

Company Profile

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Sales Office:	Kitakami, Sendai, Niigata, Utsunomiya, Kita-Kanto, Kanto, Nagano, Shizuoka, Kanazawa, Nagoya, Kyoto, Osaka, Hiroshima, Fukuoka, OVERSEAS Division
Capital:	382,500,000 yen
Sales turnover:	14,348 million yen (Mar.2011)
Established:	29 th Mar. 1975
Bank:	Bank of Tokyo-Mitsubishi UFJ, Ltd., Resona Bank, Ltd., Mizuho Corporate Bank, Ltd., Sumitomo Mitsui Banking Corporation, Shoko Chukin Bank

www.punch-ti.com

For business inquire

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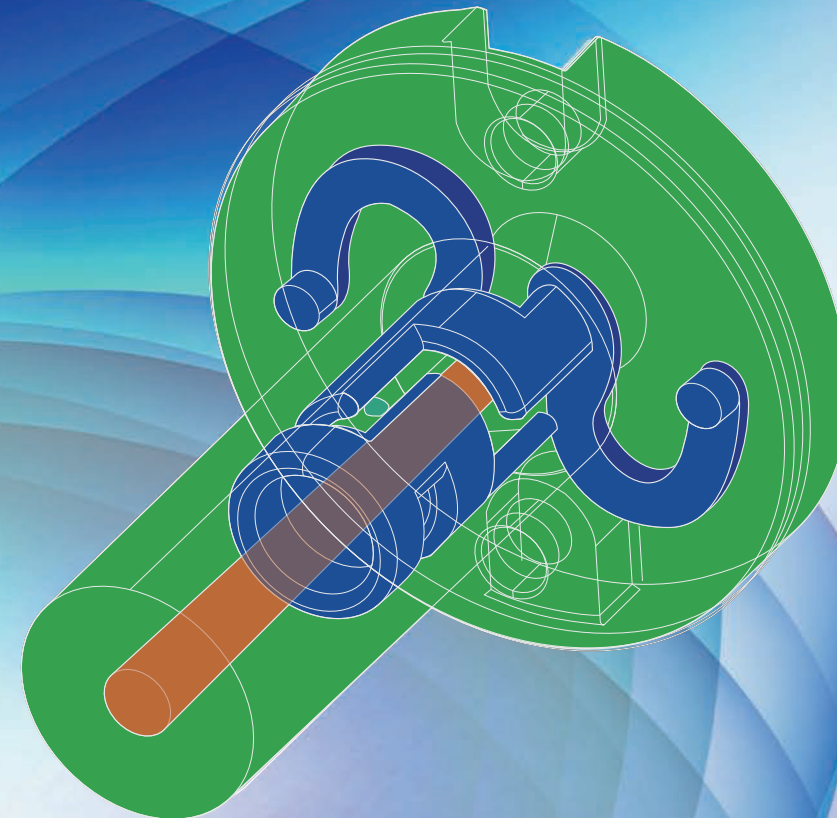
with Technological Innovations



**To Reduce Cooling Time for
High Cycle&High Quality Molding**

**PLASTIC MOLDING COMPONENTS TI SERIES
SPIRAL COOLING SPRUE BUSHING**

Patent Applied



BE COMPETITIVE! with Technological Innovations

The "Ti series" which congregates high technology standard components has been born in order to propose brand-new solutions to customers. The spiral cooling sprue bushing is the first product of "Ti series". And Punch Industry will keep on creating a product which can offer a new value to you.

'Ti series' will provide you

Improving competitiveness

Upgrading existed equipment

Creating new value

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INSTRUCTION

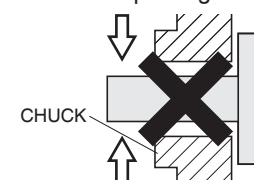
◆ NOTANDUMS

Please read this instruction carefully before use.

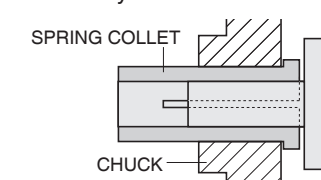


Forbidden

Do not chuck the body of "Spiral Cooling Sprue Bushing". It can cause breakage of the wall of the water passage in its body.



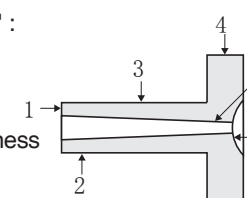
You MUST use a spring collet to chuck softly "Spiral Cooling Sprue Bushing" only when necessary.



Forbidden

Do not modify "Spiral Cooling Sprue Bushing" :

- 1 By shortening L (Length of sprue)
 - 2 By grinding down outer taper at the tip
 - 3 By grinding down D (Body diameter)
 - 4 By grinding down head diameter and head thickness
 - 5 By enlarging the nozzle touch SR11
 - 6 By widening sprue part (Angle&Dia.)
- in order to avoid breakage of the wall of the water passage.



Please contact us when additional process to "Spiral Cooling Sprue Bushing" is needed.

◆ Accessory List

Please check these before use.

Spiral Cooling Sprue Bushing	1
Cap Screw CCB5-12 (M5-12)	2
O ring OORP6 [Fluoric rubber (JIS Class 4 D)]	2

Usable temperature range for O ring -15~150°C

Please contact us when it needs additional process to outer Dia., internal Dia. and/or etc. since there is a water passage in its body.

◆ Suggested condition of use

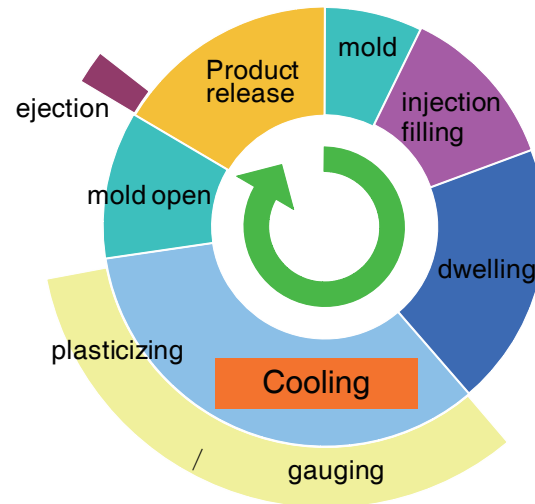
A multiple of cooling media are available with this water passage.

※Cooling medium should be filtered.

Be sure to do optimum corrosion control treatment when idle.

► Spiral cooling sprue bushing

In plastic injection molding process, the cooling process takes the longest time in each molding cycle. Especially, with small and/or microscopics products, the sprue is one of the parts that needs long time to solidify because of its thickness. In general, it can be cooled by cooling channel in the mold plates. For the efficiency of heat exchange, the sprue part may be low, because these channels are mainly used to cool product. Punch's new product "Spiral Cooling Sprue Bushing" is made by using the latest technology "Selective Laser Sintering with Milling Method". It can cool the sprue part directly with 3D water passage structure inside itself, and cooling medium is able to run into the water passage close to the heat spot. Therefore, it contributes to improving production performance in molding.

