



## Design and manufacturing of plastic injection mould

### 08 – Runner system

1

## Content

- Identification of injection location
- Cold sprue
- Runner system
- Type of gates
- Hot drop
- Hot runner

2

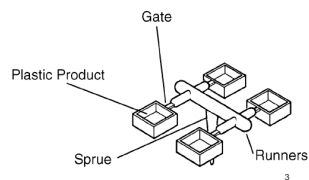
## Aim of injection system

- Drive the melted plastic to the cavities



### Parts

- Sprue
- Runners
- Gate



3

## Type of injection system

- Cold injection system
- Hot injection system (heated)
- Combined system

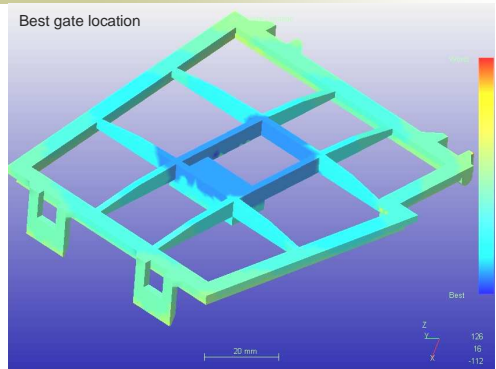
4

## Identify the gate location

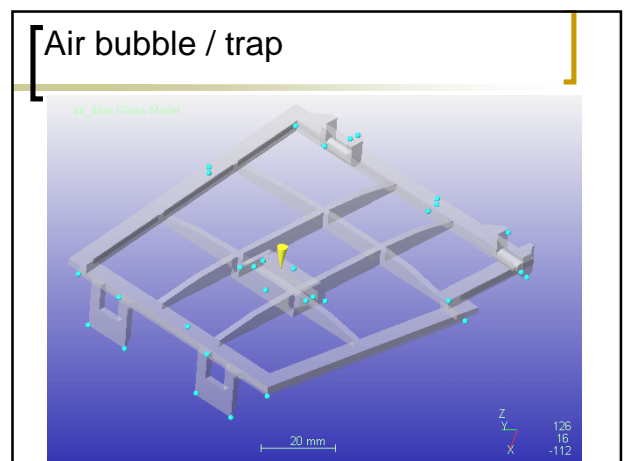
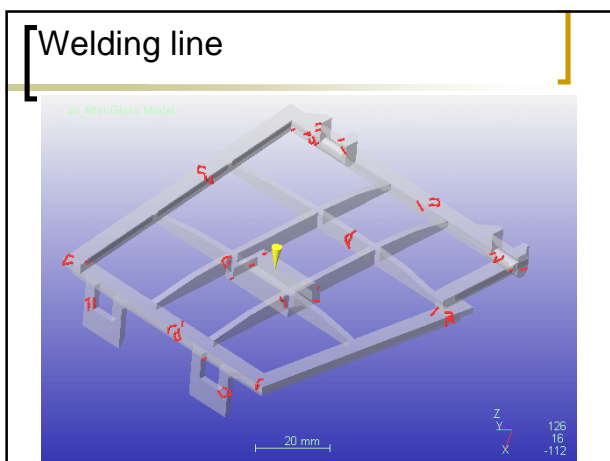
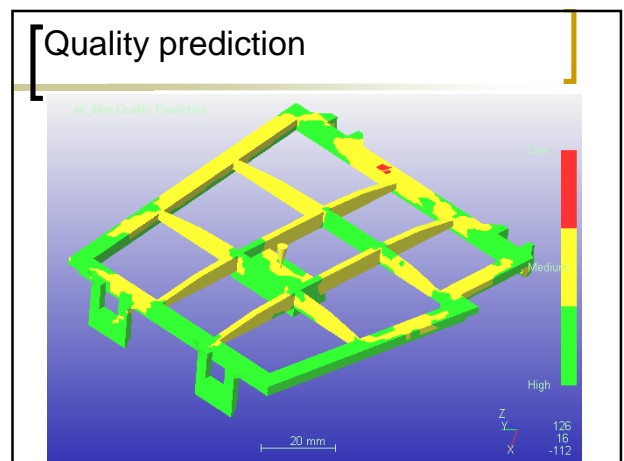
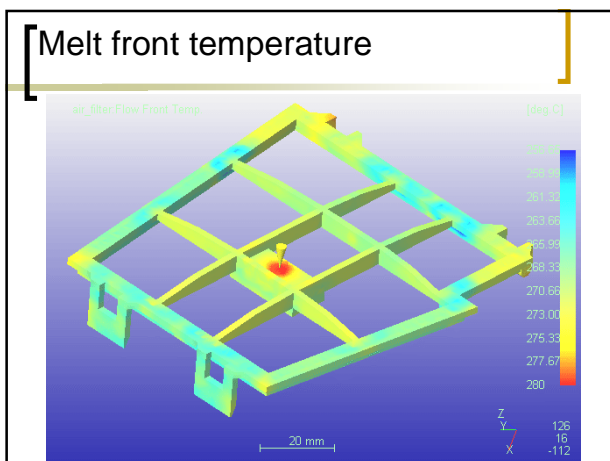
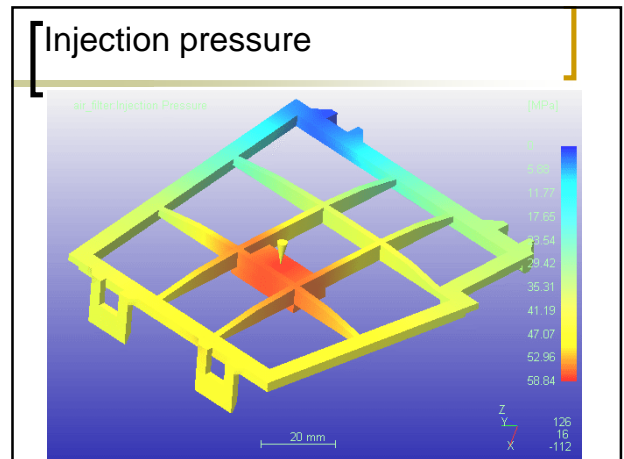
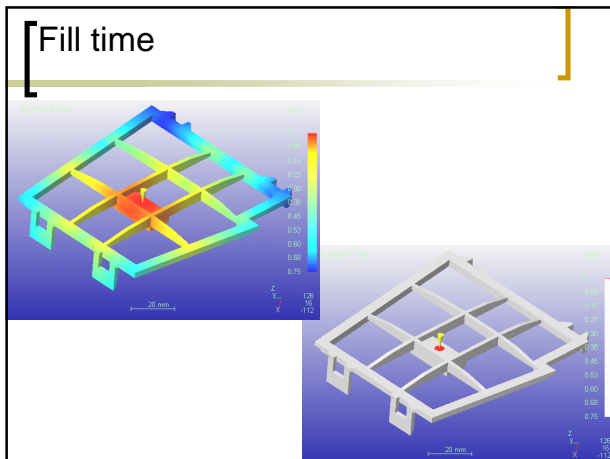
- Equal filling up of the cavities
- Minimal welding line
- Minimal distance
- Parting line geometry
- Esthetic viewpoint

