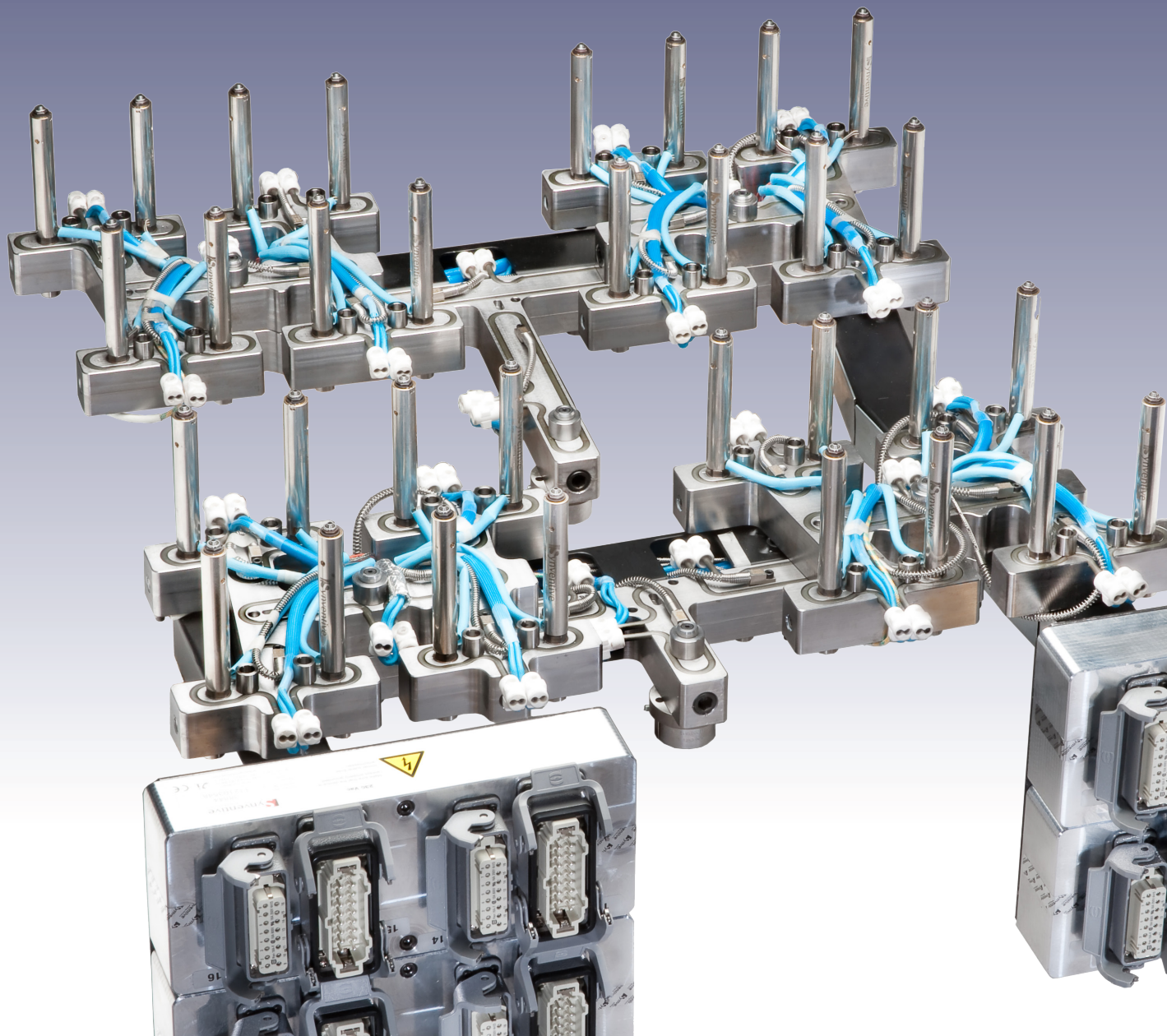


Hot Runner Guide

Layout and Design



Stabilize your Process _____

Synventive[®]
molding solutions

CAT-14-0001_EN-Rev12 (EN) 01 / 2023

A business of BARNES



Layout and Design

The purpose of this Hot Runner Guide

The Hot Runner Guide - Layout and Design is intended to help everyone who designs feed systems for injection molds or simply wants to find out about designing feed systems in the following way:

- Overview of the Synventive hot runner product range
- Insight into the layout of feed systems with hot runner technology
- Help to select suitable hot runner components

Important note

All the information contained in these pages is based upon our current knowledge and experience gained from both theory and practise. However because of many factors outside our control they do not guarantee the suitability of our products for any particular application. Always consult Synventive for your specific application.

Table of Contents

Page 3

Page 4

Page 5

Page 6

Page 7

Page 8

Page 9

Page 10

Page 11

Page 12

Page 13

Page 14.....

Page 15.....