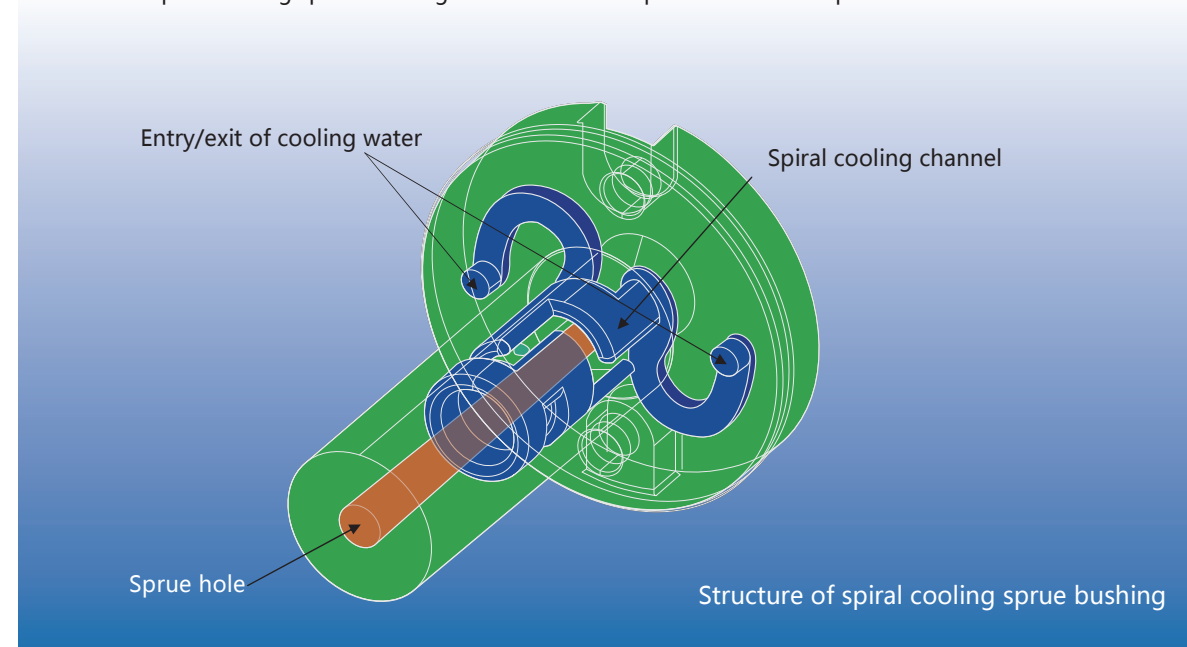


► Features of "Spiral cooling sprue bushing"

Improving production performance

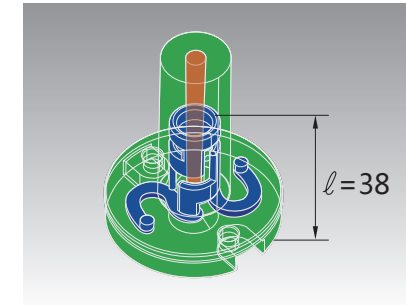
- 1) For trouble-free molding and durability improvement
Mold temperature control and prevention of stringiness
- 2) Cost reduction
Improving production efficiency
Reducing power consumption
- 3) High-cycle molding
Reducing the cooling time

We achieved the manufacture of spiral-type cooling passage inside the sprue bushing and we also offer small diameter "Spiral cooling sprue bushing" to customers. One piece structure to prevent leaks.



► Specification

Spiral cooling sprue bushing is made of two materials. one is base-material with a hardness of 40HRC, and another is a metal forming from special-mixed alloy powder which is processed by selective laser sintering with milling method.

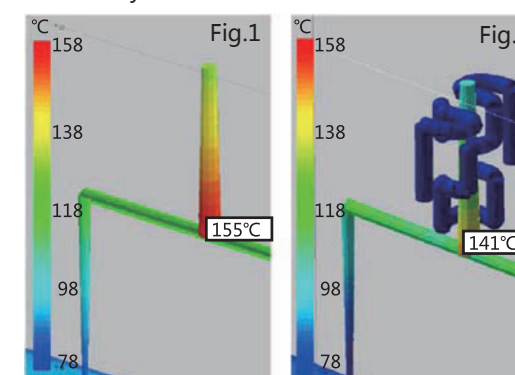


There is no leak because the interface of base-material and metal forming part is fused completely.

► Instance of cooling performance simulation

When ABS resin at 230°C is filled from a plastics injection machine. The sprue part of under solidification which showed a high temperature at 151°C, it remains in critical condition for continuous molding. (*Fig. 1 shows the result). By using the Spiral cooling sprue bushing, it can take control of a heat spot to 141°C from 155°C. (*Fig. 2 shows the result). As a result, user can reduce the cooling time, and can move more stable molding condition.

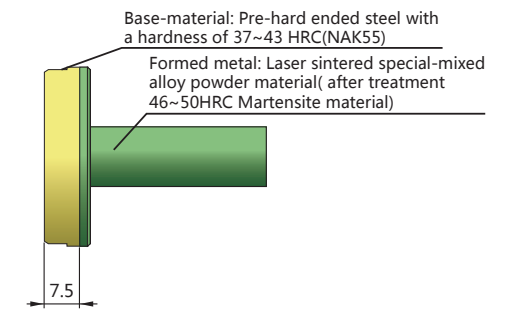
*The table below shows the molding condition for this analysis.



Molding condition

Material	ABS resin
Temperature of a injection nozzle	230°C
Die temperature	40°C
Cooling medium	water
Flow rate	7l/min above
Molding cycle	25 sec

the diagram is our company conditions, the result will change with the conditions.



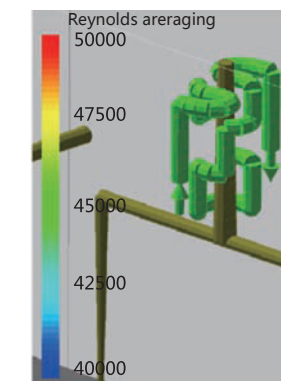
► Cooling passage cubage rate

D	ℓ Total volume mm³	cooling passage cubage mm³	cooling passage cubage rate
13	3311	707	21.4%
16	5228	814	15.6%
20	8407	1377	16.4%

The cooling passage is manufactured 38 mm from the shoulder.