5

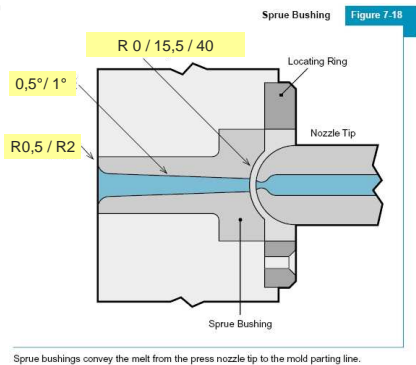
## Computer aided analysis



6



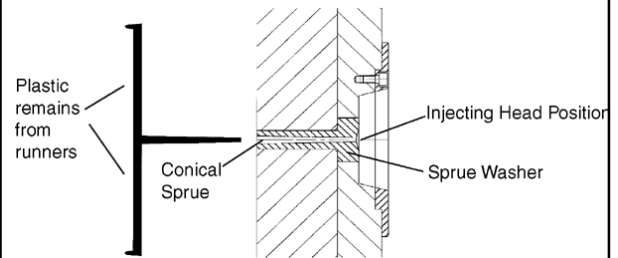
## Sprue bushing



Sprue bushings convey the melt from the press nozzle tip to the mold parting line.

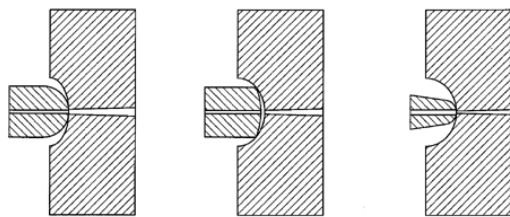
13

## Sprue bushing



14

## Role of radii



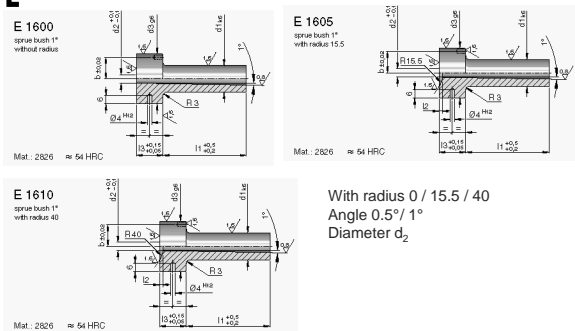
A) ☒   
  $R_s > R_m$

B) ☐

C) ☐

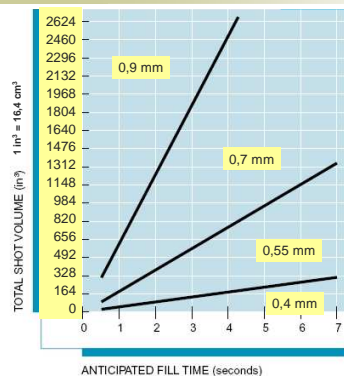
15

## Catalogue components



16

## Size of the sprue diameter



17

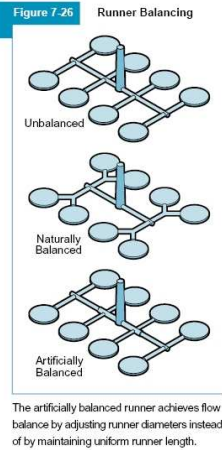
## Runner system

- Short length
- Balancing
- Optimal cross section
- Simple manufacturing

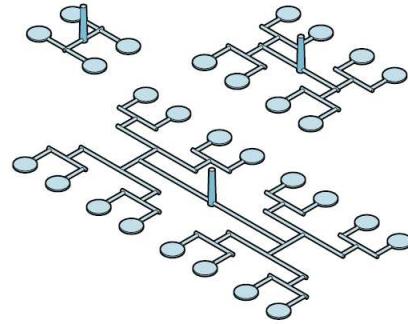
18

## Balancing

- Aim: same fill up time
- Naturally balancing: equal runner length
- Artificial balancing: adjust runner cross section



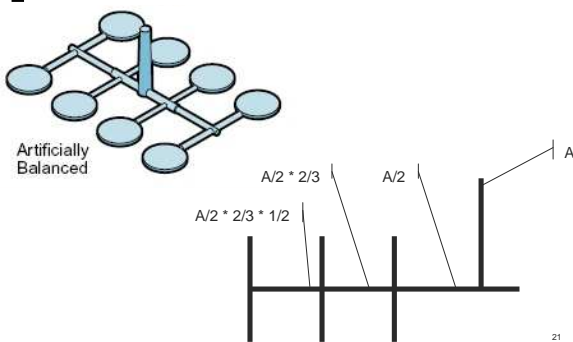
## Natural balancing



Naturally balanced runners for cavities in two rows.

20

## Artificial balancing



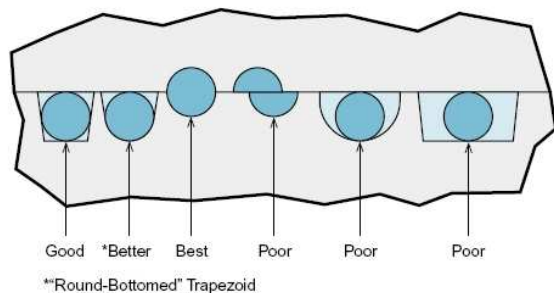
21

## Combined balancing



22

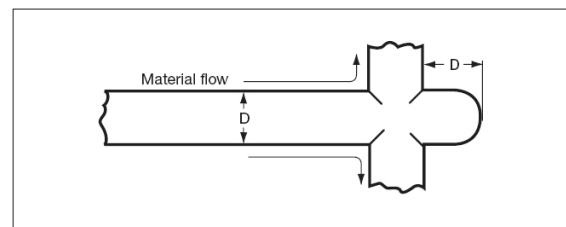
## Runner cross section



Full round runners provide the most efficient flow.

