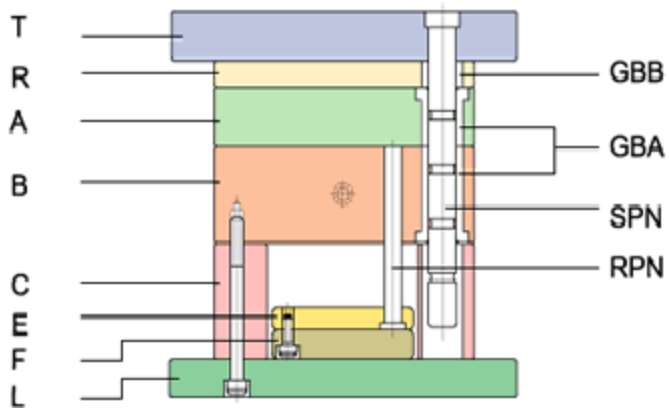
- ✗ 脫料板(流道剝料板)
Runner Stripper Plate
- ✗ 活動板(剝料板)
Stripper Plate
- ✓ 承板
Support Plate

◎標準模座的種類

簡易小水口模座

沒有導銷→拉杆兼具導銷功能

FC 型



脫料板(流道剝料板)

Runner Stripper Plate



活動板(剝料板)

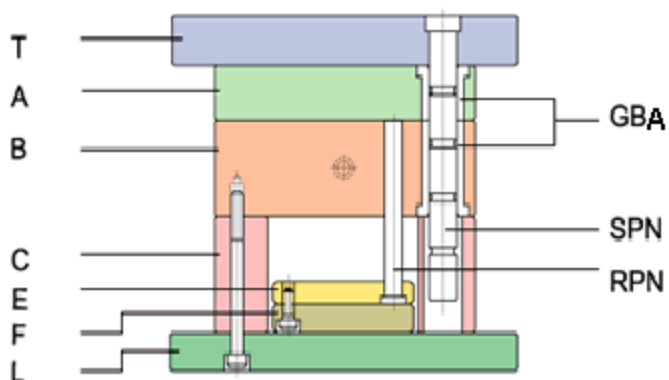
Stripper Plate



承板

Support Plate

GC 型



脫料板(流道剝料板)

Runner Stripper Plate



活動板(剝料板)

Stripper Plate



承板

Support Plate

◎標準模座的種類

選擇模座

① → ② → ③ → ④ → ⑤ → ⑥ → ⑦

大水槽模座-SA
 大水槽模座-SB
 大水槽模座-SC
 大水槽模座-SD
 小水槽模座-DA
 小水槽模座-DB
 小水槽模座-DC
 小水槽模座-DD
 小水槽模座-EA
 小水槽模座-EB
 小水槽模座-EC
 小水槽模座-ED
 簡易小水槽模座-FA
 簡易小水槽模座-FC
 簡易小水槽模座-GA
 簡易小水槽模座-GC

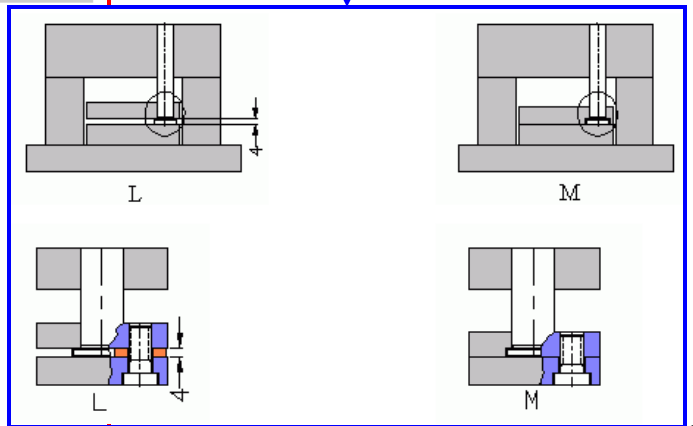
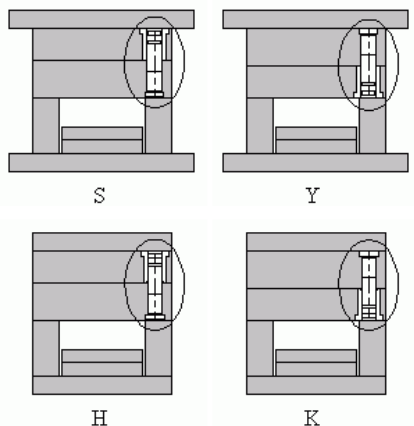
MDC SA: 1515
 A板厚度: 25
 B板厚度: 40
 C板厚度: 50
 導針位置: S
 頂針板規格: M

套用訂購習慣

預覽

選擇加工

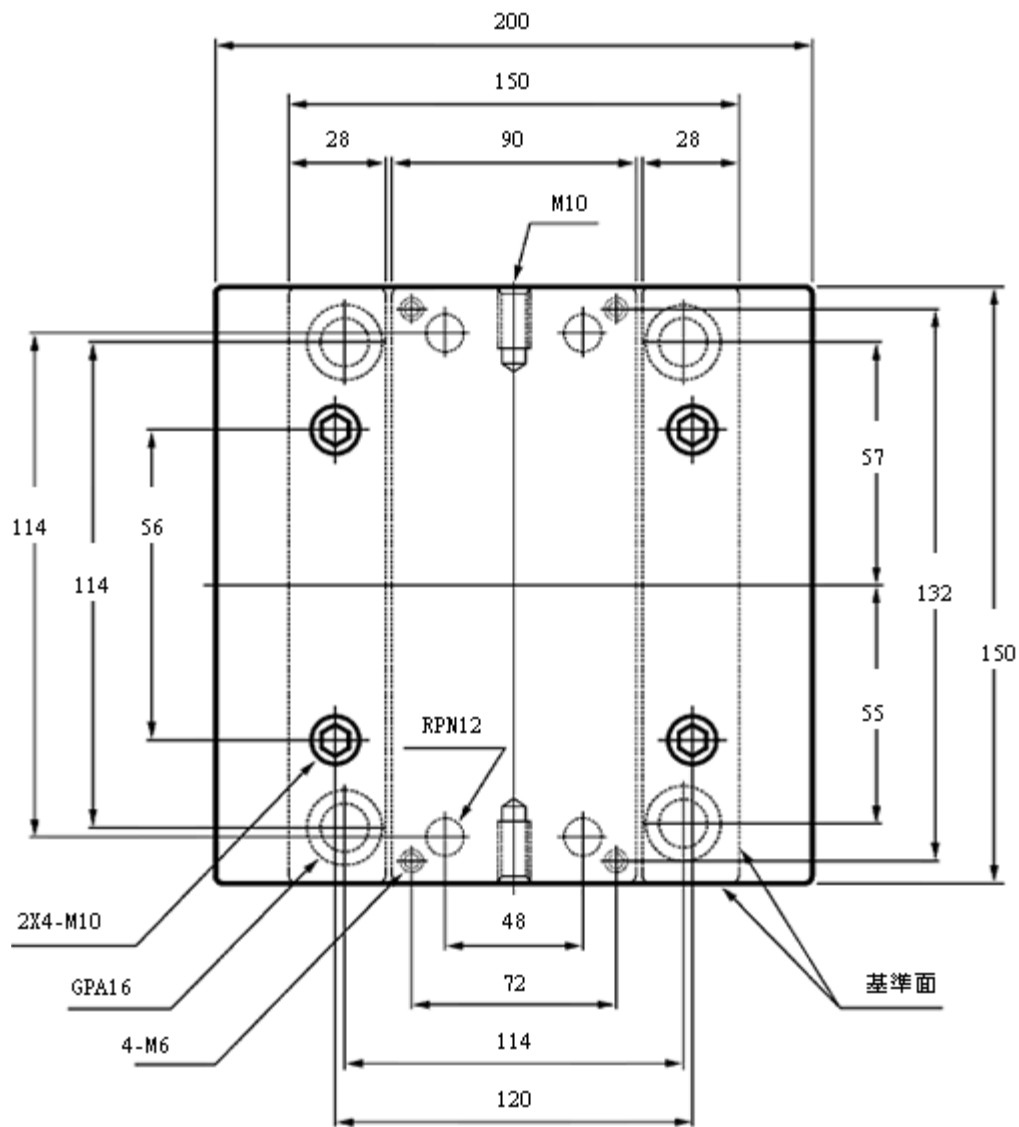
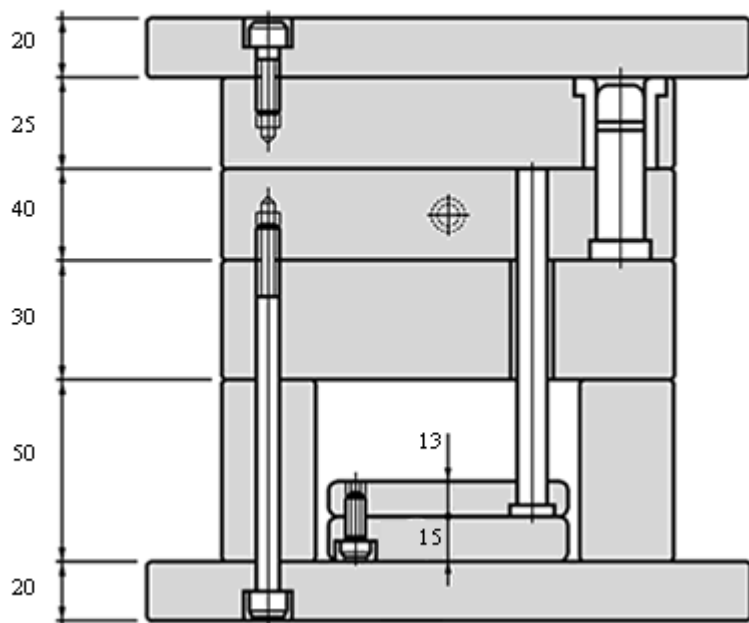
導針	導針位置	
	固定板	固定板
工字模 (JT Type)	S	Y
直身模 (HT Type)	H	K



◎標準模座的種類

◎預覽結果

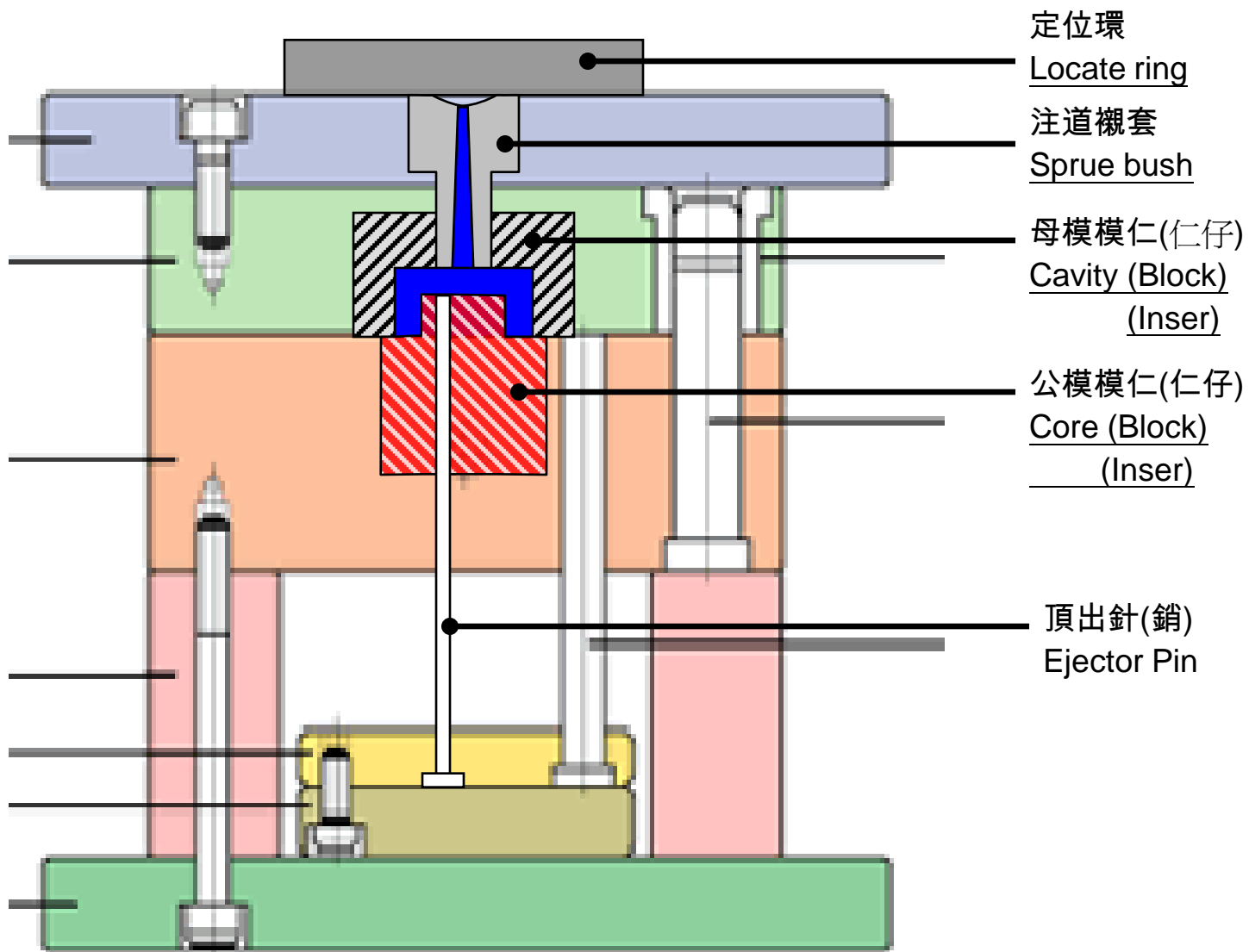
SA
Type



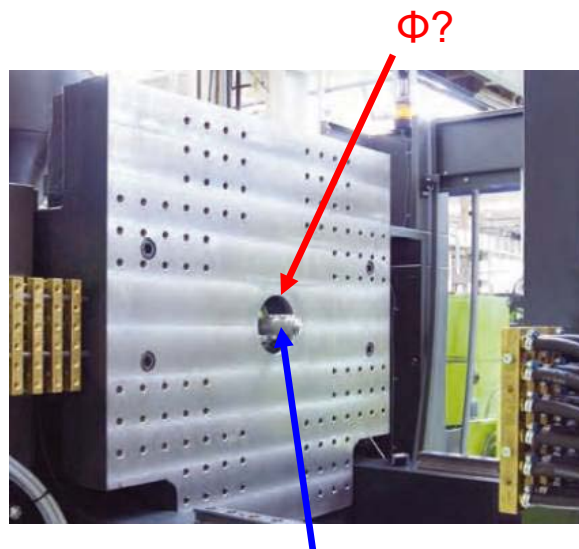
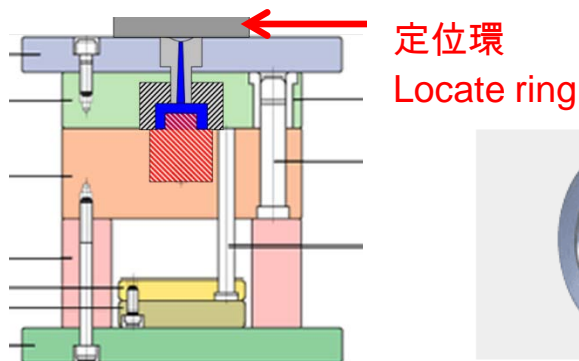
三、 模具基本架構的設計&零件介紹

- ◎標準模座以外的零件
- ◎模具各零件的尺寸規格設計&介紹

◎標準模座以外的零件



◎定位環



射出機噴嘴(Nozzle)

FANUC ROBOSHOT S-2000i50A

机构部规格

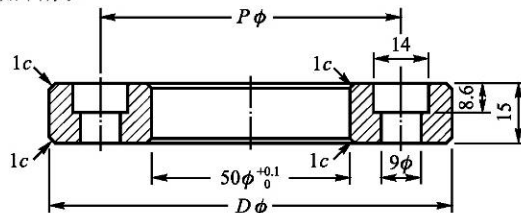
项	目	单位	内容
合模部	合模方式	—	双肘节
	最大合模力	kN	标准 500 (50tonf) / 选购件 650 (65tonf)
	模厚 (最大 - 最小)	mm	标准 350-150 / 选购件400-200
	模开闭行程	mm	250
	定位环直径	mm	φ 100
	连接杆间隔 (横 × 竖)	mm	320×320
	台板尺寸 (横 × 竖)	mm	460×460
	最小模具尺寸 (横 × 竖) 注释1)	mm	185×185
	推顶器行程	mm	70
	推顶器推顶力	kN	20 (2.0tonf)

→需考慮機台設備定位環直徑的尺寸

◎定位環

定位環(locate ring)尺寸規格

- 適用範圍：本規格適用於射出成形模具用定位環
- 材料：原則上使用 S50C，S55C，SK7，(S65C(T))
- 形狀、尺寸：如下所示



單位：mm

標稱尺寸	D		P
	尺寸	尺寸公差	
90	90		70
100	100		75
(101.6)	(101.6)		75
※ 110	110	-0.2	75
120	120	-0.4	90
※ 125	125		90
(127)	(127)		90
150	150		120
(152.4)	(152.4)		120
※ 175	175		120

- 備考：(1)括弧中所示數值，儘可能避免使用。
 (2)所用之內六角沉頭螺絲為 M8，使用二件。
 (3)未標示公差之尺寸，適用 JIS B 0405 中級公差或 CNS 4018 之 2 級者。
 (4)註有※者未有規定，僅供參考。

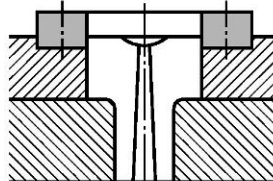
4.品質：

- 外觀：不得有有害之傷痕、裂紋、銹蝕等瑕疵，加工情況良好
- 表面精度：6S

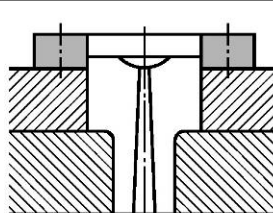
5.製品標稱法：規格名稱及標稱尺寸表示之

例：射出成形模具用定位環 100

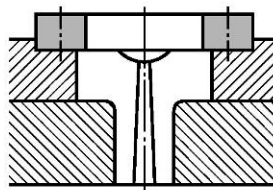
定位環之使用例



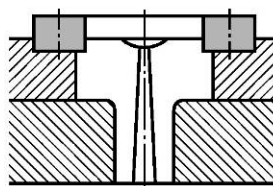
- 此方式為最一般性的使用例



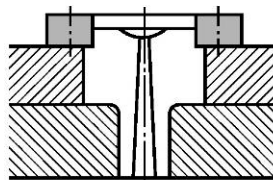
- 此方式可省去固定側固定板之柱坑加工，為最簡單的使用例，但將會使注道襯套加長



- 此方式以定位環抵壓於注道襯套上，能防止注道襯套脫出，且可使注道襯套縮短

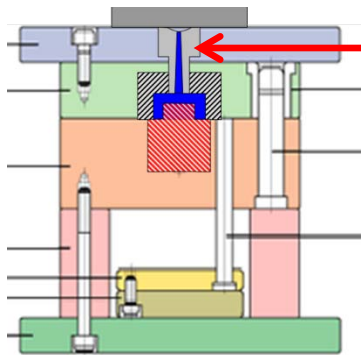


- 此方式以定位環抵壓於注道襯套凸肩上，能防止注道襯套脫出

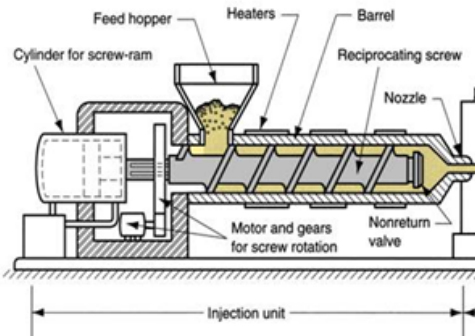


- 此方式可省去固定側固定板之柱坑加工，並可防止注道襯套脫出，頗受歡迎

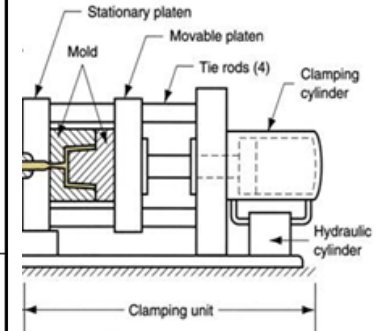
◎注道襯套



注道襯套
Sprue bush



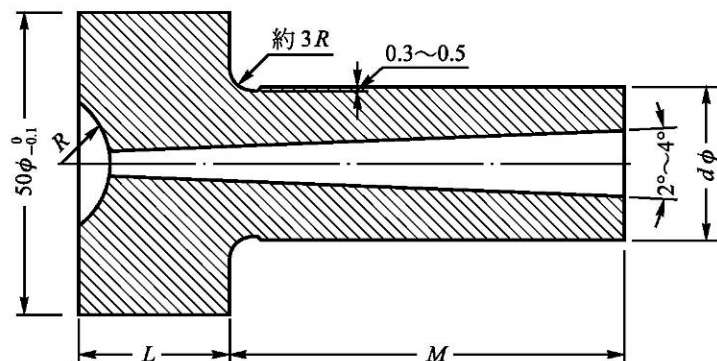
使用例	摘要	使用例	摘要
	<ul style="list-style-type: none"> 噴嘴端面r與注道襯套前端R之關係 $r \leq R$ 一般情形：$R = r[1 + (0 \sim 0.1)]$ 		<ul style="list-style-type: none"> $r > R$之場合，注道脫出不良
	<ul style="list-style-type: none"> 注道襯套前端D與噴嘴端面d之關係：$d < D$ 一般情形：$D = d + (0.5 \sim 1.0)$ 		<ul style="list-style-type: none"> $d > D$之場合，注道脫出不良



◎注道襯套

A形注道襯套(sprue bush)尺寸規格

- 1.適用範圍：本規格適用於射出成形模具用之注道襯套
- 2.材料：原則上使用 S50C，S55C，SK₅ (S85C(T))~SK₇ (S65C(T))，SCM₄ (S40CrMo)
- 3.形狀、尺寸：如下所示



單位：mm

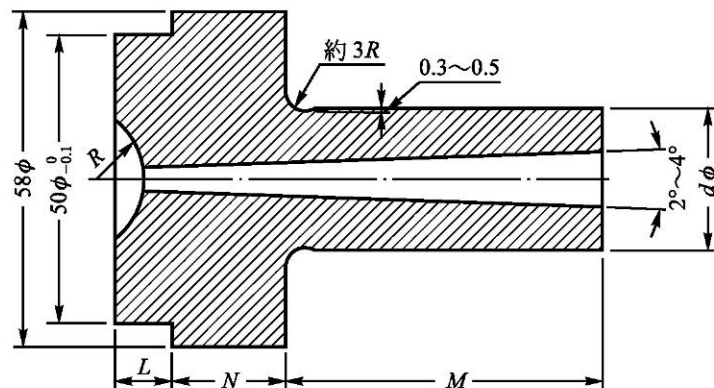
標稱尺寸	d	
	尺寸	尺寸公差
20	20	+ 0.013 - 0.008
25	25	+ 0.013 - 0.008
35	35	+ 0.015 - 0.010

備考：M、L 及 R 由使用者指定。

4.品質：

- 4.1 外觀：不得有有害之傷痕、裂紋、銹蝕及其他瑕疵，加工情況必需良好
 - 4.2 表面精度：內緣表面精度為 1.5S
 - 4.3 硬度：熱處理場合之硬度為 HRC40 以上
- 5.製品標稱法：規格名稱及、形式及標稱尺寸×M×L×R 表示之
例：射出成形模具用 A 形注道襯套 25×50×20×20

B形注道襯套尺寸規格



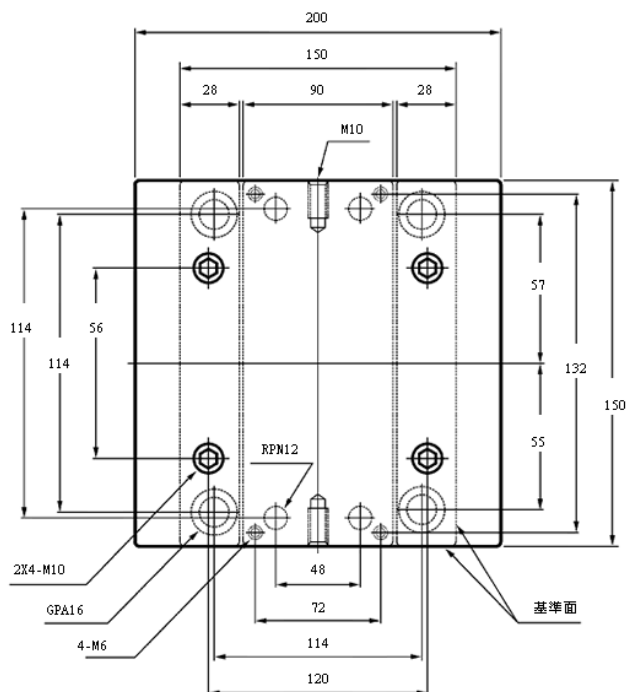
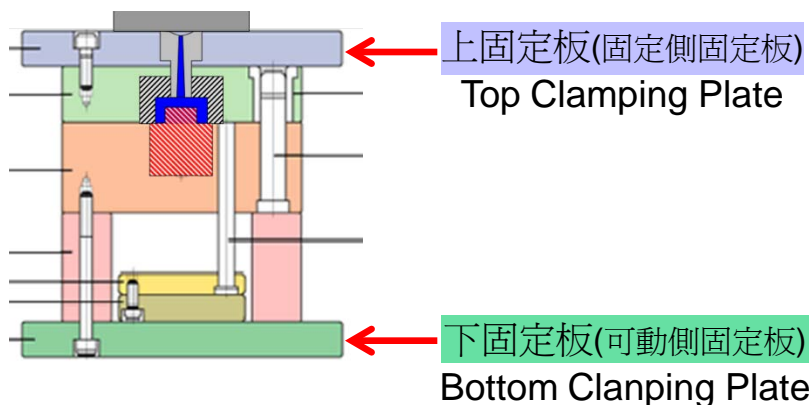
單位：mm

標稱尺寸	d	
	尺寸	尺寸公差
16	16	+ 0.013 - 0.008
20	20	+ 0.013 - 0.008
25	25	+ 0.013 - 0.008
35	35	+ 0.015 - 0.010

備考：M、N、L 及 R 由使用者指定。

- 1.用途：經由抵壓，防止脫出時使用
- 2.材料、品質：依 A 形之規定
- 3.製品標稱法：名稱形式及標稱尺寸×M×N×L×R 表示之
例：注道襯套 B 形 25×50×20×10×20

◎上、下固定板

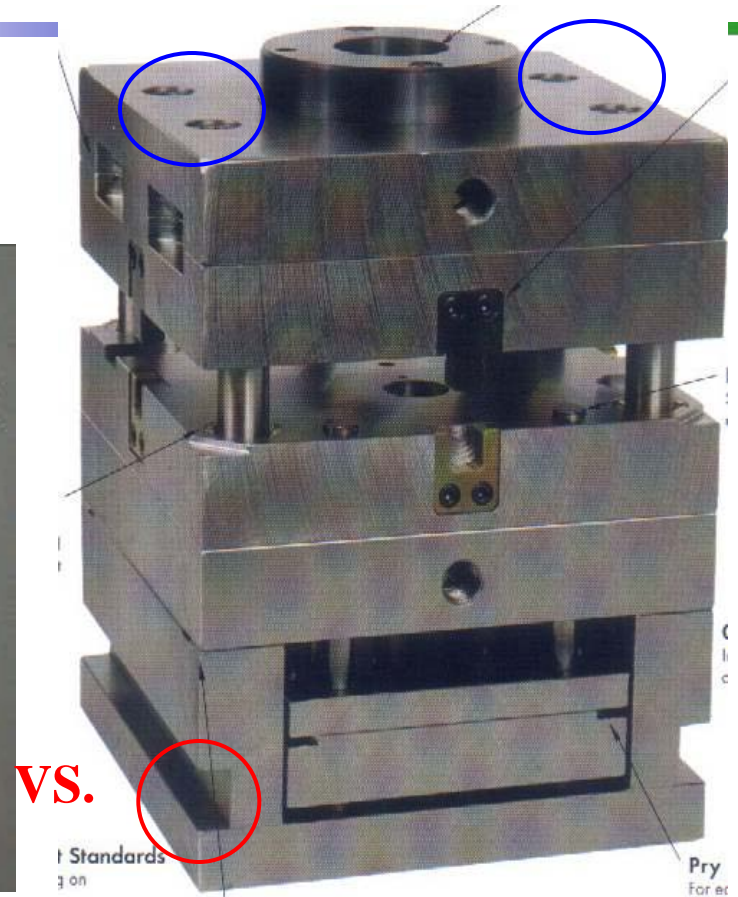
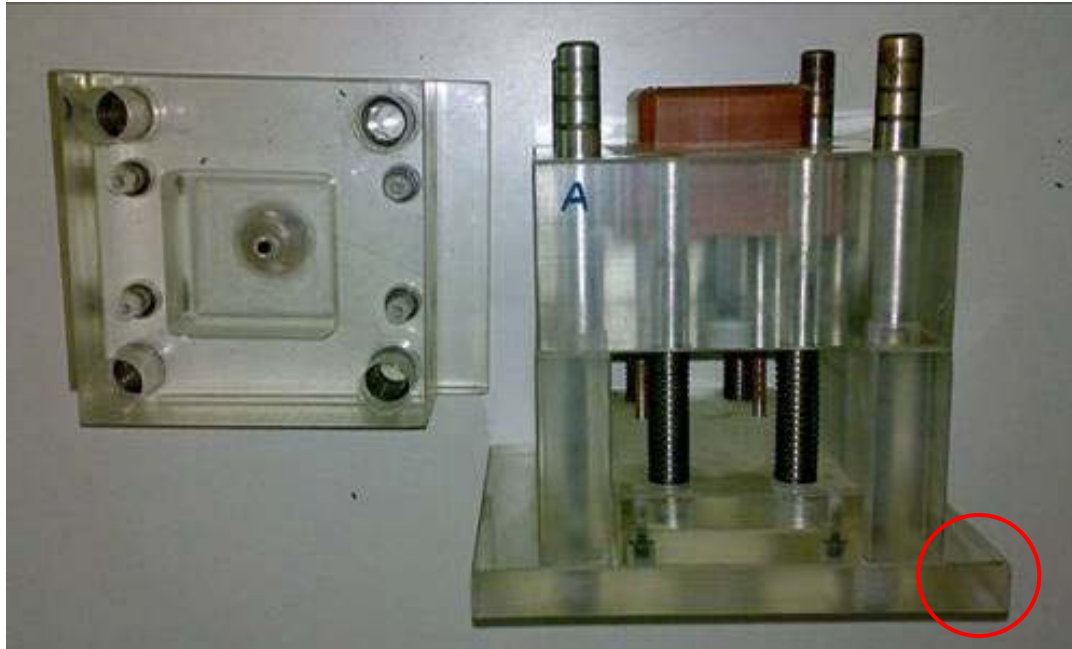


FANUC ROBOSHOT S-2000i50A

机构部规格

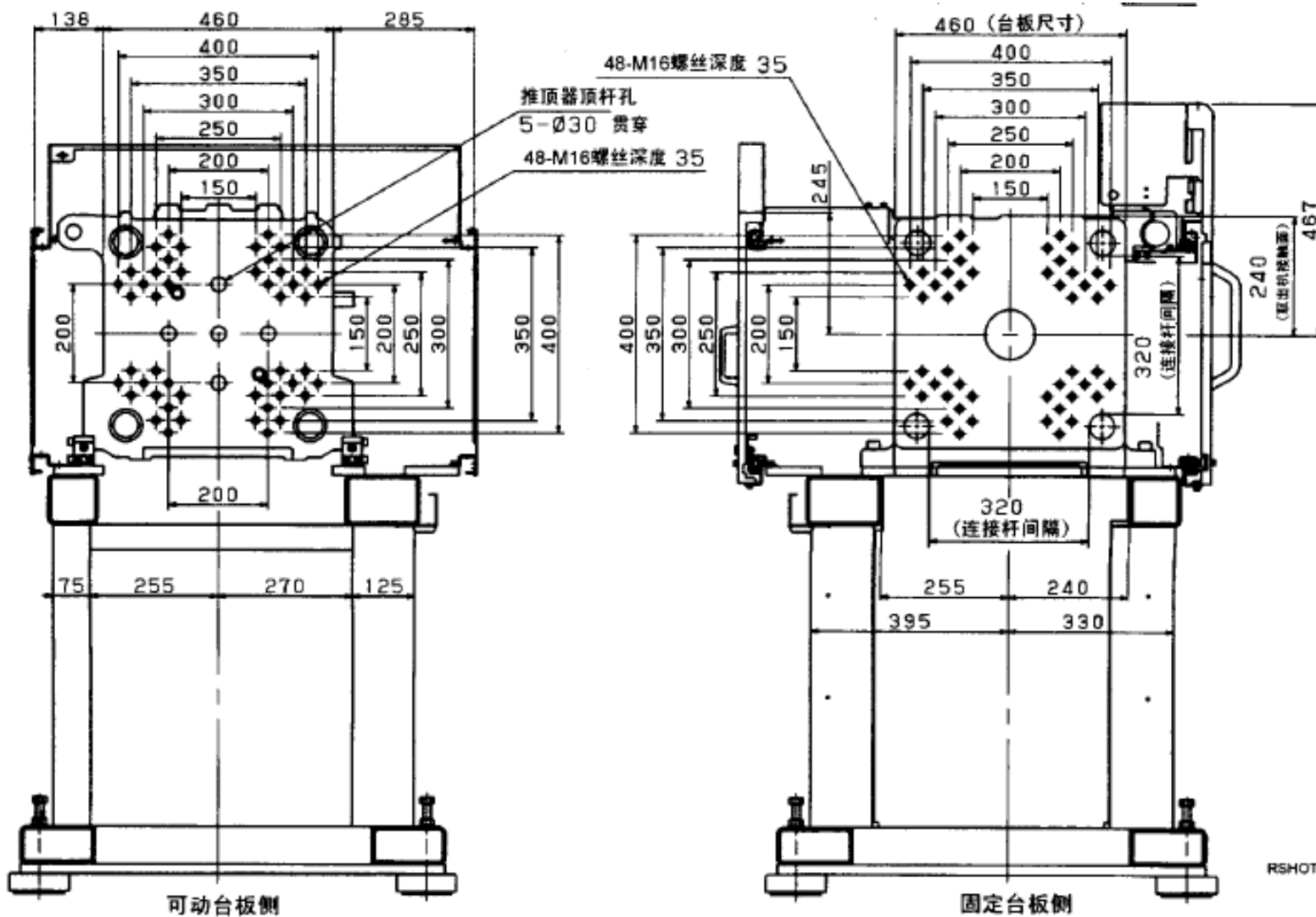
项	目	单位	内容
合模部	合模方式	—	双肘节
	最大合模力	kN	标准 500 (50tonf) / 选购件 650 (65tonf)
	模厚 (最大 - 最小)	mm	标准 350-150 / 选购件400-200
	模开闭行程	mm	250
	定位环直径	mm	φ 100
	连接杆间隔 (横 × 竖)	mm	320×320
	台板尺寸 (横 × 竖)	mm	460×460
	最小模具尺寸 (横 × 竖) 注释1)	mm	185×185
	推顶器行程	mm	70
	推顶器推顶力	kN	20 (2.0tonf)

◎上、下固定板



- 功能：
- 1.提供螺絲孔讓內六角承窩型螺絲鎖附各模板。
 - 2.將模具板固定在成形機的鎖模板上,裝置方法鑽孔式,或直接用壓板鎖附,該板厚度依模具大小而定,一般大於20mm以上。

◎上、下固定板與機台鎖模板(盤)的關係

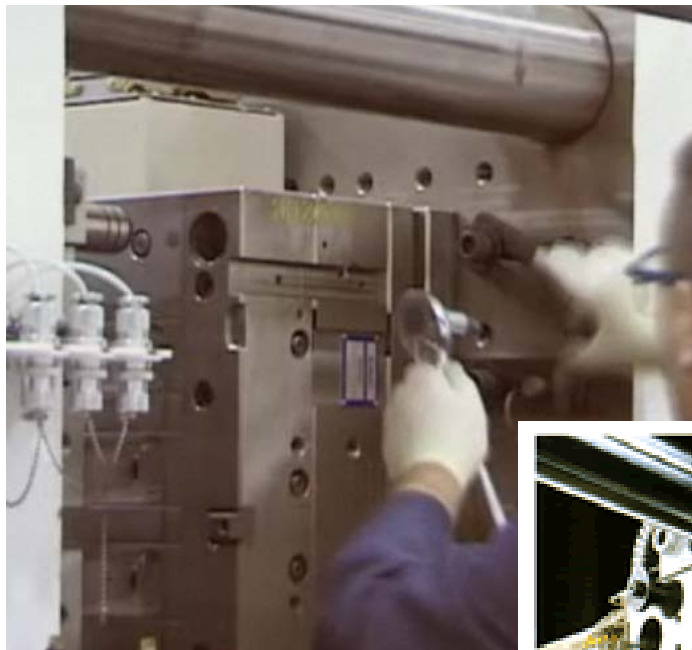


RSHOT S-2000/50A(CM)-01A
2002.12

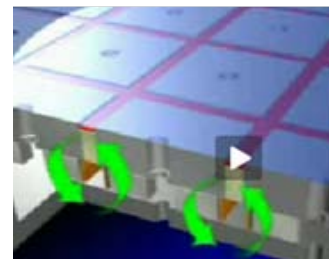
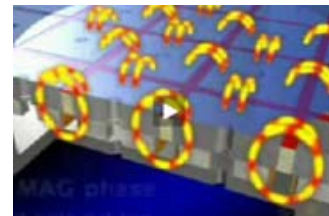
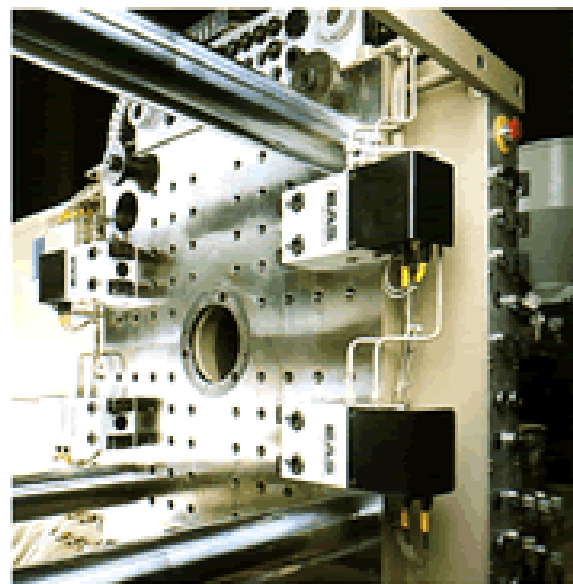
◎上、下固定板與機台鎖模板(盤)的關係