Page 16

Page 17

Introduction

The Custom Hot Runner Solution from Modular Components

Hot Runner Components

Nozzles

Overview of Nozzles Series

Key Nozzle Data

Manifolds

Basic manifold Dimensions

Flow Control

Actuators

Material Suitability

Nozzle Tip Description VTP Series

Nozzle Tip Description VSP Series

Nozzle Tip Description VSW, VTW Series

Nozzle Tip Description TTP, TTW Series

Nozzle Tip Description TFP Series

Tip Modifications

Tip Modifications VSP, VSW Series

Tip Modifications VTP, VTW Series

Tip Modifications TTP, TTW, TFP Series

Hot Runner Design

Shot Weight per Nozzle

Thermal Expansion Guidelines



The Custom Hot Runner Solution from Modular Components

1 Hot Runner Components**Product Range Structure**

Hot runner systems may comprise of many subsets, each customized for a specific application.

a) Nozzles

Wide range of nozzles to suit most applications.

b) Hot Runner Systems

Available in standard shapes - I, H, X, Y - and in any realisable custom shape, the ranges of manifolds cover all possible injection configurations and mold concepts.

c) Melt Flow Control Technology

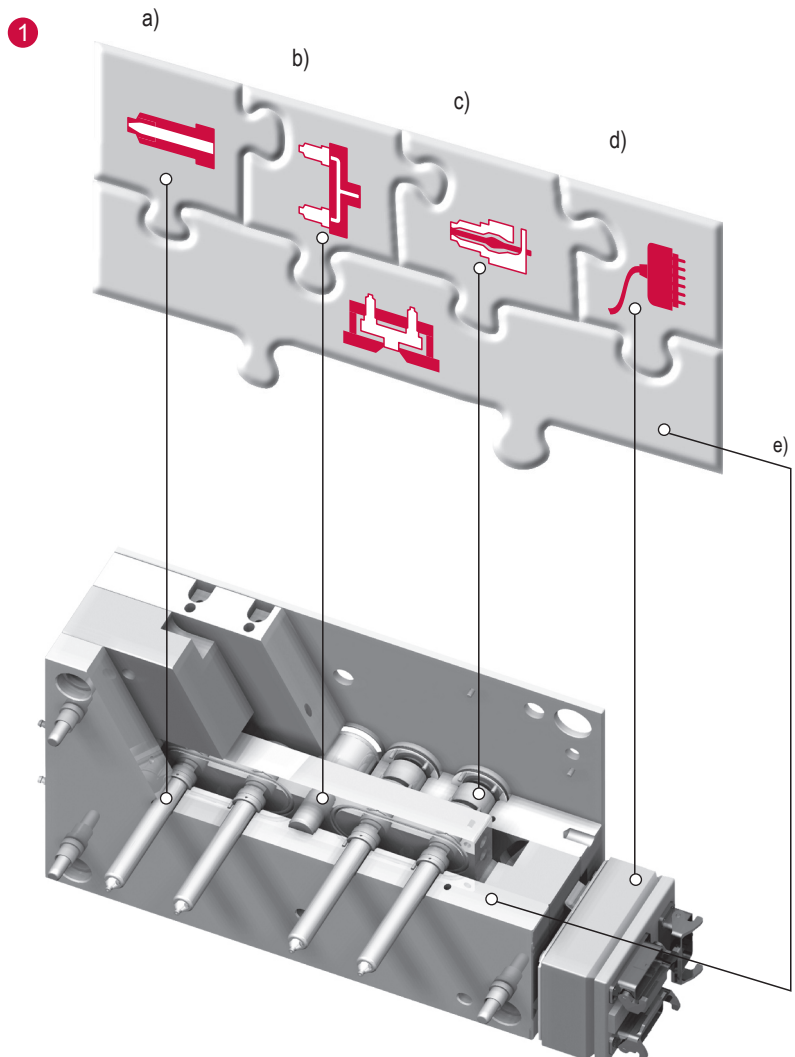
Utilizing valve gate technologies, Synventive provides solutions from traditional SVG to activeGate® technology to meet the needs of the most challenging applications.

d) Connections

To customer specification or Synventive standard, Synventive hot runner systems are available pre-wired, pre-plumbed and pre-tested.

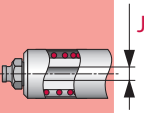
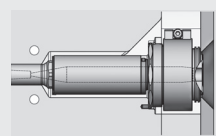
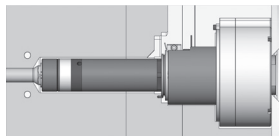
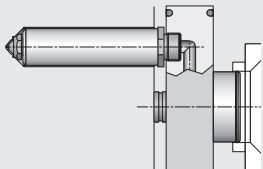
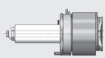

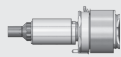
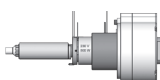


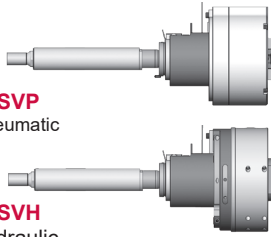
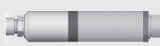


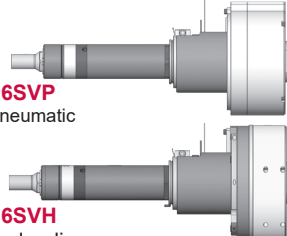




e) Hot Halves

Hot runner systems are supplied completely mounted in mold plates, pre-wired, pre-piped if required and fully adjusted.