► Reynolds averaging of cooling medium flow volume

The water passage optimized for improving reynolds averaging by using exclusive analysis software, as a result, the cooling medium was able to flow smoothly, and achieved to take control of a heat spot more efficiently.



$$Re = UL / (\mu / \rho) = UL / \nu$$

U: special speed (m/s)
L: special length (m)
 ν : eddy viscosity coefficient rate (m²/s)
 μ : viscosity rate (Pa · s)
 ρ : density (kg/m³)

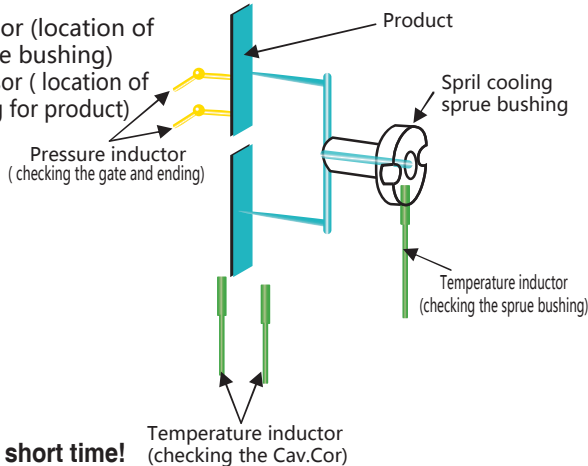
► Comparison between spiral sprue bushing(with water passage) and normal sprue bushing(without passage)

● Experiment:

- ① Compared measured temperature by heat sensor (location of measurement :Cav, Cor and Spiral cooling sprue bushing)
- ② Compared filling pressure of resin by pressure sensor (location of measurement :gate neighborhood and end of filling for product)
- ③ Evaluated the advantage of reducing molding cycle(with water passage,or without one.)

Condition

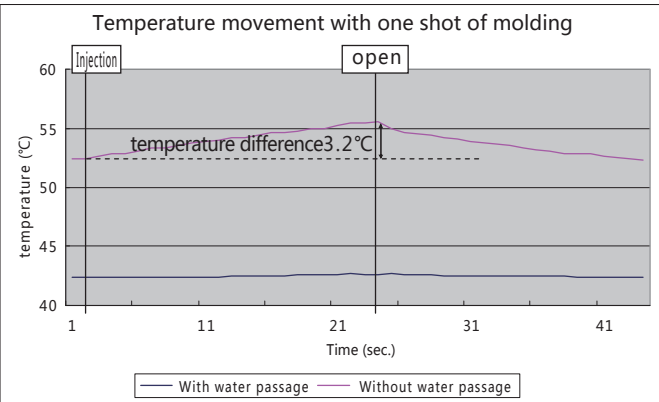
Material	ABS resin
Gate temperature	230℃
Die temperature	40℃
Cooling medium	water
Flow rate	7ℓ/min above
Cycle (without water passage)	25sec(cooling time 11sec)
Cycle (with water passage)	18.5sec(cooling time 4.5 sec)



► Stable molding quality! Shift to stable molding in a short time!

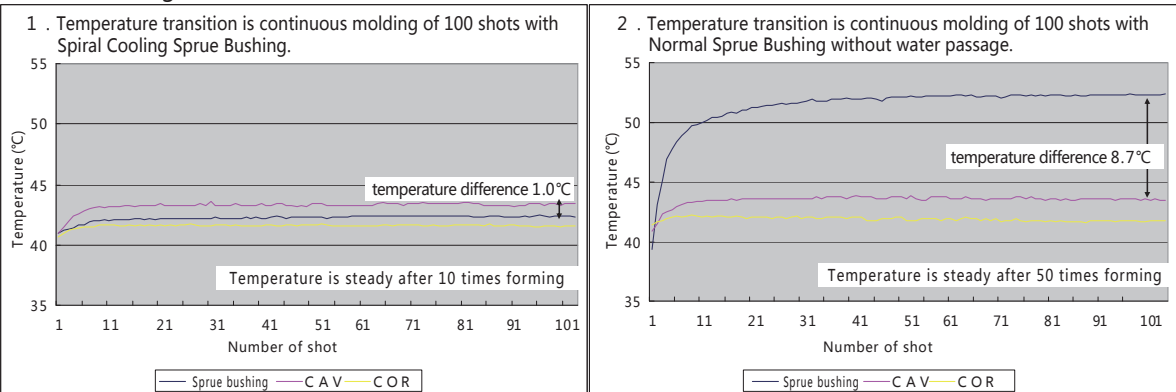
In the starting operations of the plastics injection molding,a trial molding is needed until the temperature of the molding die becomes constantly.By using spiral cooling sprue bushing,stable molding can be reached in short time.

Comparison of temperature transition in a shot of molding between ones with and without water passage Compared the temperature transition in a shot between Spiral cooling sprue bushing with water passage or without water passage, the figure below shows that temperature transition has been more stable with water passage, In case of without one, the molding condition became unstable because of fluctuating 3.2℃ in a shot.



- To compare the temperature movement from start to stable forming between the sprue bushings with and without water passage

The temperature will be steady after 50 times for without cooling, but only 10 times the temperature is steady for with cooling



► Quality stability(mass change,dimension accuracy) of plastics product

"With a multi-cavity mold,The quality(mass change, dimension accuracy)of plastics product is severely affected by fluctuatingthe temperature in each molding cycle, we offer to be able to move from a unstable condition to more stable molding condition by using Spiral cooling sprue bushing."

● Inner pressure in molding

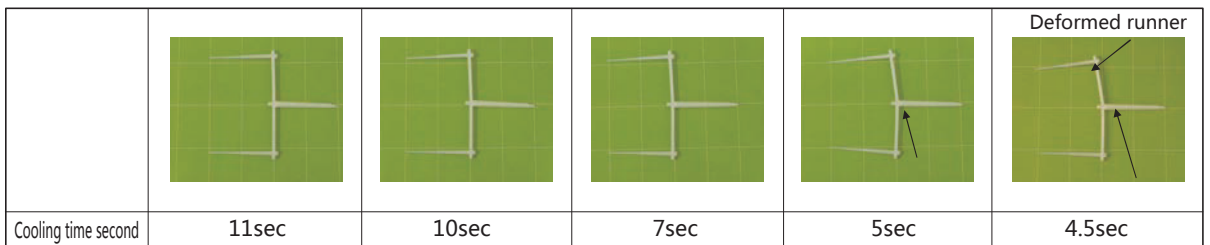
Location of pressure inductor	Without cooling		With cooling	
	ending	gate nearby	ending	gate nearby
Top pressure standard difference (Mpa)	0.16	0.30	0.14	0.24
Total pressure value standard difference (Mp) a	1.15	2.35	1.12	1.73

❗ The smaller the value is, the more steady the pressure and the quality are.