-各種鎖附模具之型式

*磁性吸附



*油壓頂住

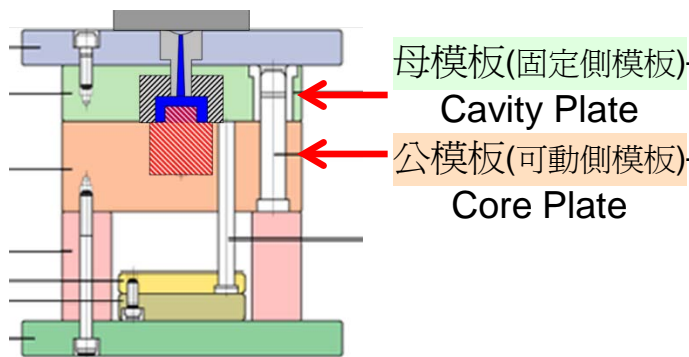


*壓板鎖附&螺絲鎖附



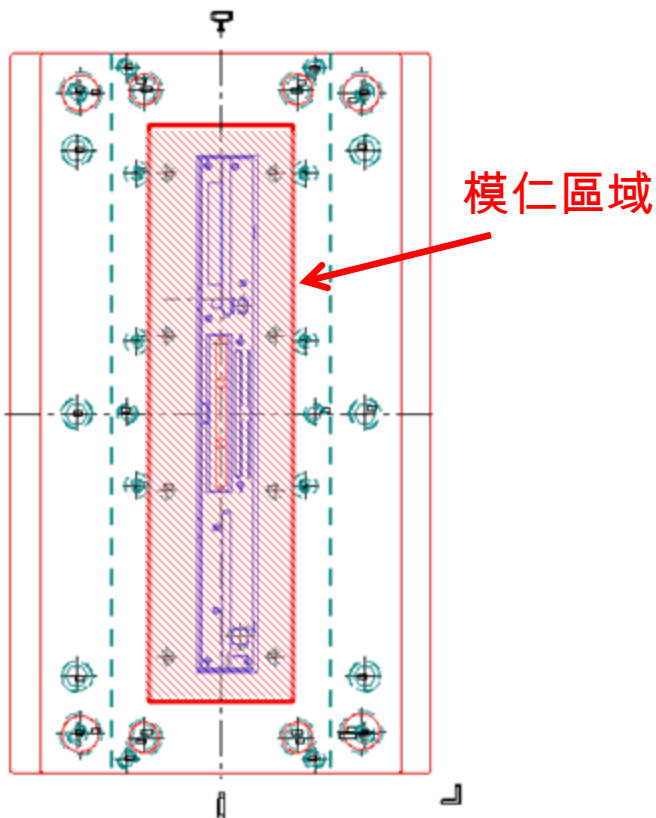
◎固定側&可動側模板

→尺寸定義：高度？長、寬？



模板厚度：視產品高度來決定
 計算方法：母模仁高度x2mm和母模仁高度x2-10mm之間
 模板大小：視模仁大小→產品大小來決定
 計算方法：如下表

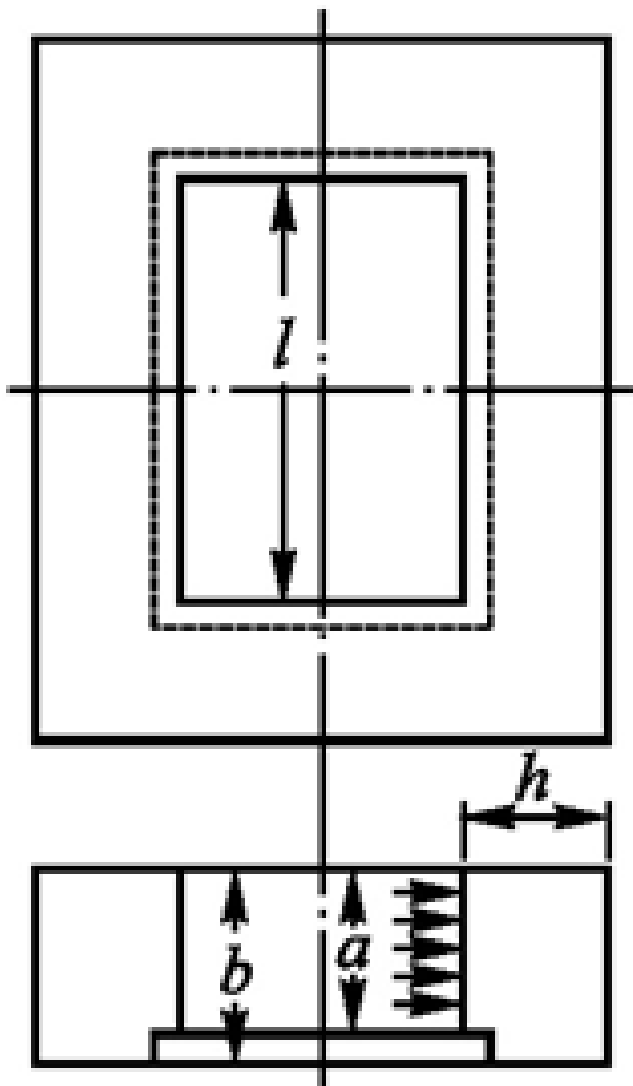
模板厚度：視壓力和成形品的投影面積而定
 計算方法→公模仁高度x2mm和公模仁高度x2+10mm之間
 模板大小：視模仁大小→產品大小來決定
 計算方法→如下表



模仁寬(mm)	模板寬(mm)	模板長(mm)
<80	150	IL + 66
<110	200	IL + 80
<140	250	IL + 85
<190	300	IL + 120
<230	350	IL + 130
<250	400	IL + 130
<280	450	IL + 150
<320	500	IL + 160
<340	550	IL + 160
<390	600	IL + 160

註：IL 為模仁長度

◎有貫穿之模板高度尺寸計算



計算公式：

$$h = \sqrt{\frac{12pl^4a}{384Eb\delta}}$$

h ：側壁厚度(mm)

P ：成形壓力(kg/cm²)

l ：型穴長度(mm)

a ：承受壓力部份之高(mm)

E ：彈性係數 2.1×10^6 (kg/cm²)

b ：型穴之高度(mm)

δ ：容許撓曲量(mm)

例： $P=500\text{kg/cm}^2$ ， $l=300\text{mm}$

$a=200\text{mm}$ ， $b=250\text{mm}$

$\delta=0.08\text{mm}$

解：作圖法

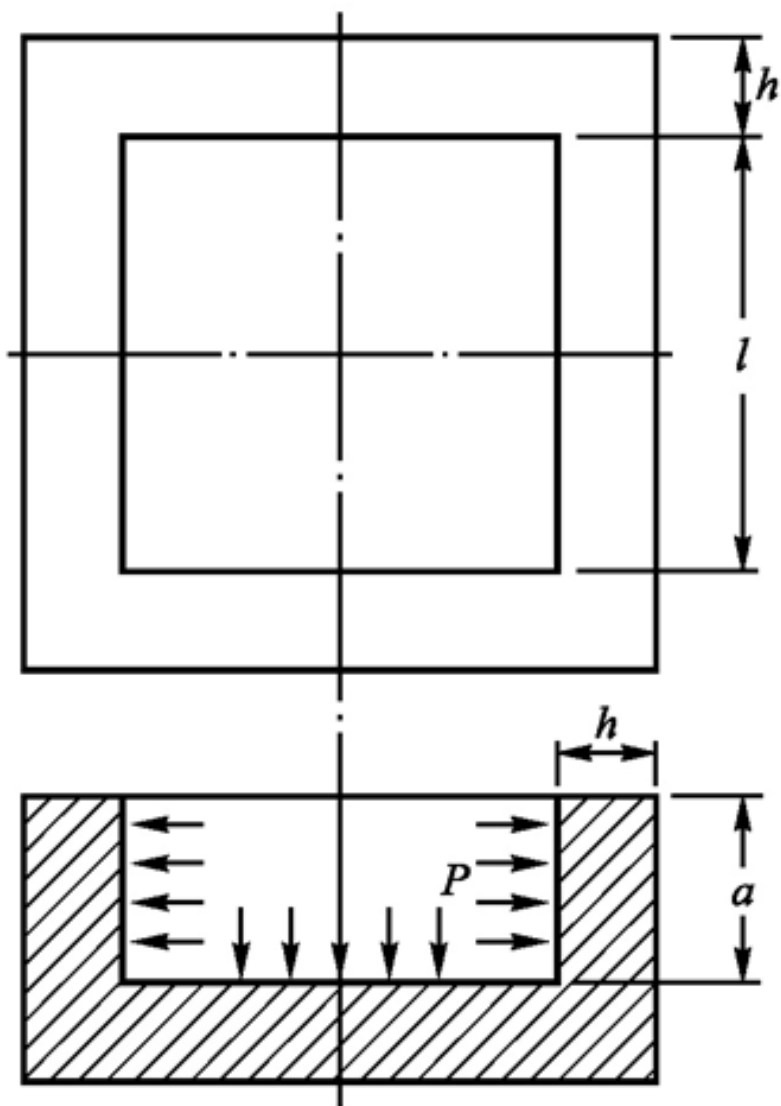
① $P=500$ ， $l=300$ 連線與 Pl 交於 A 點

② A 點與 $b=250$ 連線與 $\frac{Pl}{b}$ 交於 B 點

③ B 點與 $a=200$ 連線與 $\frac{Pla}{b}$ 交於 C 點

④ C 點與 $\delta=0.08$ 連線與 h 交於 86 處($h=86$ 即為所求)

◎無貫穿之模板高度尺寸計算



計算公式：

$$h = \sqrt[3]{\frac{CPa^4}{E\delta}}$$

h = 側壁厚度(mm)

p = 成形壓力(kg/cm²)

a = 型穴之深度(mm)

l = 型穴長度(mm)

E = 彈性係數(鋼為 2.1×10^6 kg/cm²)

δ = 容許撓曲度(mm)

C 與 l/a 之關係如下表：

l/a	c	l/a	c	l/a	c
1.0	0.044	1.5	0.084	2.0	0.111
1.1	0.053	1.6	0.090	3.0	0.134
1.2	0.062	1.7	0.096	4.0	0.140
1.3	0.070	1.8	0.102	5.0	0.142
1.4	0.078	1.9	0.106		

例： $p = 500$ kg/cm²， $l = 300$ mm

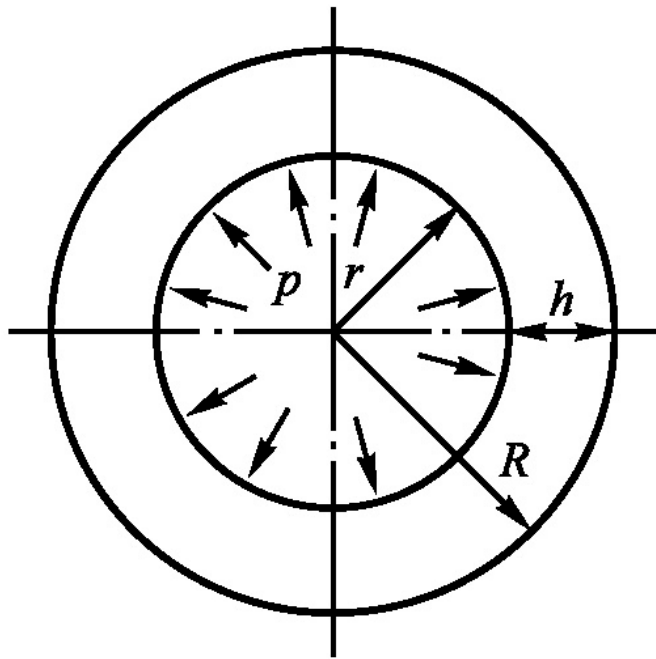
$a = 200$ mm， $\delta = 0.08$ mm

($\frac{l}{a} = 1.5$ ，由此得 $C = 0.084$)

$$h = \sqrt[3]{\frac{0.084 \times 500 \times 200 \times 200 \times 200 \times 200}{2.1 \times 1,000,000 \times 0.08}}$$

$$= 73(\text{mm})$$

◎圓形模板高度尺寸計算



計算公式：

$$\delta = \frac{rp}{E} \left(\frac{R^2 + r^2}{R^2 - r^2} + m \right)$$

δ = 內半徑之變形量(mm)

p = 成形壓力(kg/cm²)

E = 彈性係數(鋼為 2.1×10^6 kg/cm²)

r = 內半徑(mm)

R = 外半徑(mm)

m = 蒲松氏比鋼為 0.25

例： $r = 75$ mm， $p = 630$ kg/cm²

$\delta = 0.053$ mm，求側壁厚？

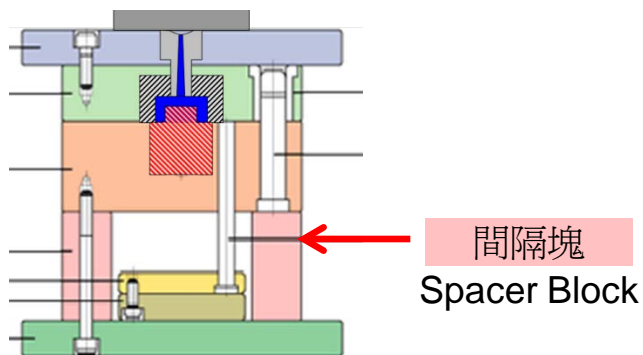
$$\delta = \frac{rp}{E} \left(\frac{R^2 + r^2}{R^2 - r^2} + m \right)$$

$$0.053 = \frac{75 \times 630}{2.1 \times 10^6} \left(\frac{R^2 + 75^2}{R^2 - 75^2} + 0.25 \right)$$

$$R = 125$$

$$\therefore \text{側壁厚 } h = R - r = 125 - 75 = 50\text{mm}$$

◎ 間隔塊

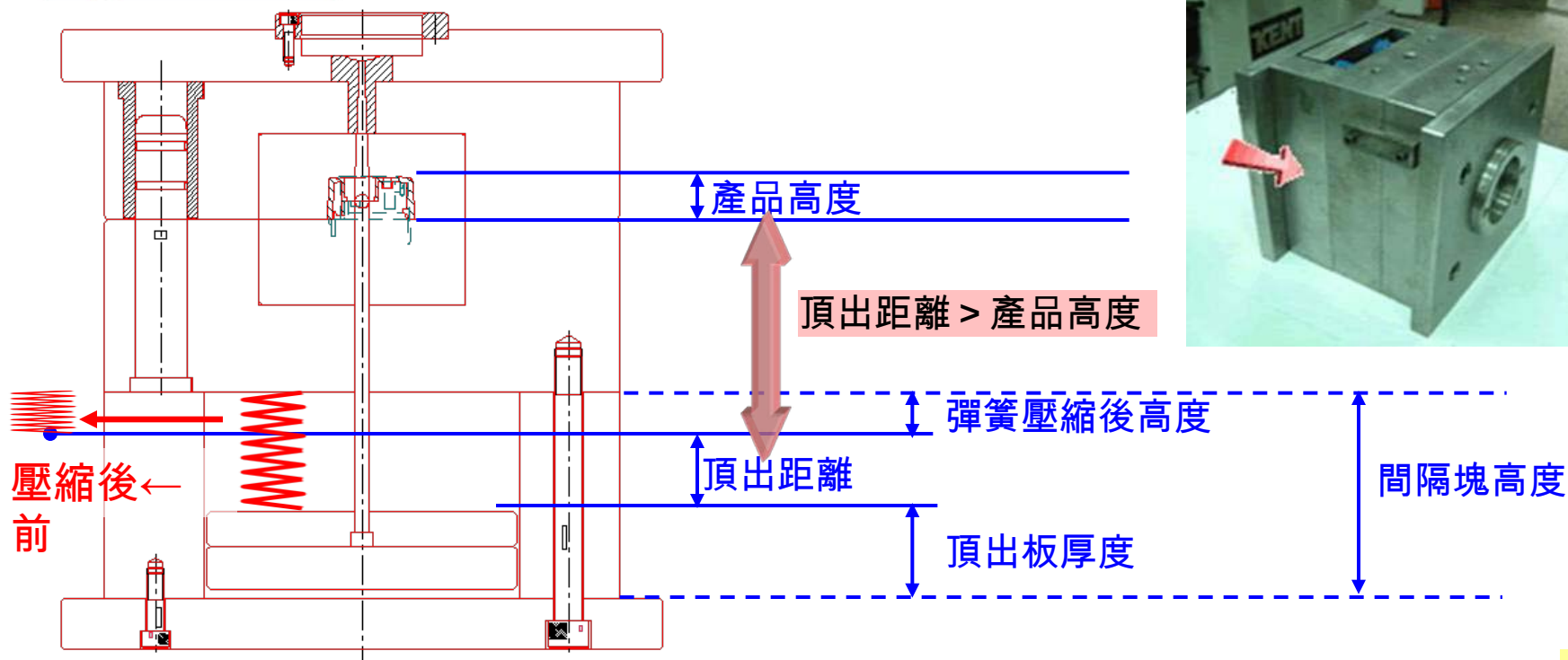


→ 尺寸定義：高度？長、寬？

是為確保成形的頂出距離,放在承板(公模板)與下固定板之間的墊塊

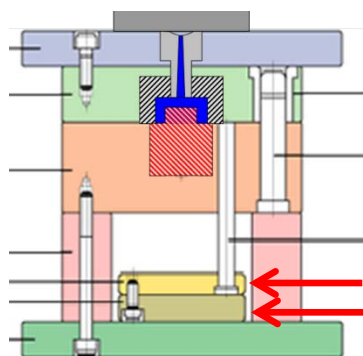
間隔塊大小：標準模座已固定

間隔塊高度：頂出板厚度+頂出距離+行程擋塊的高度
(彈簧壓縮後高度)

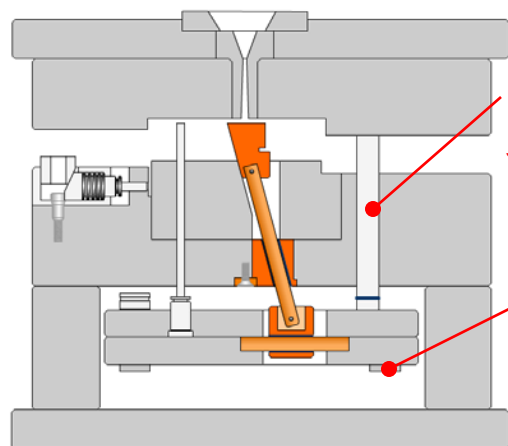


05-Injection Molding Basics - Mold (excerpt).mp4

◎上、下頂出板



上頂針板(頂出銷定位板)
Ejector Locating Plate
下頂針板(頂出銷固定板)
Ejector Clamping Plate



回位銷考量：
比頂出針早接觸母模板

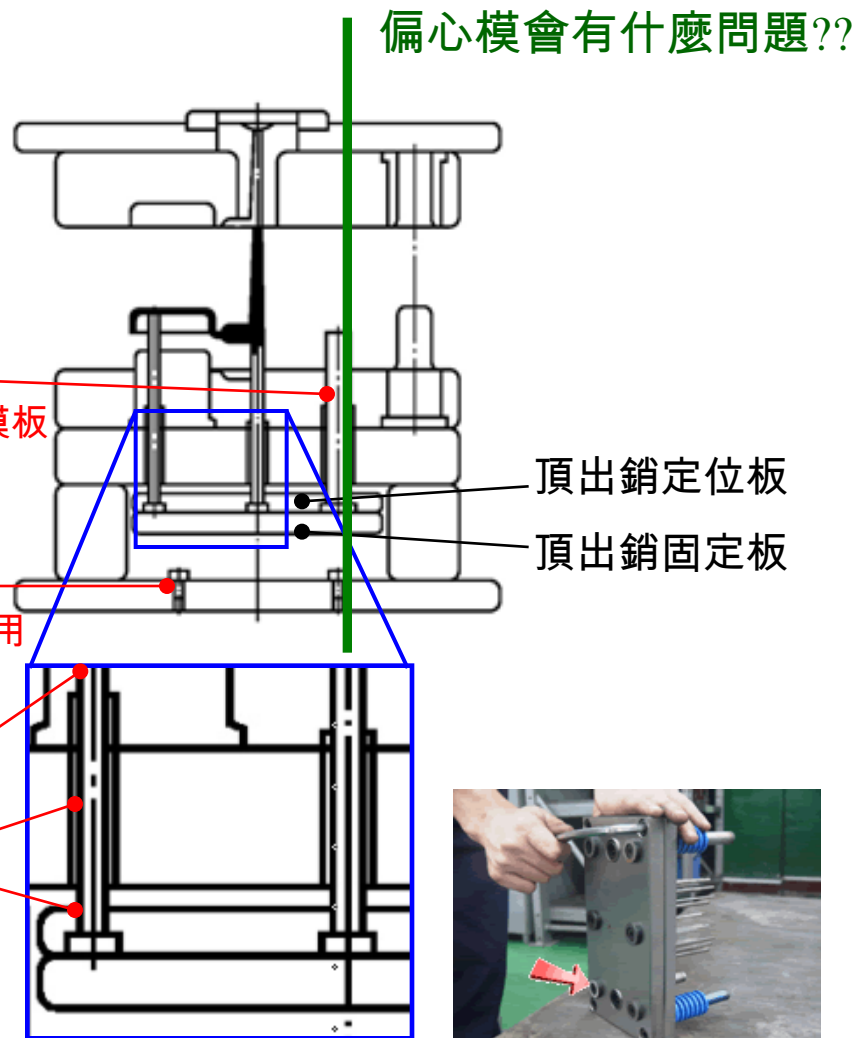
停止銷考量：
3030以上的模具使用

頂針孔尺寸的考量：

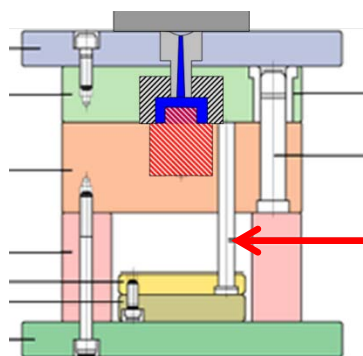
頂針孔(一般)： $d+0.2\sim 0.3\text{mm}$

頂針孔(逃氣)： $d+1\text{mm}$

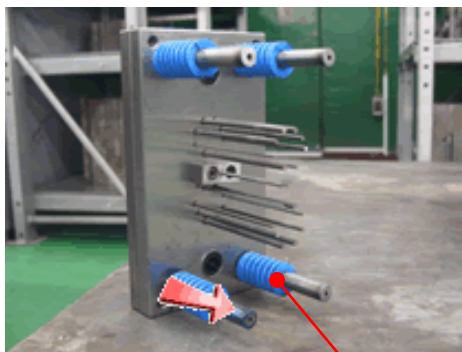
*d：頂出針直徑



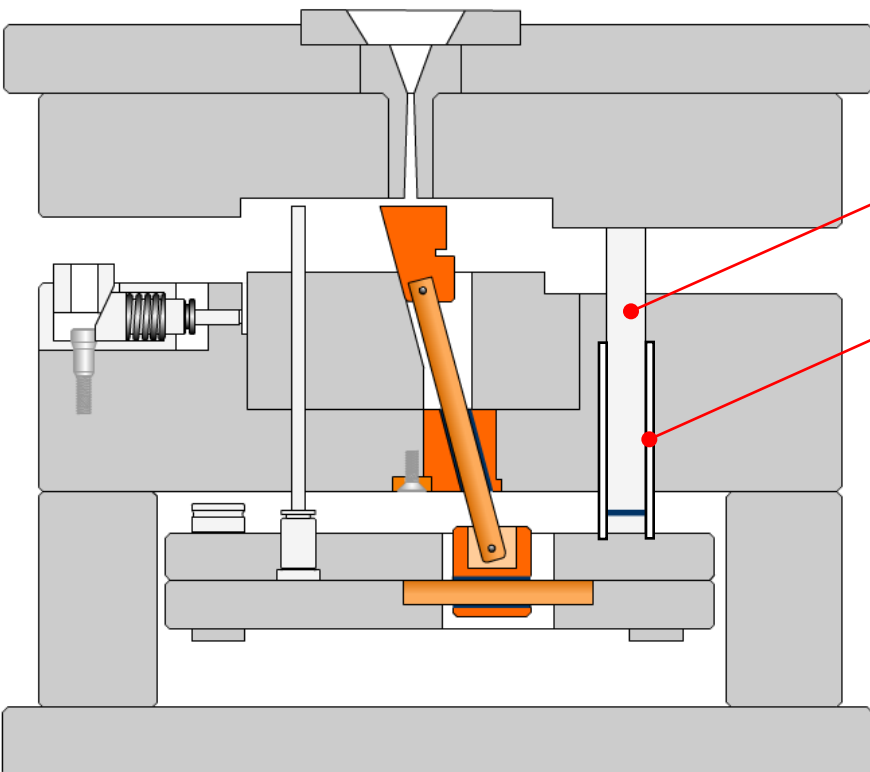
◎ 回位銷



回位銷(回針)
Return Pin

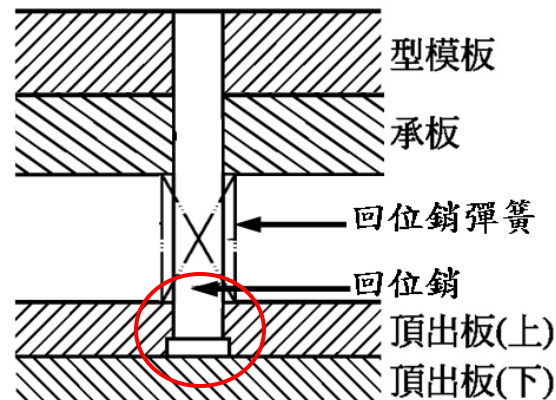


回位銷彈簧 0.15mm, 以利作動



回位銷考量：
比頂出針早接觸母模板

回位銷與公模間隙：
0.05~ 0.15mm



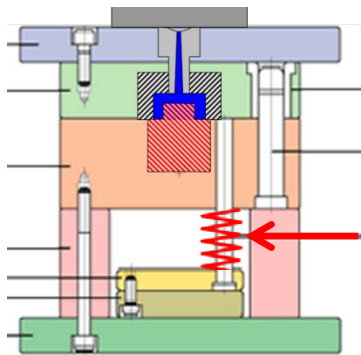
HASCO斜頂出塊動畫.swf

→與回位梢彈簧配合組成頂出機構中重要的一部份，並固定於上頂出板上。

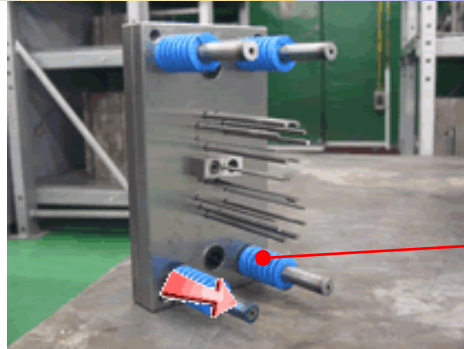
→當頂出完成后，回位銷能通過彈簧的力量讓頂出板回到起始位置。

→它與公模板配合間隙為0.05~

◎ 回位銷彈簧

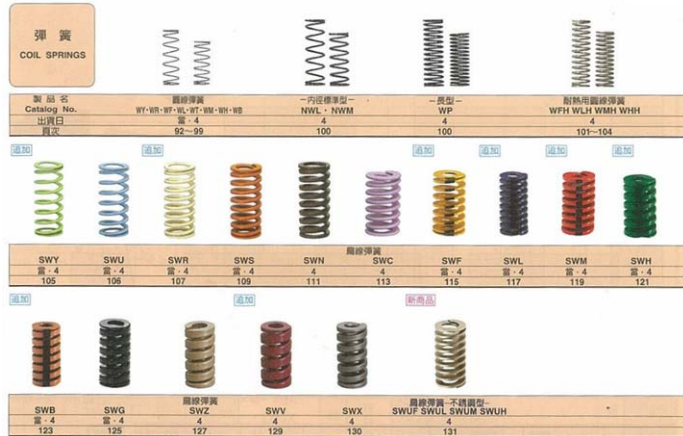


回位銷彈簧
Coil Spring



回位銷彈簧需考量：

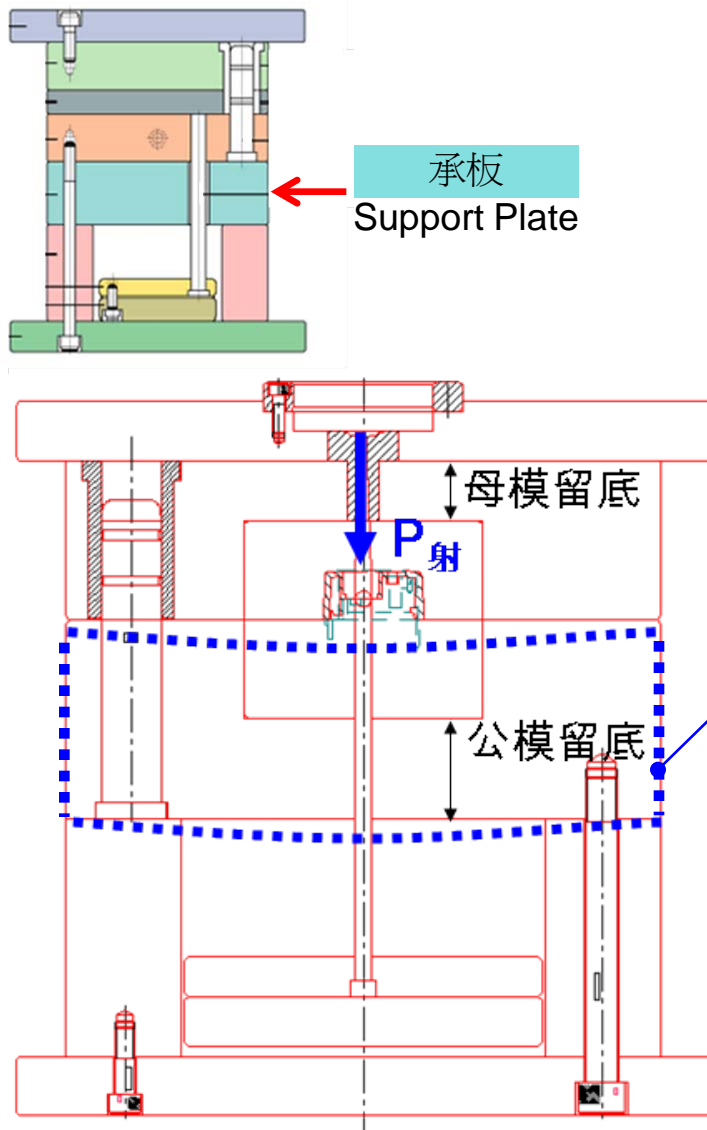
1. 直徑尺寸
2. 全長尺寸
3. 最大壓縮量
4. 荷重



種類	特長	頁次	類型		直徑尺寸 外徑 (內徑)		全長尺寸		最大 壓縮量	荷重 N(kgf)	
			Catalog No.	顏色	min.	max.	min.	max.		min.	max.
異形線扁線彈簧 — 高荷重用 —		P.113	SWC (極輕少荷重)	紫色 ●	φ 6 (φ 3)	φ 30 (φ 15)	15	200	50% (100萬次) {2.8}	27 {40.0}	392 {471}
		P.115	SWF (輕少荷重)	黃色 ●	φ 6 (φ 3)	φ 70 (φ 38.5)	10	500	40% (100萬次) {4.8}	47 {320}	3136 {3920}
		P.117	SWL (輕荷重)	藍色 ●	φ 6 (φ 3)	φ 70 (φ 38.5)	10	350	32% (100萬次) {6.0}	63 {488}	4782 {610}
		P.119	SWM (中荷重)	紅色 ●	φ 6 (φ 3)	φ 70 (φ 38.5)	10	350	25.6% (100萬次) {8.0}	78 {664}	5978 {680}
		P.121	SWH (重荷重)	綠色 ●	φ 6 (φ 3)	φ 70 (φ 38.5)	10	350	32% (30萬次) {10}	98 {850}	8330 {1044}
		P.123	SWB (極重荷重)	棕色 ●	φ 6 (φ 3)	φ 70 (φ 38.5)	10	350	19.2% (100萬次) {11}	110 {1257}	10046 {1280}
		P.125	SWG (超重荷重)	黑色 ●	φ 10 (φ 5)	φ 50 (φ 25)	25	200	16% (100萬次) {14}	142 {1740}	13655 {17069}
		P.127	SWZ (超極重荷重)	金色 ●	φ 10 (φ 5)	φ 50 (φ 25)	25	200	20% (30萬次) {50}	392 {40}	9807 {1000}
		P.129	SWV (最極重荷重)	酒紅色 ●	φ 10 (φ 5)	φ 50 (φ 25)	25	200	10.5% (100萬次) {42}	416 {53}	12959 {1636}
		P.130	SWX (極重荷重高速用)	— (無烤漆)	φ 20 (φ 9.5)	φ 40 (φ 20.5)	25	100	13% (30萬次) {53}	515 {644}	16045 {19904}
P.131	SWUF SWUL SWUM SWUH	— (無烤漆)	φ 10 (φ 5)	φ 30 (φ 15)	20	60	10.5% (100萬次) {66}	644 {797}	14904 {18452}		
高速用											
耐蝕 耐熱用	新商品										請參照 P.131

● 對直徑之荷重設定為一定標準。

◎承板



模仁面積 (mm x mm)	公模留底 (mm)	母模留底 (mm)
150x150	30	30
200x200	50	30
250x250	55	35
300x300	60	35
350x350	65	35
400x400	80	40
450x450	90	50

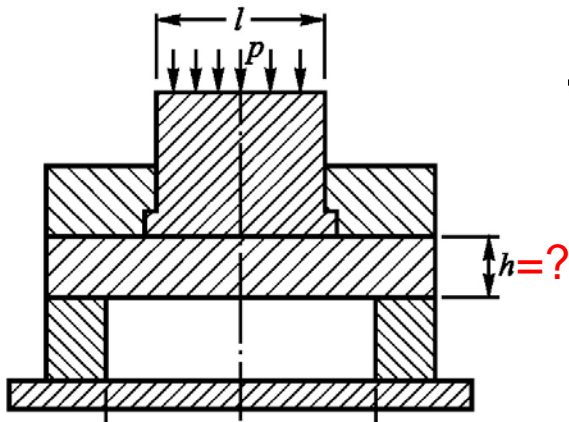
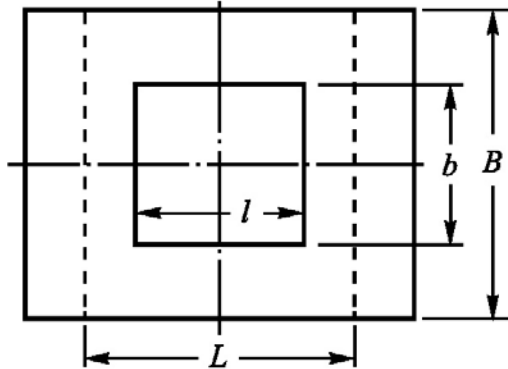
模板厚度如果不夠，成型時模板可能因為成型壓力($P_{射}$)過大而造成變形

Q：增加公模留底厚度？增加承板結構？
A：1.成本考量
2.加工考量

◎承板高度尺寸計算

承板厚度的考量：
射出壓力造成公模板厚度不足時

- 承板經由成形壓力可致變形，變形大時，成形品肉厚產生變化，或發生毛邊，最大變形量必需在 0.1~0.2mm 以下。參照左圖得知



p = 成形壓力(kg/cm²)

h = 承板厚度(mm)

L = 間隔塊距離(mm)

l = 承受成形壓力之長度(mm)

b = 承受成形壓力之寬度(mm)

B = 模板寬度(mm)

δ = 容許撓曲度(mm)

E = 彈性係數(鋼為 2.1×10^6 kg/cm²)