Overview of Nozzle Series

<p>Nozzle style →</p> <p>Nozzle size ↓</p> 	<p>S</p>  <p>Sprue bushings (thermal gate)</p>	<p>SV</p>  <p>Single axis valve gate nozzles (pneumatic / hydraulic)</p>	<p>E</p>  <p>Threaded nozzles (thermal gate / valve gate)</p>
<p>06</p> <p>J=Ø6</p>	 <p>06 S</p>		 <p>06 E</p>
<p>09</p> <p>J=Ø9</p>	 <p>09 S</p>	 <p>09SVP pneumatic</p>	 <p>09 E</p>
<p>12</p> <p>J=Ø12</p>	 <p>12 S</p>	 <p>12SVP pneumatic</p> <p>12SVH hydraulic</p>	 <p>12 E</p>
<p>12 16</p>			 <p>12 EX 16</p>
<p>16</p> <p>J=Ø16</p>	 <p>16 S</p>	 <p>16SVP pneumatic</p> <p>16SVH hydraulic</p>	 <p>16 E</p>
<p>16 22</p>			 <p>16 EX 22</p>
<p>22</p> <p>J=Ø22</p>	 <p>22 S</p>		 <p>22 E</p>

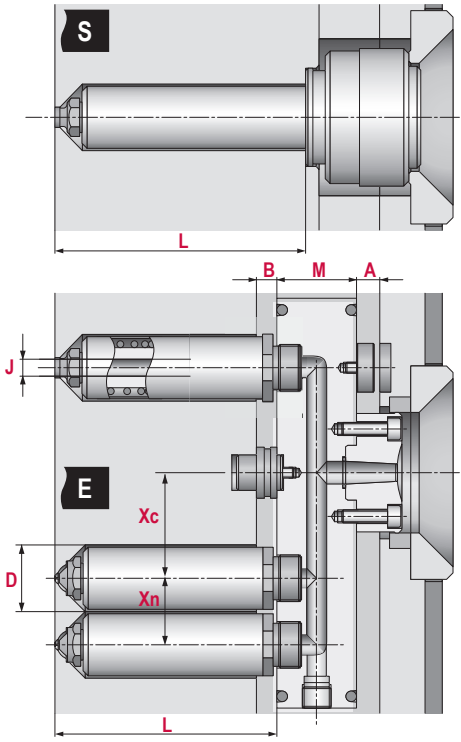


Key Nozzle Data

Key nozzle data		Max. shot weight per nozzle (g)						Major Dimensions				
		Thermal gate			Valve Gate			J	L	D	*Thermal Gate	
		high ^{a)}	medium ^{b)}	low ^{c)}	high ^{a)}	medium ^{b)}	low ^{c)}				Xn	Xc
S	06 S	30	70	120	-	-	-	Ø6	60...200	Ø20	-	-
	09 S	70	120	250	-	-	-	Ø9	60...400	Ø27	-	-
	12 S	500	800	1500	-	-	-	Ø12	60...650	Ø35	-	-
	16 S	1000	1500	2000	-	-	-	Ø16	96...627	Ø50	-	-
	22 S	1500	2500	5000	-	-	-	Ø22	96...627	Ø60	-	-
	SV	09 SVP	-	-	-	10	50	80	Ø9	50...400	Ø27	-
12 SVP		-	-	-	80	150	300	Ø12	50...400	Ø35	-	-
12 SVH		-	-	-	80	150	300	Ø12	50...400	Ø35	-	-
16 SVP		-	-	-	250	600	1500	Ø16	100...395	Ø50	-	-
16 SVH		-	-	-	250	600	1500	Ø16	100...395	Ø50	-	-
E	06 E	30	70	120	10	45	80	Ø6	60...200	Ø20	20	22.5
	09 E	70	120	250	40	80	120	Ø9	60...400	Ø27	27	28.5
	12 E	500	800	1500	100	250	500	Ø12	60-675	Ø35	35	35.5
	12 EX 16	700	1000	2000	250	450	1000	Ø12 - Ø16	200-750	Ø45	45	43
	16 E	1000	1500	2500	500	800	1500	Ø16	90-685	Ø45	45	43
	16 EX 22	1200	2000	3500	650	1000	1700	Ø16 - Ø22	200-750	Ø55	55	48
	22 E	1500	2500	5000	800	1200	2000	Ø22	100-675	Ø55	55	48

- 1 Shot weight based on gating type and viscosity of melt
 - 2 Major dimensions and heater zones
- Viscosity of melt (at medium melt temperature and at a shear rate of 1000 1/s)
- > 150 Pa s a) high
PC, PMMA PEEK, PES, PSU, PEI, POM
 - = 60...150 Pa s b) medium
ABS, SAN, ASA, PBT, PET, POM (Copo), PA, PPE, PPO, PPS, PC/ABS, PC/PBT
 - < 60 Pa s c) low
PP, PE, PS, LCP, TPE

*Thermal Gate nozzle related minimal distance (theoretical)
 Xn minimal distance between nozzles
 Xc minimal distance between nozzle and center support





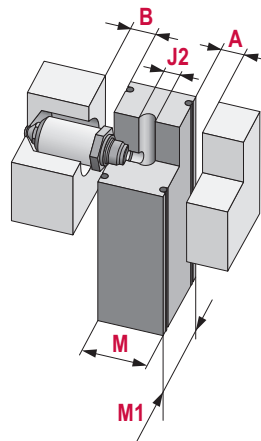
Basic Manifold Dimensions

Available manifold series	Nozzle size	Nozzle series	V-37				V-42				V-45				V-50				V-55				V-65				
			M=		M1=		M=		M1=		M=		M1=		M=		M1=		M=		M1=		M=		M1=		
			J2 max.	NT	V	A	B	J2 max.	NT	V	A	B	J2 max.	NT	V	A	B	J2 max.	NT	V	A	B	J2 max.	NT	V	A	B
06	06 E	.....	10	10	10	15																					
09	09 E	.....					10		10	15	12	12	10	15													
12	12 E	.....													12	12	15	15									
16	12 EX 16	.....																	16	16	20	20					
	16 E	.....																	16	16	20	20					
22	16 EX 22	.....																						26	26	20	20
	22 E	.....																						26	26	20	20