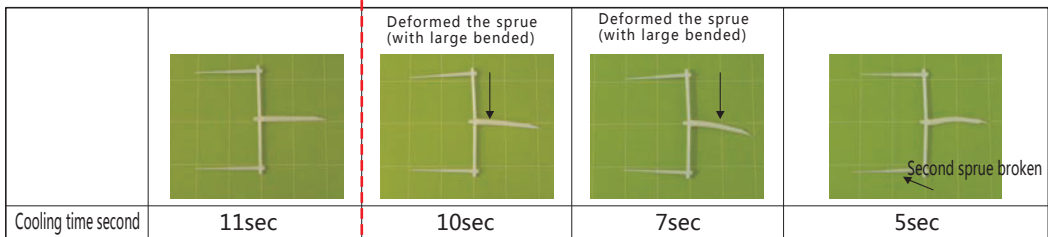
► Results of molding cycle time

Under the same molding conditions(resin temperature, dwell pressure,etc). We verified the state of sprue and runner made using different processes as show in figures below

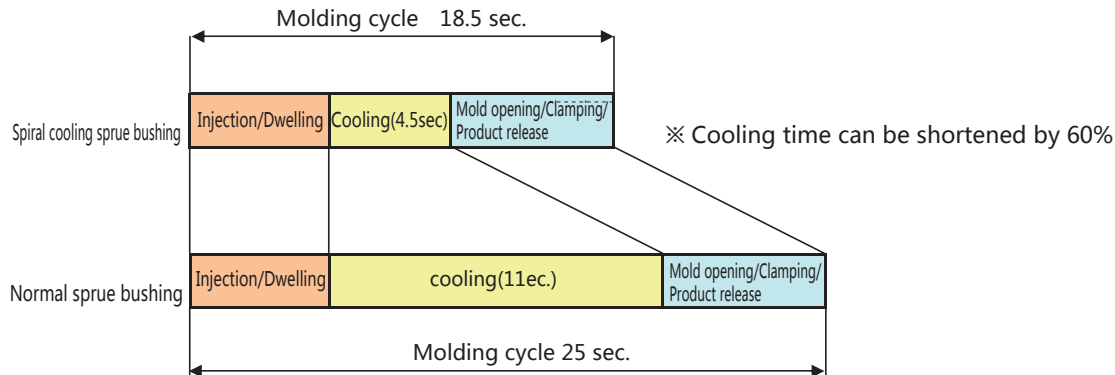
● Spiral cooling sprue bushing (with water passage)



● Normal sprue bushing (without water passage)



Applicable for molding ← → Inapplicable for molding



❗ the diagram is our company conditions, the result will change with the conditions.

► Case of user

No.	Resin	characters of products			Temperature(°C)		Molding cycle(sec.)			Reduce molding cycle time rate %
		product	Thickness (mm)	Max.thickness (mm)	molding	Sprue bushing	normal sprue bushing	Spiral cooling sprue bushing	Reduce time	
1	PC+GF30%	Portable player	0.6	1.2	80	60	26	12	14	53.8
2	PET	Power plug of cell phone	0.2	2	80	70	37	15	22	59.4
3	PC	Accessory of cell phone	0.5	0.6	110	90	21	14	7	33.3
4	PC+GF20%	Drawtube component of digital camera	1	2.6	120	100	13	7	6	46.1
5	ABSburn resistan+GF	Component of motorcycle	2	3	100	100	35	22	13	37.1
6	PBT+GF	Contact of automobile	0.8	2.2	60	60	18	14	4	22.2
7	PC	LED light guide	0.5	—	—	—	8	4	4	50.0
8	PC	Battery protector	0.25-0.5	—	70	60	12	6.7	5.3	44.1
9	PP	Clapboard	1.5	—	50	50	10	5.3	4.7	47.0
10	PBT	Contact of	0.5	1.5	80	70	16.2	13.1	3.1	19.1

► Target of effect (about structure of molding parts)

The time for solidying each part	The effect of using spiral cooling sprue bushing
Solidifying time of product, runner < sprue bushing solidifying	Shorten the cooling time and keep the forming steady
Solidifying time of product, runner ≥ sprue bushing solidifying	Forming steady continually

►Target of effect (about product thickness)

Product Thickness(mm)	Effect
0	↑ Profound effect ↓ Ineffective Bifurcation (Product thickness 1.6mm)
1.0	
1.6	
2.0	

❗ It is a profound effect when the thickness of product is less than 1.6mm

► The effect of an increase in the number of products by using Spiral cooling sprue bushing

Evaluated cost reduction by reducing molding cycle with spiral cooling sprue bushing.
Possible to expect a cost reduction from thousands to millions of yen (shown the table below)
Possible to cut the number of die for production by reducing molding cycle
"The table below shows by common calculational procedure"

● Cost saving table based on calculation of reduced molding cycle with number of shot (Unit : JPY)

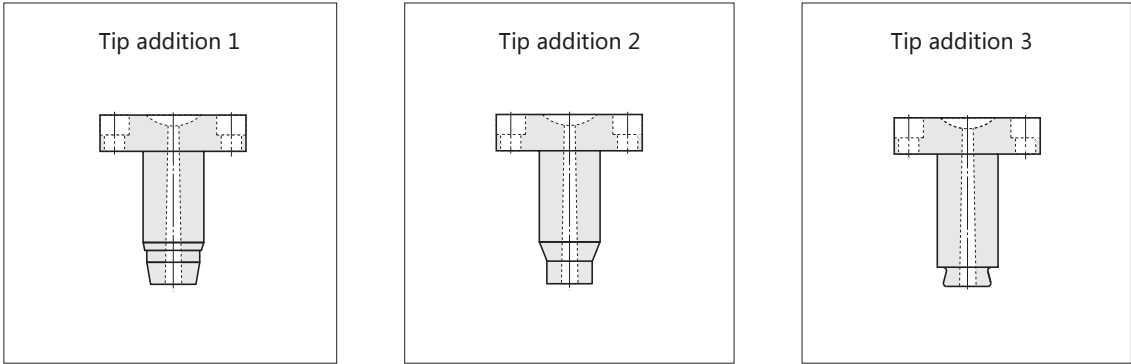
Shortened cooling time(sec.)	Number of shot					
	50,000	100,000	200,000	300,000	500,000	1,000,000
1	20,833	41,667	83,333	125,000	208,333	416,667
2	41,667	83,333	166,667	250,000	416,667	833,333
3	62,500	125,000	250,000	375,000	625,000	1,250,000
4	83,333	166,667	333,333	500,000	833,333	1,666,667
5	104,167	208,333	416,667	625,000	1,041,667	2,083,333
6	125,000	250,000	500,000	750,000	1,250,000	2,500,000
7	145,833	291,667	583,333	875,000	1,458,333	2,916,667
8	166,667	333,333	666,667	1,000,000	1,666,667	3,333,333
9	187,500	375,000	750,000	1,125,000	1,875,000	3,750,000
10	208,333	416,667	833,333	1,250,000	2,083,333	4,166,667