* I (慣性矩) = $1/12(Bh^3)$

- 簡化計算，設定 $l=L$ ，則計算公式如下：

$$\delta = \frac{5pbL^4}{384EI} = \frac{5pbL^4}{384 \cdot \frac{1}{12} Bh^3 E}$$

$$= \frac{5pbL^4}{32EBh^3}$$

$$\therefore h = \sqrt[3]{\frac{5pbL^4}{32Eb\delta}}$$

例： $L = 500$ mm， $b = 500$ mm

$p = 700$ kg/cm²， $B = 700$ mm

$\delta = 0.1$ mm

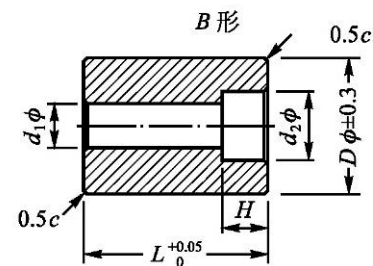
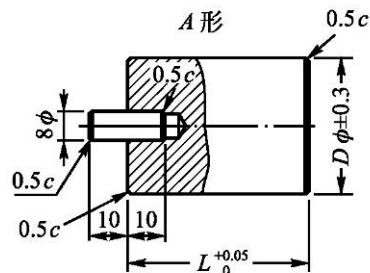
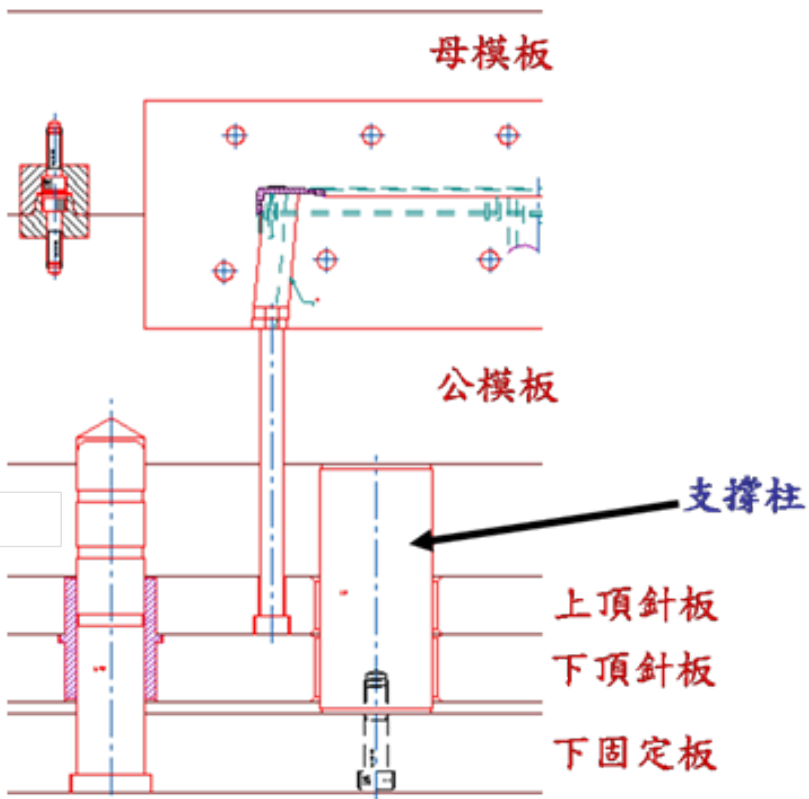
$$\begin{aligned} \text{得 } h &= \sqrt[3]{\frac{5 \times 700 \times 500 \times 500^4}{32 \times 2.1 \times 10^6 \times 700 \times 0.1}} \\ &= 275 \text{mm} \end{aligned}$$

◎承板→支撐柱



支撐柱的考量：

- 1.尺寸
- 2.位置



單位：mm

D	L
25	指定尺寸
30	
35	
40	
45	
50	
60	
80	

備註：亦可一體加工製造

單位：mm

D	d	d ₁	d ₂	H	L
25	10	11	17.5	11	指定尺寸
30	10	11	17.5	11	
35	10	11	17.5	11	
40	10	11	17.5	11	
45	10	11	17.5	11	
50	10	11	17.5	11	
60	12	13	20	14	
80	16	17	23	18	

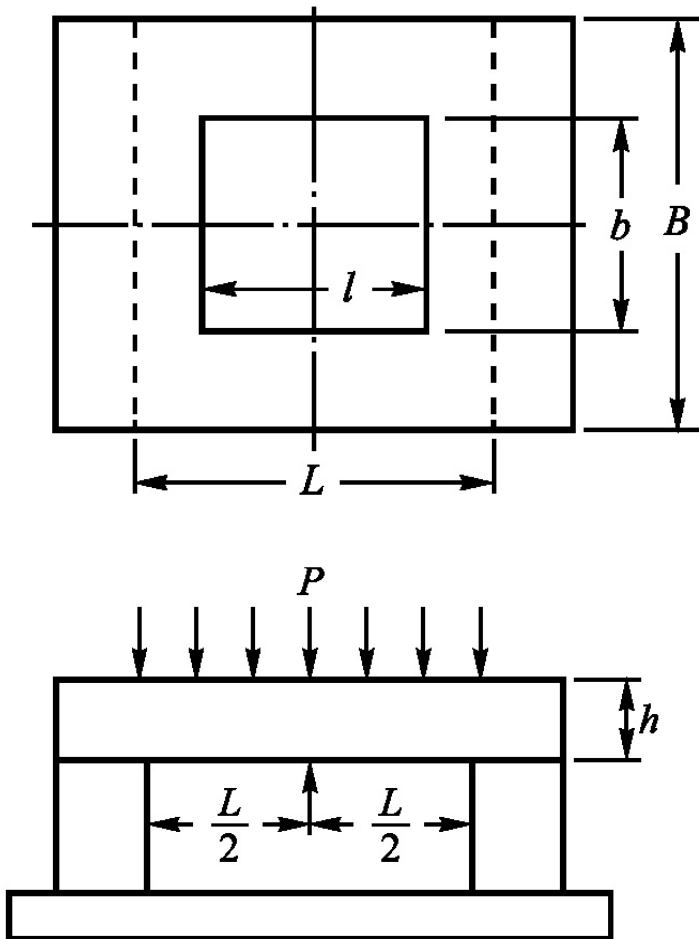
備註：d 為使用螺絲直徑

- 1.材料：S25C~S55C
- 2.製品標稱法：名稱、形式及標稱尺寸×L
例：支座 A形 50×100

◎承板→支撐柱

1/2處支撐柱的設計

-承板、公模留底需為多少??



- 成形品的投影面積增大時，則承板的厚度也隨之增大，可加裝中間支承，使承板厚度減小。於中間加裝一支支承之場合，厚度變為

$$h = \sqrt[3]{\frac{5pb(L/2)^4}{32Eb\delta}}$$

- 此式所求得支 h 值為中間無支承者的 $\frac{1}{2.5}$

- 例：加工條件與例一相同

$$L = 500\text{mm}, b = 500\text{mm}$$

$$p = 700\text{kg/cm}^2, B = 700\text{mm}$$

$$\delta = 0.1\text{mm}$$

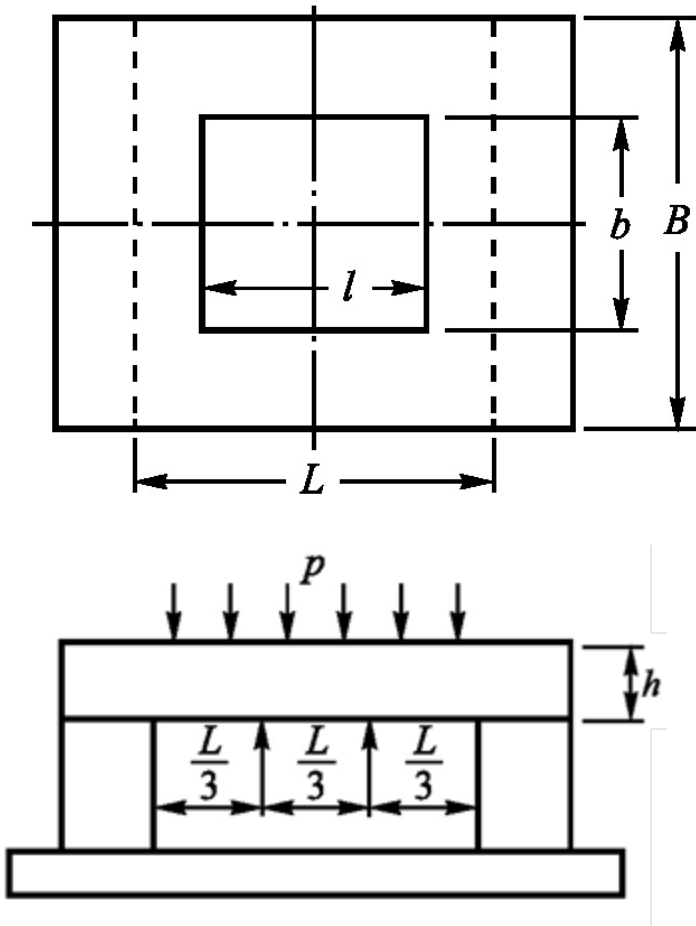
- 但中間加裝一支支承之場合，得

$$h = \sqrt[3]{\frac{5 \times 700 \times 500 \times (500/2)^4}{32 \times 2.1 \times 10^6 \times 700 \times 0.1}} = 110\text{mm}$$

◎承板→支撐柱

1/3處支撐柱的設計

-承板、公模留底需為多少??



- 在兩間隔塊間三等分，加裝二支支承時，厚度變為

$$h = \sqrt[3]{\frac{5pb(L/3)^4}{32Eb\delta}}$$

- 此式得之 h 值為中間無支承者的 $\frac{1}{4.3}$

• 例：加工條件與例一相同，但中間加裝二支支承之場合 δ 值減為 0.05mm，得 h

$$= \sqrt[3]{\frac{5 \times 700 \times 500 \times (500/3)^4}{32 \times 2.1 \times 10^6 \times 700 \times 0.05}}$$
$$= 80\text{mm}$$

◎其他零件

■ガイドピン



品名	M-GPA
タイプ	リング油溝付き
材質	SUJ2
熱処理硬さ	60~64HRC (高周波焼入れ)

■リターンピン



品名	M-RP8B
タイプ	ツバ厚8mm
材質	SUJ2
熱処理硬さ	60~64HRC (高周波焼入れ)

■サポートピン



品名	M-SPN
タイプ	リング油溝付き
材質	SUJ2
熱処理硬さ	60~64HRC (高周波焼入れ)

■ガイドプッシュ



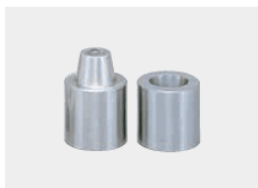
品名	M-GBB
タイプ	油溝なし
材質	SUJ2
熱処理硬さ	58~62HRC

■ガイドプッシュ



品名	M-GBA
タイプ	油溝なし
材質	SUJ2
熱処理硬さ	58~62HRC

■テーパロックピン



セット品	M-TLBS
品名	ピン単體 M-TLBP
	プッシュ単體 M-TLBB
タイプ	精密JISタイプ
材質	SKS3
熱処理硬さ	58~62HRC
ピンorプッシュに 対するテーパ部 の 單體同軸度	0.005以下

■PLプラー



品名	M-PLLA
材質	PAR (プラスチックスリーブ) SCM435 (テーパースリーブ) ボルト

■型開き防止プレート



品名	M-OPC
保安色	赤 黄 黒
材質	S45C

■アイボルト



品名	M-IBM
材質	SS400

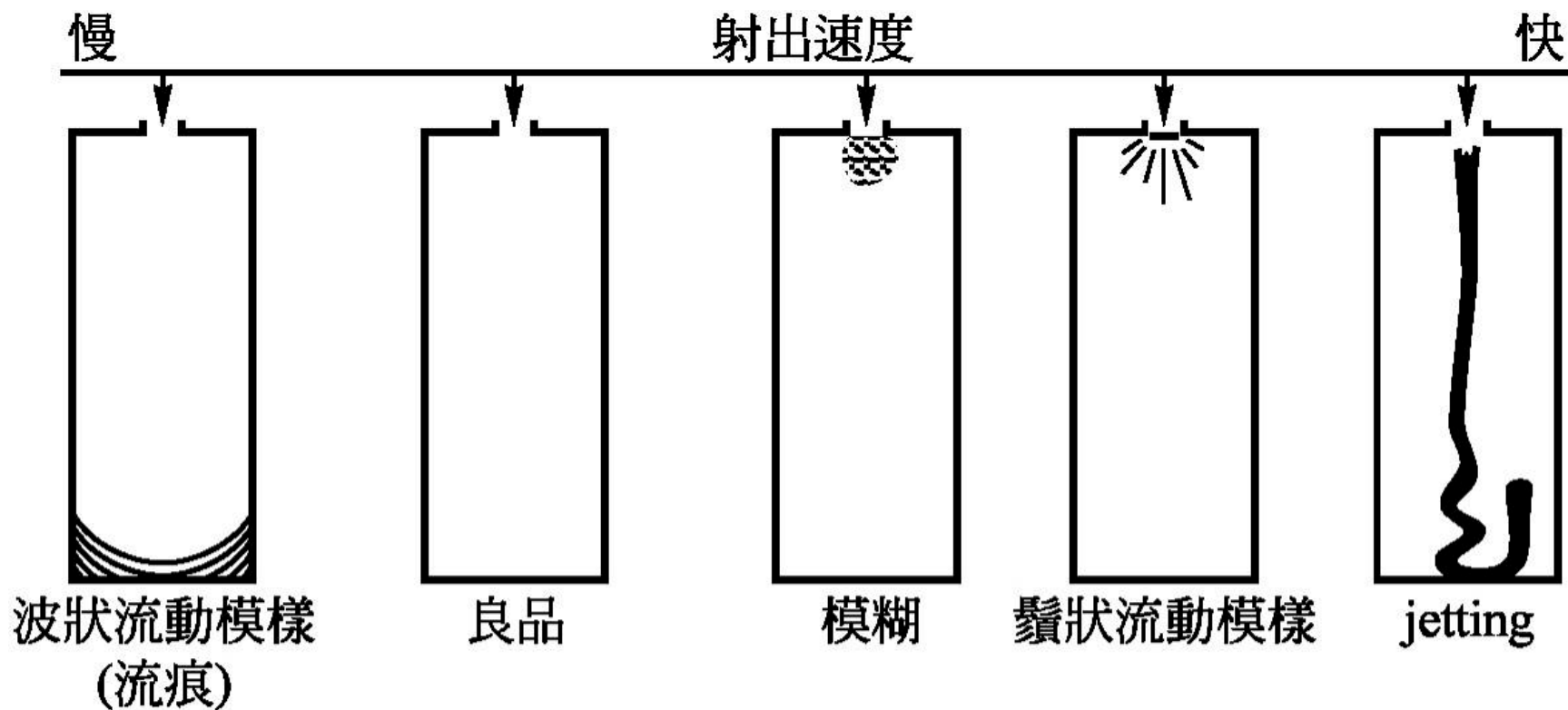
四、模具充填區域的設計

- ◎澆口型式
- ◎熱流道系統
- ◎產品延伸至模具的設計
- ◎射出問題點&改善流程
- ◎模具加工

◎澆口型式

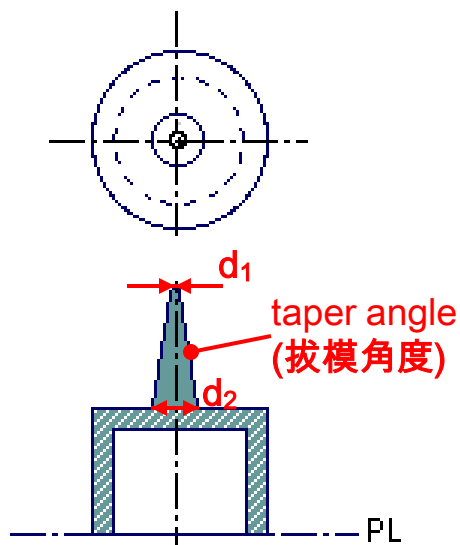
*澆口設計的好壞&恰當與否→會影響射出成形射出速度的調整空間

*射出速度的調整恰當與否→又將會影響產品外觀與成形精度



◎澆口型式

直接式澆口-Direct (sprue) gate



●尺寸定義：

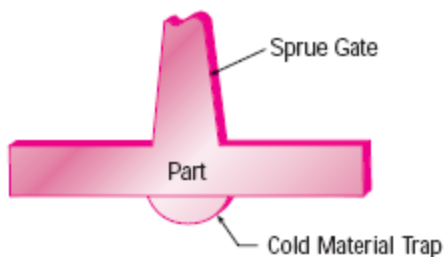
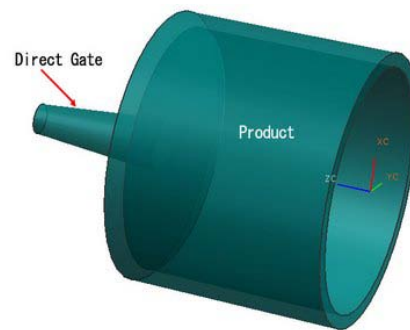
$$d_1 = d_{\text{nozzle}} + 1\text{mm}$$

$$d_2 = 2 \times \text{肉厚 (至少 } 1.5\text{mm)}$$

taper angle (拔模角度) = 1~2.4度

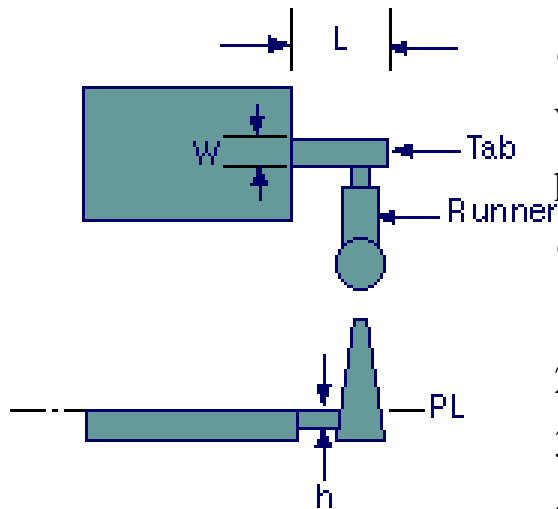
●優缺點：

1. 一模一穴的產品。(圓形對稱產品)
2. 拔模角度太小，產品會卡在母模面or澆口斷在注道襯套中。
3. 拔模較度太大，將會延長冷卻時間。
4. 澆口部位切除時，產品會有明顯的痕跡。
5. 尺寸若為特殊，注道襯套則需額外訂做，成本較高。



◎澆口型式

凸片式澆口-Tab gate



●尺寸定義：

$W=6.4\text{ mm}$

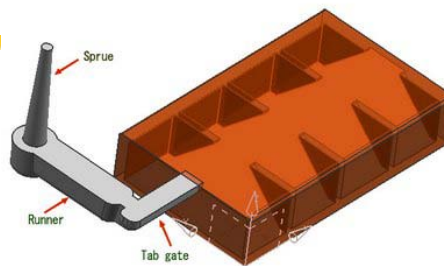
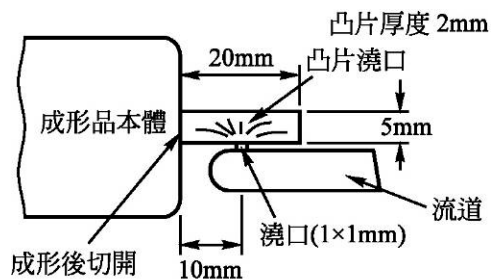
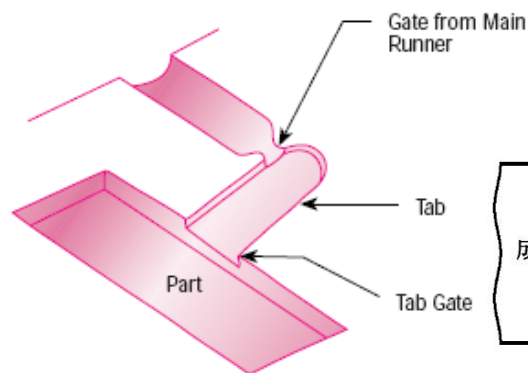
$h=75\% \times \text{肉厚(模穴深度)}$

●優缺點：

1. 平坦、薄型產品上使用。
2. Runner Gate所產生的過大剪切力(剪切熱)，可再次塑化(熔融塑膠)。
3. 會有壓力損失。
4. 有效降低成型時剪切力過大所產生不良產品表面的現象。

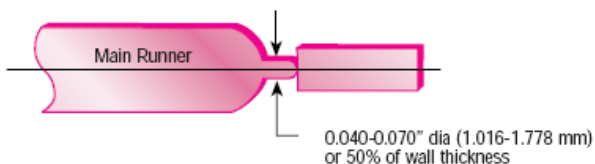
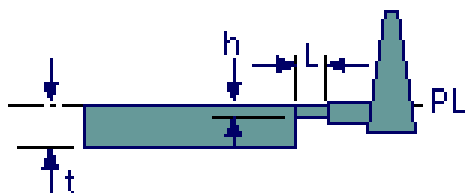
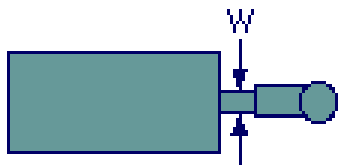
(ex. 流痕-flow mark、噴流痕-jetting mark)

5. 澆口切除不易。



◎澆口型式

側狀澆口- Side(edge & standard) gate



●尺寸定義：

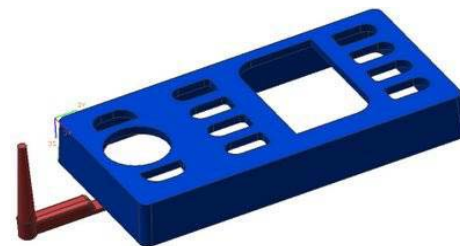
$W=1.6\sim 12.7\text{mm}$

$L=0.5\sim 1.0\text{mm}$ (理想0.5mm)

$h=6\%\sim 75\%\times$ 肉厚 t (0.4~6.4 mm)

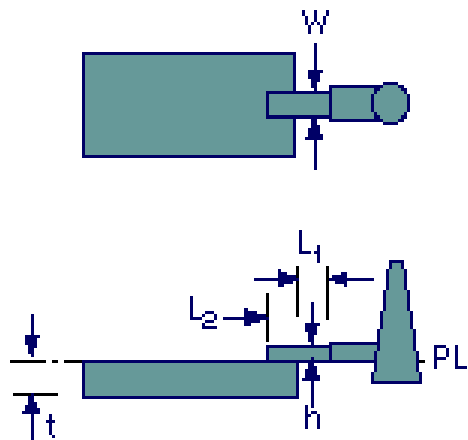
●優缺點：

1. 可使用在產品任何位置(ex.側邊&頂、底部)。
2. 澆口所產生的剪切力(剪切熱)，可再次塑化(熔融塑膠)。
3. 會有壓力損失。
4. 產品容易產生不良產品表面的現象。
(ex.流痕-flow mark、噴流痕-jetting mark)
5. 澆口較易切除。



◎澆口型式

重疊式澆口-Overlap gate



●尺寸定義：

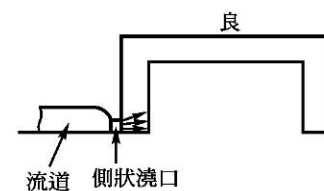
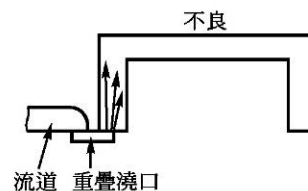
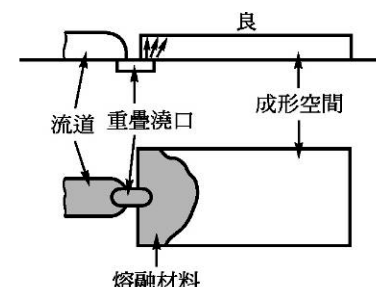
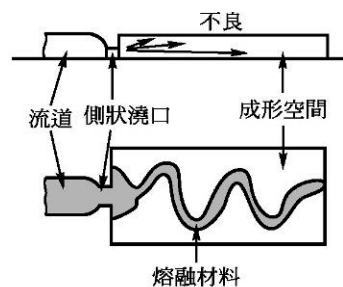
$W=1.6\sim 12.7\text{mm}$

$h = 0.4\sim 6.4\text{ mm}$

●優缺點：

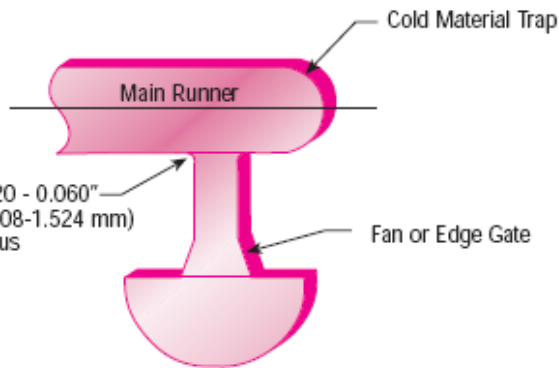
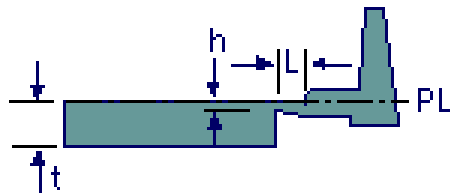
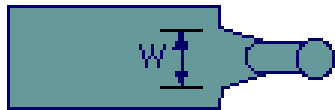
- 1.擁有側狀澆口的優點。
- 2.澆口所產生的剪切力(剪切熱)，可再次塑化(熔融塑膠)。
- 3.會有壓力損失。
- 4.產品不易產生不良產品表面的現象。
(But還是得依產品實際狀況考量)

5.澆口較難切除。



◎澆口型式

扇形式澆口-Fan gate



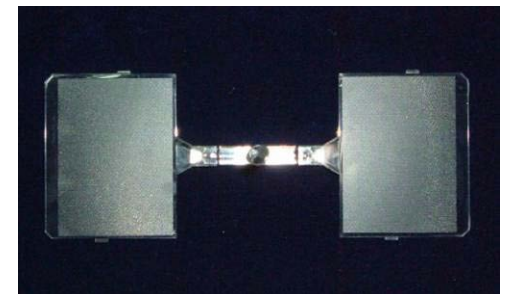
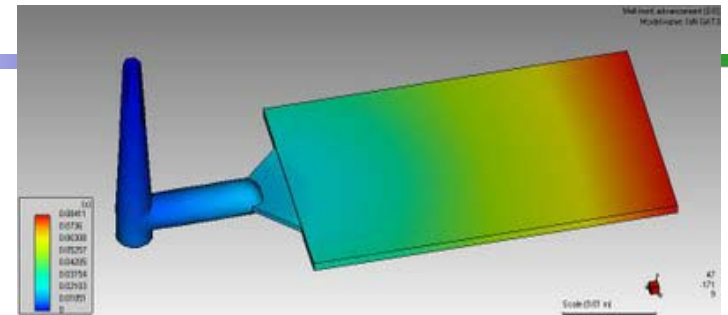
●尺寸定義：

$W=6.4\text{mm}\sim 25\%$ 模穴長

$h < 75\% \times t_{\text{mm}}(0.25\sim 1.6\text{mm})$

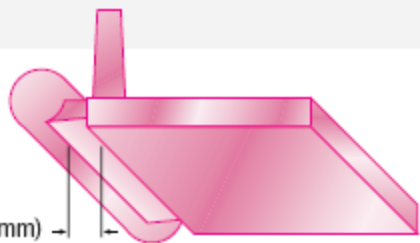
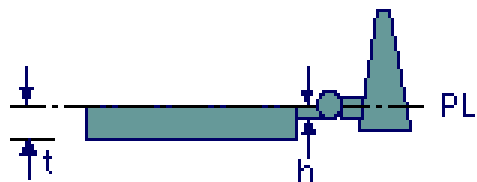
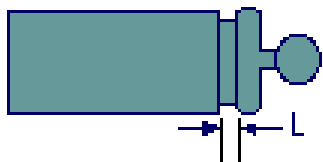
●優缺點：

- 1.可均勻充填同樣斷面的產品。
- 2.可有效防止產品變形翹曲問題。
- 3.產品不易產生不良產品表面的現象。
- 4.澆口較難切除。



◎澆口型式

薄膜式澆口-Film (flash) gate



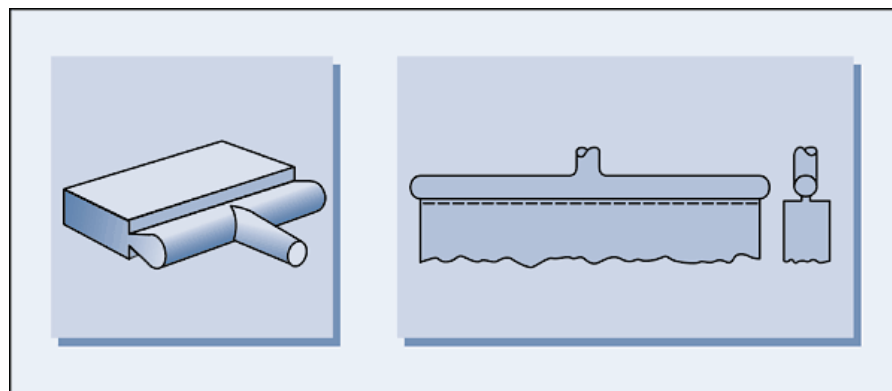
●尺寸定義：

$L=0.63 \text{ mm}$

$h=0.25\sim 0.63 \text{ mm}$

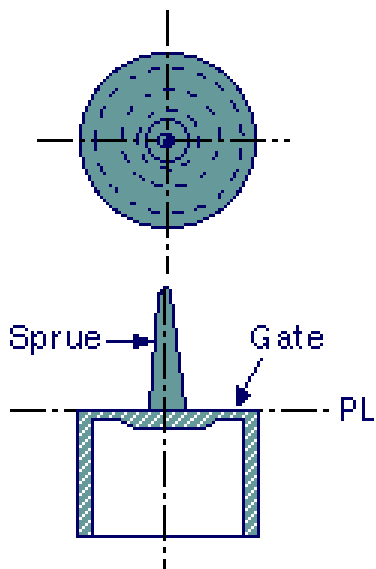
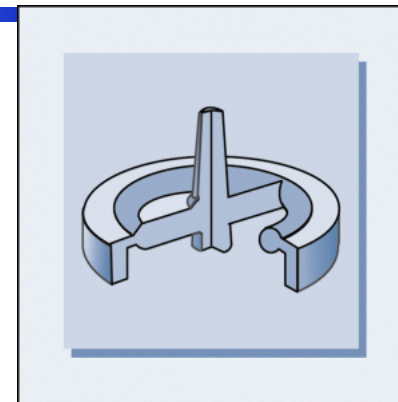
●優缺點：

- 1.適用於大面積斷面相同的產品。
- 2.澆口所產生的剪切力(剪切熱)，可再次塑化(熔融塑膠)。
- 3.會有壓力損失。
- 4.可有小改善大平面產品翹曲的問題。
- 5.澆口較難切除。



◎澆口型式

圓盤澆口-Disk (diaphragm diaphragm) gate

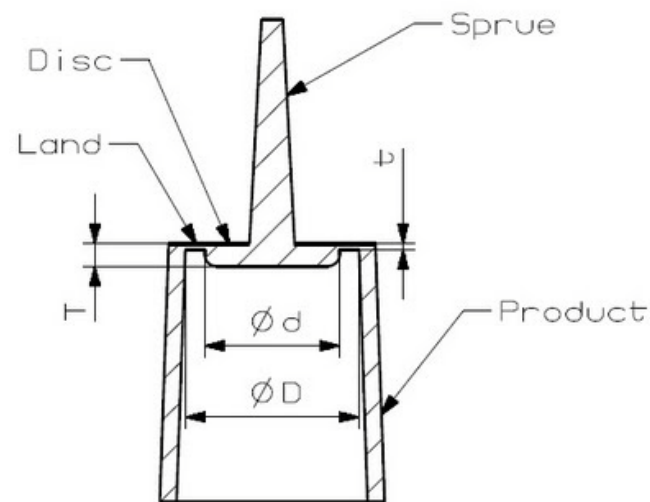
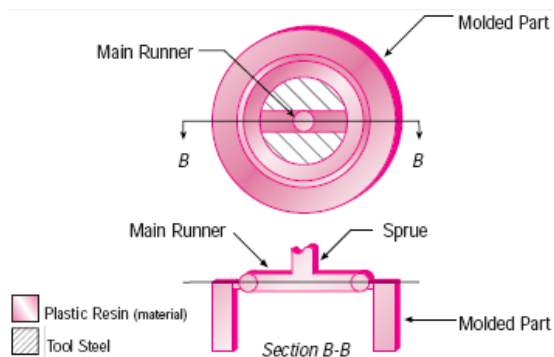


●尺寸定義：

$$h=0.25\sim 1.27\text{mm}$$

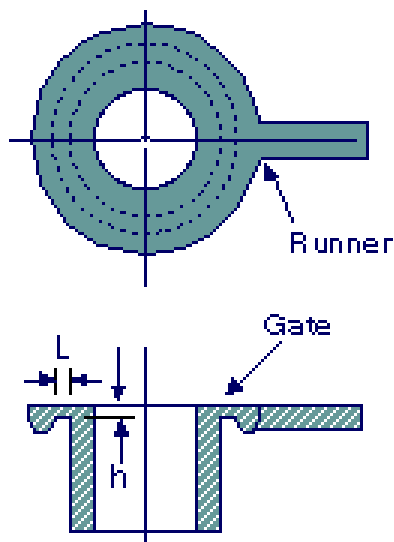
●優缺點：

1. 成形要求真圓度的圓形產品。
2. 不會有縫合線產生。
3. 多穴產品時需使用三板模or熱流道模具。
4. 澆口較難切除。



◎澆口型式

環型澆口-Ring gate

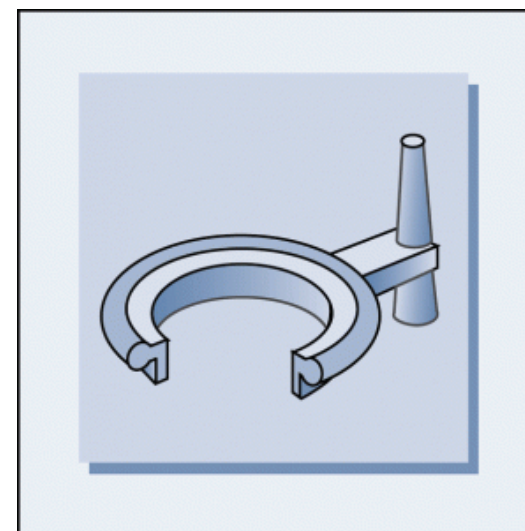
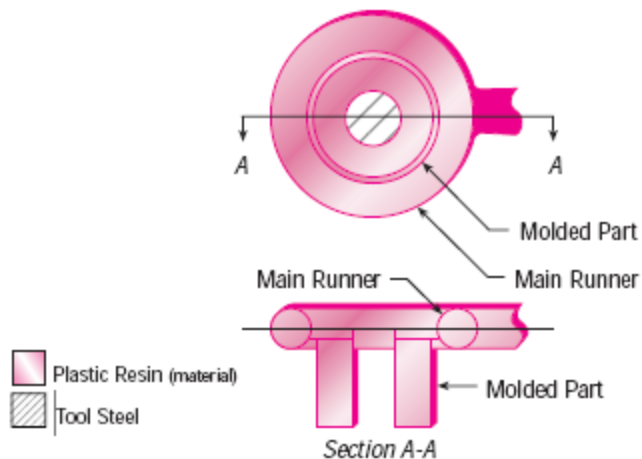