NT: Open nozzles

V: Valve gate nozzles

1 Major dimensions





Actuators

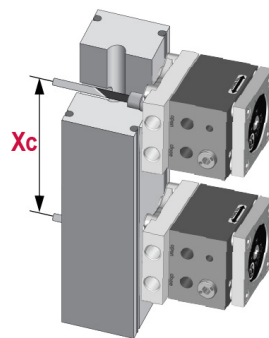
		hydraulic					pneumatic						electric					
Actuators		HYC4520M	HB2508	HB4016	HYZ3908	QCVG16	PNC3008B	PNC4508B	PNC6018B	PB4008	PB6016	PB8016	VP4008P	VP8016P	ELA4308P	ELA5708P	ELA8708P	ELA7616M
Nozzle size	Nozzle series	Xc	Xc	Xc	Xc	Xc	Xc	Xc	Xc	Xc	Xc	Xc	Xc	Xc	Xc	Xc	Xc	Xc
06	06 E	-	38		-	-	42	-	-	61			55	-	45	60	-	-
09	09 E	-	38	61	53	-	-	61	-	61	77	97	55	-	-	-	90	
12	12 E	96		61	-	100	-	-	76		77	97	-	97	-	-	-	x*
16	12 EX 16	140		61	-	100	-	-	76			97	-	97	-	-	-	-
	16 E	140		61	-	100	-	-	76			97	-	97	-	-	-	x*
22	16 EX 22	140		61	-	100	-	-	-			97	-	97	-	-	-	-
	22 E	140		61	-	100	-	-	-			97	-	97	-	-	-	x*

* Reference, eGate 2.0 For Medium-to-Large Part Molding, Catalog CAT-16-0039_EN-Rev##

1

Actuator bolted to the manifold

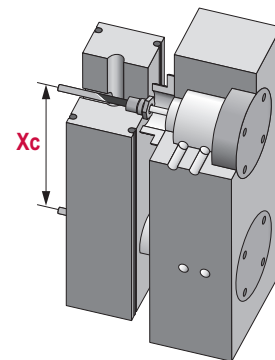
- HB Series
- PB Series
- ELA M Series



2

Actuator in mold plate

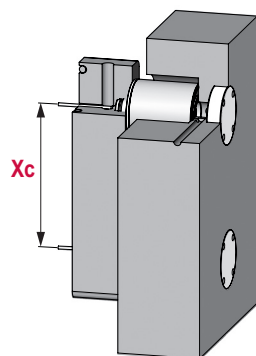
- HYZ Series
- QCVG Series
- VP Series



3

Actuator with backing plate

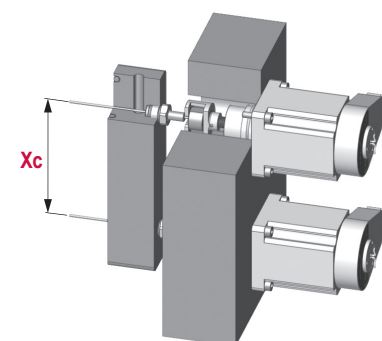
- PNC####B Series



4

Electric actuator in mold plate

- ELA P Series

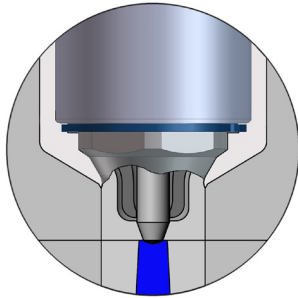




Nozzle Tip Description - VTP

Nozzle Tip Selection

From the nozzle tip descriptions, individual configurations can be selection to suit a specific application.

**VTP**

Valve Gate - Tapered Pin - Plunged Through

F=0, F=30, F= 0-30 MOD

Universal tip

For direct gating or cold runner applications

Recommended for all common polyolefin and amorphous resins

Talc filled resins

GF not recommended

Inner part made of heat conductive material

Melt is covered and controlled until gate

Tip face must always be against plastic to avoid heat loss and mechanical loads when closing mold

Wall thickness in gating area \geq Gate-diameter

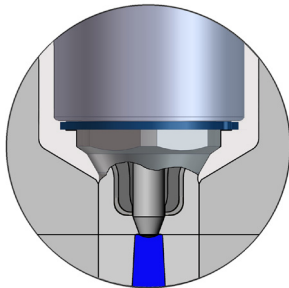
Industrial standard for head and rear lamp applications

Gate quality lower than straight needle, risk of flash

Unsuitable for cosmetic gating and amorphous plastics when direct gating on part

Non-homogeneous cavity surface temperature

Significant effect with slow needle opening, strongly recommended for activeGate®

**VTP-SC**

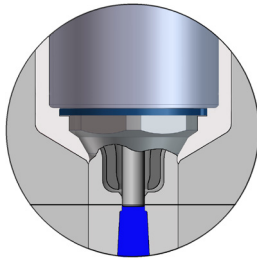
Most effective solution for color change applications

Slightly hotter tip surface than VTP

Flame retardant resins



Nozzle Tip Description - VSP

**VSP**

Valve Gate - Straight Pin - Plunged Through

F=0, F=30, F= 0-30 MOD

Universal tip

For direct gating or cold runner applications.