● Evaluate: forming fee=1,500(JPY/hour)

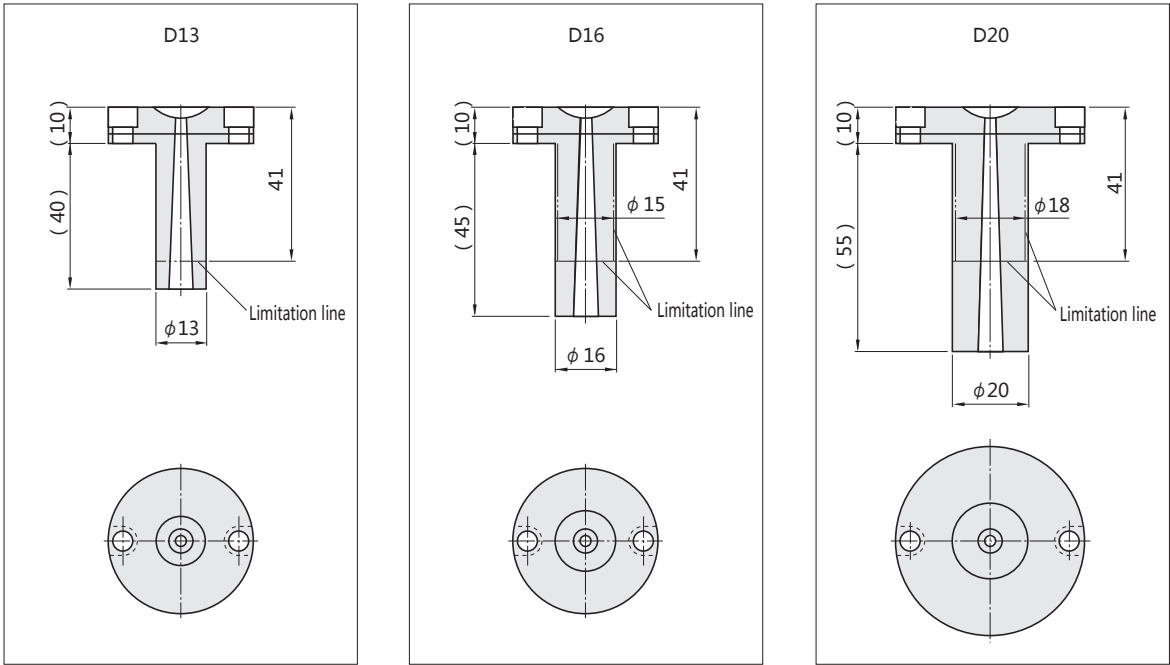
► Tip addition

● Feel free to contact us when any hird of special shape is needed.

● Example of tip addition



● Limitation



Spiral cooling sprue bushing

punch
PLASTIC MOLDING COMPONENTS TI SERIES

[illegible]

- | Code No. | | A | P | L | D ₁ | P ₁ | P ₂ | D _{h6} | |
|---------------|----|---|---|----|----------------|----------------|----------------|-----------------|---|
| Code | D |  0.5 |  0.5 | | | | | | |
| TISB
TISBP | 13 | 2.0 | 2.0~3.0 | 40 | 40 | 30 | 28 | 13 | $\begin{smallmatrix} 0 \\ -0.011 \end{smallmatrix}$ |
| | 16 | 2.0~3.0 | | 45 | | | | 16 | |
| | 20 | 2.0~4.0 | | 55 | 50 | 36 | 35 | 20 | $\begin{smallmatrix} 0 \\ -0.013 \end{smallmatrix}$ |



Code	addition	
LC	L alteration	To alter L $31.0 \leq LC < L$ 0.1 α changes with LC LC40
Code	addition	
DGC	Tip taping alteration	To alter taping on tip. $1 \leq DGC \leq 10$ $\alpha + 2 \leq V < D$ DGC: 1 V: 0.1 $31 \leq L - t$ $t = \frac{D - V}{2 \tan(DGC - 0.25)}$ DGC5-V12

EX

Fixed clamping plate

2-Rc1/8

Fixed mold plate or runner pushing plate

2-O ring groove

P₂

2-φ4

A part

1.4

Spiral cooling sprue bushing

2-φ6

E

L

A Enlarge

φ4

O ring

1.4 ± 0.05

φ4

φ9 +0.05

- ## Spiral cooling sprue bushing

CHARACTERS OF PLASTIC MATERIAL(1)

			Thermoplastic material							
			Polythene			Ethane-vinyl acetate	Ethane-ethyl acrylate	Ionomer resion	Polypropylene	
			LDPE	HDPE	UHMWPE				homopolymer	copolymer, 40% fiberglass
Forming ability	JIS K6899-1		PE-LD	PE-HD	PE-UHMW	EVA	EEA		PP	PP
	pre-drying	temperature °C	—	—	—	—	—	—	—	—
		Time hr	—	—	—	—	—	—	—	—
	Injection forming	Cylinder temperature °C	150~235	175~260	—	175~220	175~220	150~290	190~290	190~290
		Molding temperature °C	20~60	10~60	—	20~60	20~60	20~60	10~60	10~60
		Forming shrinkage %	2~2.2	1.5~5	—	0.7~3.5	0.2~0.6	0.3~1.0	1.0~2.5	1.0~2.5
		Flowing rate L/t	120~240	200~600	—	320				
Extrusion temperature °C		150~235	175~275	200~260	150~195	150~195	150~235	200~260	200~260	
1) Re-manufacture	chemic-electroplate		—	—	—	—	—	—	—	—
	Plating print		+	+	+	+	+	+	+	+
	Vacuum distill plating		+	+	+	+	+	+	+	+
	Print		+	+	+	+	+	+	+	+
	Supersonic weld		—	—	—	—	—	—	—	—
	Conqlutinatiion		—	—	—	—	—	—	—	—
ConsistencyJIS K7112 g/cm³			0.917~0.932	0.941~0.965	0.94	0.922~0.943	0.93~0.94	0.93~0.96	0.90~0.91	0.89~0.91
Mechanical	stretch ASTM D638 MPa		10~20	22~30	38	15~27	4~22	17~37	30~42	28~38
	Ductibility ASTM D638 %		100~1000	600~1000	425~525	300~750	200~900	300~700		
	Camber ASTM D790 MPa		170~500	600~1200		5~20		<40	1100~2000	900~1400
	Impulse (Izod) ASTM D256 kJ/m²		un-break	210~220	un-break	un-break	un-break	un-break	20~75	60~75
	Hardness	Rockwell hardness JISK7202			R50				R80~100	R65~96
		Hardness instrument JISK7215 Bacoor	D44~60	D66~73	D61~63	D17~45	D16~49	D60~65		D70~73
Heat-resistant	melting point									
	crystal melting point °C	98~115	130~140	125~140	40~100			160~175	150~170	
	vitrify temperature °C						86~98	-20		
	Load bending temperature (JIS K7207) (bending force0.455MPa) °C	40~45	80~90	40~50			40~47	50~60	85~100	
	(bending force1.8MPa) °C			70~80					55~60	
Others	Thermal dilation rate 10 ⁻⁶ /K		100~220	60~110			24~28	80~100	70~95	
	Heat exchange rate W/(m·K)		0.33~0.34	0.46~0.50			0.24	0.17	0.15~0.17	
	transparency		semi-transparency	semi-transparency	transparency	semi-transparency	semi-transparency	transparency	semi-transparency	
	Bibulous (24hrs) JIS K7209 %		<0.01	<0.01	<0.01				0.01~0.03	0.03