## Cold slug well

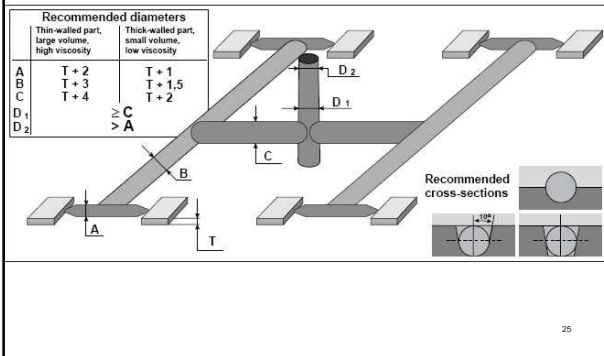
Figure 39 – Recommended Design of a Cold Slug Well



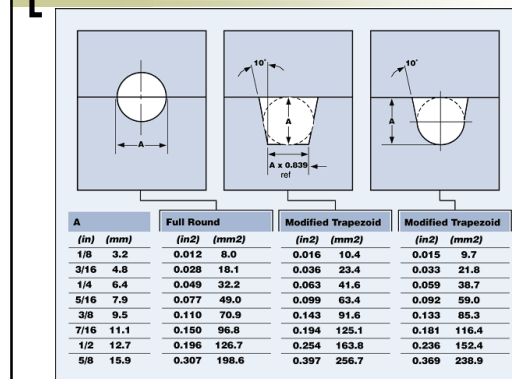
Collect the not too good quality material of the melt front.

24

## Runner diameter



## Runner size



## Runner diameter

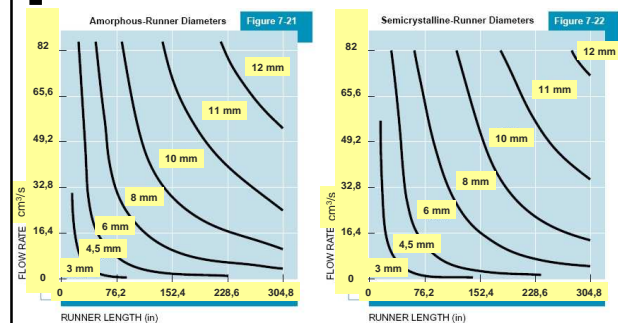
$$D = \frac{w^{1/2} \times L^{1/4}}{3.7}$$

where:

- D = runner diameter (mm)
- W = part weight (g)
- L = runner length (mm)

27

## Runner diameter



## Maximum runner length

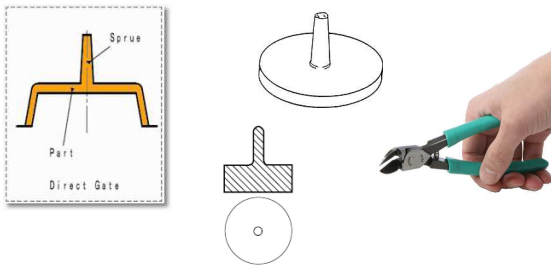
Runner Diameter		Maximum Runner Length			
(in)	(mm)	Low Viscosity		High Viscosity	
		(in)	(mm)	(in)	(mm)
1/8	3	4	100	2	50
1/4	6	8	200	4	100
3/8	9	11	280	6	150
1/2	13	13	330	7	175

29

## Gate type

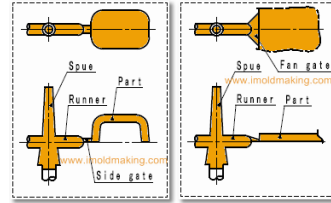
- Sprue gate
  - Edge gate / Side gate / Fan gate
  - Pin gate / Drop gate
  - Tab gate
  - Diaphragm gate
  - Internal ring gate
  - External ring gate
  - Flash gate / Film gate
  - Submarine gate / Tunnel gate
  - Curved tunnel gate / Banana gate
- 30

## Sprue gate



31

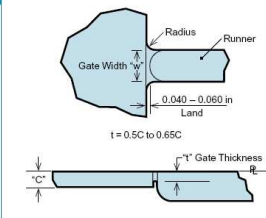
## Edge gate / Side gate / Fan gate



32

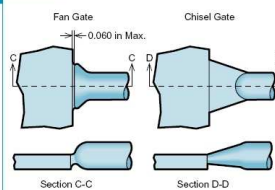
## Edge gate / Side gate

Figure 7-28 Common Edge Gate



Common edge-gate guidelines.