●尺寸定義：

$$h = 0.25 \sim 1.6 \text{mm}$$

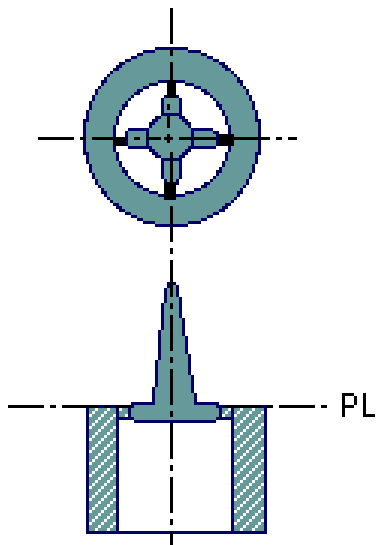
●優缺點：

1. 成形圓形產品。
2. 較不易有縫合線產生。
3. 多穴產品可使用二板模模具。
3. 澆口較難切除。



◎澆口型式

輪軸式澆口-Spoke (spider) gate



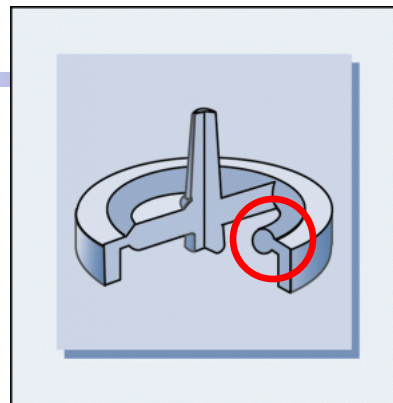
●尺寸定義：

$W=1.6\sim 6.4\text{mm}$

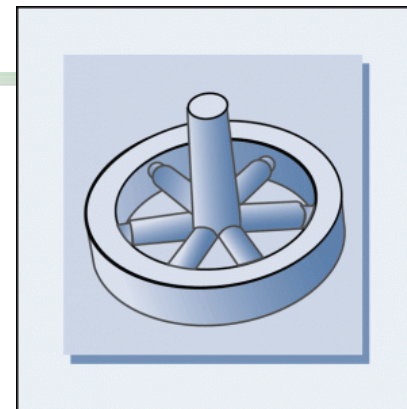
$h = 0.8\sim 4.8\text{ mm}$

●優缺點：

- 1.成形圓形產品。
- 2.有縫合線產生。
- 3.真圓度差。
- 4.多穴產品時需使用三版模or熱流道模具。
- 5.澆口較難切除。



有儲存槽

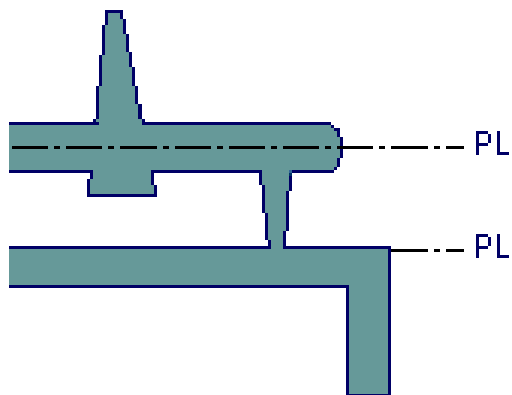


無儲存槽



◎澆口型式

點狀式澆口-Pin gate

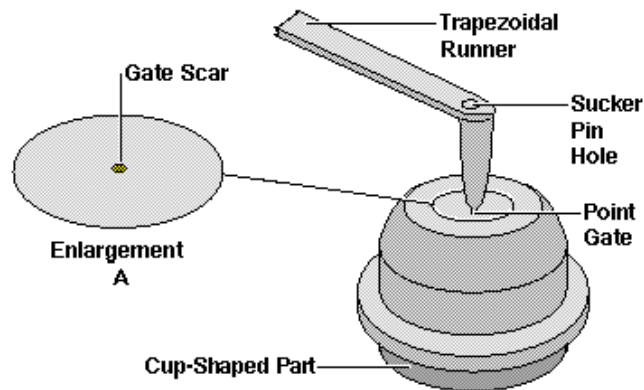


●尺寸定義：

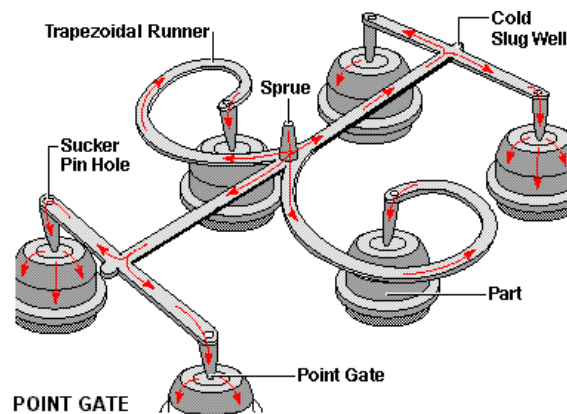
澆口 $d = \Phi 0.25 \sim 1.6 \text{ mm}$

●優缺點：

1. 僅適用於三板模模具
2. 澆口所產生的剪切力(剪切熱)，可再次塑化(熔融塑膠)。
3. 會有壓力損失。
4. 適用於一模多穴產品，並達較一致的充填(流動平衡)。
5. 澆口容易切除。(開模就切除了)

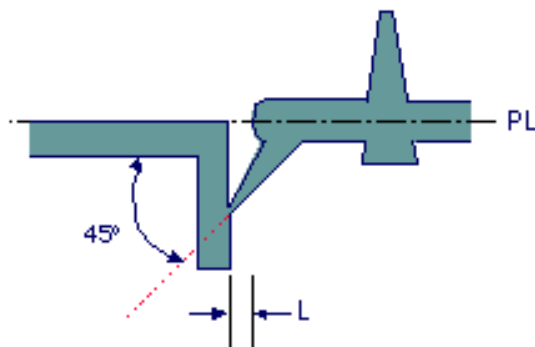


Wall Thickness mm (in)	Gate Diameter / Length mm (in)
0.7 - 1.2 mm (0.02 - 0.05)	0.7 - 1.0 / 0.8 - 1 (0.02 - 0.04 / 0.03 - 0.04)
1.2 - 3.0 mm (0.05 - 0.12)	0.8 - 2.0 / 0.8 - 1 (0.03 - 0.08 / 0.03 - 0.04)
3.0 - 5.0 mm (0.12 - 0.20)	1.5 - 3.5 / 0.9 - 1 (0.06 - 0.14 / 0.04 - 0.04)
≥ 5.0* (0.20)	3.5 - 6.0 / 0.9 - 1 (0.14 - 0.24 / 0.03 - 0.04)



◎澆口型式

潛入式澆口-Submarine (tunnel, chisel) gate

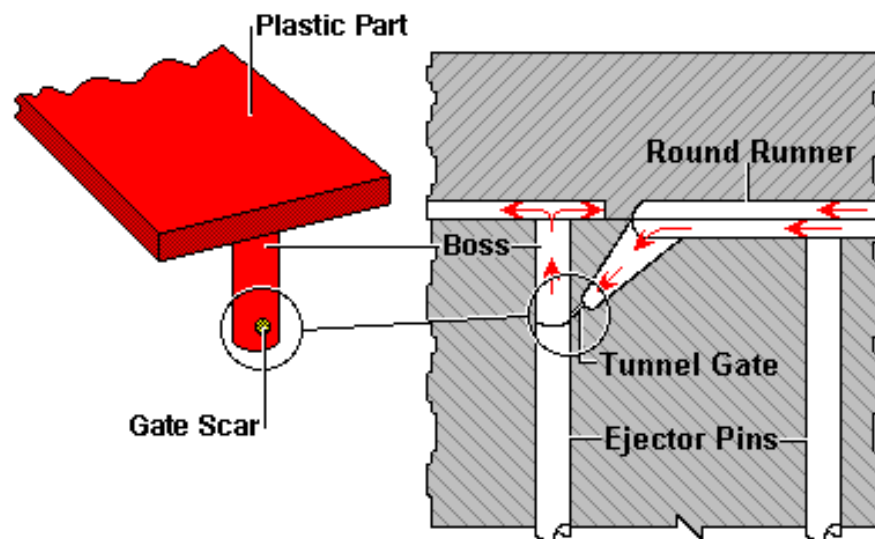
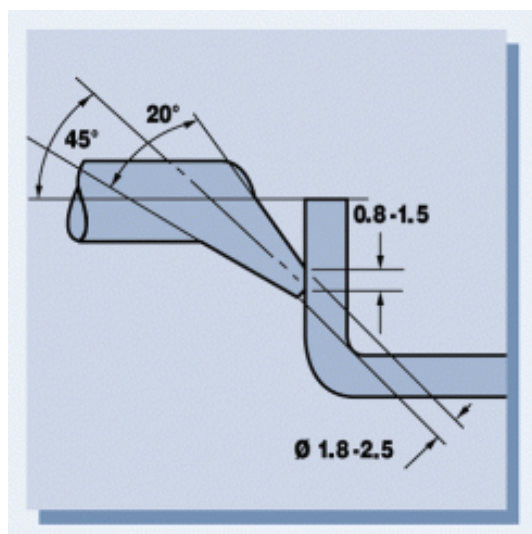
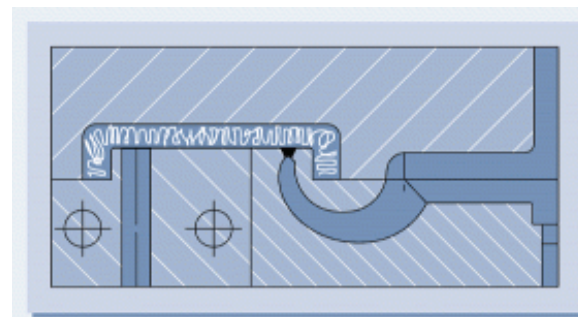


●尺寸定義：

$d = \Phi 0.25 \sim 1.6 \text{ mm}$

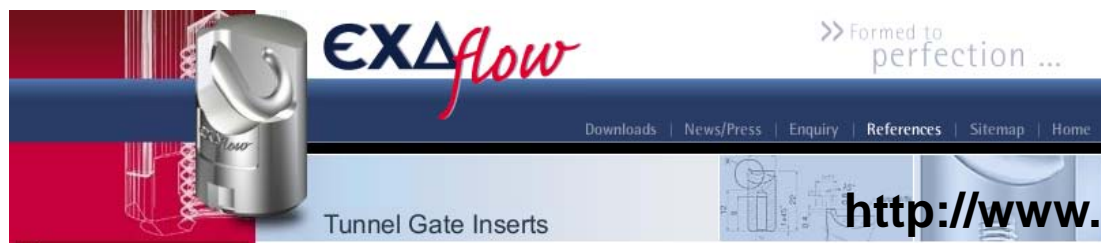
●優缺點：

1. 僅適用於二板模模具
2. 澆口所產生的剪切力(剪切熱)，可再次塑化(熔融塑膠)。
3. 會有壓力損失。
4. 適用於一模多穴產品。
5. 澆口容易切除。(開模就切除了)



◎澆口型式

潛入式澆口-Submarine (tunnel, chisel) gate → Tunnel Gate Inserts



Ringflow - GRF-1

For rear surface gating of small-to-medium sized mouldings. Supports gate diameters up to 2.5 mm and shot weights up to 200 g per insert. The GRF-1 from EXAflow® can be used to process all common non reinforced plastic types. For filled and brittle plastics please contact us beforehand!



Maxiflow - GXX

Available types are GXX-1, GXX-2 and GXX-3. For tunnel gating of medium-to-large sized mouldings. Supports contouring to a depth of 11.5 mm. Suitable for gate diameters up to 3.5 mm and shot weights up to 1,200 g per insert. The Maxiflow from EXAflow® can be used to process all common plastics, including reinforced types (e.g., PA comprising 50% glass fiber).



Standardflow - GTR

For tunnel gating of small to medium-sized mouldings along a flat parting line. The raised head ensures concealed de-gating at the injection point. Available in 10, 12 and 14mm sizes with 0.8 to 2.4mm gate diameters.



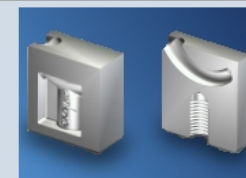
Standardflow - GTE

Rectangular design, otherwise functionally identical to GTR types. Available in 10 x 8mm, 12 x 10mm and 14 x 12mm sizes with 0.8 to 2.4mm gate diameters.



Konturflow - GTK

For tunnel gating of small to medium-sized mouldings contoured in the gate area. Konturflow gate inserts can be machined to a depth of 3 mm and are available for gate diameters up to 1.7mm.



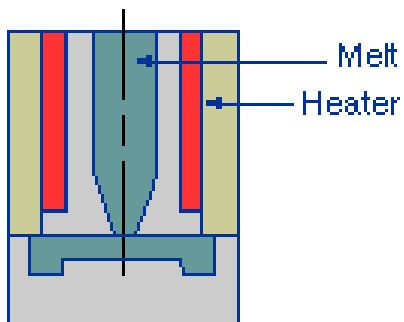
Miniflow - GTM

For tunnel gating of small, thin-walled components. Designed without head, these models are suitable for use on components with very low wall thicknesses. Ultra-compact design (10 x 5 mm), for 0.5 to 1.1mm gate sizes.



◎澆口型式

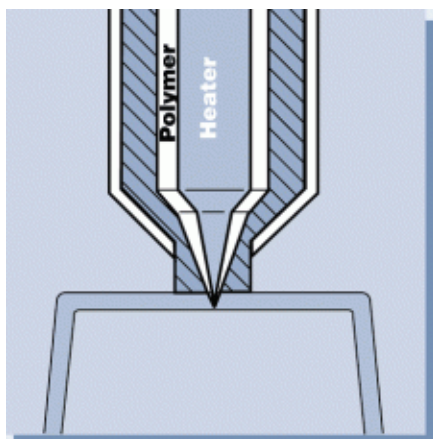
熱流道式澆口-Hot-runner (hot-probe) gate



- 尺寸定義：

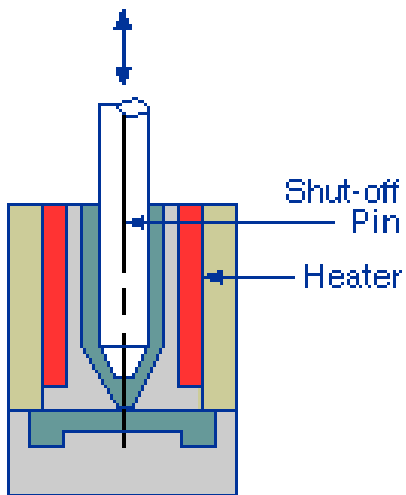
- 優缺點：

- 1.沒有冷流道的廢料產生。
- 2.澆口冷卻時間拉長，產品成型視窗變大，品質較佳。
- 3.模具加工較為複雜。
- 4.成本較高。
- 5.澆口不需去除。(開模後產品面冷卻，澆口面還是熔融狀態)
- 6.成形週期縮短。(不需等待流道系統固化)



◎澆口型式

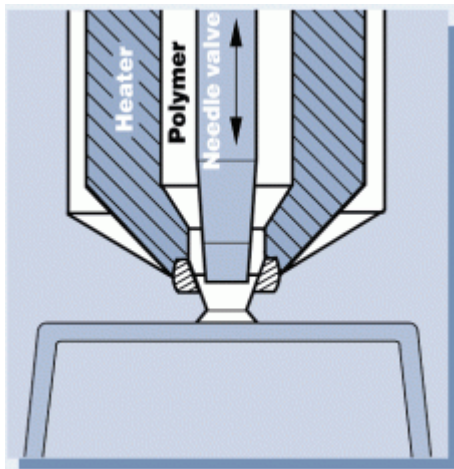
閥式澆口-Valve gate



●尺寸定義：

●優缺點：

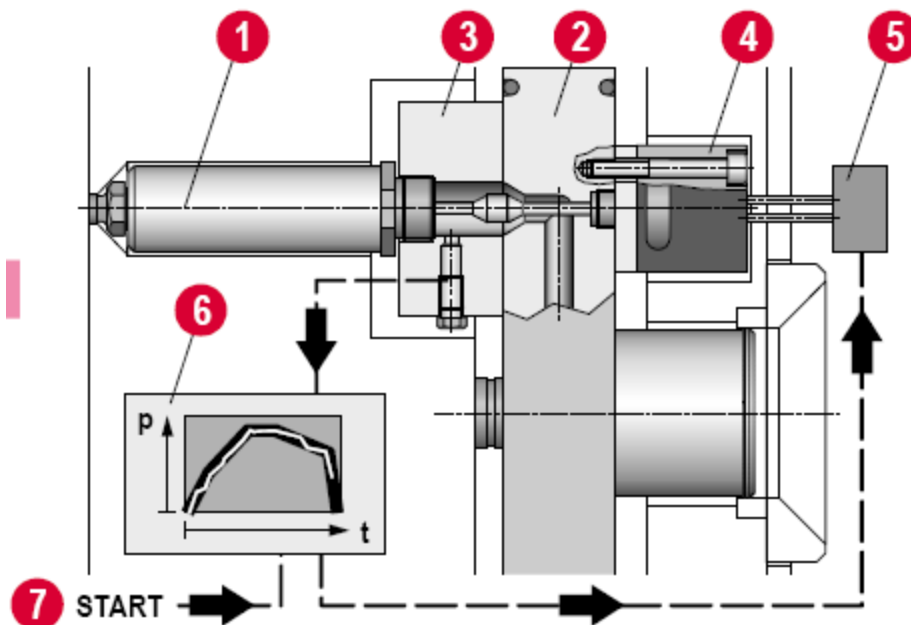
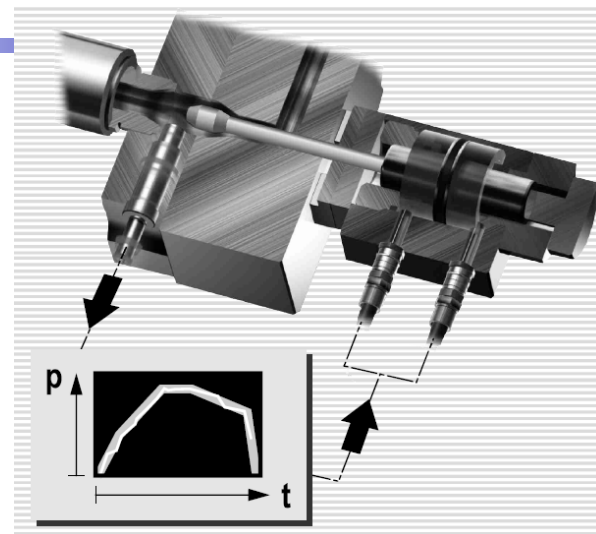
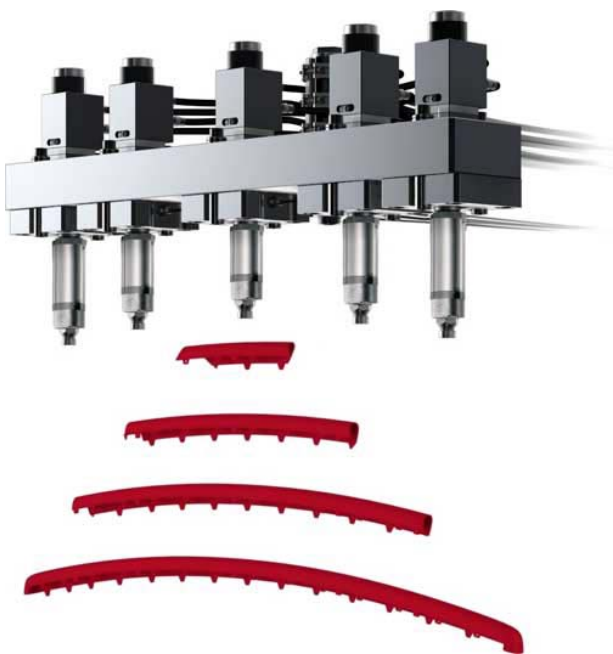
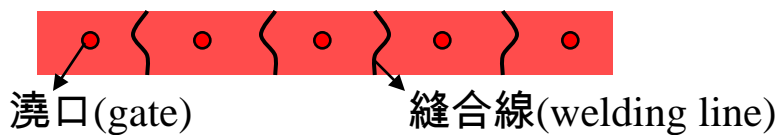
- 1.沒有冷流道的廢料產生。
- 2.澆口冷卻時間拉長，產品成型視窗變大，品質較佳。
- 3.模具加工較為複雜。
- 4.成本較高。
- 5.澆口不需去除。(開模後產品面冷卻，澆口面還是熔融狀態)
- 6.成形週期縮短。(不需等待流道系統固化)
- 7.可控制澆口的開/關，使成型過程變化多樣化。



◎澆口型式

閥式澆口-Valve gate

Q：五個澆口充填一狹長型產品時，會產生什麼問題？



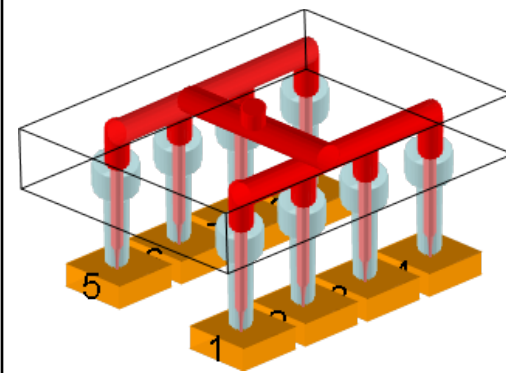
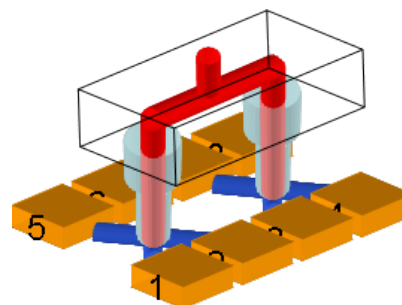
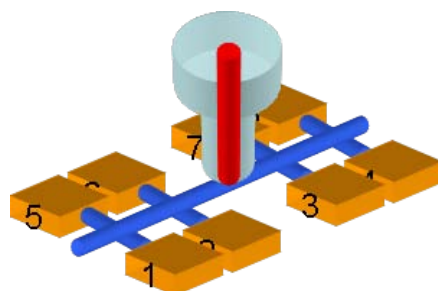
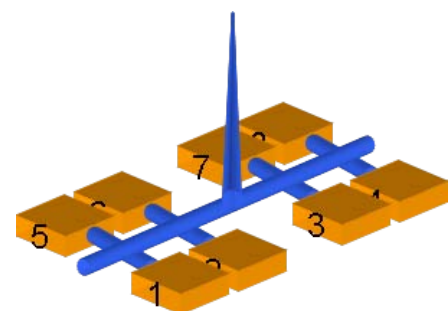
◎熱流道系統

-冷流道VS.熱流道

冷流道

半熱流道

熱流道



成本： 低

中

高

生產效率： 低

中

高

廢料： 高

中

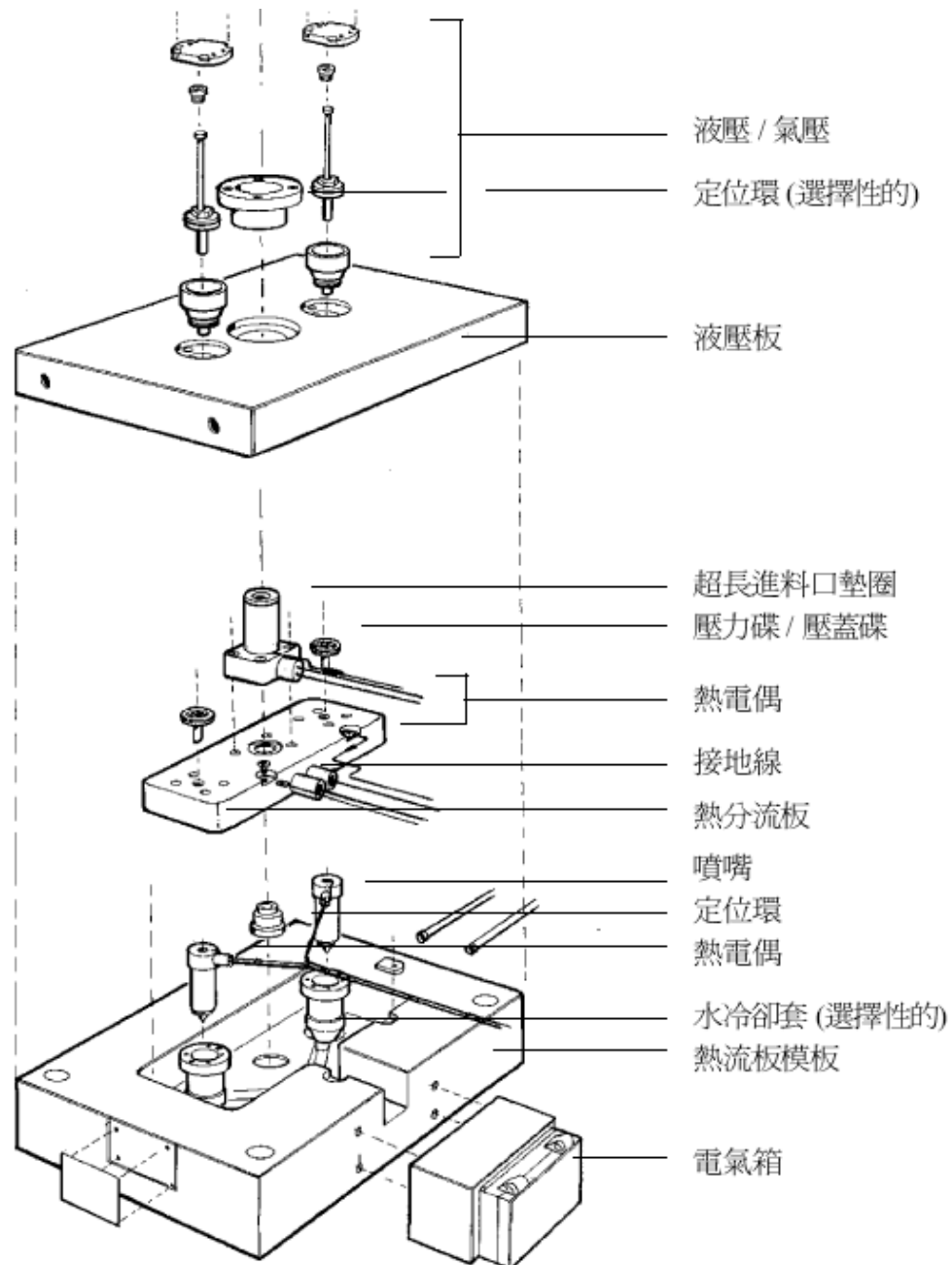
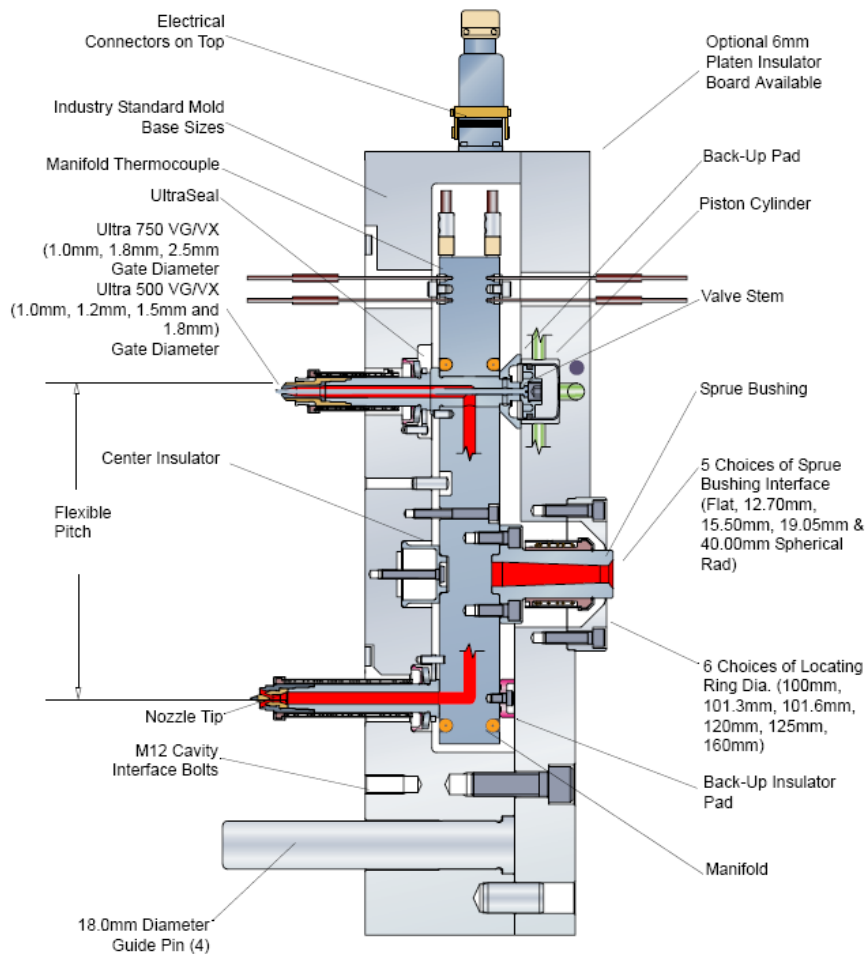
低

成型視窗： 窄

中

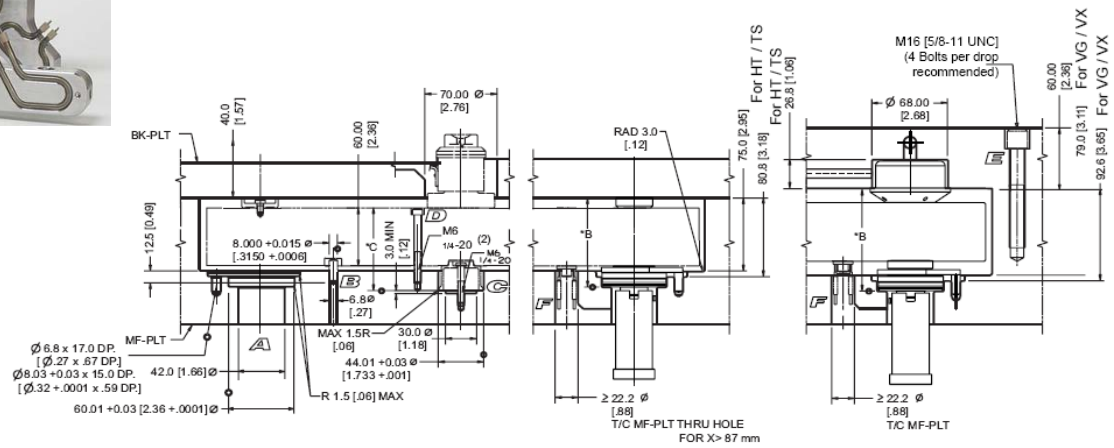
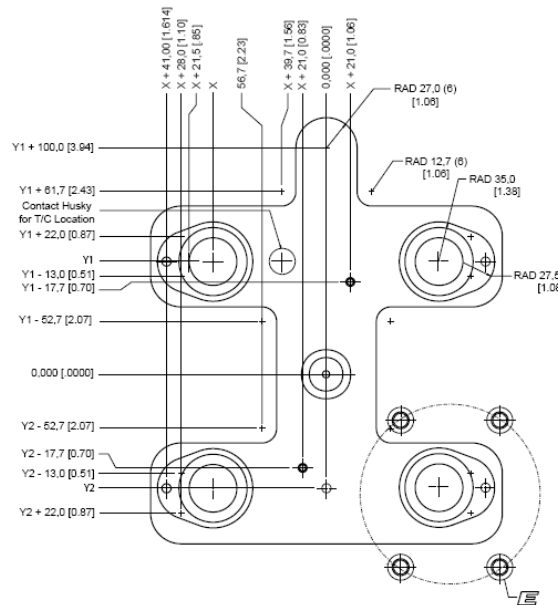
高

◎熱流道系統



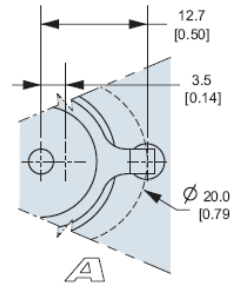
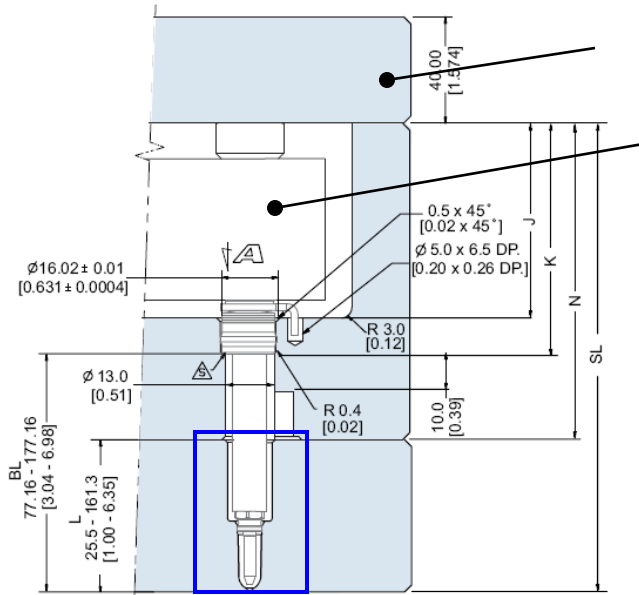
◎熱流道系統

-熱流板

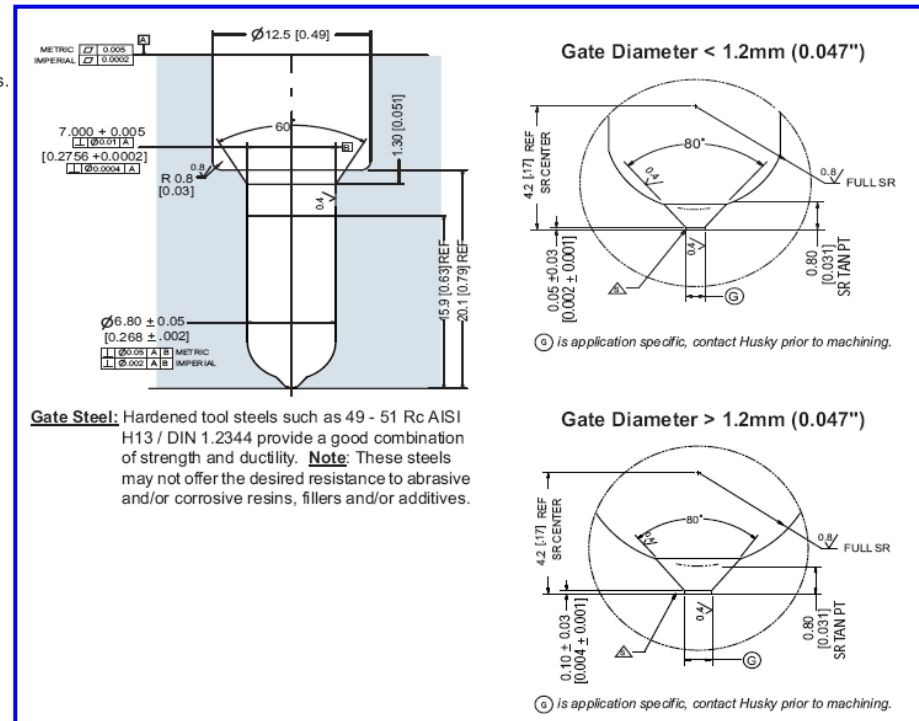


◎熱流道系統

-熱澆道設計



① For more than 16 drops.



*資料來源：<http://www.husky.ca/asia/default.aspx>

◎熱流道系統



 HUSKY <i>Keeping our customers in the lead</i>	http://www.husky.ca/asia/default.aspx
 Mold Masters performance delivered	http://www.en.moldmasters.com/
映通公司Amold	http://www.anntong.com.tw/indexAHS.html

◎熱流道系統



Product Comparison Analysis



Hot runners offer many advantages compared to cold runners:

- For many applications, the wasted cold runner can double the piece part cost
- Higher productivity yields due to reduced process cycle times
- Eliminating the cold runner saves the added labour from runner handling, gate trimming, and regrinding
- Managing additional overhead and operational factors such as added chilling capacity and the noise and dust related to grinding scrap runners

This hot runner justification tool will allow for a quick analysis of hot and cold runner economics.