			Thermoplastic material						
			PVC		polymethyl methacrylate	polyamide (nylon)			
			Hard	Soft		nylon6	30% fiberglass	nylon66	30% fiberglass
JIS K6899-1			H-PVC	S-PVC	PMMA	PA6	PA6-GF30	PA66	PA66-GF30
Forming ability	pre-drying	temperature °C	—	—	80	80	80	80	80
		Time hr	—	—	2~6	8~15	8~15	8~15	8~15
	Injection forming	Cylinder temperature °C	150~200	150~200	180~280	230~290	230~290	265~300	265~300
		Molding temperature °C	10~80	10~20	40~90	40~120	40~120	80~120	80~120
		Forming shrinkage %	0.1~0.5	0.1~0.5	0.1~0.4	0.5~1.5	0.3~0.5	1.7~2.2	0.2~0.6
		Flowing rate L/t	160~250	150~500	200~500	400~600		800	
	Extrusion temperature °C		160~200	150~200	180~260	230~275			
1) Re-manufacture	chemic-electroplate								
	Plating print		++	++	++	++	++	++	++
	Vacuum distill plating		++	++	++	+	++	+	+
	Print		++	++	++	++	++	++	++
	Supersonic weld		++	-	++	+	++	+	++
	Conqlutinatiion		++	++	++	++	++	++	++
ConsistencyJIS K7112 g/cm³			1.30~1.58		1.17~1.20	1.12~1.14	1.35~1.42	1.13~1.15	1.35~1.4
Mechanical	stretch ASTM D638 MPa		40~50	10~24	70~75	70~85	160	80~85	185
	Ductibility ASTM D638 %		40~80	200~450	2~10	200~300	2.2~3.6	2.5~4	2.5~4
	Camber ASTM D790 MPa		2300~4000		2500~3300	2500	8300~9700	1700~3700	8700
	Impulse (Izod) ASTM D256 kJ/m²								
	Hardness	Rockwell hardness JISK7202			M85~105	R119	M93~96	R120	R101~119
Hardness instrument JISK7215		D65~85	A50~100						
Heat-resistant	melting point	Bacoor							
		crystal melting point °C				210~220		255~265	
	vitrify temperature °C		24~40	24~40	90~105				
	Load bending temperature (JIS K7207)	(bending force0.455MPa) °C	60~80		80~105	185~190	215~220	215~245	210~260
		(bending force1.8MPa) °C	60~80		75~100	70~85	200~215	210~255	210~255
Others	Thermal dilation rate 10 ⁻⁶ /K		50~100	70~250	50~90	80~83	16~80	80	15~54
	Heat exchange rate W/(m·K)		0.4~0.6	0.35~0.4					
	transparency		transparency	transparency	transparency	semi- transparency		semi- transparency	
Bibulous (24hrs) JIS K7209 %			0.15~0.75	0.04~0.4	0.1~0.4	1.3~1.9	0.9~1.2	1.0~2.8	0.7~1.1

remarks: Normal data. 1) ++Better +fine - failure 1MPa=10.2kgf/cm 1W(m·K)=0.860kcal (m·hr·°C) 1kJ/m²=0.981kgfcm/cm²

Thermoplastic material											
Polypropylene copolymer, 40% fiberglass	4-methyl- 1-pentene	polystyrene		cinnamic- maleic anhydride	cinnamic- acrylonitrile	30% fiberglasss	ABS			Acrylonitrile/ Cinnamic / Acrylate	Acrylonitrile/ Ethene / Cinnamic
		Normal	hige-impulse force				high-riqid	High force resistant	30% fiberglasss		
PP-GF40	PMP	PS(GPPS)	SB(HIPS)	SMA	SAN	SAN-GF30	ABS	ABS	ABS-GF30	ASA	AES
—	—	—	—	80	80	80	80	80	80	80	80
—	—	—	—	2~4	2	2	2	2	2	2	2
230~290	270~330	170~250	170~250	220~265	180~290	200~290	200~290	200~260	200~260	200~260	200~260
20~90	30~80	20~60	20~80	50~90	50~80	50~80	50~80	60~80	50~80	40~80	40~80
0.3~0.5	1.6~2.0	0.4~0.7	0.4~0.7	0.4~0.6	0.3~0.5	0.1~0.2	0.1~0.2	0.4~0.9	0.1~0.2	0.5~0.7	0.4~0.7
		200~500	200~500								
200~260		180~250	180~250	90~260	180~230						
-	-						++	++	+		
+	+	++	++	++	++	++	++	++	++	++	++
+	+	++	++	++	++	++	++	++	++	++	++
+	+	++	++	++	++	++	++	++	++	++	++
+	-	++	++	++	++	++	++	++	++	++	++
-	-	++	++	++	++	++	++	++	++	++	++
1.22~1.24	0.83	1.04~1.05	1.03~1.06	1.08~1.12	1.06~1.08	1.22~1.3	1.03~1.06	1.01~1.05	1.22	1.05~1.08	1.05~1.06
56~100	15~17	40~57	25~35	35~65	65~80	110~120	40~50	32~42	100~120	27~40	45~50
1.5~4	25~120	1.5~2.5	25~35	1.8~3.0	1~1.2	2	3~25	5~40	2		20~25
7500~10000	450~1300	2200~3200	2000~2700	2200~3100	3200~3700	7000~9000	2000~2700	1500~2200	6700	1800~2300	2350~2600
	40			2							
R102~111	R35~80	M70~85	M60~80	M70~80	M80~90	M100~105	R110~115	R85~105	R114~117	R95~115	R100~113
	235~240										
		85~110	93~105	114	125	125	110~125	95~110			
165	100						98~108	95~108	110	93~100	
150~165	80~90	75~90	70~95	101~118	88~94	101~104	95~105	95~102	105~115	85~88	85~105
27~32	65	60~80		80~90	65~68	38~40	80~100	95~110	38~40	80~90	60~100
0.4	0.12	0.13					0.21~0.23	0.21~0.23			
	transparency	transparency	ivory	transparency	transparency		ivory	ivory		ivory	ivory
	0.01	0~0.03	0.04~0.07	0.1	0.2~0.3	0.15~0.3	0.2~0.45	0.2~0.45	0.15~0.3	0.3~0.4	0.3