For all common resins

Talc filled resins

GF< 30% crystalline; PA6.6 GF<20%

Inner part made of heat conductive material

Melt is covered and controlled until gate

Tip face must always be against plastic to avoid heat loss and mechanical loads when closing mold

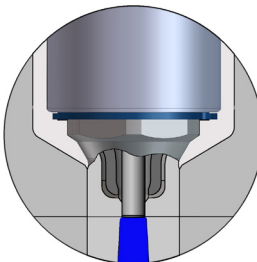
Wall thickness in gating area \geq Gate-diameter

Gate quality better than tapered needle

Unsuitable for cosmetic gating and amorphous plastics when direct gating on part

Non-homogeneous cavity surface temperature

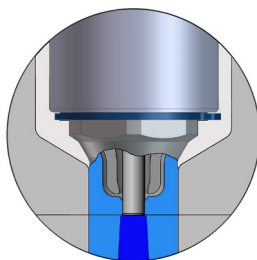
No significant effect with slow needle opening (activeGate)

**VSP-SC**

For color change applications

Flame retardant resins

Slightly hotter tip surface than VSP

**VSP-WC Wear C**

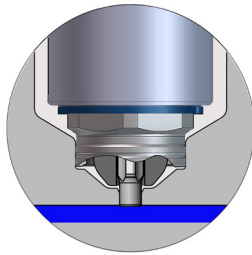
External component – best possible wear resistance (abrasion and corrosion) with a standard heat transfer rate

Internal component – high heat transfer rate

GF>30% crystalline; PA6.6 GF>20%; LGF



Nozzle Tip Description - VSW, VTW

**VSW**

Valve Gate - Straight Pin - Blind

Inner part made of heat conductive material

Melt is covered and controlled until gate

For direct gating and cold runner applications

Recommended for most common resins

Wear and/or Cooling insert strongly recommended

Talc filled resins

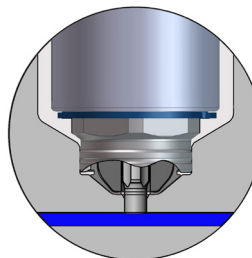
GF < 20% (crystalline materials) GF < 30% (amorphous and polyolefin materials)

Wall thickness in gating area min 0,7 – 1,0 x Gate-diameter recommended

Gate quality better than tapered needle

Unsuitable for crystalline resins with narrow process windows (PA 4.6, ...)

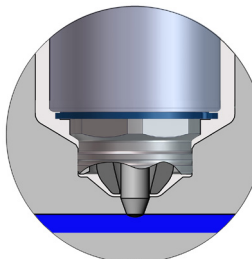
If not using separate wear inserts, hardened gate area to greater than 54 HRC

**VSW-SC**

For use on color change applications, when a straight and blind tip is requested

Slightly hotter cavity surface than VSW

Flame retardant resins

**VTW**

Valve Gate - Tapered Pin - Blind

Inner part made of heat conductive material

Melt is covered and controlled until gate

For direct gating and cold runner applications

For most common amorphous resins recommended

Wear and/or Cooling insert strongly recommended

Talc filled resins

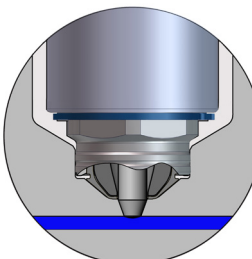
Wall thickness in gating area min 0,7 – 1,0 x Gate-diameter recommended

Industrial standard for head and rear lamp applications

Unsuitable for crystalline resins with narrow process windows (PA 4.6, ...)

If not using separate wear inserts, hardened gate area to greater than 54 HRC

Unsuitable for glass fiber resins

**VTW-SC**

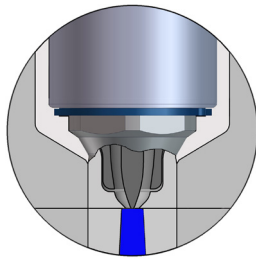
For use on color change applications, when a blind tip is requested

Slightly hotter cavity surface than VSW

Flame retardant resins



Nozzle Tip Description - TTP, TTW

**TTP**

Thermal Gate - Torpedo – Plunged Through

All Tips F=0, F=30, F= 0-30 MOD

Inner part made of heat conductive material

Melt is covered and controlled until gate

Tip face must always be against plastic to avoid heat loss and mechanical loads when closing mold

For direct gating and cold runner applications

For most common resins recommended

Sprue as short as possible

Talc filled resins

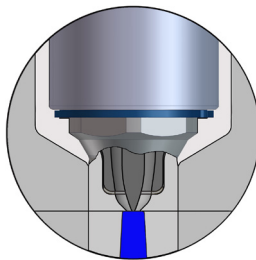
GF < 20% (crystalline materials) GF<30% (amorphous and polyolefin materials)

Unsuitable for cosmetic gating and amorphous plastics when direct gating on part

Processing with polyolefins and amorphous plastics the front tends to stick if the mold cooling is not optimal (W-Tip)

Non-homogeneous cavity surface temperature

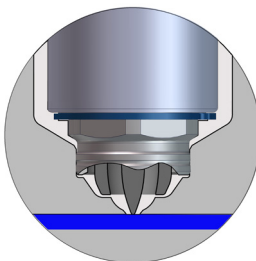
Unsuitable for highly filled resins (>30%) full flow or valve gate recommended

**TTP-SC**

For color change applications, if thermal gate is requested

Slightly hotter tip surface than TTP

Flame retardant resins

**TTW**

Thermal Gate - Torpedo - Blind

Inner component made of heat conductive material

Melt is covered and controlled until gate

For direct gating and cold runner applications

For most common resins recommended

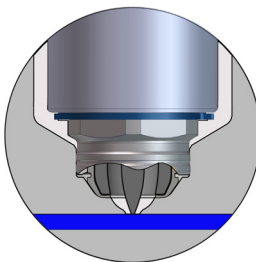
Talc filled resins

GF < 20% (crystalline materials) GF<30% (amorphous and polyolefin materials)

Unsuitable for crystalline resins with narrow process windows (PA 4.6, ...)