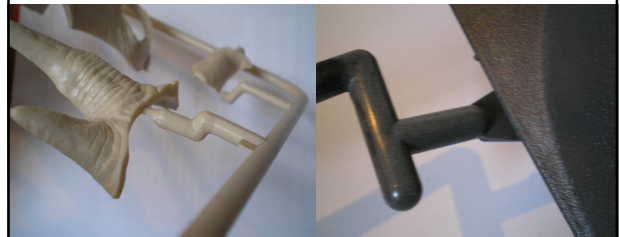
Figure 7-29 Variations of the Edge Gate



Fan gates and chisel gates can provide better cosmetics in some applications.

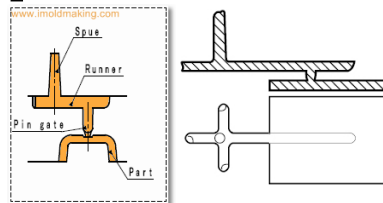
33

## Examples



34

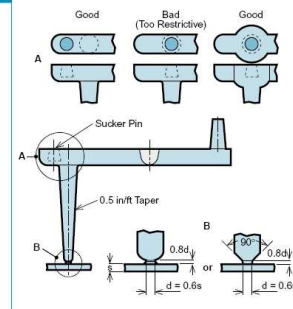
## Pin gate / Drop gate



35

## Pin gate / Drop gate

Figure 7-27 Three-Plate Runner

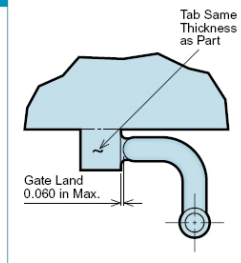


Three-plate runner system guidelines.

36

## Tab gate

Figure 7-30 Tab Gate



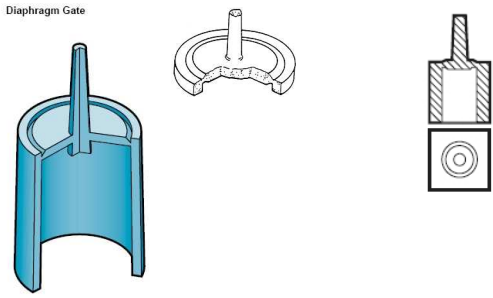
The gate tab can be hidden in the assembly or trimmed off after molding.



37

## Diaphragm gate

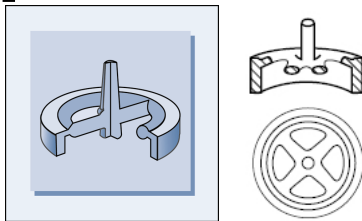
Figure 7-42 Diaphragm Gate



The diaphragm gate, which extends from the center disk to the inside of the cylinder, must be removed in a secondary step.