Thermoplastic material												
polyamide (nylon)		Nylon MXD6 30% fiberglass	POM	30% fiberglass	Polycells		polyethylene terephthalate		Polybutylece terephthalate		MPPO	30% fiberglass
nylon11	nylon12											
PA11	PA12	PA/MXD6-GF30	POM	POM-GF30	PC	PC-GFG30	PET	PET-GF30	PBT	PBT-GF30	PPE/PS	PPE/PS-GF30
80	80	80	—	—	120	120	120	120	120	120	100	100
8~15	8~15	8~15	—	—	>4	>4	>4	>4	>4	>4	2	2
200~270	200~270	245~290	180~230	180~230	270~300	290~340	265~325	265~275	225~275	225~275	200~300	200~300
20~100	20~100	120~140	60~120	60~120	80~120	80~120	130~150	40~80	40~80	40~80	40~120	40~120
1.2	0.3~1.5	0.3~0.5	2~25	0.4	0.5~0.7	0.1~0.3	2~2.5	0.9~2.2	0.2~0.8	0.2~0.8	0.5~0.8	0.2~0.4
200~500	200~500		50				500					
200~250	175~200										225~275	
					+						+	
++	++	++	+	+	++	++	+	+	+	+	++	++
+	+	+	+	+	++	++	+	+	+	+	+	+
++	++	++	+	-	++	++	+	+	+	+	++	++
-	-	++	++	++	++	++	+	++	++	++	++	++
++	++	++	-	-	++	++	-	-	-	-	++	++
1.03~1.05	1.01~1.12	1.34	1.40~1.42	1.61	1.2	1.41~1.43	1.29~1.40	1.55~1.57	1.30~1.38	1.48~1.50	1.06~1.10	1.28~1.32
55~56	34~60	126	60~75	125	55~70	125~135	47~70	140~155	55~60	94~125	40~60	100~125
300	250~390	3	10~75	3	100~130	0.2~0.5	30~300	2~7	50~300	2~4	50~60	2~5
1000	1200~1250	7750	2700~3600	8200	2000~2500	6400~8000	2700~11000	8700~11000	2400~3000	8700~9700	2100~2500	6500~8500
			60~120		750~1000	80~160			38~52			
R108	R70~109	M112	M78~94	M90	M77	M92~R119	M94~101	M90~110		M90	R110~120	R115~126
191~194	160~209		175~181				245~265		200~267			
					140~150		73~80				110~112	
	70~150		155~170		138	150~152	65				110~137	
50~55	40~60	209	110~125	163	130~140	145~150	21~38	21~23	50~85		82~129	135~158
100~150	120~180	18	50~120		68	22~23	65	25~30	60~95	210~215	33~40	14~25
		0.49	0.23		0.2	0.6~0.95	0.14~0.15		0.18~0.29		0.46~0.7	0.44~0.47
semi-transparency	semi-transparency	semi-transparency	ivory		transparency		transparency; ivory		ivory		ivory	
0.3	0.3	0.27	0.22~0.4	0.29	0.1~0.2	0.15	0.1~0.2	0.05	0.08~0.09	0.06	1.06~1.1	0.06

			Thermoplastic material							
			PPS	30% fibergalss	LCP	30% fibergalss	Polysulfone	PES	PEEK	PAR
JIS K6899-1			PPS	PPS-GF30	LCP	LCP-GF30	PSU	PES	PEEK	PAR
Forming ability	pre-drying	temperature °C					160			120
		Time hr					5			6~8
	Injection forming	Cylinder temperature °C	280~350	280~350	280~320	290~320	315~370	320~390	350~400	315~400
		Molding temperature °C			10~40	120~170	100~160	110~180	130~170	120~140
		Forming shrinkage %	1.5~1.6	0.4~0.9	0.1	0~0.4	0.7	0.6	1.1	0.6~0.9
		Flowing rate L/t								
	Extrusion temperature °C					325~380	300~350			
1) Re-manufacture	chemic-electroplate									
	Plating print		—	—	+	+	+	+	++	++
	Vacuum distill plating		+	+	+	+	++	++	++	++
	Print		+	+	+	+	++	++	++	++
	Supersonic weld		++	++	++	++	++	++	++	++
	Conqlutinatiion		—	—	—	—	++	++	++	++
ConsistencyJIS K7112 g/cm³			1.35	1.57~1.6	1.35~1.4	1.62	1.24~1.25	1.37	1.3	1.21~1.22
Mechanical	stretch ASTM D638 MPa		80~85	190	105~134	140~210	68	83~84	100	58~65
	Ductibility		1~2	0.9~4	1.3~4.5	2~2.4	5~10	40~100	>60	50~65
	Camber ASTM D790 MPa		3700	10000	12500~16000	10300~14700	2400	2600~2650	4000	2000~2200
	Impulse (Izod) ASTM D256 kJ/m²									
	Hardness	Rockwell hardness JISK7202	M89	M100	R89	M84	M69	M69,R120	M99,R126	R125
Hardness instrument JISK7215										
Heat-resistant	melting point	Bacoor								
		crystal melting point°C	285~290	285~290	230~280	230~280				
		vitrify temperature °C	88	88			190			190
	Load bending temperature (JIS K7207)	(bending force0.455MPa) °C					180			180
		(bending force1.8MPa) °C	135	250~260	170	230	177	174~220	152~156	170~175
	Thermal dilation rate 10 ⁻⁶ /K		49	22	0~1	0.2	5.6	5.5	4.7	61~62
	Heat exchange rate W(m·K)		0.11	0.13		0.2			0.25	0.14
Others	transparency						transparency	transparency	transparency	transparency
	Bibulous (24hrs) JIS K7209 %		<0.02	0.02		0.05	0.3	0.4	0.5	0.03