If not using separate wear inserts, harden gate area to greater than 54 HRC

Unsuitable for highly filled resins (>30%) full flow or valve gate recommended

**TTW-SC**

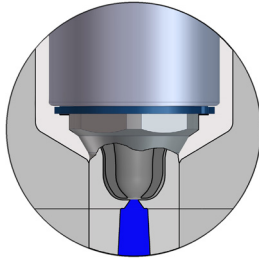
Most effective solution for color change applications, if thermal gate and blind tip is requested

Slightly hotter cavity surface than TTW

Flame retardant resins



Nozzle Tip Description - TFP

**TFP**

Thermal Gate – Full Flow – Plunged Through

All Tips F=0, F=30, F= 0-30 MOD

Inner part made of heat conductive material

Melt is covered and controlled until gate

Tip face must always be against plastic to avoid heat loss and mechanical loads when closing mold

For shear sensitive resins, with do not tend to string

For cold runner applications

Suitable for highly filled resins

Talc filled resins

Limited for direct gating because of possible gate vestige

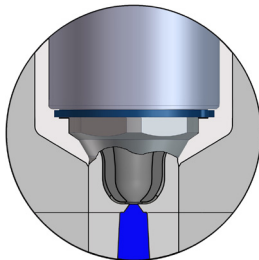
Sprue as short as possible

Unsuitable for cosmetic gating

Gate tends to string

Gate vestige not defined

Non-homogeneous cavity surface temperature

**TFP-SC**

Best solution for color change applications, if valve gate is not necessary and gating at cold runner

Slightly hotter tip surface than TFP

Flame retardant resins

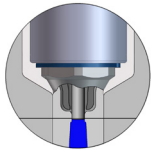


Tip Modifications 12E, 16E, 22E Series

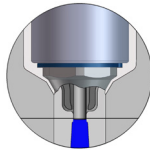
Illustrations simplified, schematically drawn and not to scale.

VSP

Standard

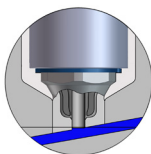


Alternate Cutout



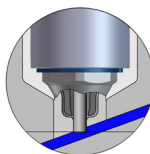
Space Restrictions, Contoured or Angled Parting Line

Angled Gating



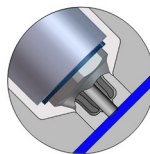
Option 1
Angle max 12° (recom.)

Angled Gating



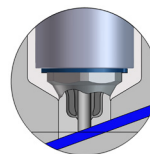
Option 2
Angle max 12° (recom.)
Extended land tip orifice with Valve Pin to accommodate
Consult Synventive

Angled Gating



Option 3
Angle >12°
Consult Synventive

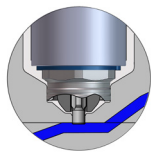
Angled Gating



Needle modification NOT applicable

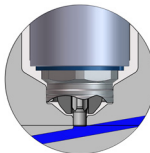
VSW

Angled Gating



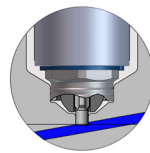
Angle to part

Angled Gating



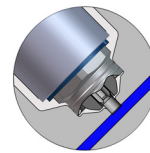
Option 1
Angle max 10° (recom.)

Angled Gating



Option 2
Angle max 10° (recom.)
Valve pin +1,5 mm
Consult Synventive

Angled Gating



Option 3
Angle >10°
Consult Synventive

Preferred

Available

Not Available

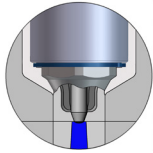


Tip Modifications 12E, 16E, 22E Series

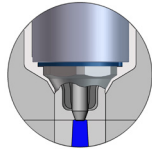
Illustrations simplified, schematically drawn and not to scale.

VTP

Standard

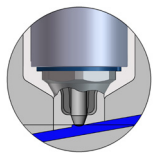


Alternate Cutout



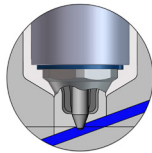
Space Restrictions, Contoured or Angled Parting Line

Angled Gating



Option 1
Angle max 5° (recom.)
Consult Synventive

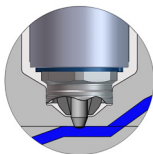
Angled Gating



Option 2
Angle max 10° (recom.)
Extended land tip orifice with reduced orifice and Valve Pin to accommodate.
Tapered pin extended = special part
Consult Synventive

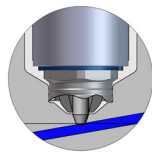
VTW

Angled Gating



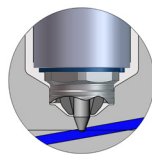
Angle to part

Angled Gating



Option 1
Angle max 5° (recom.)
Consult Synventive

Angled Gating



Option 2
Angle max 10° (recom.)
Tapered pin extended = special part
Consult Synventive

Preferred

Available

Not Available

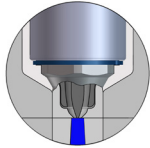


Tip Modifications 12E, 16E, 22E Series

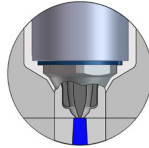
Illustrations simplified, schematically drawn and not to scale.