The basic tool requires only three simple user inputs that are focused on:

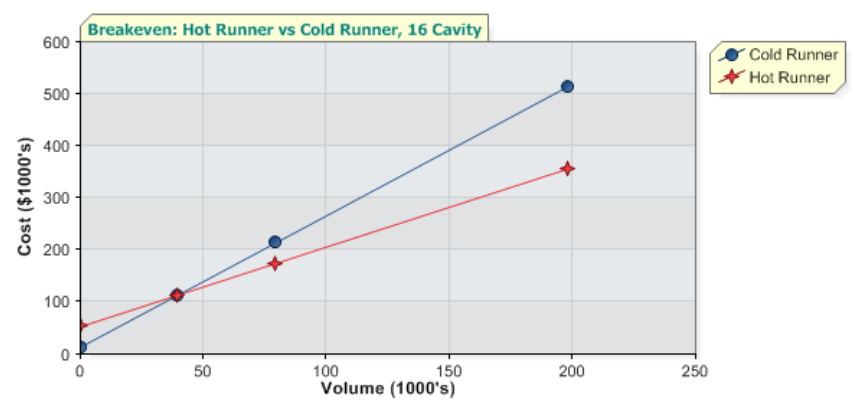
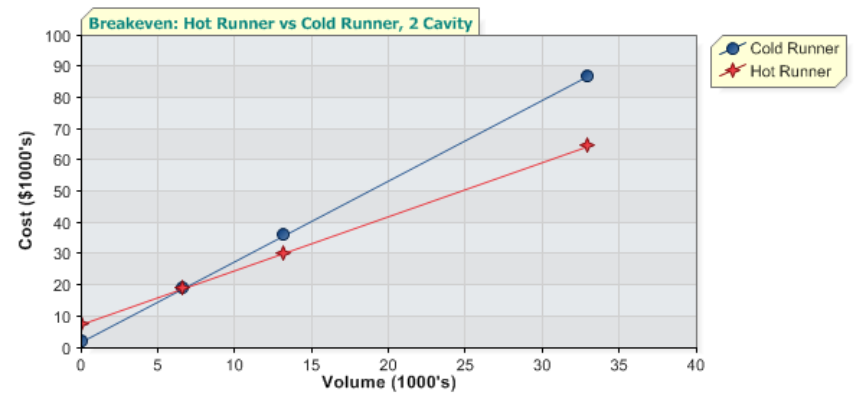
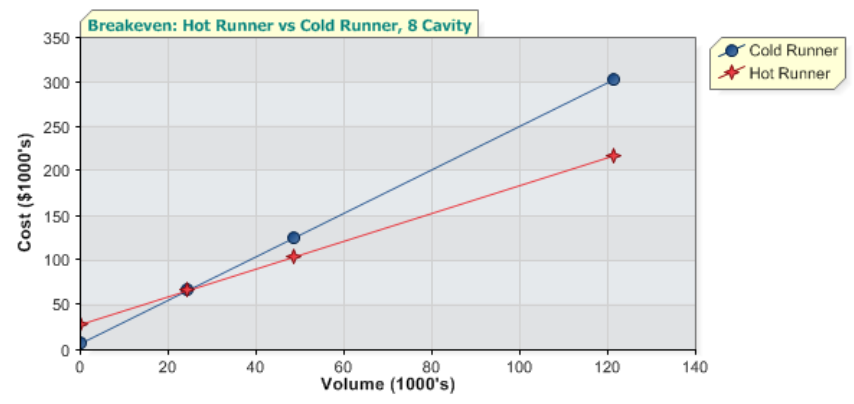
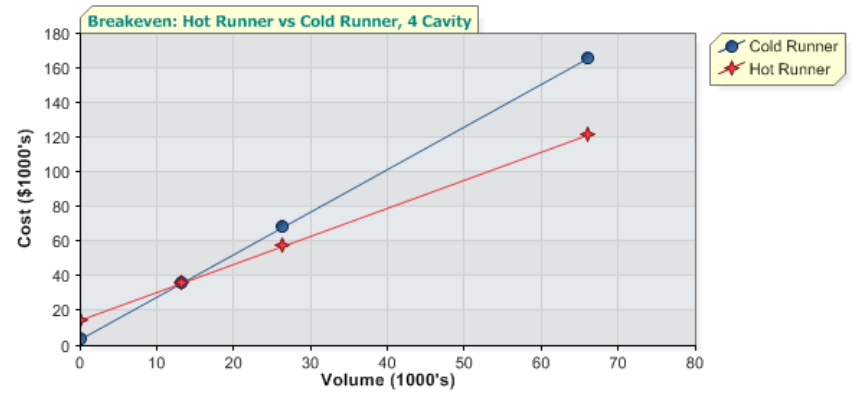
1. Molded part weight
2. Maximum wall thickness
3. Resin

BASIC		ADVANCED
BASIC USER INPUTS	COLD / HOT RUNNER	
Part Weight (kg)	<input type="text" value="0.5"/>	
Maximum Part Thickness (mm)	<input type="text" value="2"/>	
Resin (\$/kg)	<input type="text" value="ABS (2.86)"/>	

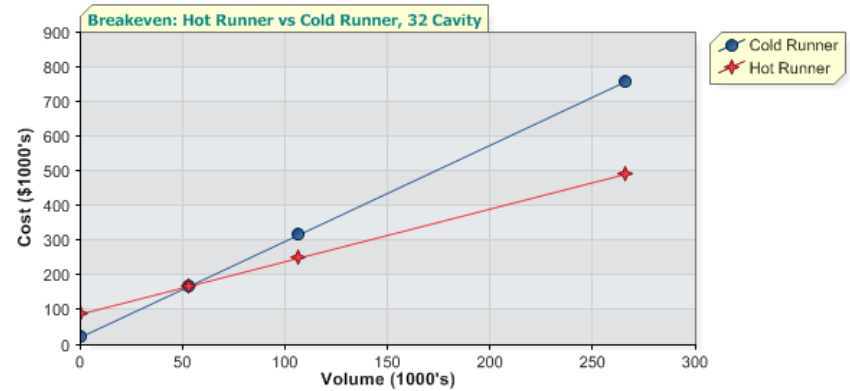
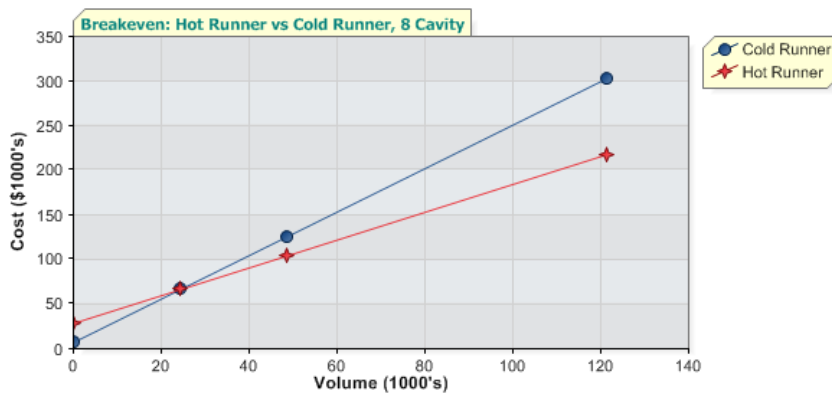
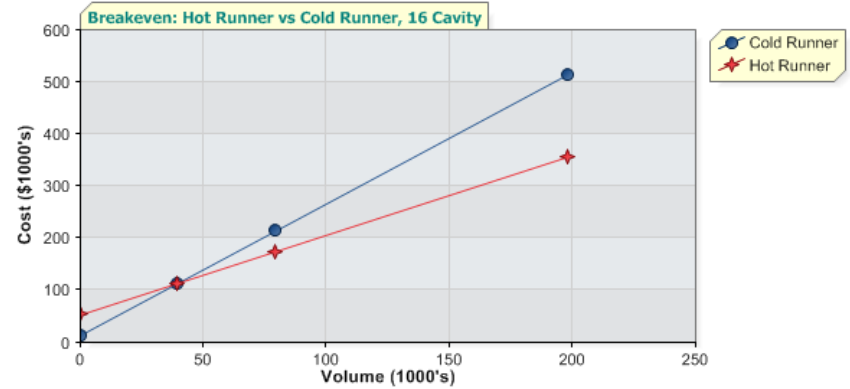
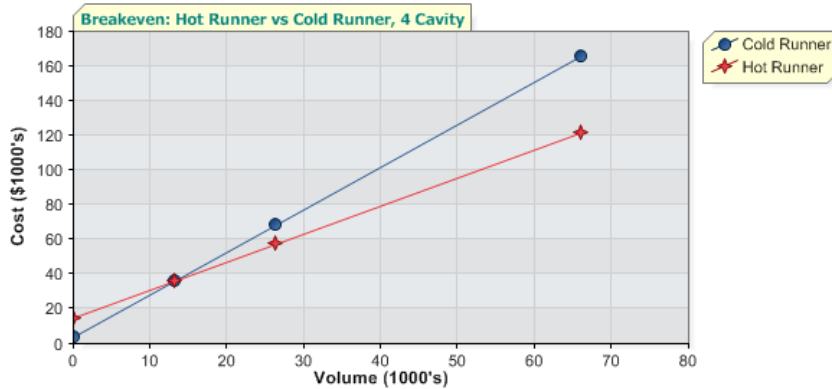
◎ 熱流道系統



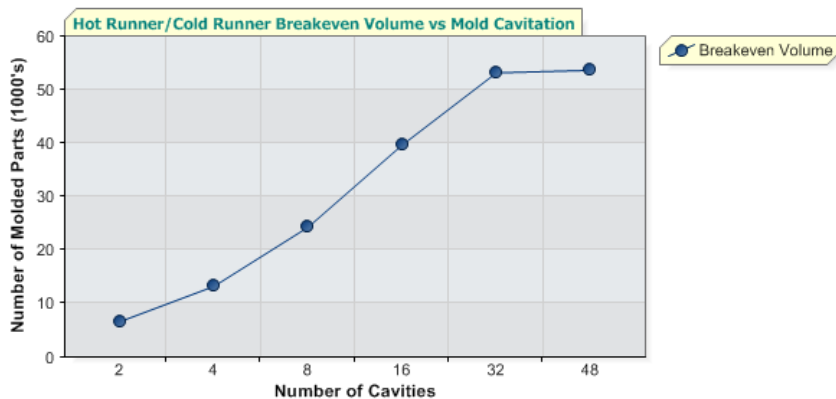
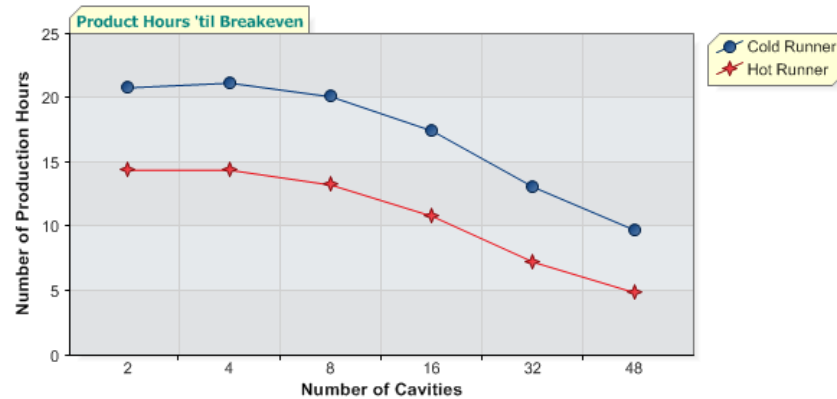
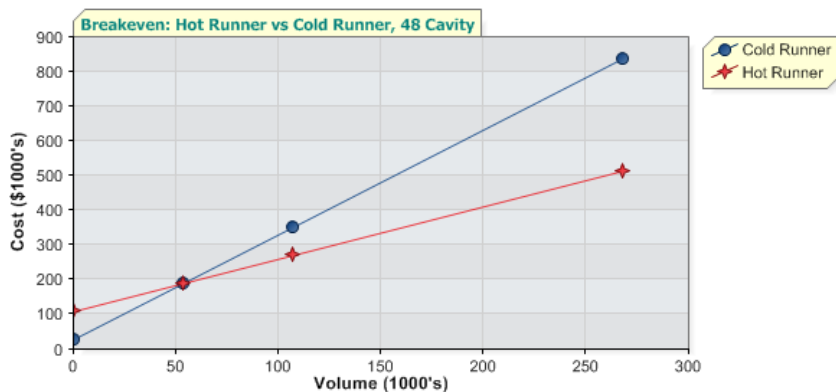
ADVANCED USER INPUTS	
Part Weight (kg)	0.5
Maximum Part Thickness (mm)	2
Resin (\$/kg)	ABS (2.86)
Resin Cost (\$/kg)	2.86
Allowable Percentage of Regrind (%)	0 %
Energy Cost (\$/kWhr)	0.08
Manpower Cost – Machine Operator (\$/hr)	30
Overhead Rate - Injection Molding Machine, Building, Facilities (\$/hr)	75



◎熱流道系統

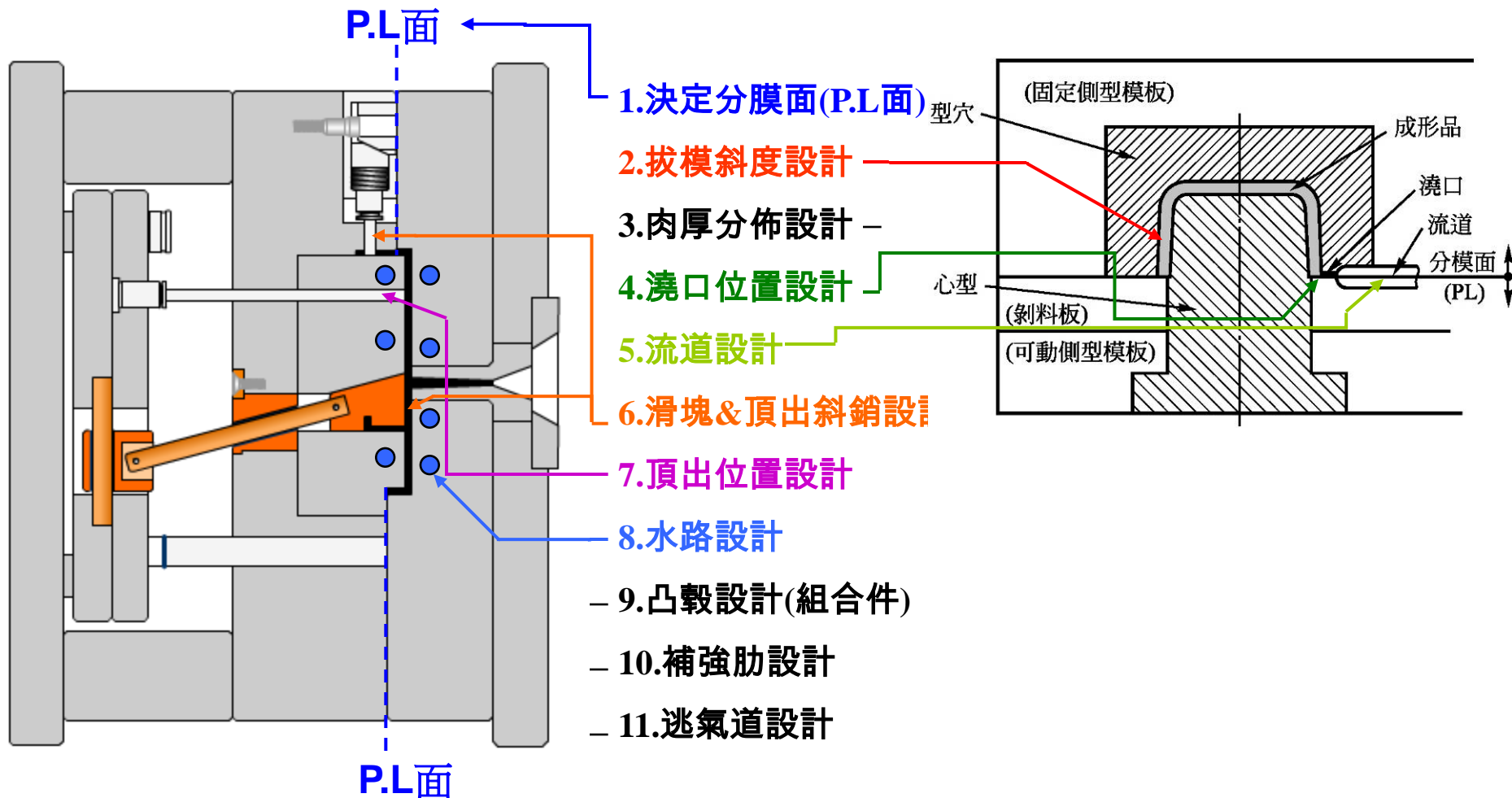


◎熱流道系統



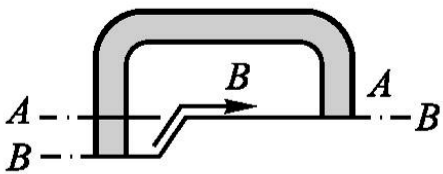
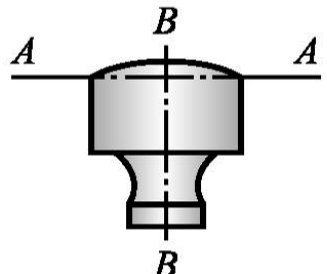
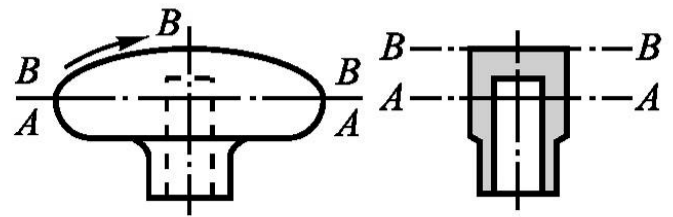
◎產品延伸至模具的設計

Q：當完成產品的外型設計後，開始著手拆解模具圖，到底要做哪些工作呢？



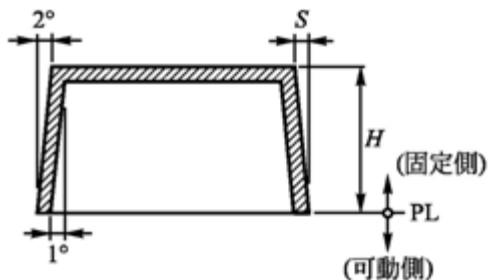
◎產品延伸至模具的設計

1.決定分膜面(P.L面)

分模線之選擇	
分模線位置	選擇要領及說明
	<p>(1)不得位於明顯位置而影響成形品外觀 <i>BB</i>(佳) <i>AA</i>(惡)</p> <p>說明： 分模線於<i>AA</i>處，影響成形品外觀</p>
	<p>(2)開模時，不成死角(undercut)之位置 <i>BB</i>(佳) <i>AA</i>(惡)</p> <p>說明： 分模線於<i>AA</i>處，開模時形成死角，必須另設側向心型才能脫模</p>
	<p>(3)位於模具加工容易之位置 <i>BB</i>(惡) <i>AA</i>(佳)</p> <p>說明： 分模線位於<i>AA</i>處，模具加工較容易</p>

◎產品延伸至模具的設計

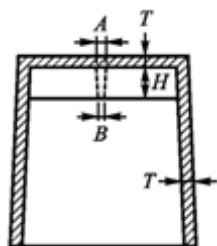
2.拔模斜度設計



外觀面、內部

*1~2度之間

*母模面>公模面

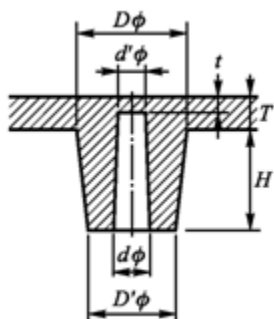


肋條-Rib

*0.25~1度之間

* $A=T \times (0.3 \sim 0.5)$ → 注重外觀面

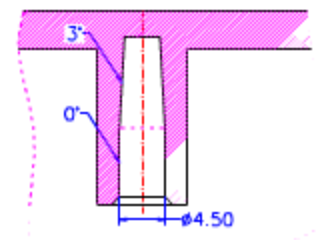
$A=T \times (0.5 \sim 0.7)$ → 不怕收縮



凸穀孔-Boss孔

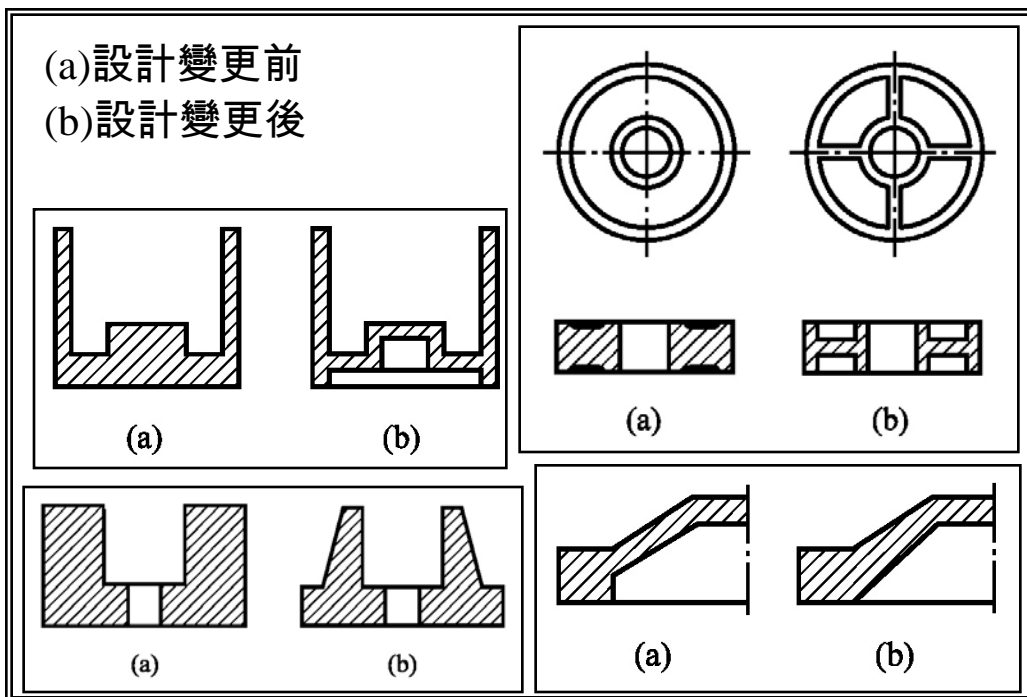
*1.5~2.5度之間

*產品允許可到3度



◎產品延伸至模具的設計

3.肉厚分佈設計



塑膠名稱	標準肉厚
PE	0.5~3.0
PP	0.6~3.0
PA	0.5~3.0
POM	1.5~5.0
PS	1.2~3.5
PBT	0.8~3.0
ABS、AS	1.2~3.5
PMMA	1.5~5.0
硬質PVC	2.0~5.0
PC	1.5~5.0
CA	1.2~3.5

◎產品延伸至模具的設計

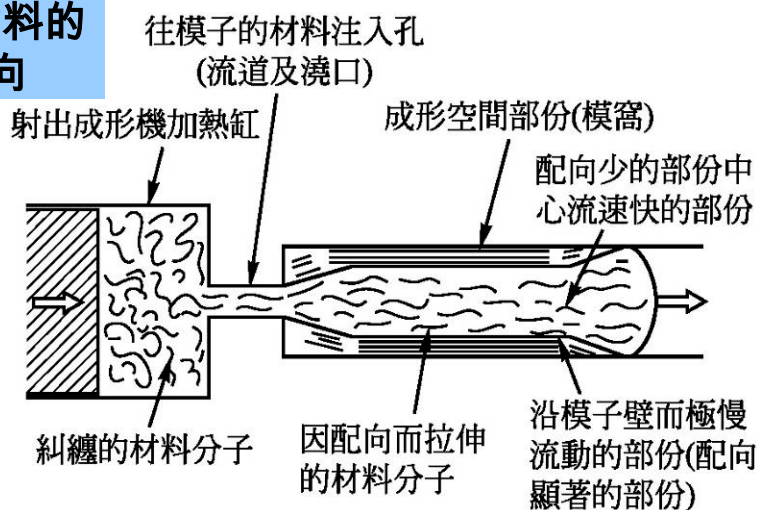
3.肉厚分佈設計

成形材料			線膨脹係數 (10 ⁻⁵ /°C)	成形收縮率 (%)	
塑膠名稱		填充料(強化材)			
熱硬化性塑膠	酚樹脂(PF)	木粉, 棉屑	3.0~4.5	0.4~0.9	
	酚樹脂(PF)	玻璃纖維	0.8~1.6	0.01~0.4	
	尿素樹脂(UF)	纖維素	2.2~3.6	0.6~1.4	
	三聚氰胺樹脂(MF)	纖維素	4.0	0.5~1.5	
	diallyl phthalate(DAP)	玻璃	1.0~3.6	0.1~0.5	
	環氧樹脂(EP)	玻璃纖維	1.1~3.5	0.1~0.5	
	聚酯(UP)	玻璃纖維	2.0~3.3	0.1~1.2	
熱可塑性塑膠	結晶性	PE(低密度)	—	10.0~20.0	1.5~5.0
		PE(中密度)	—	14.0~16.0	1.5~5.0
		PE(高密度)	—	11.0~13.0	2.0~5.0
		PP	—	5.8~10.0	1.0~2.5
		PP	玻璃纖維	2.9~5.2	0.4~0.8
		耐隆(6)	—	8.3	0.6~1.4
		耐隆(6.10)	—	9.0	1.0
		耐隆	20~40 %玻璃纖維	1.2~3.2	0.3~1.4
	非結晶性	聚縮醛	—	8.1	2.0~2.5
		聚縮醛	20 %玻璃纖維	3.6~8.1	1.3~2.8
		PS(一般用)	—	6.0~8.0	0.2~0.6
		PS(耐衝擊用)	—	3.4~21.0	0.2~0.6
		PS	20~30 %玻璃纖維	1.8~4.5	0.1~0.2
		AS 樹脂	—	3.6~3.8	0.2~0.7
		AS 樹脂	20~33 %玻璃纖維	2.7~3.8	0.1~0.2
		ABS 樹脂(耐衝擊用)	—	9.5~13.0	0.3~0.8
ABS 樹脂(耐衝擊用)	20~40 %玻璃纖維	2.9~3.6	0.1~0.2		
亞克力	—	5.0~9.0	0.2~0.8		
PC	—	6.6	0.5~0.7		
PC	10~40 %玻璃纖維	1.7~4.0	0.1~0.3		
PVC 樹脂(硬質)	—	5.0~18.5	0.1~0.5		
醋酸纖維素	—	8.0~18.0	0.3~0.8		

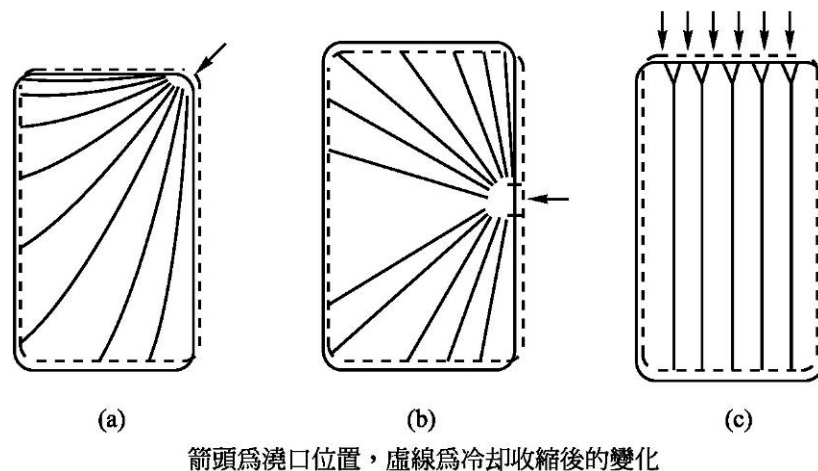
◎產品延伸至模具的設計

4.澆口位置設計

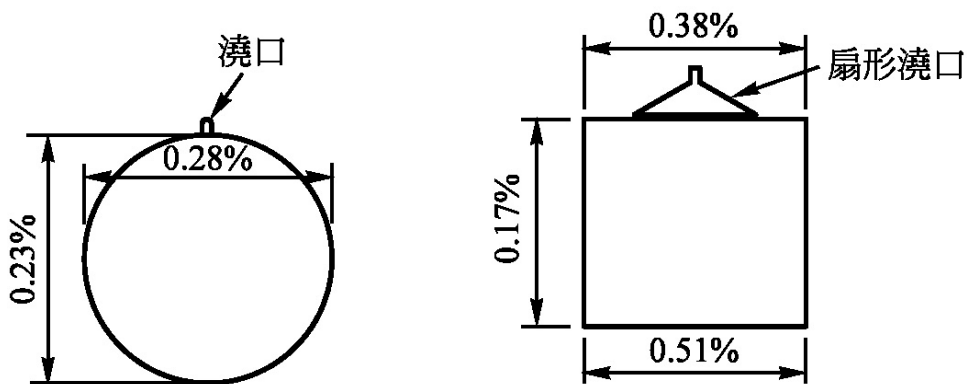
*塑膠材料的流動配向



*澆口位置vs.分子配向性VS.成形收縮率



*澆口位置vs.玻璃纖維配向性VS.成形收縮率



(a) 圓板 $\phi 120 \times 3\text{mm}$

(b) 平板 $300 \times 300 \times 3.2\text{mm}$

(c) 外蓋

*未添加玻璃纖維
→與澆口(流動波前)平行方向的尺寸收縮較劇烈

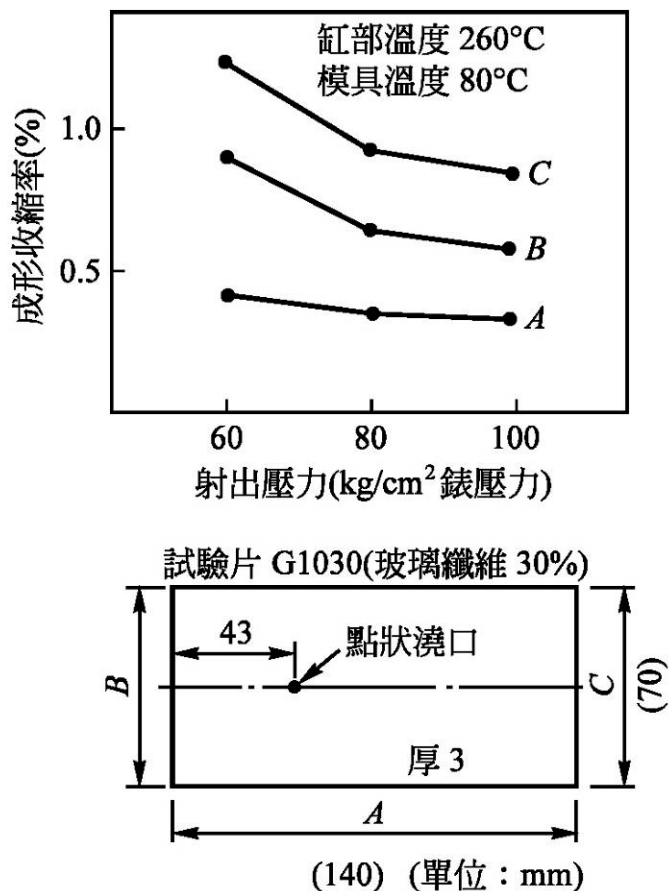
*添加玻璃纖維後
→與澆口(流動波前)垂直方向的尺寸收縮較劇烈

153×44×55mm
(肉厚 2.2mm)

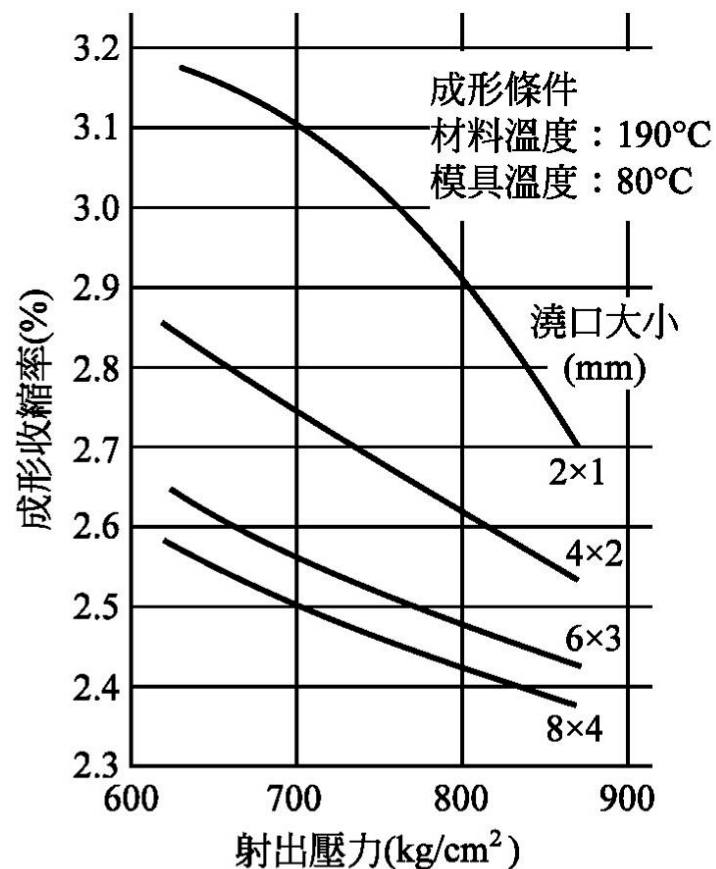
◎產品延伸至模具的設計

4.澆口位置設計

*射出壓力VS.成形收縮率

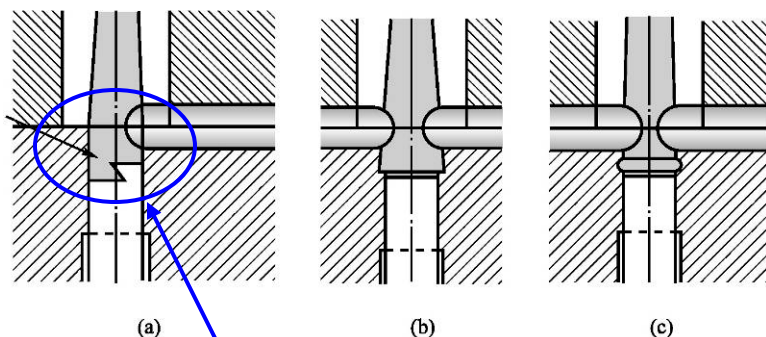
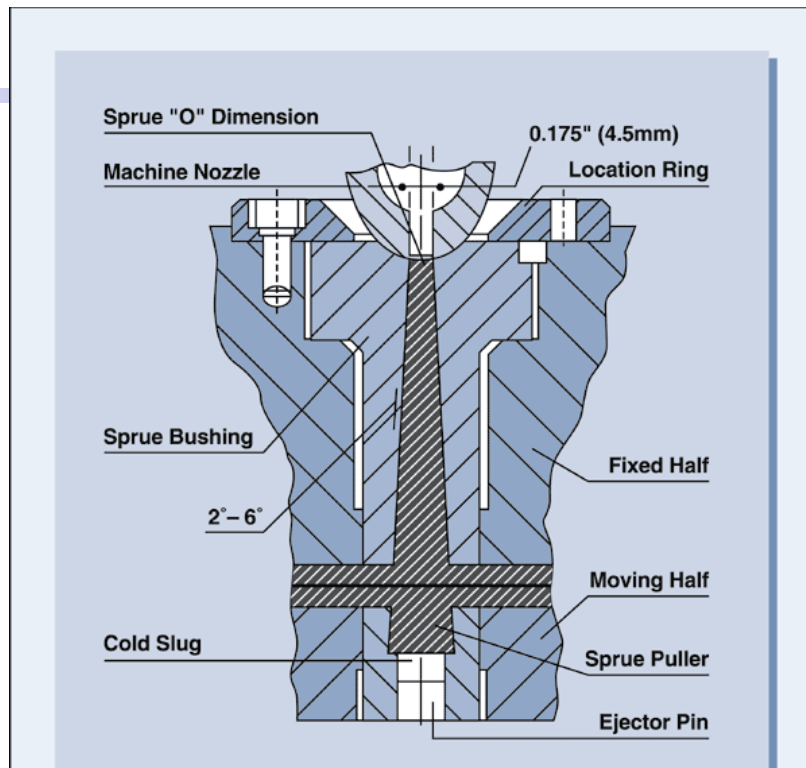
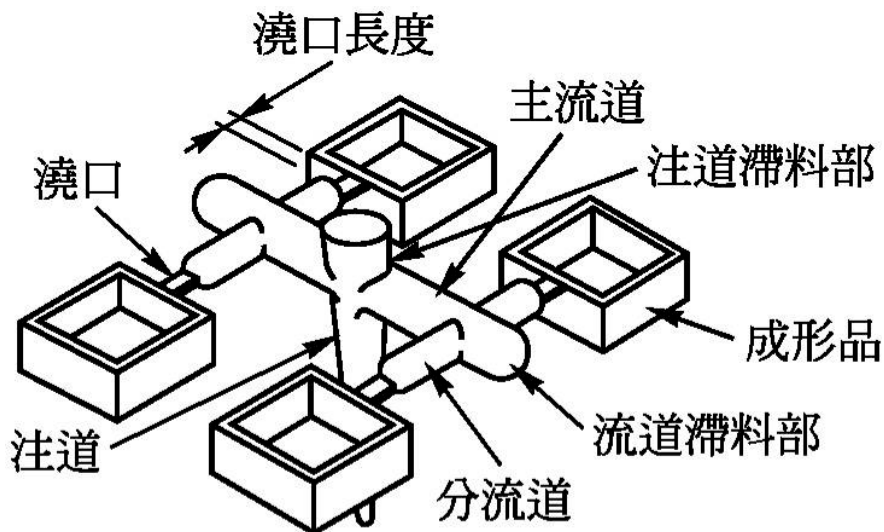


*射出壓力VS.成形收縮率

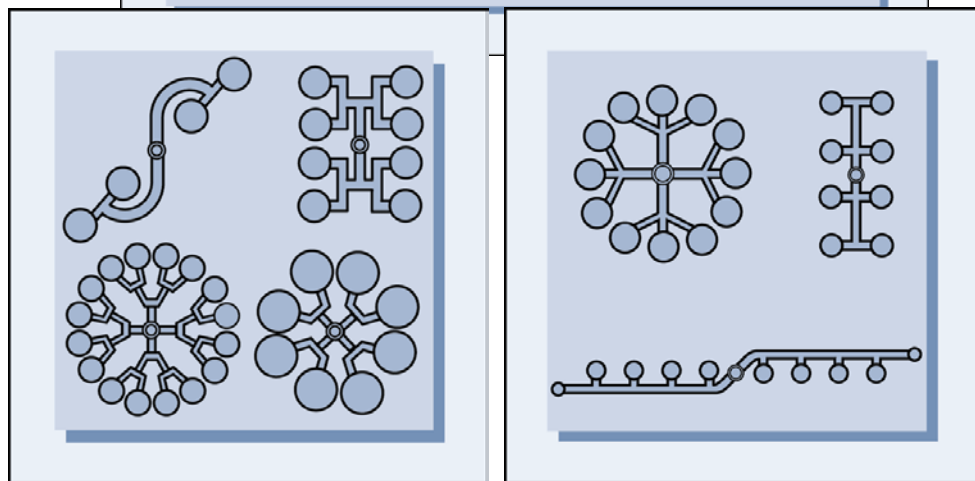


◎產品延伸至模具的設計

5.流道設計



滯料部&柱道抓銷



◎產品延伸至模具的設計

5.流道設計

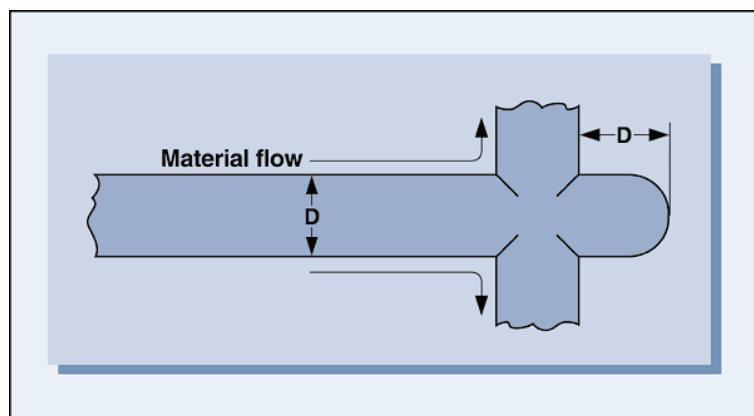
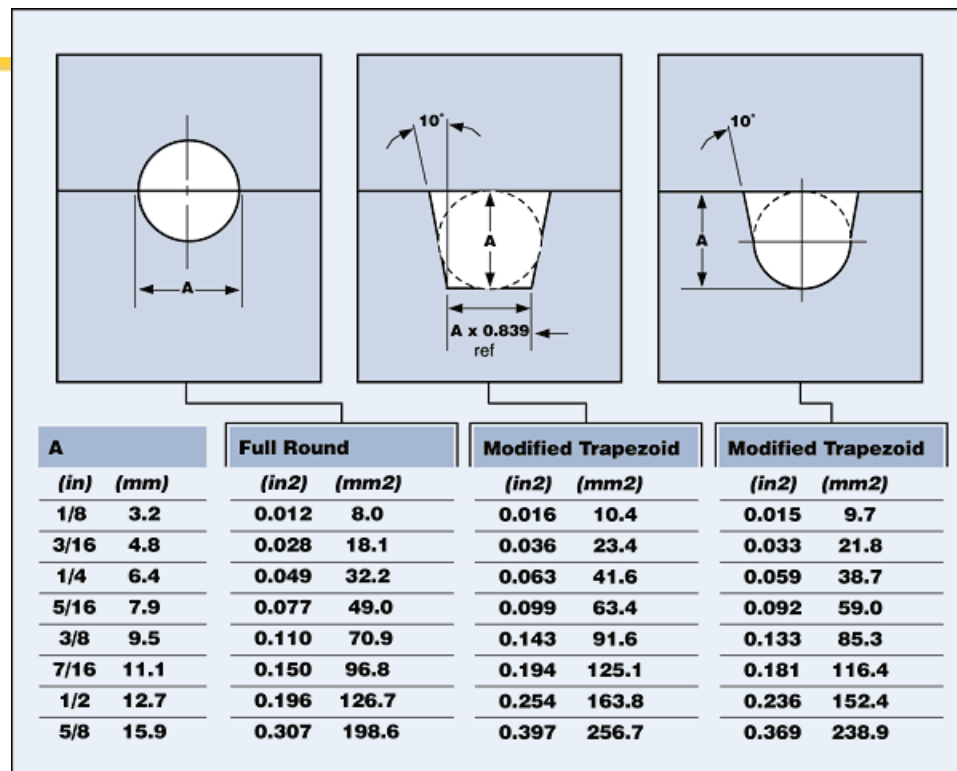
$$D = \frac{w^{1/2} \times L^{1/4}}{3.7}$$

where:

D = runner diameter (mm)

W = part weight (g)

L = runner length (mm)



Runner Diameter		Maximum Runner Length			
(in)	(mm)	Low Viscosity		High Viscosity	
(in)	(mm)	(in)	(mm)	(in)	(mm)
1/8	3	4	100	2	50
1/4	6	8	200	4	100
3/8	9	11	280	6	150
1/2	13	13	330	7	175

◎產品延伸至模具的設計

6.滑塊&頂出斜銷設計

1.斜角銷裝配孔尺寸

*斜角(撐)銷與滑塊斜孔間隙
=0.5mm

*斜角(撐)銷在模板配合長度
> = 1.5d

單位：mm

標稱尺寸	d		D	H
	尺寸	尺寸公差(H7)		
12	12	+0.018	17	10
15	15	0	20	12
20	20	+0.021 0	25	15
25	25		30	15
30	30	0	35	20
35	35	+0.025	40	20
40	40	0	45	25

2.定位角度

(1)斜角銷之傾斜角 $\alpha=25^\circ$ 以下

(2)定位接觸面角度 $\beta=\alpha+2^\circ$

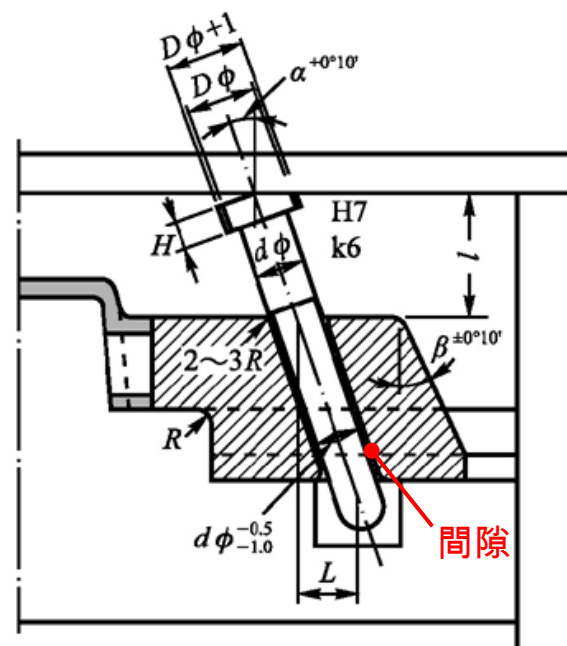
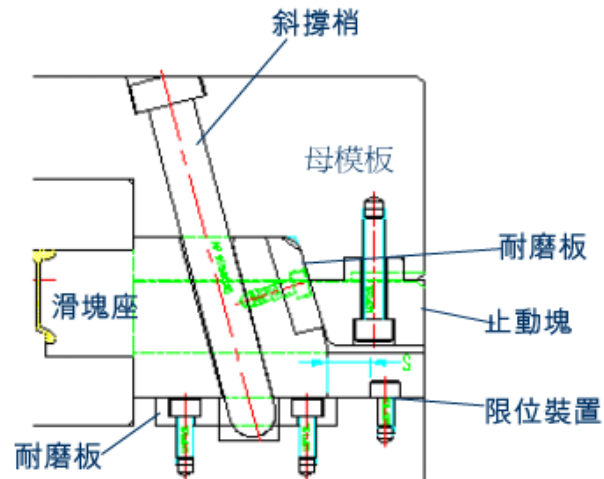
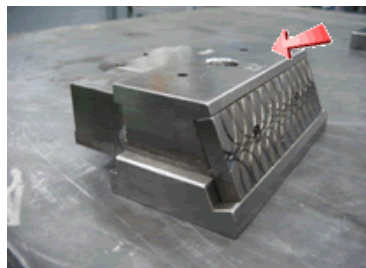
3.斜角銷長度計算式

$$M = \frac{l}{\cos\alpha} + \frac{L}{\sin\alpha} + \frac{d}{2} - H$$

傾斜角 α 之 $\sin\alpha$ 、 $\cos\alpha$ 值
單位：mm

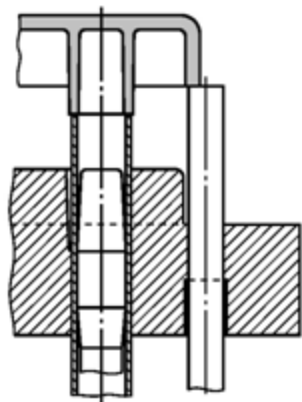
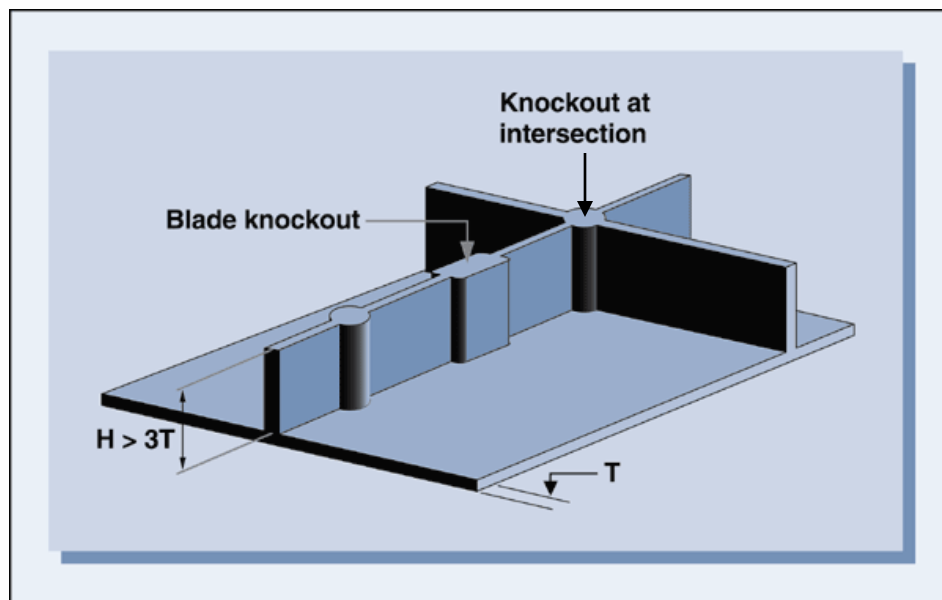
α	$\cos\alpha$	$\sin\alpha$
12	0.97815	0.20791
15	0.96593	0.25882
18	0.95106	0.30902
20	0.93969	0.34202
22	0.92718	0.37461
25	0.90631	0.42262

L：行程

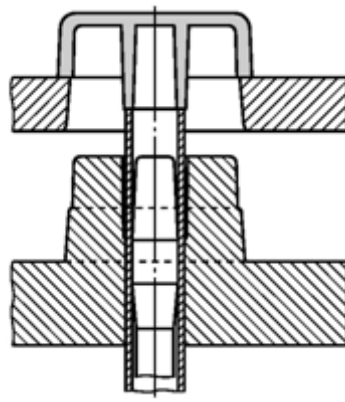


◎產品延伸至模具的設計

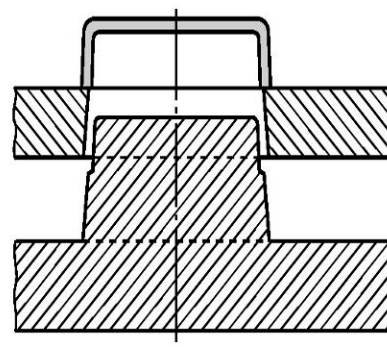
7.頂出位置設計



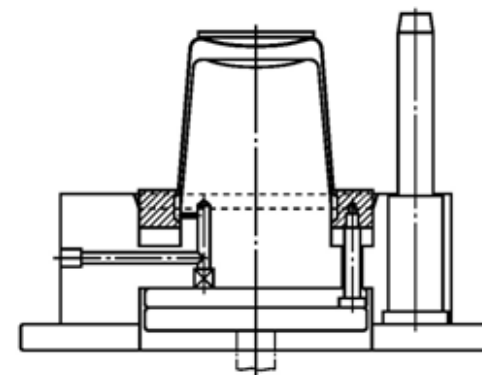
*頂出珍+頂出套筒



*剝料板+頂出套筒



*剝料板



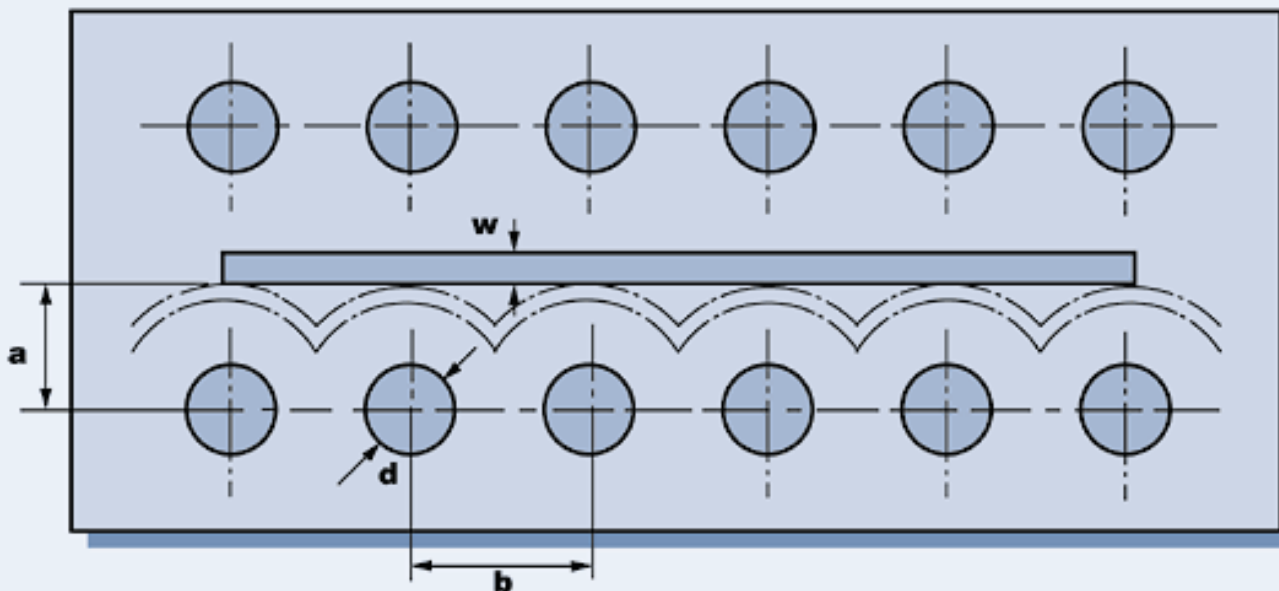
*剝料板+氣體(破真空)

◎產品延伸至模具的設計

8.水路設計

*產品各區域冷卻效率一致化，將有效減少產品翹曲的問題。

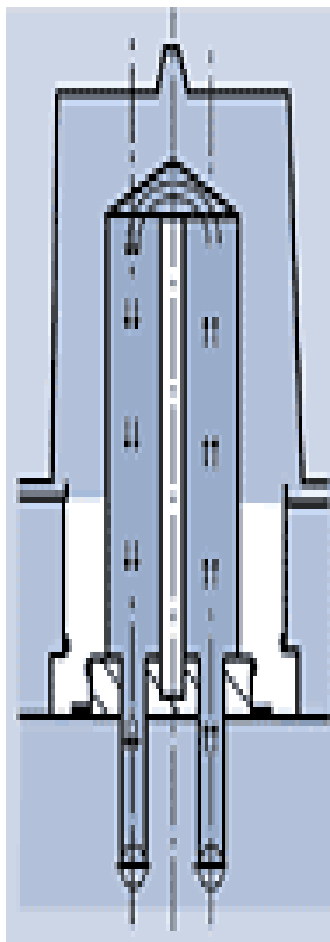
"w"	"d"	"a"	"b"
<i>wall thickness of the product</i> mm (in)	<i>diameter of the cooling channels</i> mm (in)	<i>center distance with respect to mold cavity</i>	<i>center distances between cooling channels</i>
2 (0.08)	8-10 (0.31-0.40)		
2-4 (0.08-0.16)	10-12 (0.40-0.47)	1.5-2d	2-3d
4-6 (0.16-0.24)	12-14 (0.47-0.55)		



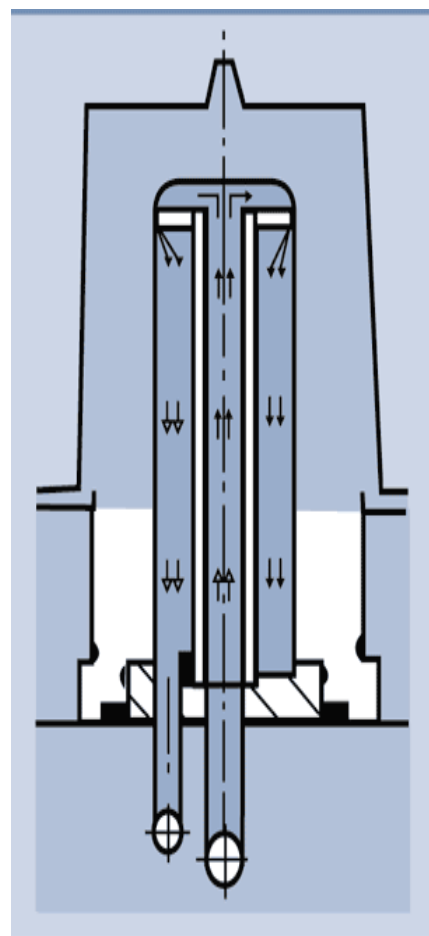
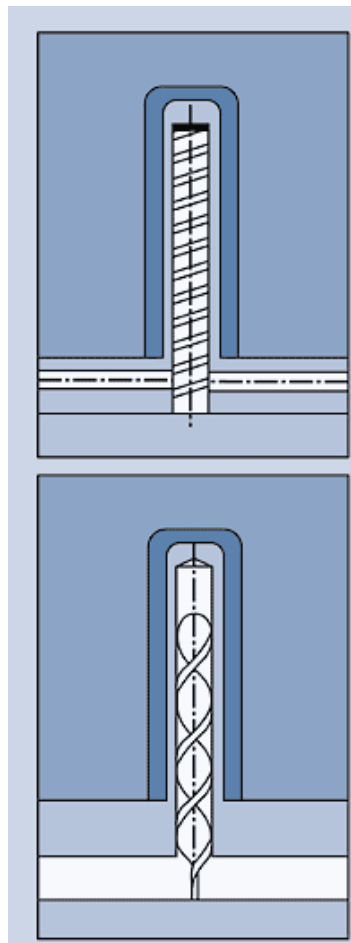
◎產品延伸至模具的設計

8.水路設計

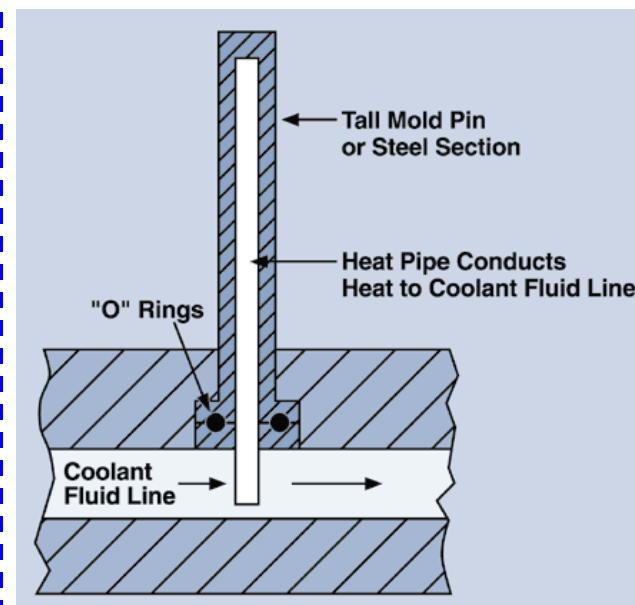
*棧板管(Baffle)



*噴泉管(Bubbler)

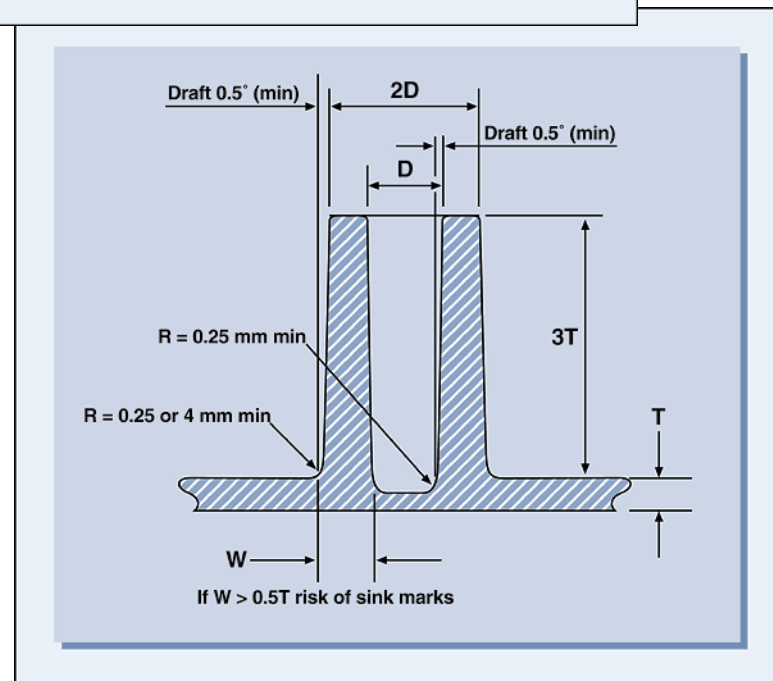
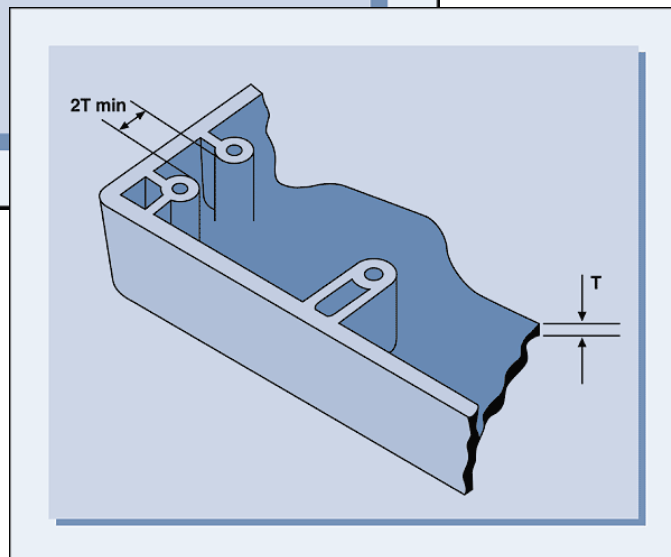
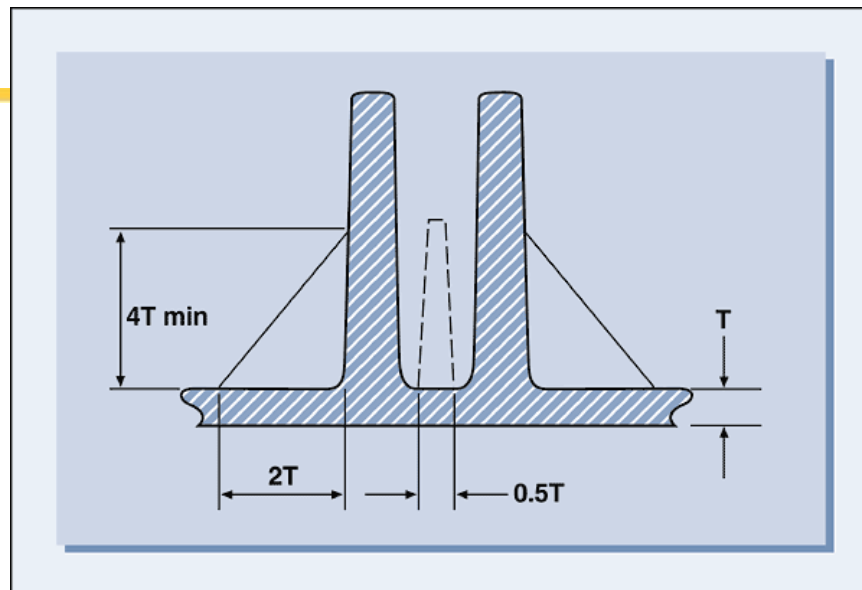
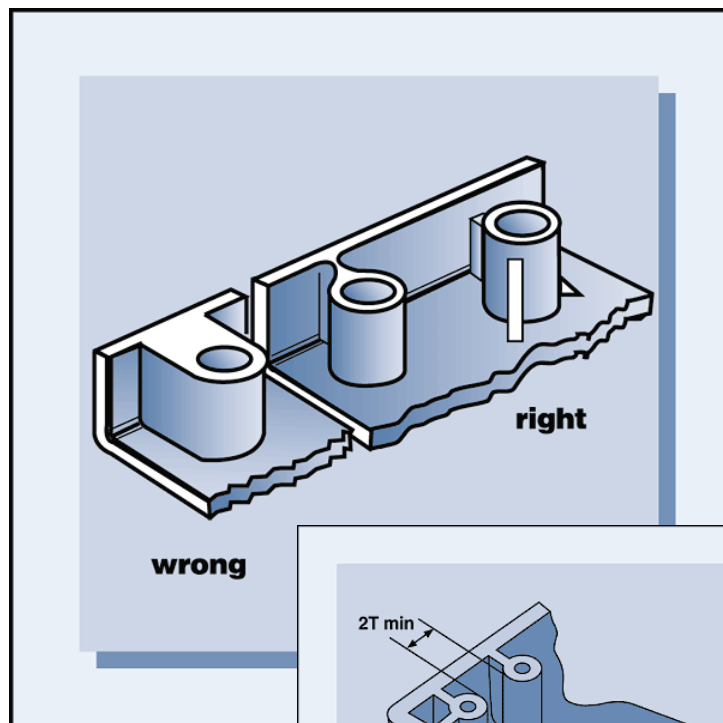


*間接散熱



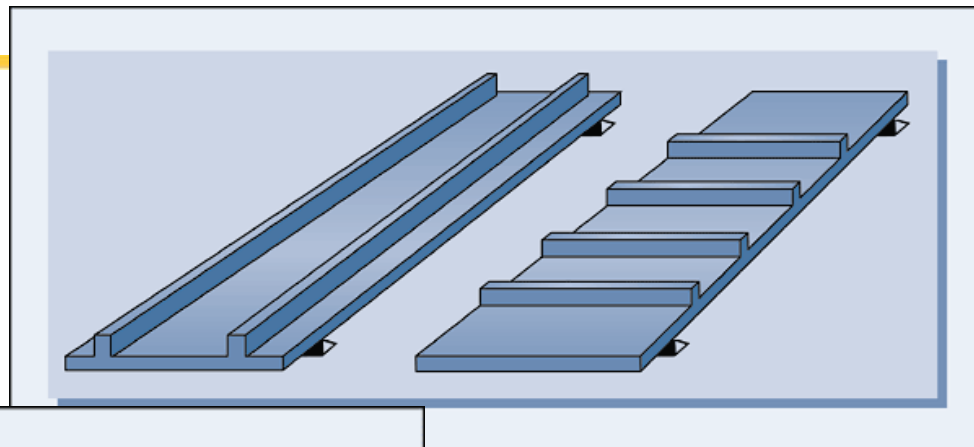
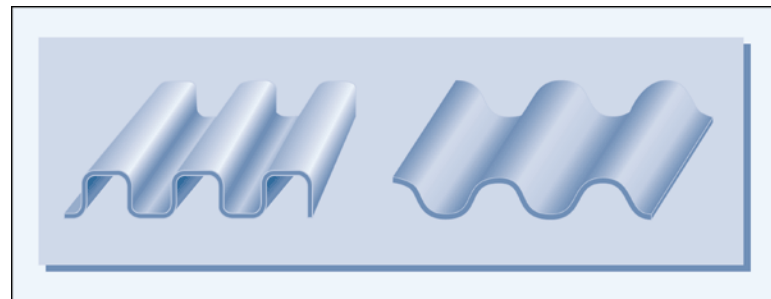
◎產品延伸至模具的設計

9.凸穀設計(組零件)



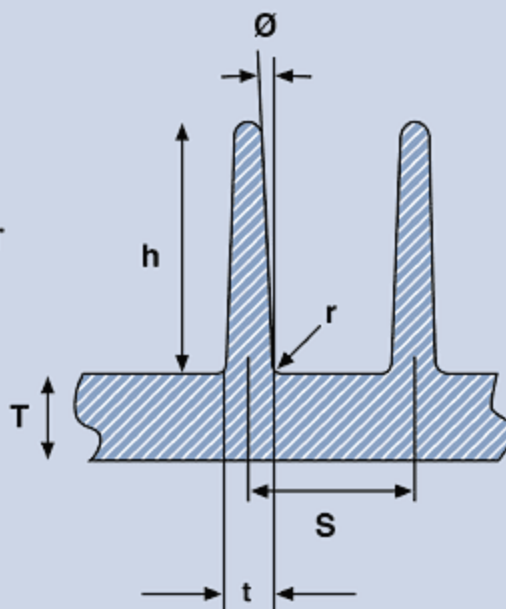
◎產品延伸至模具的設計

10.補強肋設計



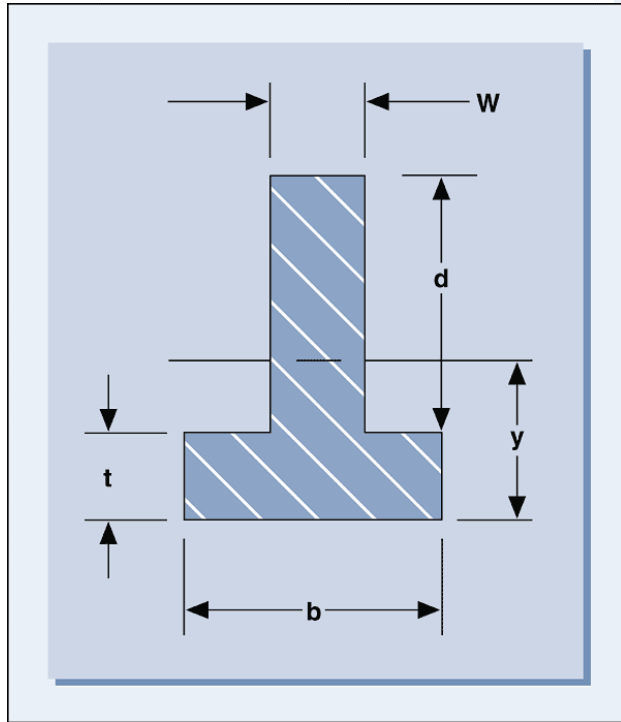
Guidelines for proportional ribs

- 1. Base thickness $t \leq 0.5 T$
- 2. Height $h \leq 3T$
- 3. Corner radius $r \geq 0.25-0.5T$
- 4. Draft angle $\phi \geq 0.5^\circ$
- 5. Spacing $S \geq 2T$



◎產品延伸至模具的設計

10.補強肋設計

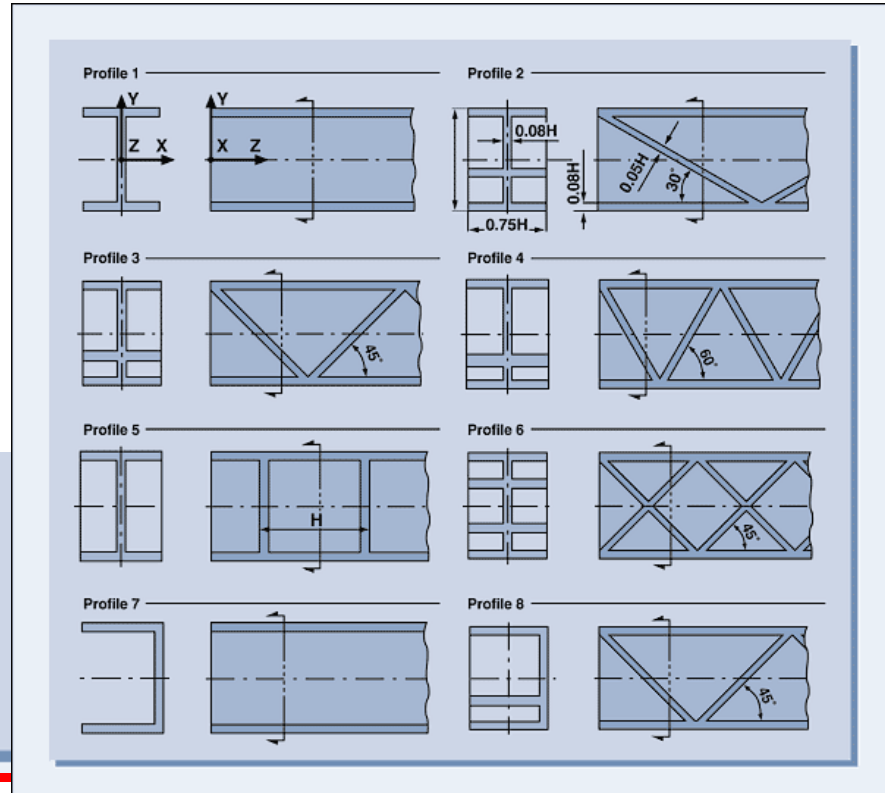


Dimension	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
b (mm)	40	40	40	40	40	40
t (mm)	4	8	4	4	4	4
d (mm)	0	0	3	6	9	12
w (mm)	0	0	2	2	2	2
Area mm ²	160	320	166	172	178	184
y (mm)	2	4	2.12	2.35	2.65	3.04
Momentum of inertia	213.3	1706.7	288.7	528.4	1018.4	1837.0
% increase stiffness	NA	700	35.3	147.7	377.4	761.1
% increase weight	NA	100	3.75	7.5	11.25	15

← 慣性矩
← 增加強度
← 增加重量

↘ 扭轉強度
↘ 水平彎曲強度
↘ 垂直彎曲強度

Profile	1	2	3	4	5	6	7	8
Torsional rigidity	1	10	17	19	1	34	1	37
Horizontal bending	1	1.1	1	1	1.1	1.1	1.9	2
Verticle bending	1	1.1	1.1	1.1	1.1	1.1	1	1

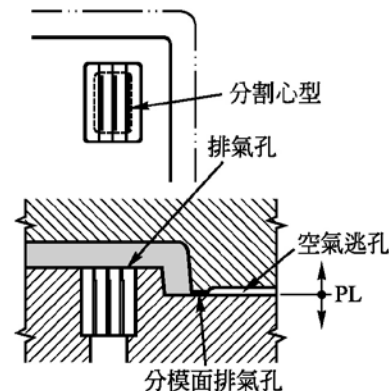
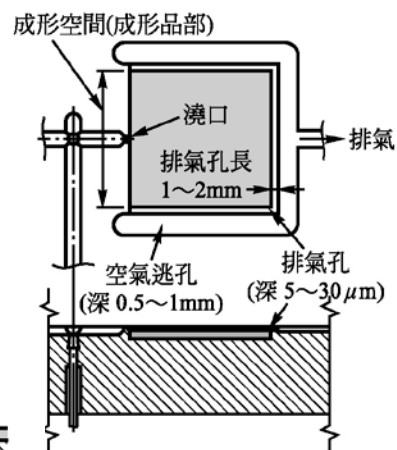
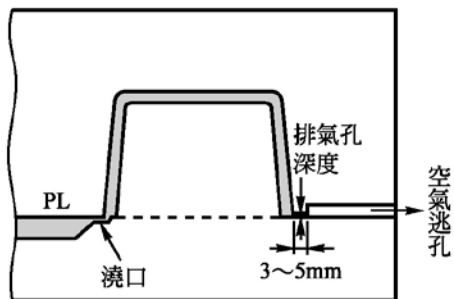


◎產品延伸至模具的設計

11. 逃氣道設計

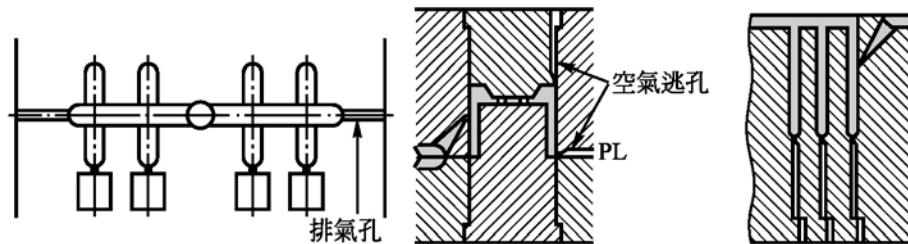
不發生毛邊的排氣孔深度

成形材料	排氣孔深度(mm)
PE	0.02
PP	0.01~0.02
PS	0.02
SB	0.03
ABS	0.03
SAN	0.03
PPO	0.03
POM	0.01~0.03
PMMA	0.03
PA	0.005~0.015
PPS	0.01~0.03
PC	0.01~0.03
PBT	0.005~0.015



(g) 大分模面之排氣孔

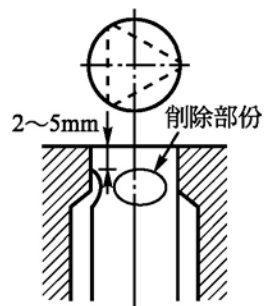
(h) 分割心型(divide core)之間加工排氣孔



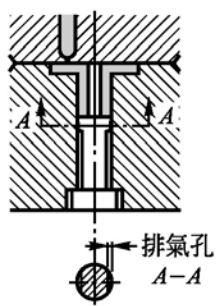
(a) 流道處之排氣孔

(b) 杯蓋類之排氣孔

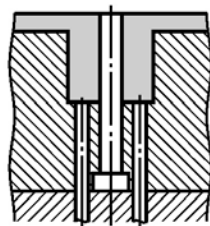
(c) 深肋處之排氣孔



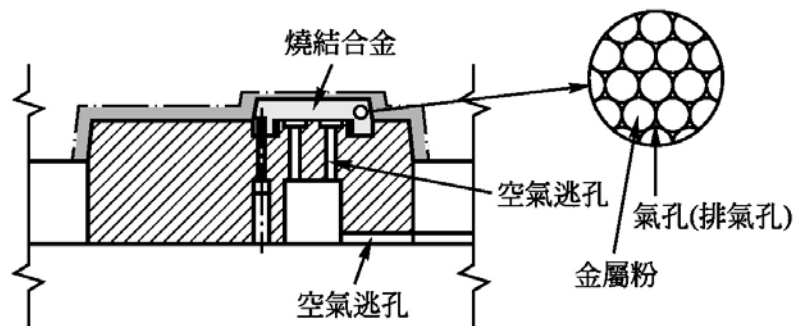
(d) 頂出銷處之排氣孔



(e) 凸軀處之排氣孔



(f) 以銷類之配合間隙當排氣孔



(i) 植入燒結合金(sinter alloy)以利排氣

◎產品延伸至模具的設計

◎鎖模力、平均成型壓力、成型品面積之間的關係：

鎖模力 > 模穴內的平均成型壓力 × 成型品在模穴內的投影面積

◎鎖模力的計算：

$$F = P * A * (\text{安全係數})$$

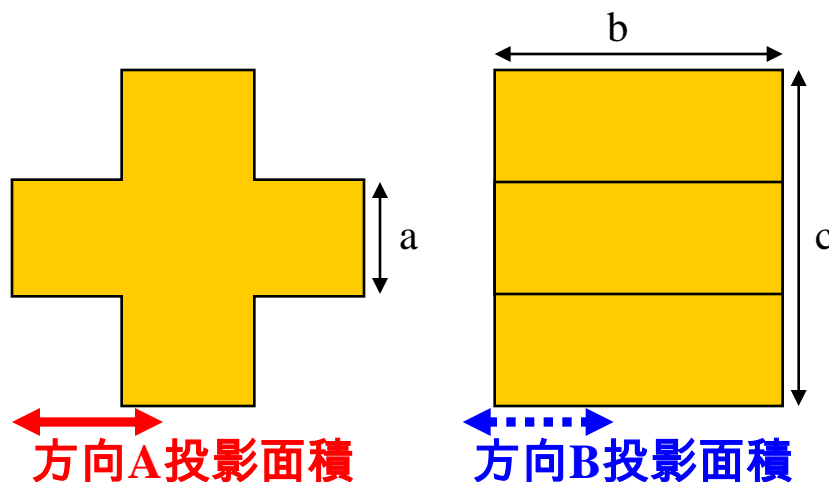
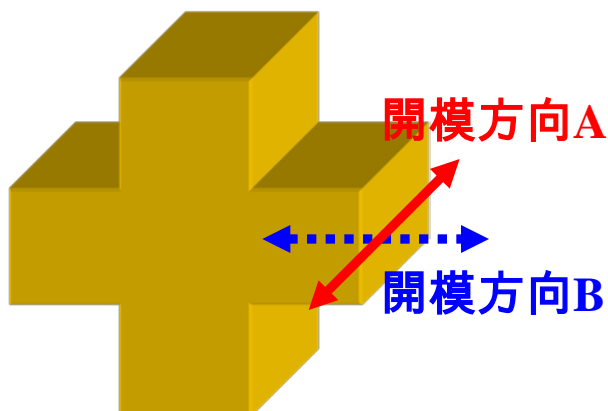
F (Ton)：鎖模力