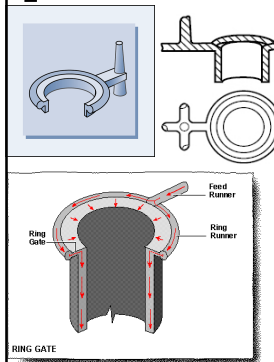
38

## Internal ring gate



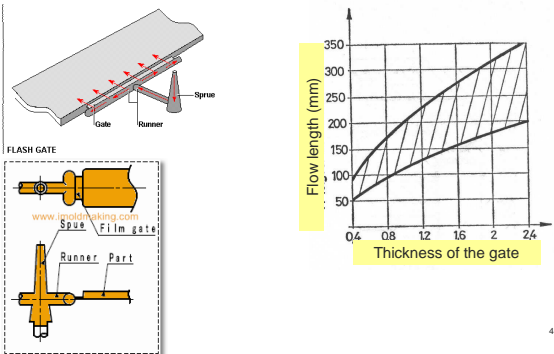
39

## External ring gate



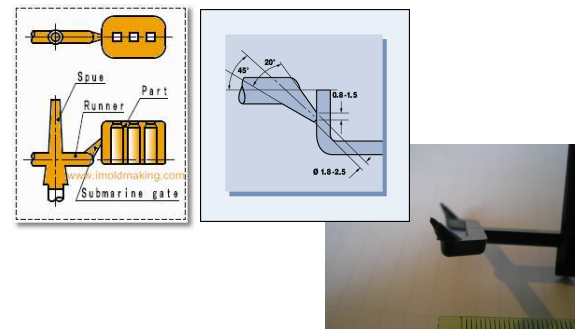
40

## Flash gate / Film gate



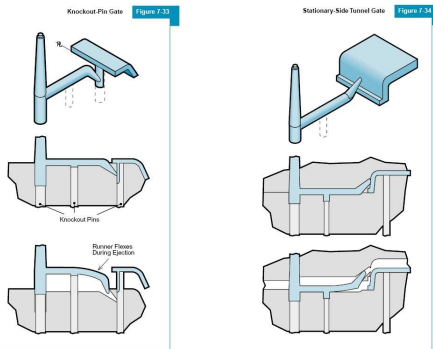
41

## Submarine gate / Tunnel gate





## Submarine gate / Tunnel gate

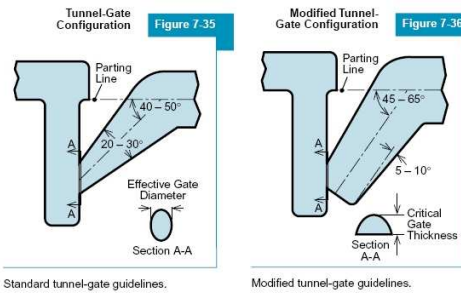


Tunnel gates that extend below the parting line on the ejector side of the mold degate during ejection.

Tunnel gates into non-ejector side of the mold degate and separate from the part during mold opening.

43

## Submarine gate / Tunnel gate

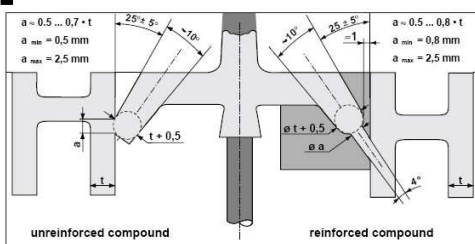


Standard tunnel-gate guidelines.

Modified tunnel-gate guidelines.

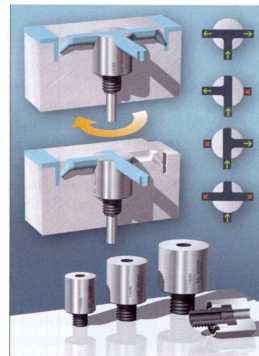
44

## Submarine gate / Tunnel gate



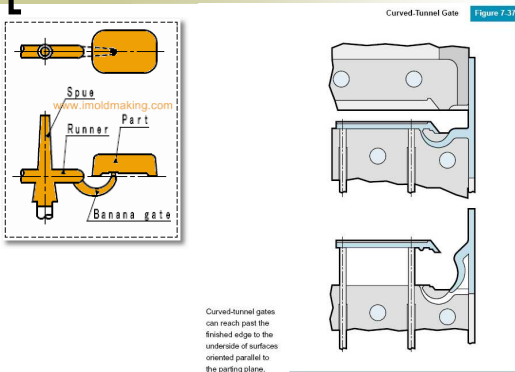
45

## Insert for family mould



46

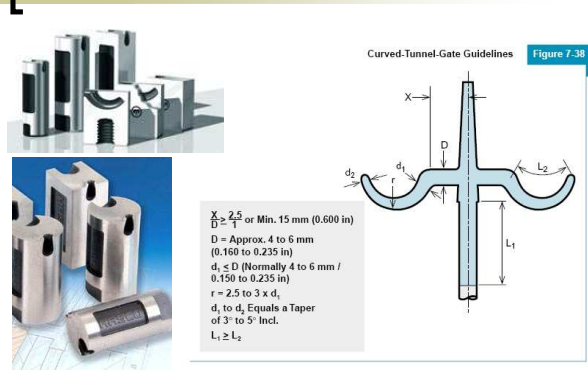
## Curved tunnel gate / Banana gate



Curved-tunnel gates can reach past the finished edge to the underside of surfaces oriented parallel to the parting plane.