TTP

Standard

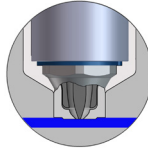


Alternate Cutout



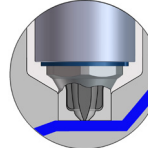
Space Restrictions, Contoured or Angled Parting Line

Dimple



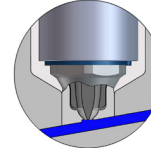
According to customer specification depth max. 1 mm

Angled Gating



Angle to part

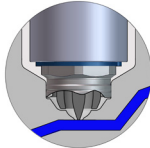
Angled Gating



Option 1
Angle max 10° (recom.)

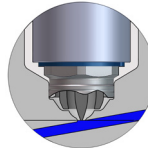
TTW

Angled Gating



Angle to part

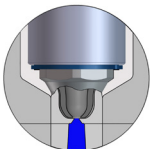
Angled Gating



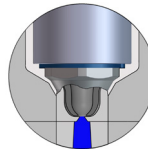
Option 1
Angle max 10° (recom)

TFP

Standard

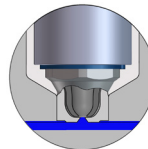


Alternate Cutout



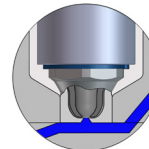
Space Restrictions, Contoured or Angled Parting Line

Dimple



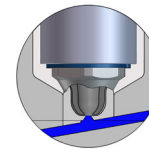
According to customer specification depth max. 1 mm

Angled Gating



Angle to part

Angled Gating



Option 1
Angle max 10° (recom.)

✓ Preferred

(✓) Available

✗ Not Available

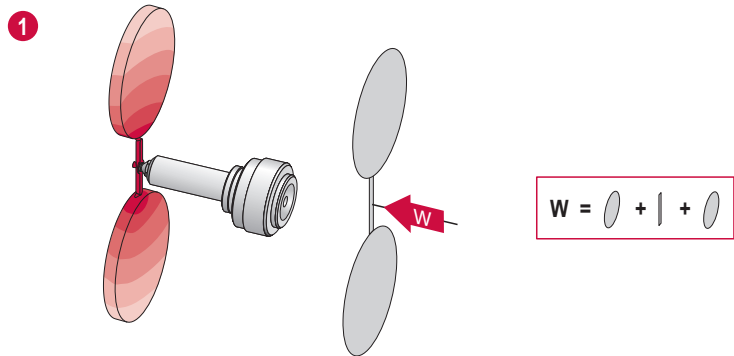


Shot Weight per Nozzle

The term "maximum shot size per nozzle" denotes the performance capacity of a hot runner nozzle, that is, the maximum quantity of plastic melt that can pass through the nozzle during operation without damaging the nozzle or plastic material.

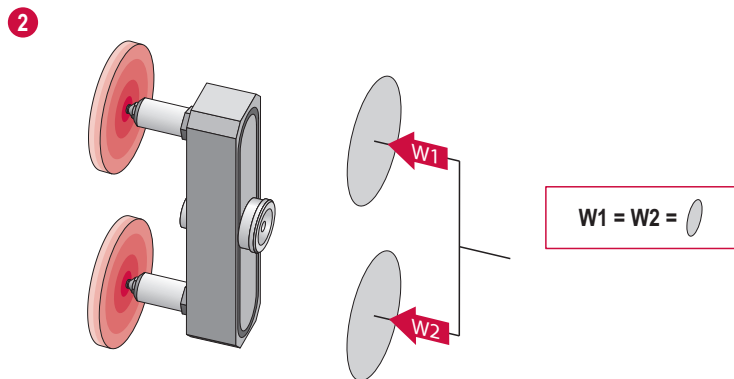
The reason performance capacity is specified in terms of weight rather than volume flow is that it is more readily understandable to the user, who has usually received information on the weight of the molded parts to be produced.

How to find the shot weight per nozzle (W) is shown on the right for three different applications.



1 Several parts per nozzle

- Multi cavity mold with sprue bushing
- Gating on cold sub runner
- Shot weight per nozzle = Parts + runner



2 One part per nozzle

- Multi cavity mold with manifold system
- Direct gating on to the part
- Shot weight per nozzle = part

3 Several nozzles per part

- Single cavity mold with manifold system
- Direct gating on to the part
- Shot weight per nozzle = Section of the cavity which is filled by one nozzle

The maximum shot size that can be achieved depends on several factors:

- Injection time
- Type of plastic: viscosity, additives, etc.
- Runner length/diameter
- Maximum permitted pressure loss
- Residence time

When the above factors are taken into consideration, conflicting requirements may arise in some cases.

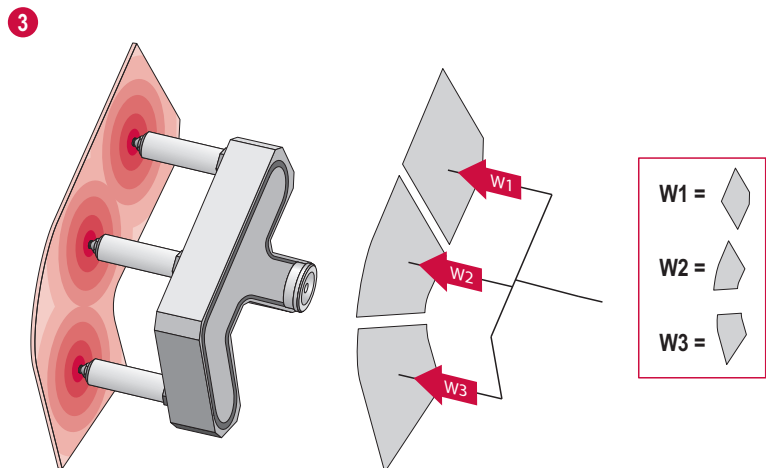
Flow channel as big as possible:

- low pressure loss
- low shear rate

Flow channel as small as possible:

- low residence time
- good melt exchange

The values for the maximum shot weight of a Synventive nozzle have been derived from practical experience as well as theoretical studies. They are valid for non-filled materials. For a specific application, please always consult Synventive.