P (kg/cm²)：平均成型壓力

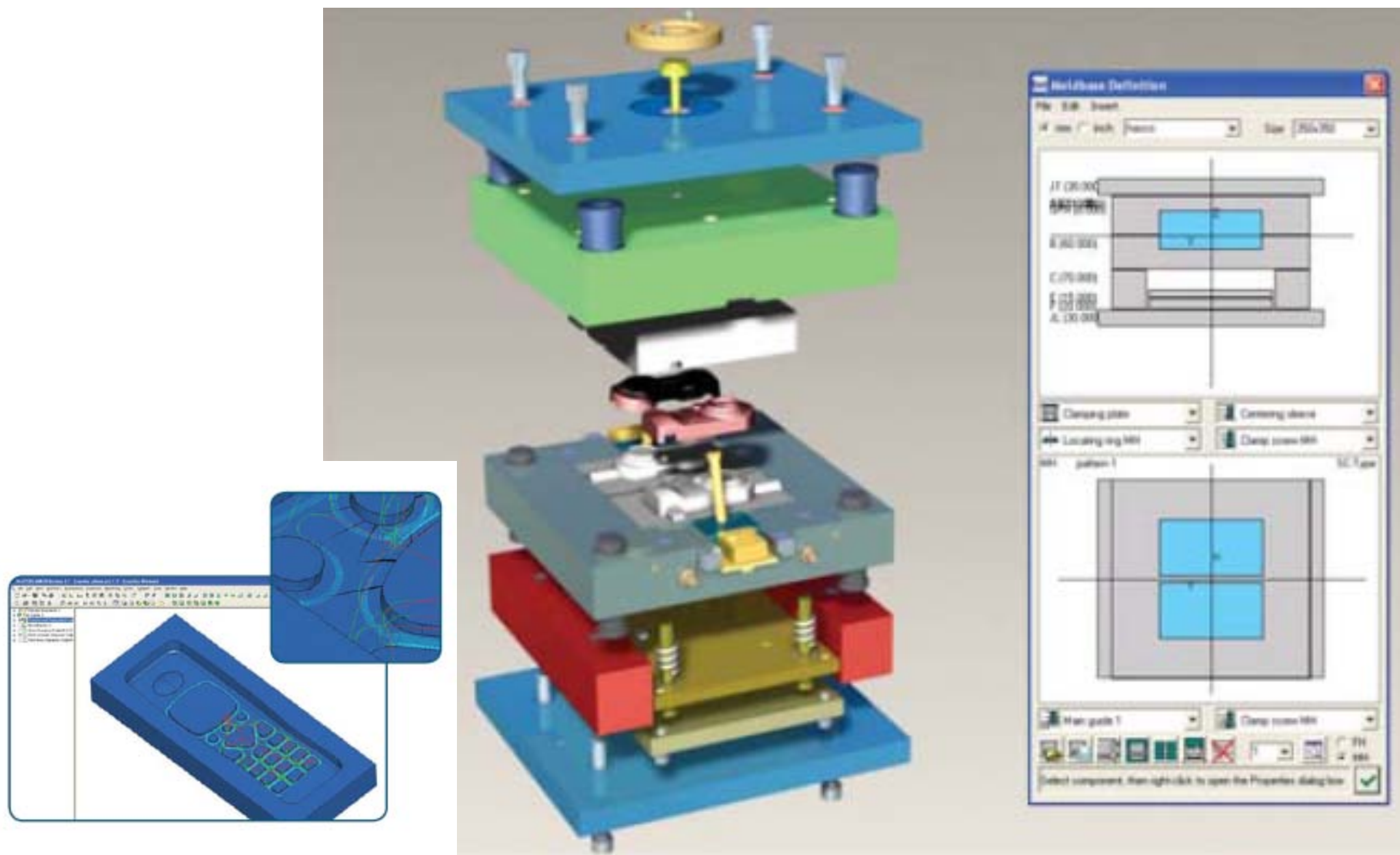
A (cm²)：成型品的投影面積

安全係數：1+@ (@=0.1~1.0)

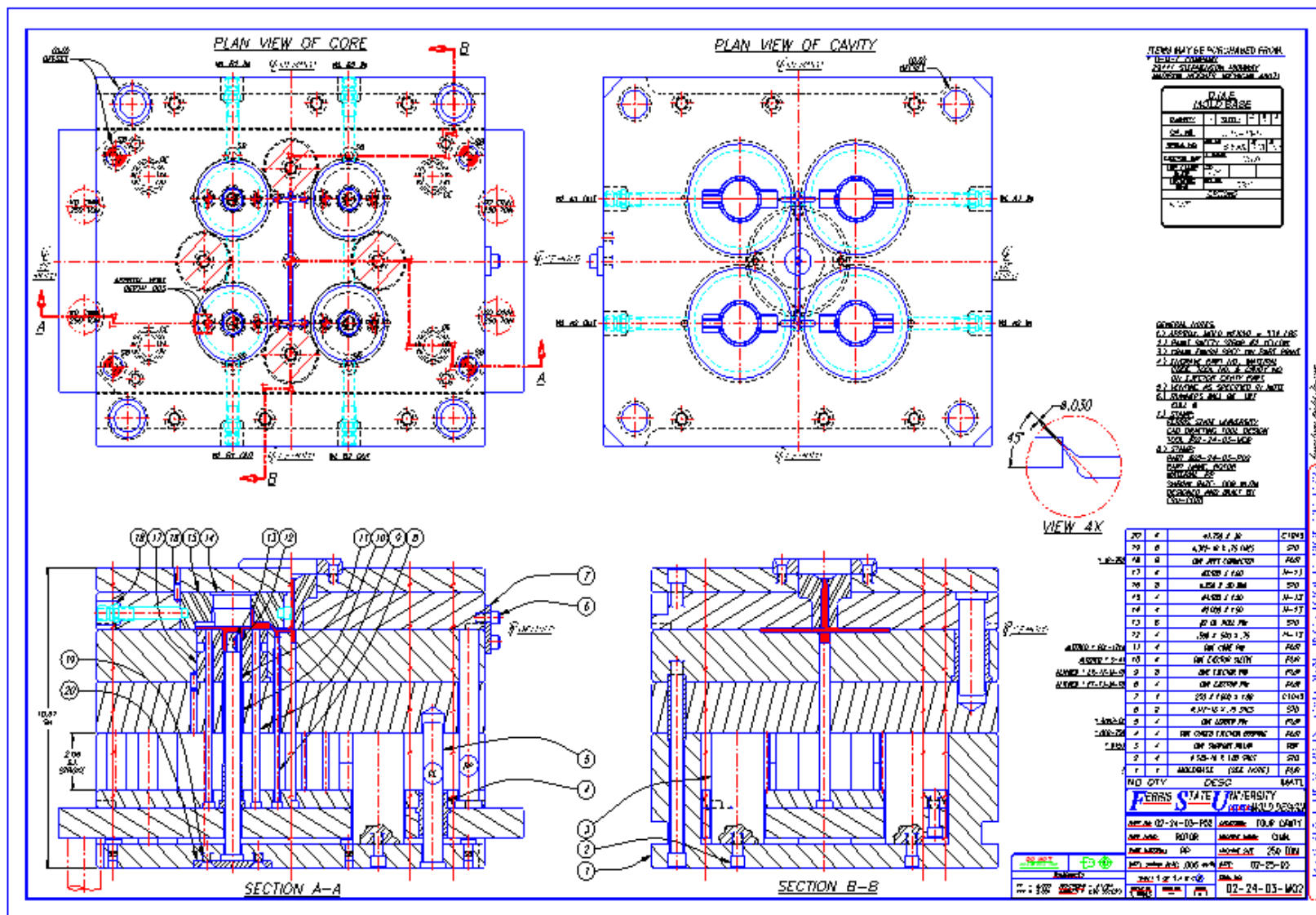
成形材料	P_m (kg/cm ²)
PS、PP、PE	250~300
ABS、SAN、PA、POM	300~400
PC、PMMA、PPO、PVC	400~600



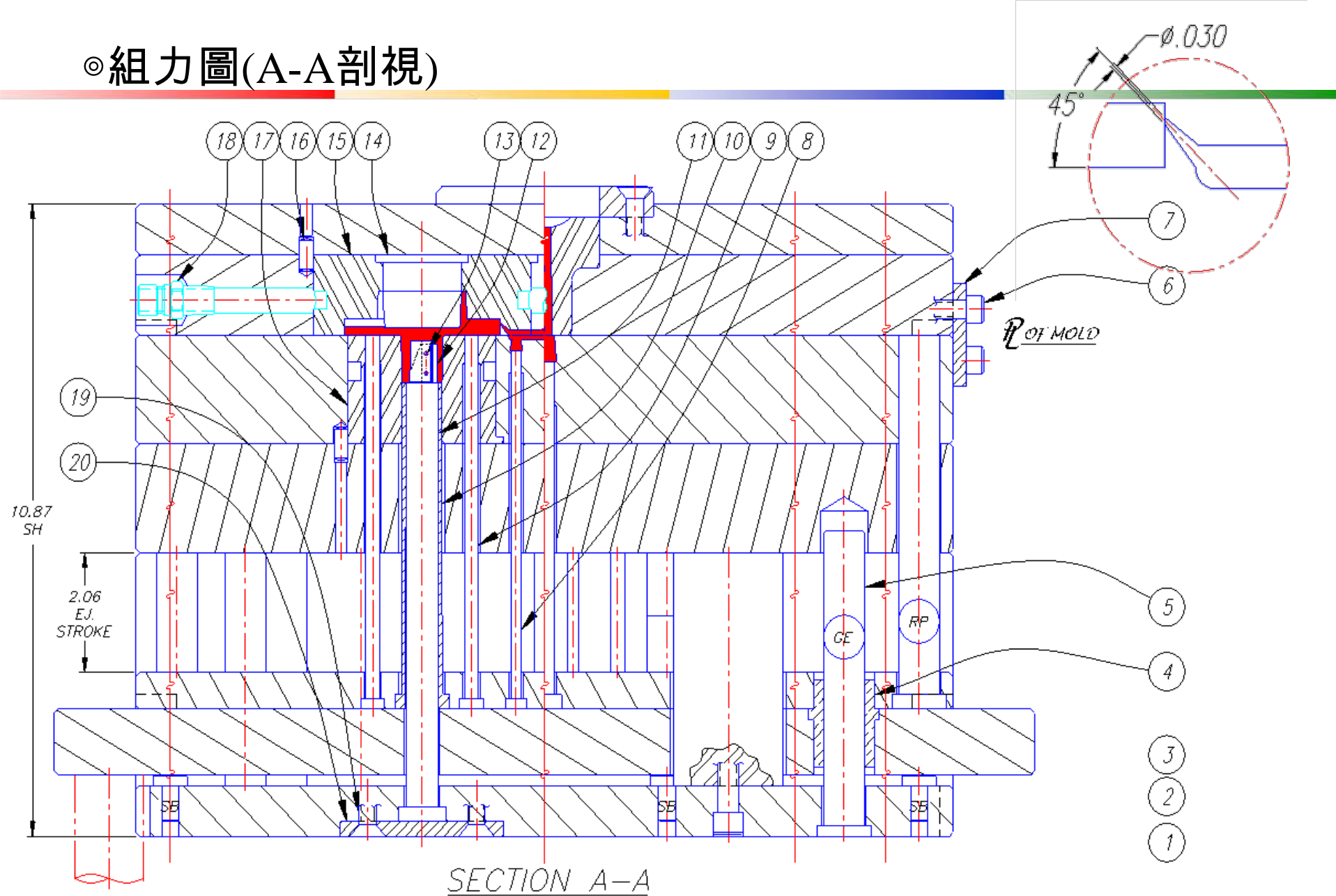
◎ 模具圖(3D)



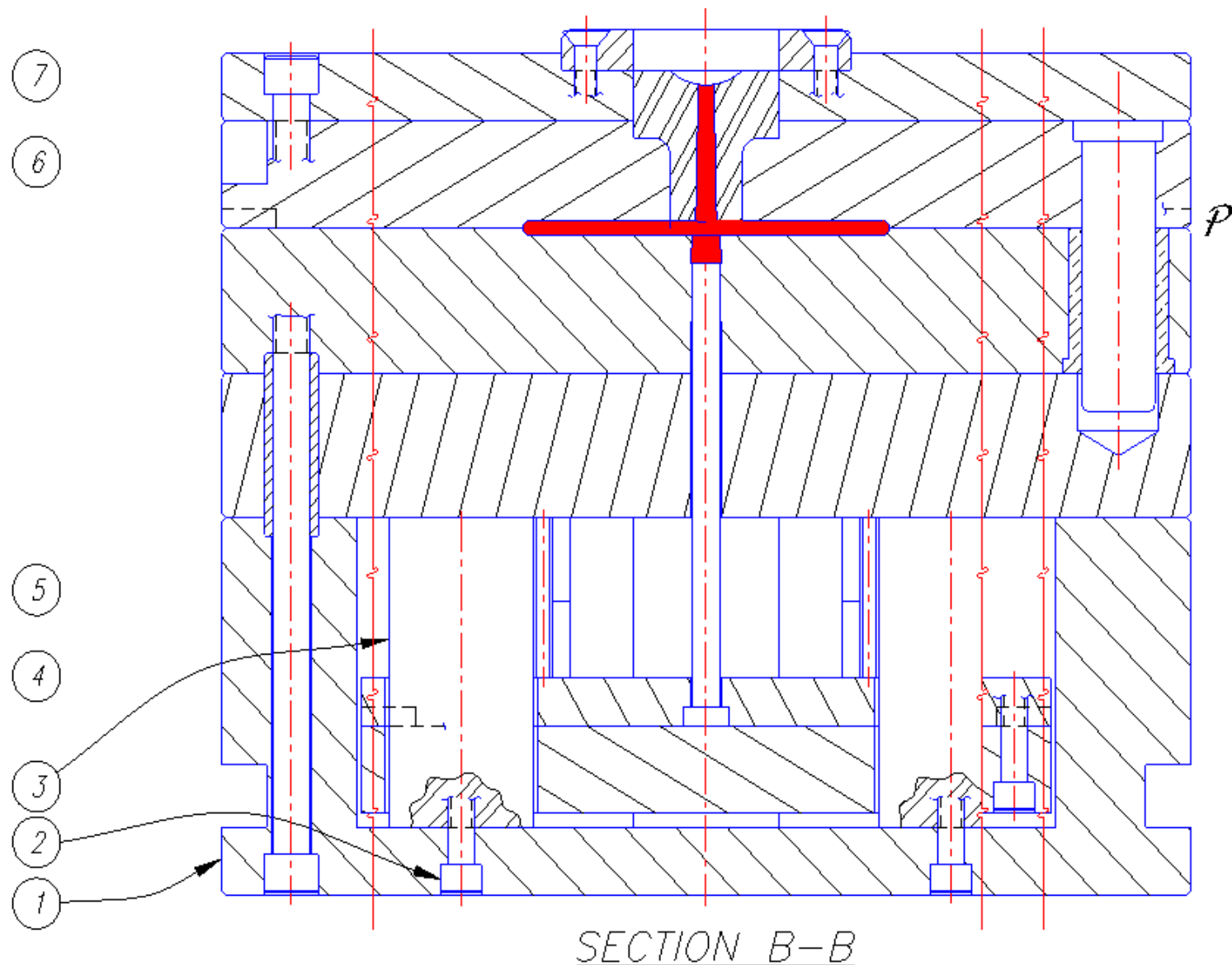
◎ 模具圖(2D)



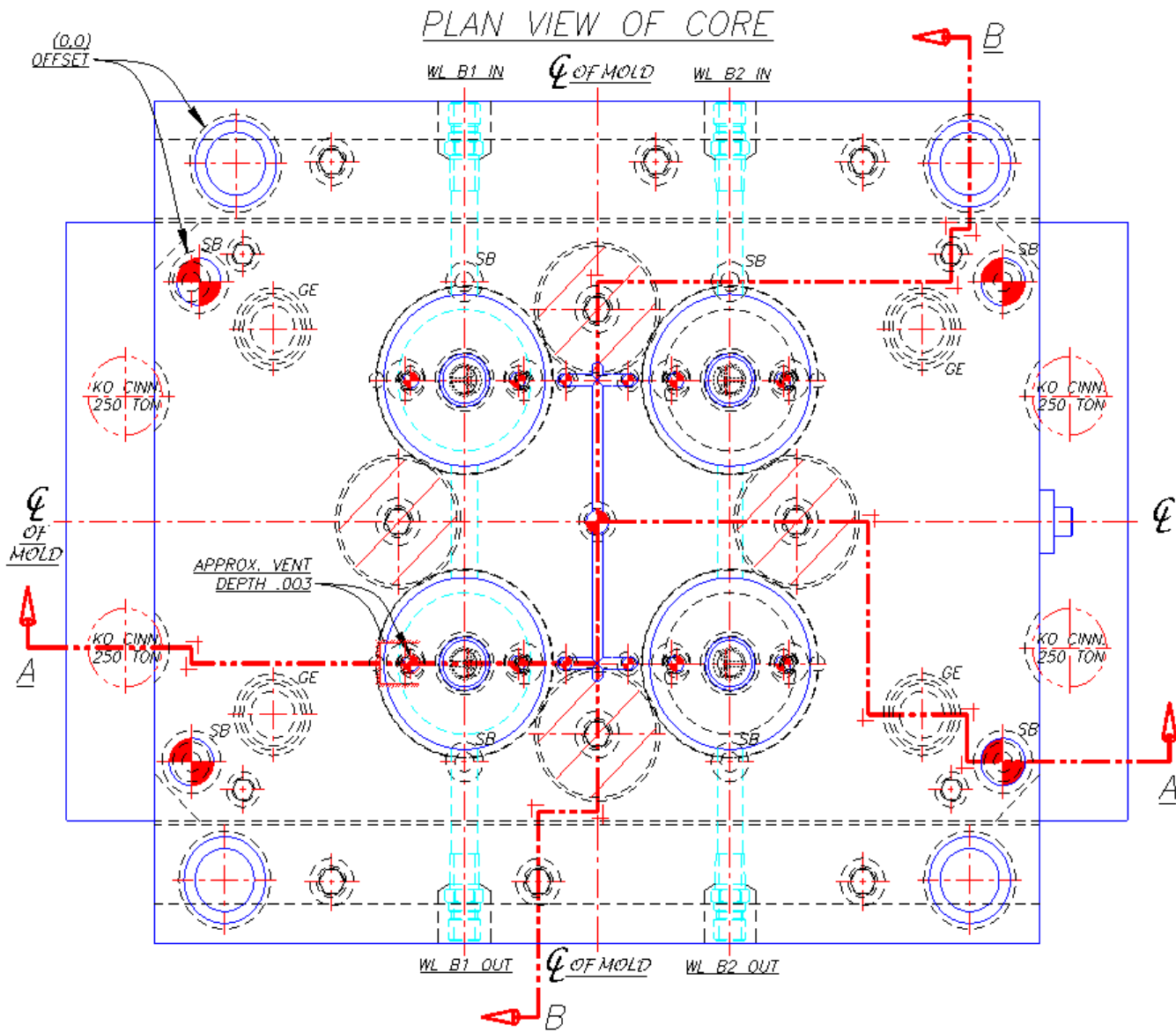
◎組力圖(A-A剖視)



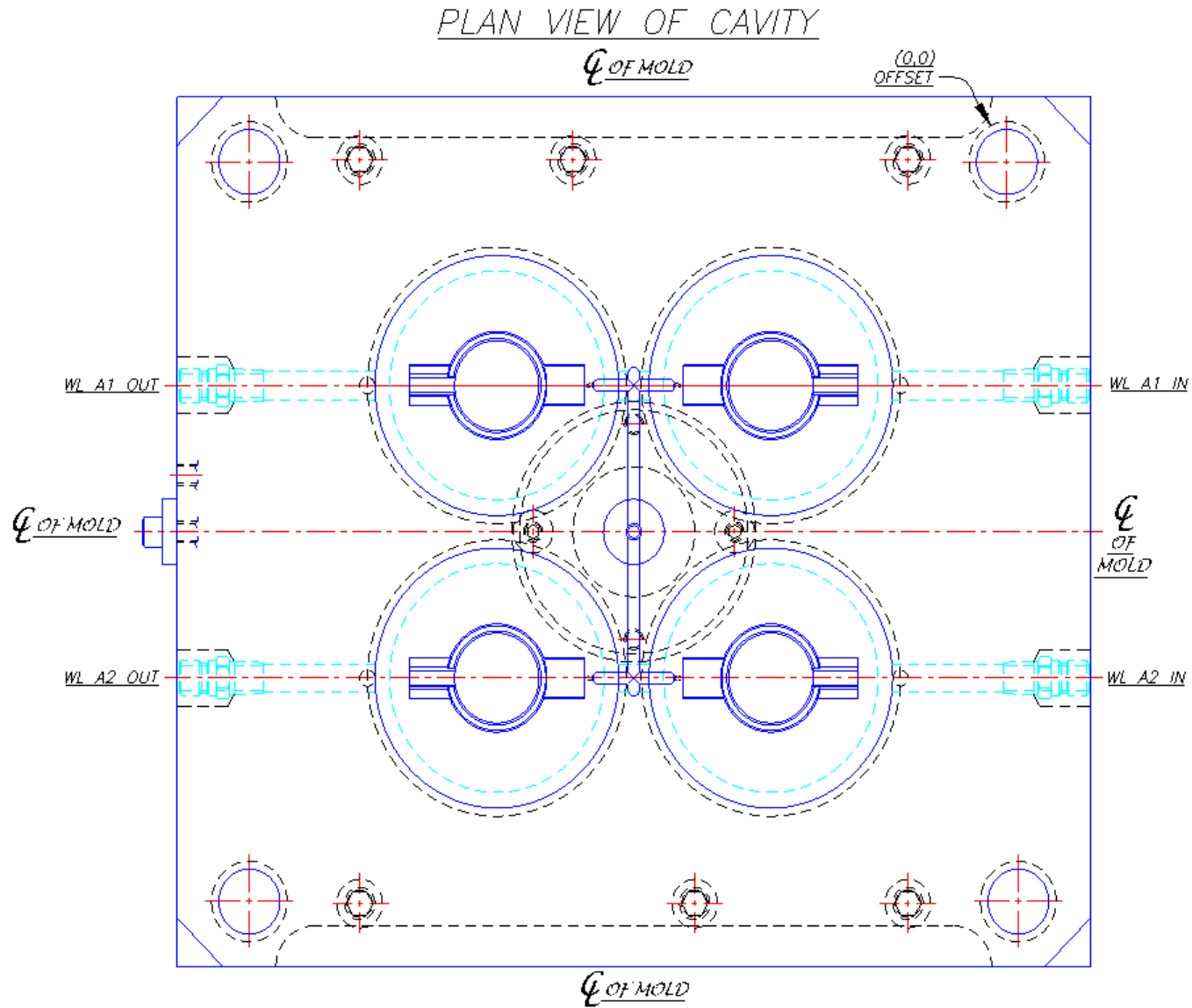
◎組力圖(B-B剖視)



◎公模面



◎ 母模面

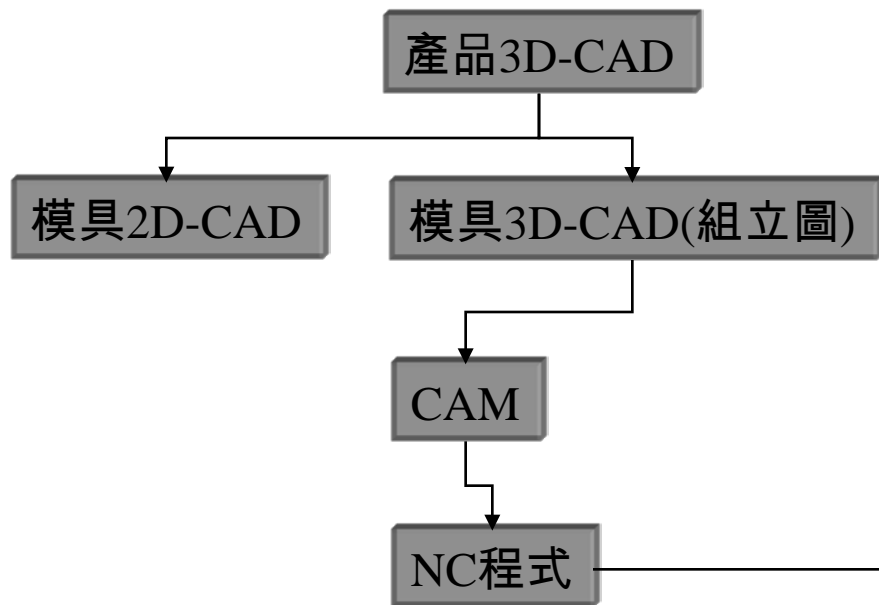


◎BOM 表

	20	4	∅1.750 X .38	C1045
	19	8	∅.312-18 X .75 FHCS	STD
<u>* JP-352</u>	18	8	DME JIFFY CONNECTER	PUR
	17	4	∅3.500 X 2.00	H-13
	16	8	∅.250 X .50 DWL	STD
	15	4	∅4.500 X 1.50	H-13
	14	4	∅2.000 X 1.50	H-13
	13	8	#2 GA. ROLL PIN	STD
	12	4	.500 X .500 X .75	H-13
<u>ALTERED * PCL-1714</u>	11	4	DME CORE PIN	PUR
<u>ALTERED * S-41</u>	10	4	DME EJECTOR SLEEVE	PUR
<u>ALTERED * EX-17-M-10</u>	9	8	DME EJECTOR PIN	PUR
<u>ALTERED * EX-13-M-10</u>	8	4	DME EJECTOR PIN	PUR
	7	1	.250 X 1.000 X 1.88	C1045
	6	2	∅.312-18 X .75 SHCS	STD
<u>* 5007-GL</u>	5	4	DME LEADER PIN	PUR
<u>* GEB-750</u>	4	4	DME GUIDED EJECTION BUSHING	PUR
<u>* 6153</u>	3	4	DME SUPPORT PILLAR	PUR
	2	4	∅.375-16 X 1.00 SHCS	STD
<u>*</u>	1	1	MOLDBASE (SEE NOTE)	PUR
	NO	QTY	DESC	MATL

◎ 模具加工

-CNC

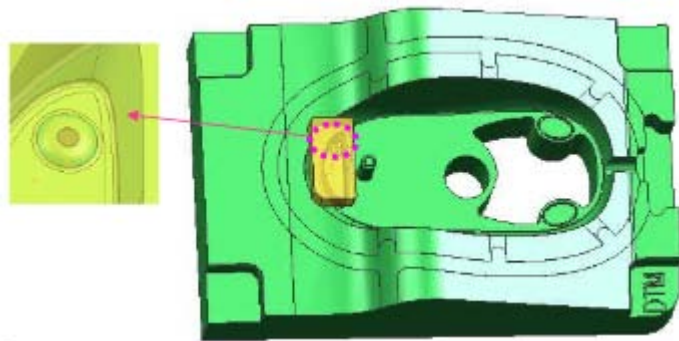


CNC



◎ 模具加工

- 放電加工



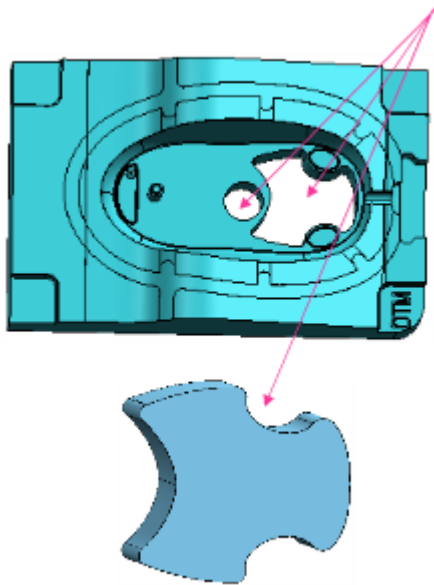
* 針對尺寸較小或尖角的模仁結構，無法銑床加工的幾何形狀

放電機

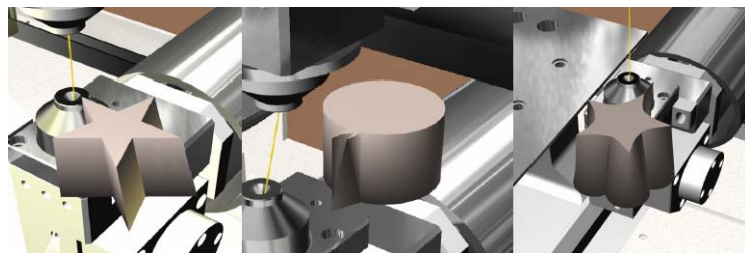
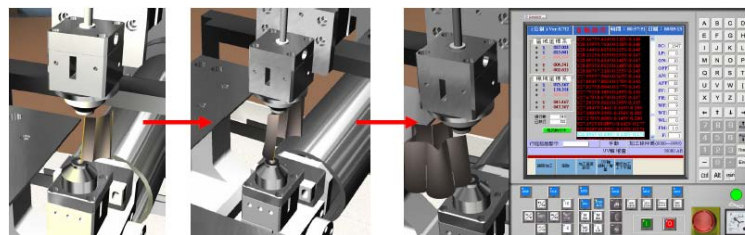


◎ 模具加工

- 線切割



* 針對模仁上通孔的加工及模仁上有異形入子



資料來源：虛擬線切割模擬系統之研發~高永洲 1、鄭新有 2、趙嘉忠 3

◎ 模具加工

-其他



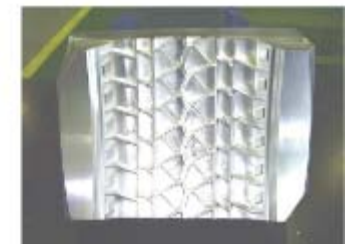
深孔加工(槍鑽)



● 汎用型 1200

資料來源：刀具~台灣鈷領股份有限公司、機器~聖宏機械廠

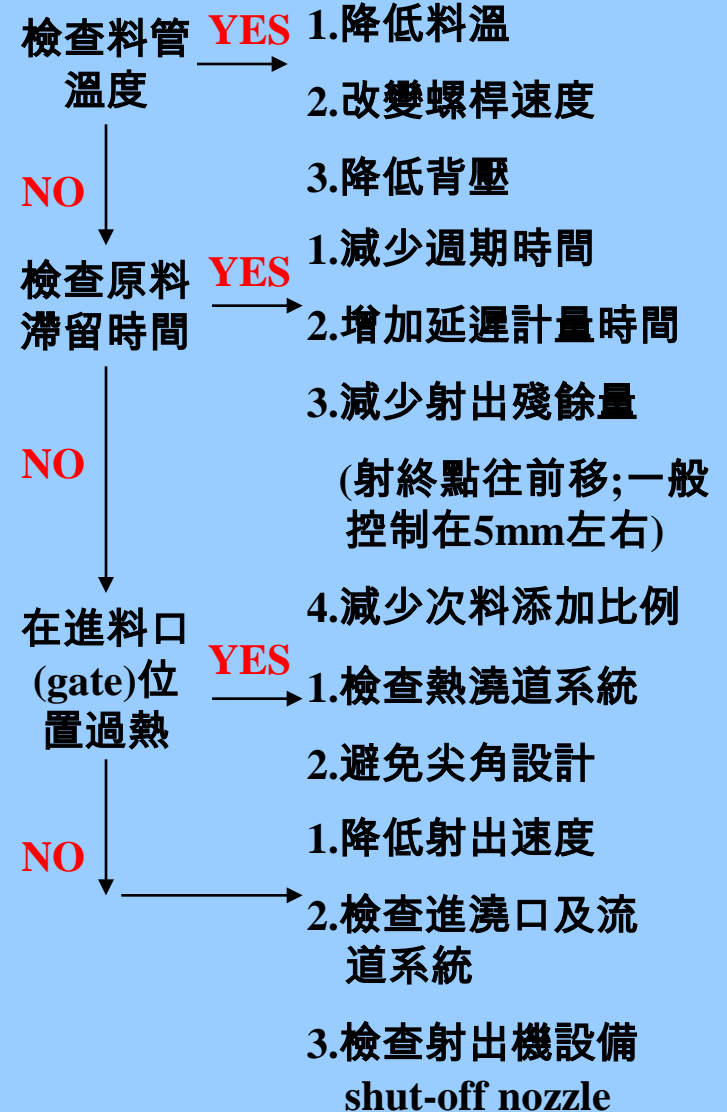
-  鑽頭(Twist Drills)
-  深孔鑽(Gun Drills)
-  絲攻(Taps)
-  銑刀(Milling Cutters)
-  鉸刀(Reamers)
-  倒角刀
(Countersinks)
-  鑽石CBN刀具
(PCD and CBN
Tools)
-  模組化刀具系統
(Modular Tooling
Systems)



資料來源：MAKINO.JP

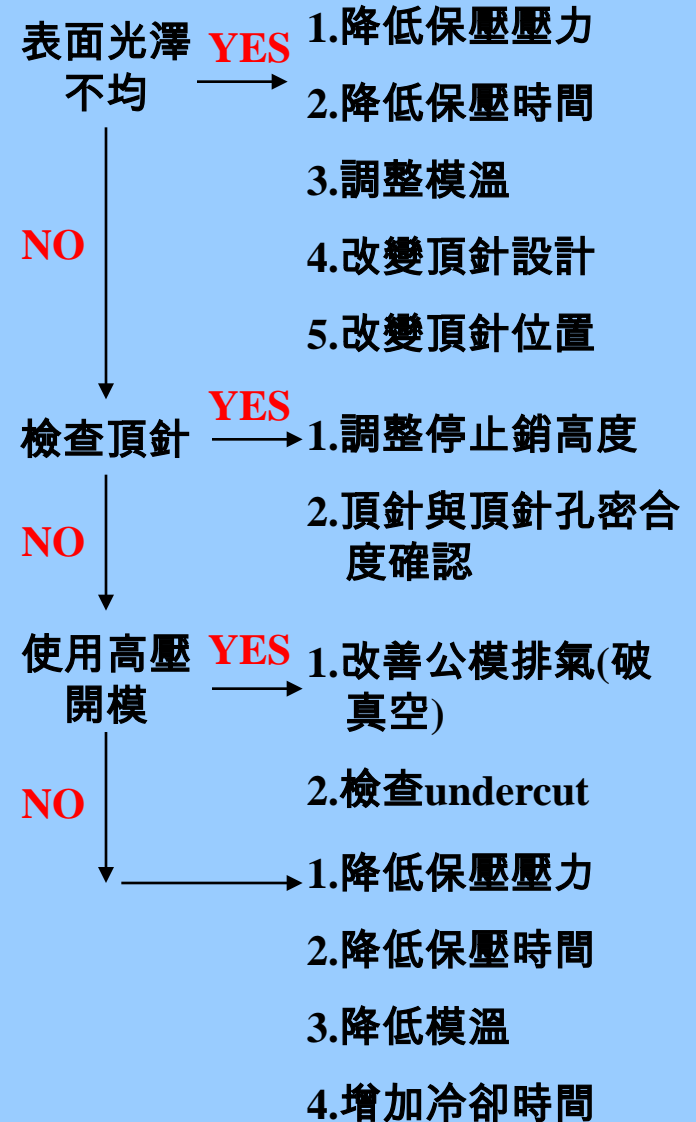
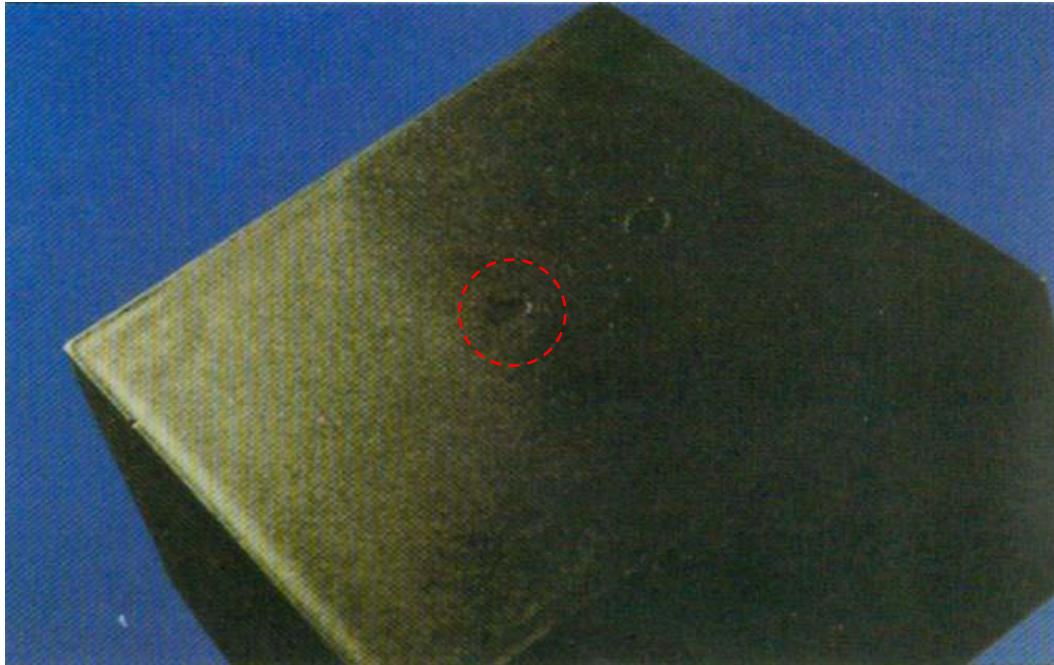
◎射出問題點&改善流程