47

## Curved tunnel gate / Banana gate



$\frac{X}{D} \geq \frac{2.5}{1}$  or Min. 15 mm (0.600 in)  
 $D = \text{Approx. } 4 \text{ to } 6 \text{ mm}$   
 $(0.160 \text{ to } 0.235 \text{ in})$   
 $d_1 \leq D$  (Normally 4 to 6 mm /  
 $0.150 \text{ to } 0.235 \text{ in})$   
 $r = 2.5 \text{ to } 3 \times d_1$   
 $d_1 \text{ to } d_2 \text{ Equals a Taper}$   
 $\text{of } 3^\circ \text{ to } 5^\circ \text{ Incl.}$   
 $L_1 \geq L_2$

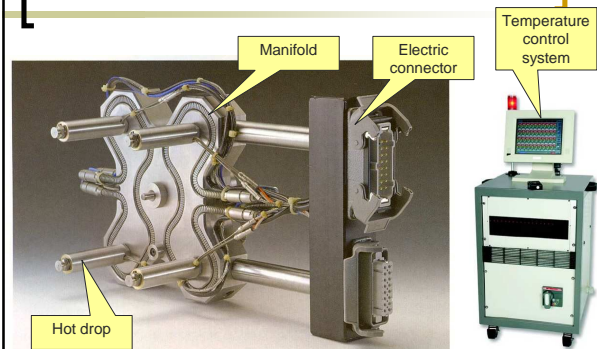


## Hot runner system

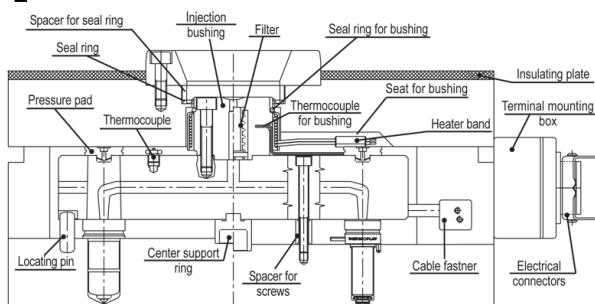
- Less material cost (no waste)
- Shorter cycle time
- More expensive mould
  - Nozzle min. 650 €
  - Manifold min. 1200 €



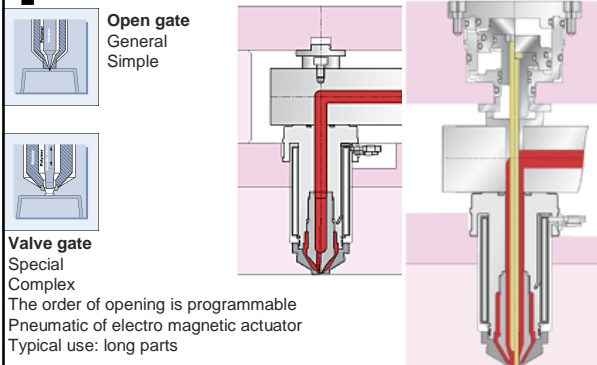
## System elements



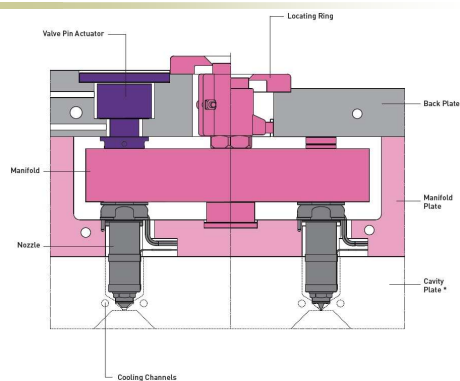
## Parts of manifold



## Nozzle types



## System elements



## Type of gates

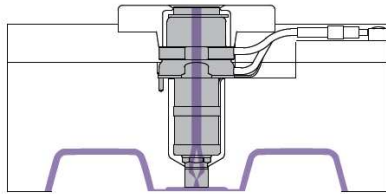


- Material
- Weight
- Cycle time

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## Combined single nozzle system

- More waste
- Cheaper mould
- Typical use: Deep cavity and high A plate



Single Nozzle Gating into a Cold Runner

55

## New trends



Adjustable manifold  
with valve gate



Complete injection size  
as catalogue part

56