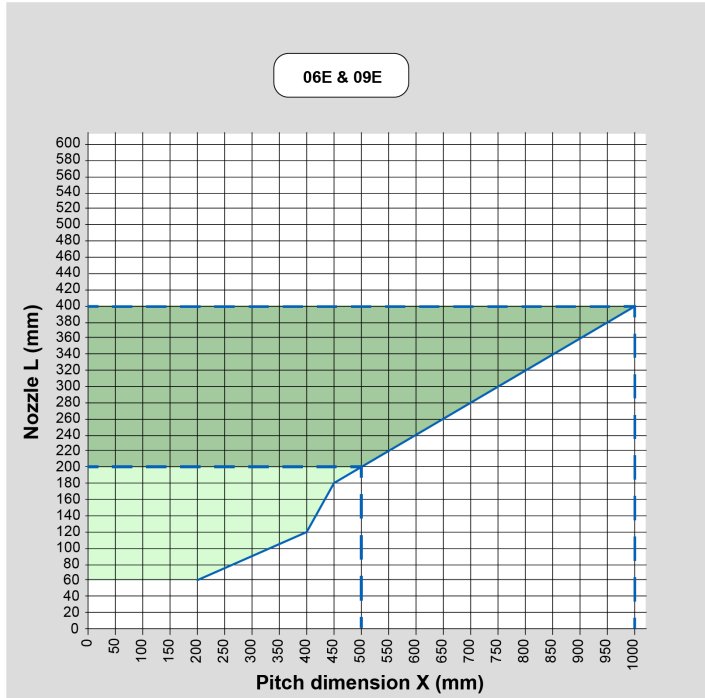




Thermal Expansion Guidelines

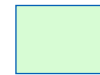
Ratio of Pitch Dimension to Nozzle length for threaded Nozzles

The thermal expansion of the manifold makes the nozzle move while the nozzle tip is fixed inside the mold cutout. In order to allow the nozzle to bend without being damaged the nozzle must adhere to a minimum length. These graphs show the minimum length of threaded nozzles in relation to its pitch dimension.



NOTICE

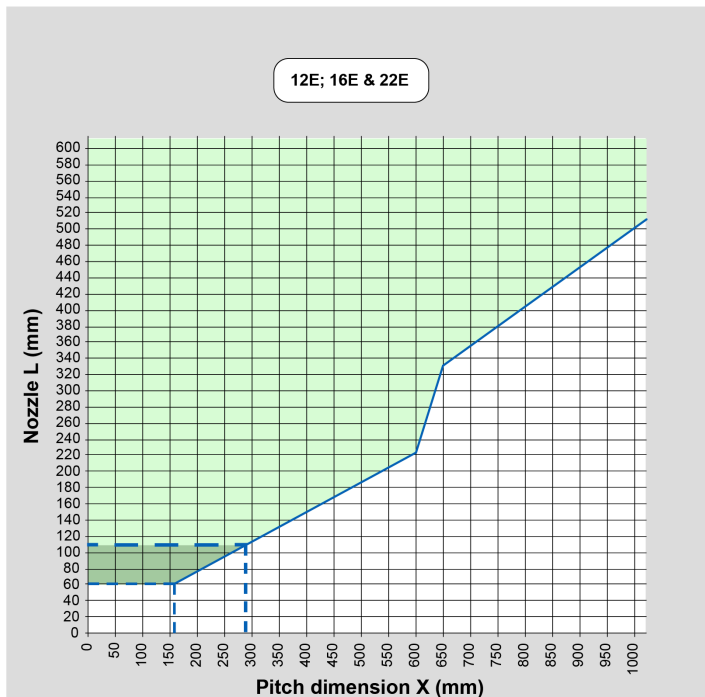
06E max length is 200 mm
06E & 09E min. length 60 mm
09E max length is 400 mm



Suitable pitch dimensions for 06E & 09E Nozzles



Suitable pitch dimensions for 09E Nozzles only



NOTICE

12E min. length is 102 mm
12E, 16E & 22E max. length 650 mm
16E & 22E min. length is 110 mm



Suitable pitch dimensions for 12E, 16E & 22E Nozzles



Suitable pitch dimensions for 12E Nozzles only

The Americas

Synventive Molding Solutions Inc.
10 Centennial Drive
Peabody, MA 01960, USA
Tel.: +1 978 750 8065
Fax: +1 978 646 3600
E-Mail: info@synventive.com

Europe

Synventive Molding Solutions GmbH
Heimrodstr. 10
64625 Bensheim, Germany
Tel.: +49 (0) 6251 / 9332-0
Fax: +49 (0) 6251 / 9332-90
E-Mail: infohrde@synventive.com

Asia

Synventive Molding Solutions (Suzhou) Co.Ltd.
12B Gang Tian Industrial Square
Suzhou Industrial Park, China 215021
Tel.: +86 512 6283 8870
Fax: +86 512 6283 8890
E-Mail: infohrcn@synventive.com