Burnt Streaks(過熱變色;過火)



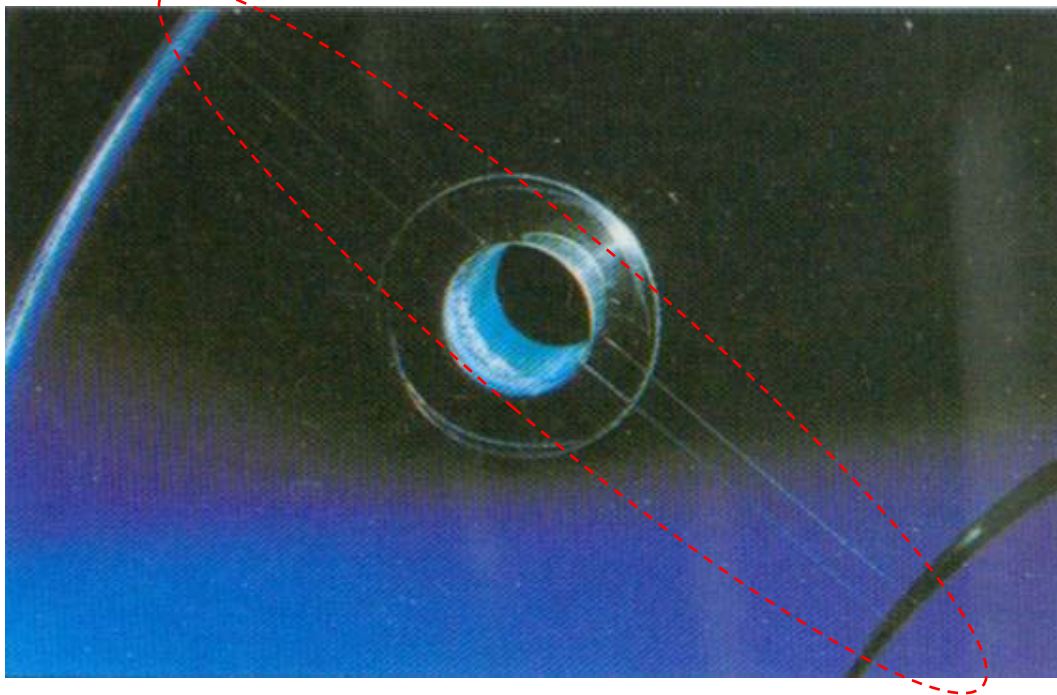
◎射出問題點&改善流程

Ejector Marks(頂出痕)



◎射出問題點&改善流程

Weld Line(結合線;縫合線)

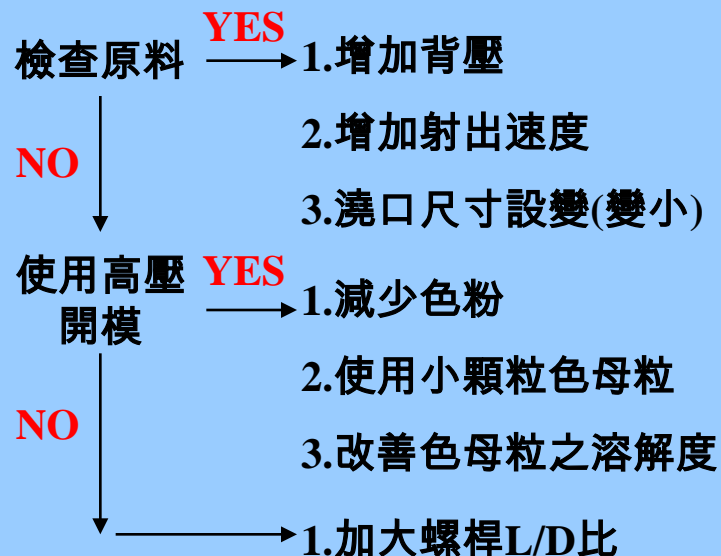


在接合線處有色差 **YES** → 1.改善色母粒或添加劑成份

NO ↓
→ 1.增加模溫
2.增加料溫
3.增加保壓
4.檢查或增加排氣
5.改變澆口設計

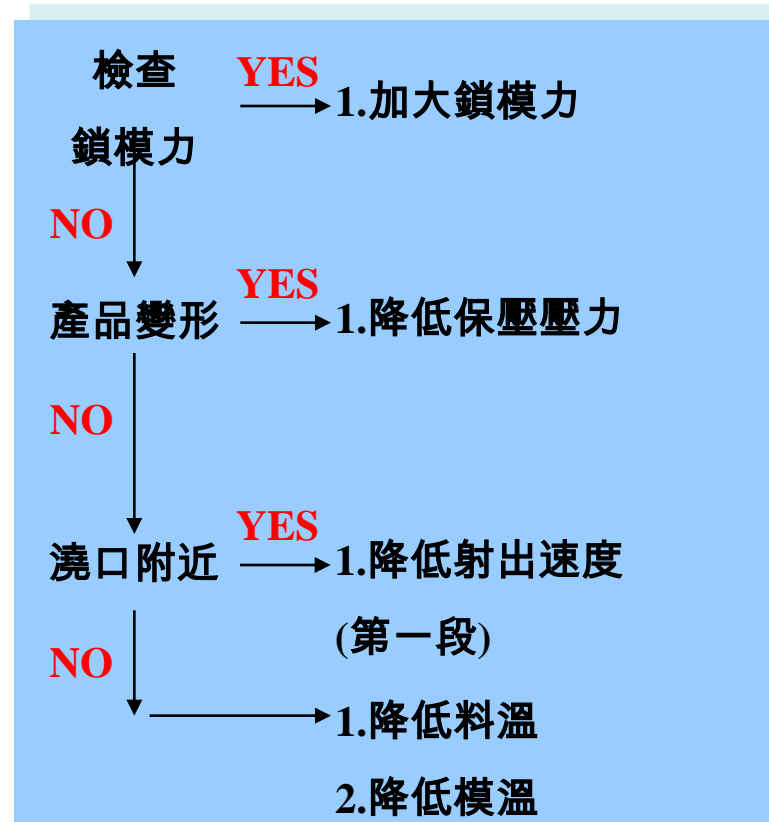
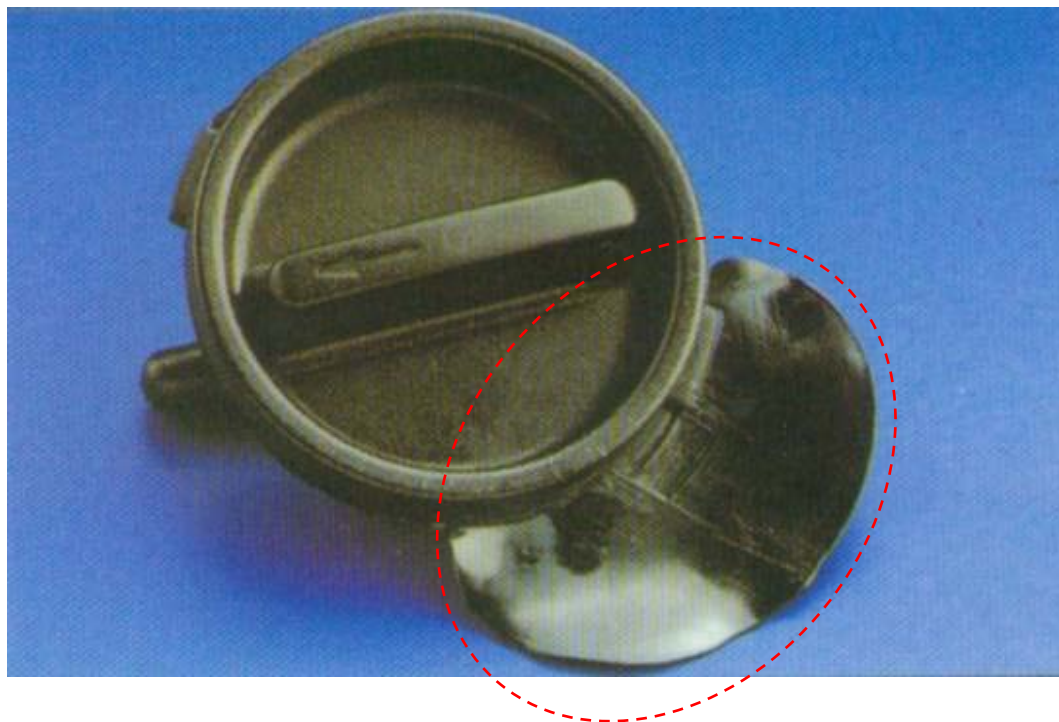
◎射出問題點&改善流程

Color Streaks(顏色不均)



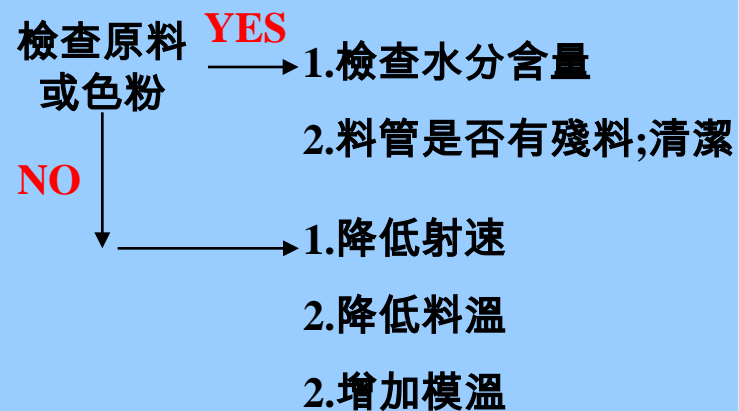
◎射出問題點&改善流程

Oversprayed Parts(毛邊)



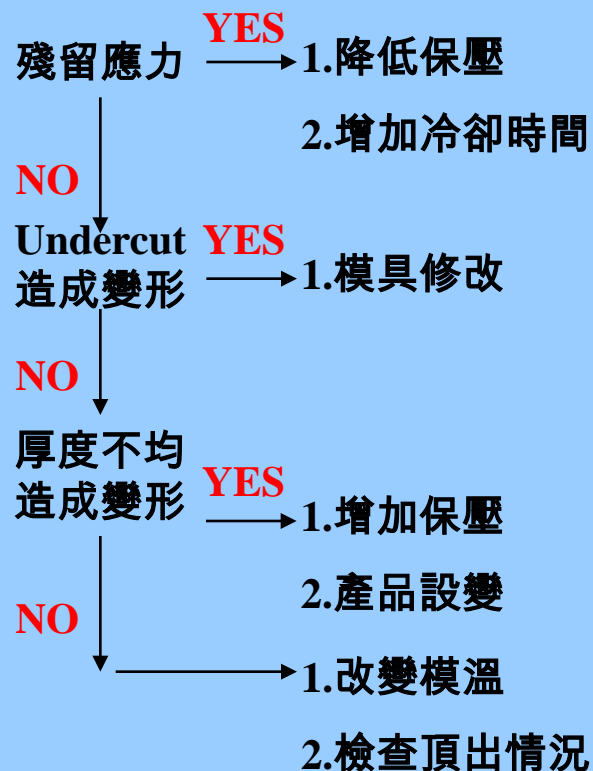
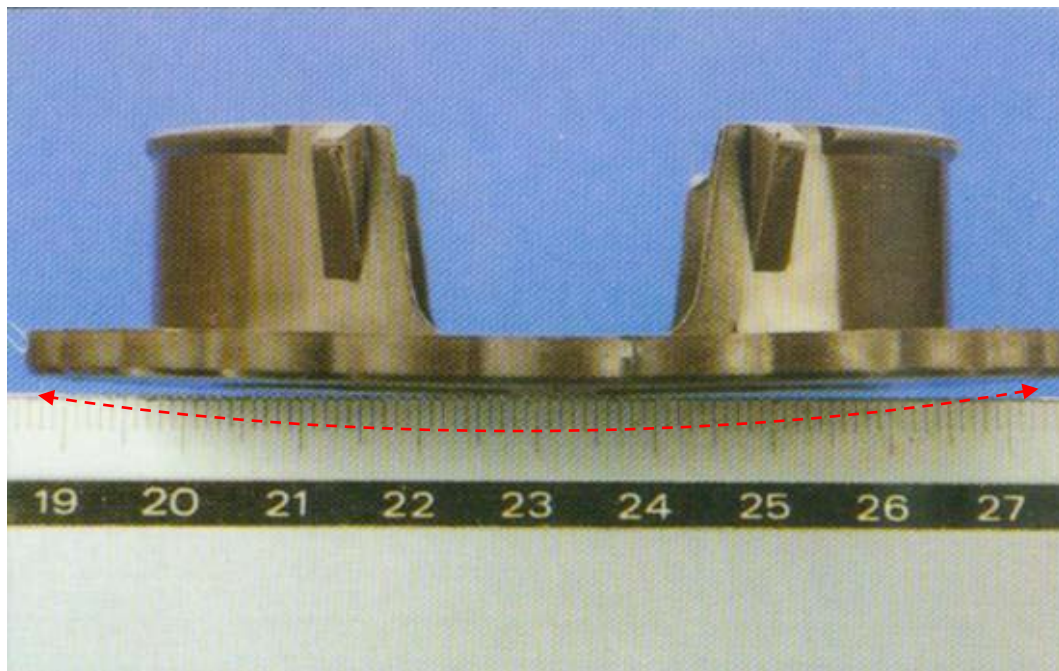
◎射出問題點&改善流程

Flaking Of Surface Layer(表面薄片;剝離)



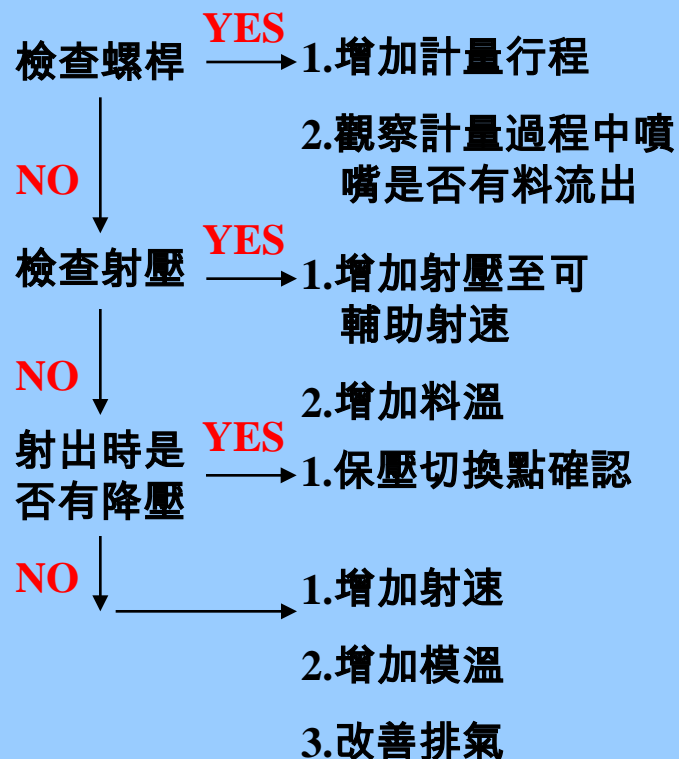
◎射出問題點&改善流程

Warp(變形;翹曲)



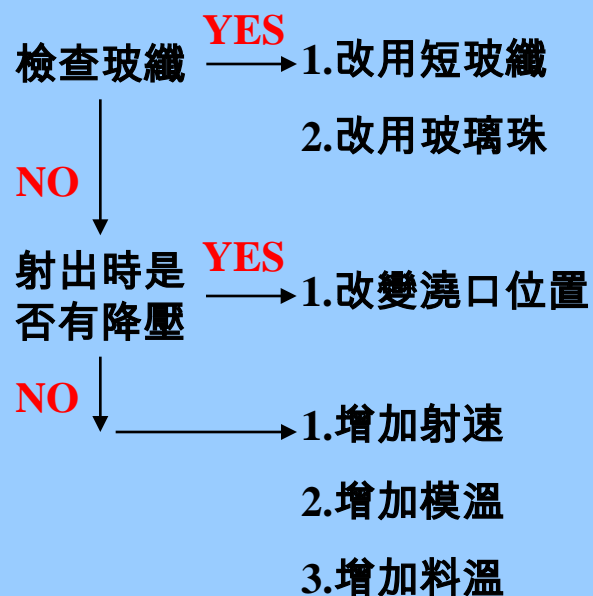
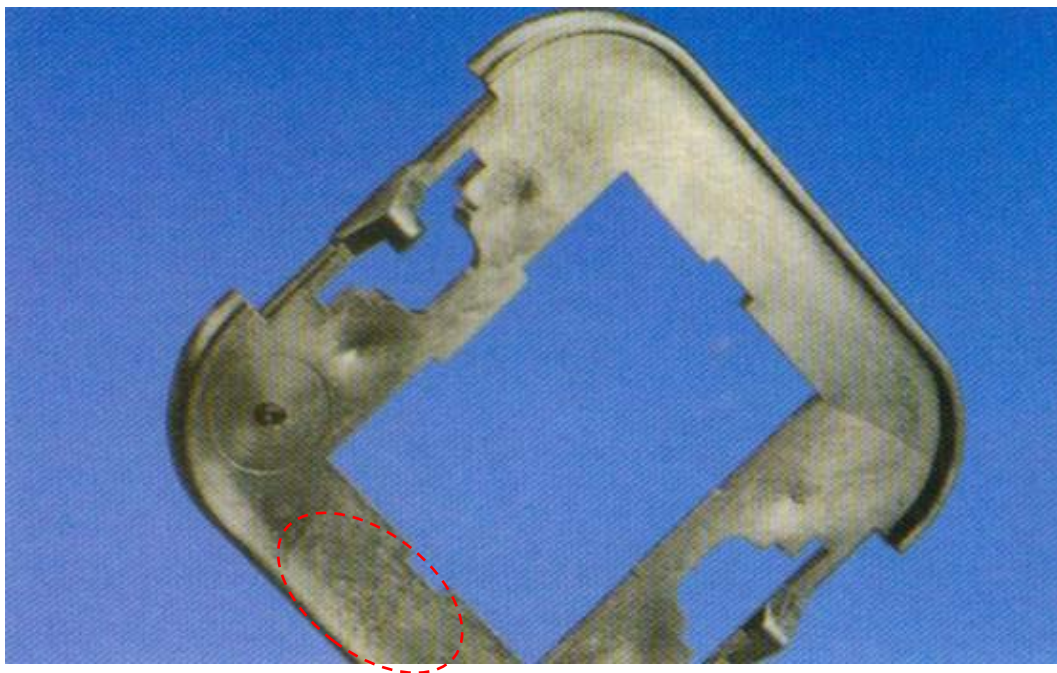
◎射出問題點&改善流程

Short Shot(短射)



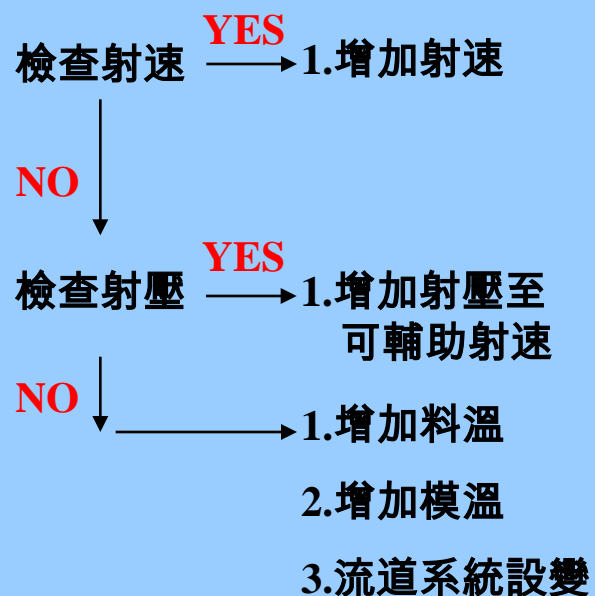
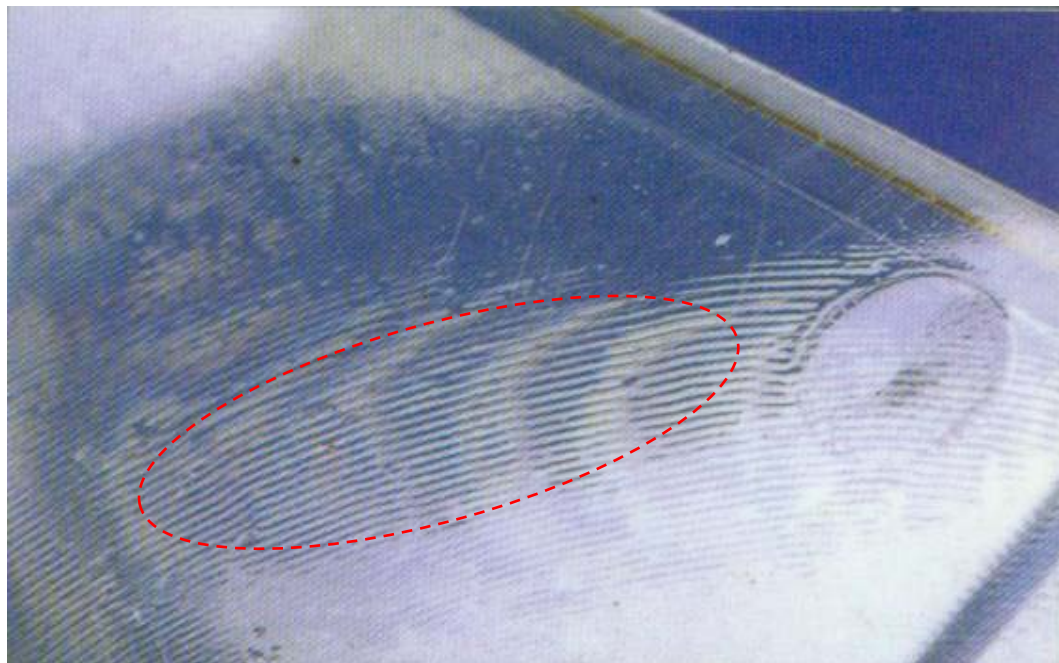
◎射出問題點&改善流程

Glass Fiber Streaks(浮纖)



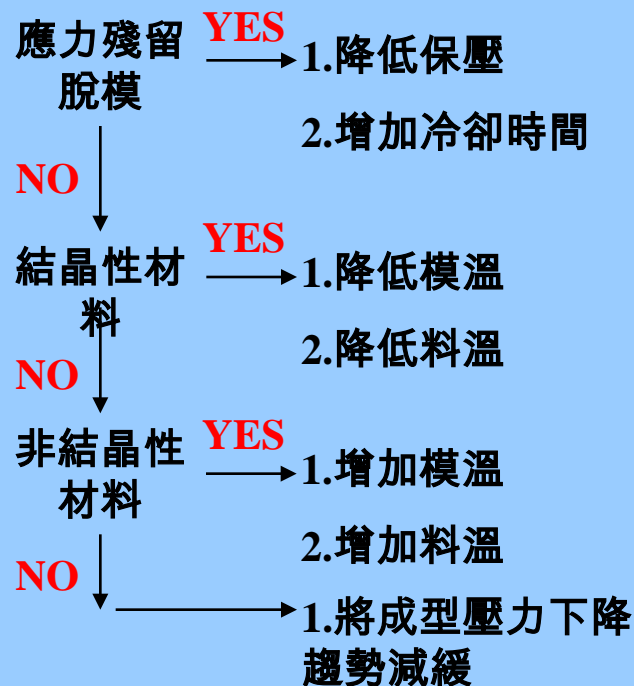
◎射出問題點&改善流程

Record Grooves effect(水波紋)



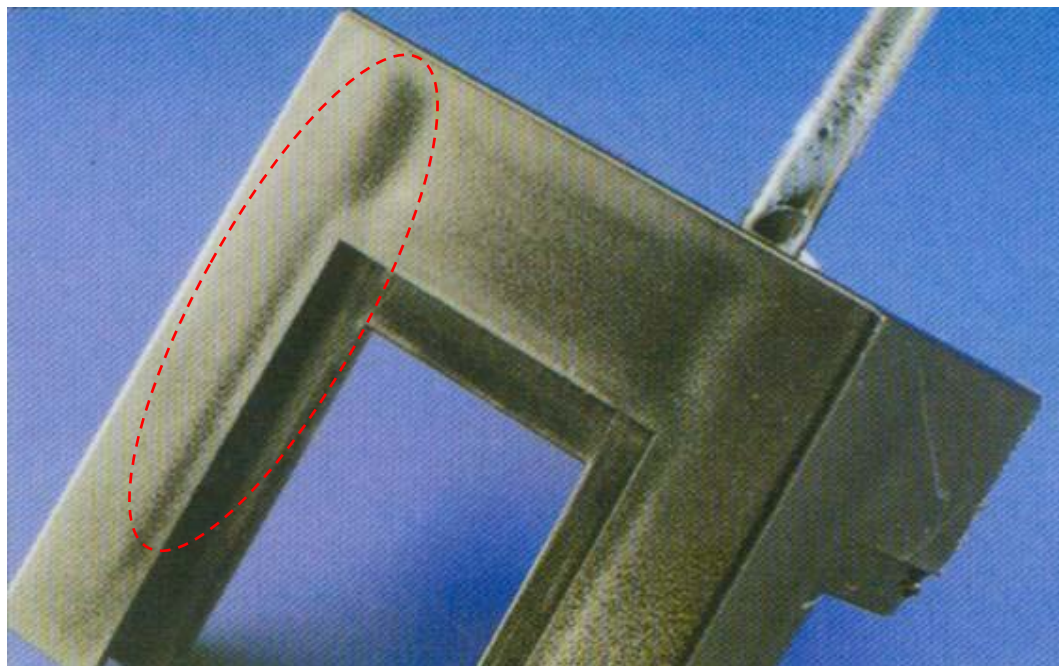
◎射出問題點&改善流程

Stress-Whitening(應力痕;龜裂)



◎射出問題點&改善流程

Sink Marks(縮水)

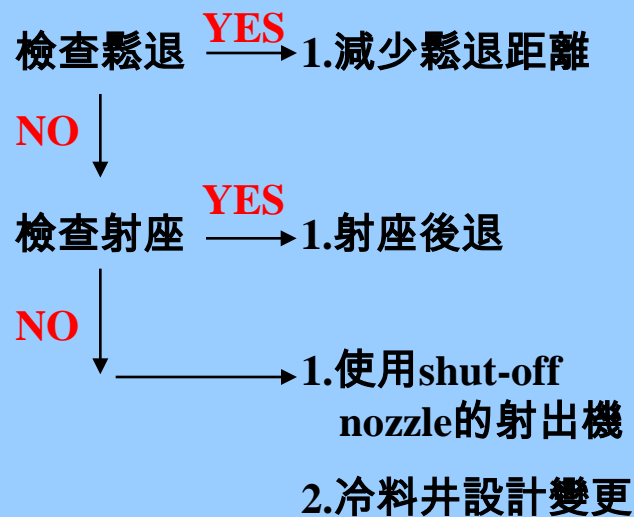
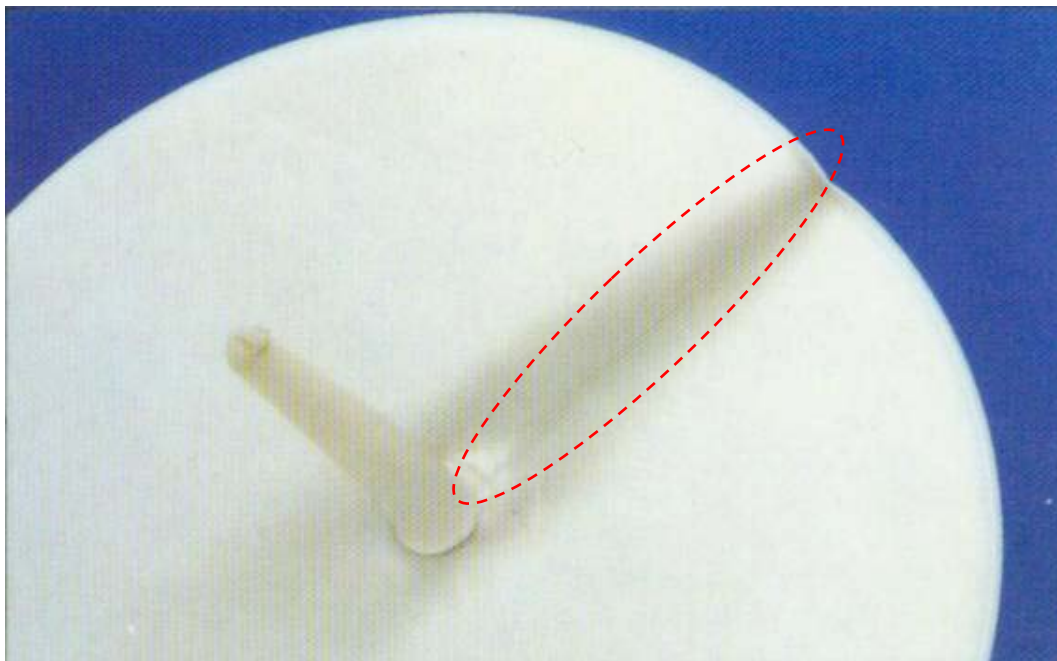


*提升表面凝固層厚度



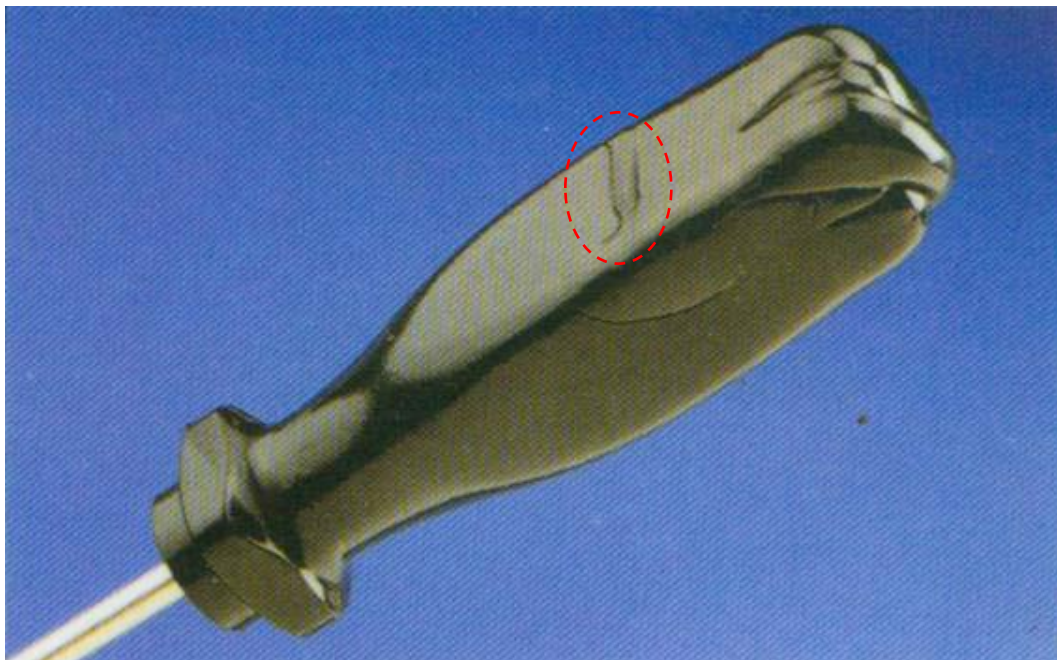
◎射出問題點&改善流程

Cold Slug(冷料流痕)



◎射出問題點&改善流程

Jetting(噴射痕;噴流痕)



檢查射速 **YES** → 1.降低射出速度

NO ↓

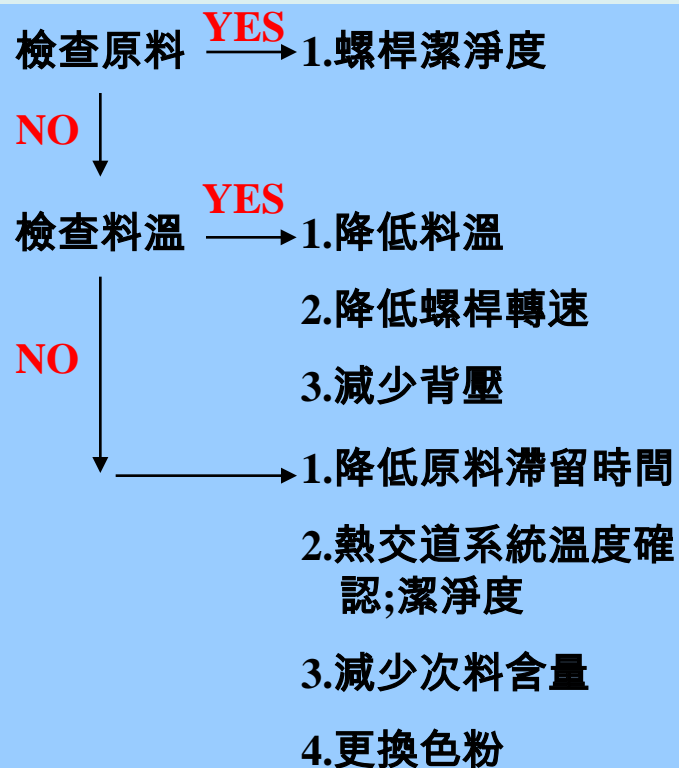
改變料溫 **YES** → 1.降低料溫

NO ↓

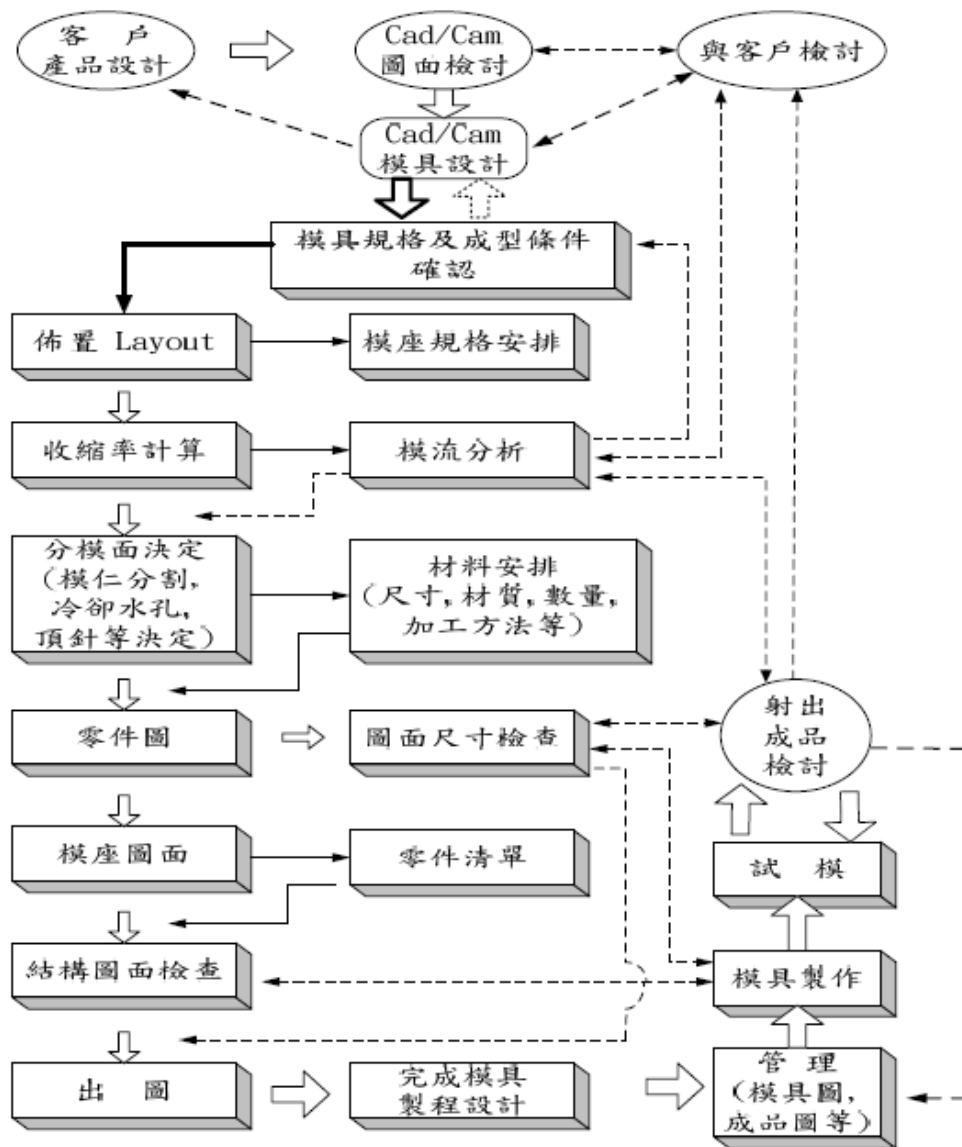
→ 1.澆口設計變更(位置、尺寸)

◎射出問題點&改善流程

Dark Spots(黑點)



◎ 模具開發流程





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