			Thermoplastic material						
			acetyl cellulose	polyetherimide	fluororesin				
JIS K6899-1			CA	PEI	PTFE	FEP	PFA	ETFE	PVDF
Forming ability	pre-drying	temperature °C	80						
		Time hr	2~4						
	Injection forming	Cylinder temperature °C	170~260	340~400		330~400	350~410	290~320	180~280
		Molding temperature °C	40~80	60~175			95~230	60~120	
		Forming shrinkage %	0.3~1.0	0.7		3~6	2~3	2~3	2~3
1) Re-manufacture	Flowing rate L/t		250~600						
	Extrusion temperature °C								
	chemic-electroplate				—	—	—	—	—
	Plating print		++	++	—	—	—	—	—
	Vacuum distill plating		++	++	—	—	—	—	—
Mechanical	Print		++	++	—	—	—	—	—
	Supersonic weld		—	++	—	—	—	—	—
	Conqlutinatiion		++	++	—	—	—	—	—
	Consistency JIS K7112 g/cm³		1.22~1.34	1.27	2.14	2.12~2.17	2.12~2.17	1.73~1.74	1.76~1.78
	stretch ASTM D638 MPa		25~60	105	27~34	20~29	27~31	44~49	44~49
Heat-resitant	Ductibility		6~70	60	200~400	250~350	250~350	420~450	100
	Camber ASTM D790 MPa		780~2000	3300	340~640	600	660	910	1270~1670
	Impulse (Izod)	ASTM D256 kJ/m²			un-break	un-break	un-break	un-break	
		Rockwell hardness JISK7202	R45~95	M109				R50	R110~115
		Hardness instrument JISK7215			D50~60	D55	D60		
Others	Bacoor								
	melting point	crystal melting point °C			327	260~280	300~305	267	160~170
		vitrify temperature °C	230						
	Load bending temperature (JIS K7207)	(bending force0.455MPa) °C	~90		55	70	75	67	110~130
		(bending force1.8MPa) °C	55~72	200					
transparency	Thermal dilation rate 10 ⁻⁶ /K		60~100	56	100	100	100	50~100	70~140
	Heat exchange rate W(m·K)		0.17~0.33		0.25	0.25	0.25	0.28	0.16
	Bibulous (24hrs) JIS K7209 %		1.7~6.5	0.25	<0.01	<0.01	0.03	<0.1	<0.05

Article 1 (Components Covered by Warranty)

1.All warranties on products purchased by the customer from Punch Industry Co., Ltd. (the "Company") (the "Products") that are listed in the Standard Components for "TI Series Spiral cooling sprue bushing catalog" (the "Catalog") are regulated exclusively in accordance with the following warranty provisions (this "Warranty"). This Warranty shall be also applicable to any custom-ordered products.

2.In respect of any products not manufactured by the Company, only the warranty, if any, furnished by the manufacturer or supplier of such products shall apply.

Article 2 (Acceptance Inspection)

The customer's acceptance of delivery of the Products shall be conclusive evidence that the customer has examined the Products and found them to be complete, in accordance with the description on the sales order or as specifically agreed in writing between the Company and the customer, in good order and condition and fit for such purpose as contemplated by both parties, if any, for which they were supplied unless otherwise brought to the notice of the Company within seven (7) days from the date of receipt of the Products.

Article 3 (Warranty Period)

The warranty period for the Products shall be one (1) year from the delivery date to the customer.

Article 4 (Warranty Standard)

1.With respect to the Products purchased by the customer, the Company will replace or repair all or part of the Products free of charge if it is deemed by the Company that there is any damage, deformation, distortion or defect to the Products (the "Defects") that is proven to be attributable solely to the Company, on the condition that the written notification stating sufficient particulars of the Defects is reached to the Company within one (1) year from the delivery date of such defective product.

2.Minor flaws such as scratches, marks or dents that do not make the Products unusable do not constitute the Defects and thus fall outside the scope of this Warranty, provided, however, that the Company deems any flaws such as scratches, marks or dents to be particularly significant, and such flaws constitute the Defects.

3.The sole warranty shall be the repair or replacement of the Products.

4.Depending on very nature of the Products, or date of manufacture, specifications or discontinuance of manufacture/sale of the Products, etc., the Company will not be able to replace or repair any or all part of the defective products as the case may be.

5.Except as specifically provided in this warranty, the company makes no other warranties, expressed or implied, in respect of the products, including without limitation, any implied warranties of merchantability or of fitness for any particular purpose. This warranty shall supersede any disclaimer or warranties statement which is included in any documentation provided with the products, to the extent the provision of such disclaimer of warranties are inconsistent with this warranty.

Article 5 (Outside the Scope of Warranty)

1.The following Defects shall fall outside the scope of this Warranty:

a.Defects caused by the customer's using the Products in violation of the provisions of this Warranty;

b.Defects caused by natural disasters, including, without limitation, earthquakes, tsunamis, fires, floods, hurricanes, tornados;

c.Defects caused by the customer's processing, repairing, modifying or disassembling the Products;

d.Defects caused by the customer's rebuilding or repair by the customer without permission of the Company;

e.Defects in the Products caused by the willful misconduct or negligence of the customer;

f.Defects caused by the customer's use or diversion for military purposes, such as weapons, arms or armaments;

g.Defects caused by the customer's use of the Products for such purposes or in such manners as are not expected by the Company;

h.Defects caused by the customer's use in violation of any provision in the Catalog or any documentation attached to the Products (including auxiliaries thereto) that describes specification, intended purpose, precautionary statement, prohibited matter, condition of use, drawing or any other items on the Products;

i.Defects attributable to any equipment other than the Products themselves; or

j.Defects caused by the customer's use of the Products for any purpose other than the intended one (i.e., use as a part/component for a general production equipment). In this case, "general production equipment" means plastic mold tools, but does not include, without limitation, production equipment for transportation devices for the purpose of transporting humans, such as automobiles, vehicles or ships, medical equipments for the purpose of curing or diagnosing humans, aerospace instruments, nuclear equipments, or consumer goods that are used in general households such as electronic and electric equipment.

2.The Company shall be exempt from any liability in this Warranty in the case where the Company clearly disclaims its obligation to replace or repair the Products in the Catalog or there is any special agreement between the Company and the customer that precludes application of this Warranty.

Article 6 (Disclaimer)

1.The Company shall not be liable for any damages arising out of or in connection with any of the following cases:

a.Infringement of patent right, utility model right, design right, trademark or any other intellectual property right of any third party in relation to the Products;

b.Delay in or prohibition of exportation of the Products due to laws, ordinances or regulations; or

c.Defects in the Products enumerated in the first paragraph of the preceding article.

2.The Company's liability in connection with the Products shall in no circumstances exceed their invoice price.

Article 7 (Warranty Standard for Oversea Customer)

This Warranty shall be applicable to use of the Products overseas. However, if the defect, trouble or damage of the Products used overseas is caused by nonconformity to the overseas technical standard, laws or regulation, shortage of electricity, defective facilities or any other difference of usage environment from that in Japan, the Company shall deem it as Item g, Paragraph 1 of Article 5 which falls outside the scope of this Warranty.

Article 8 (Usage Restriction)

This Warranty shall not be available to the Products which are used or diverted for military-related products such as weapons, arms or armaments, used in production facilities thereof or military-related factories or used for any other military-related purpose.

Article 9 (Governing Law and Jurisdiction)

This Warranty shall be governed by and construed in accordance with the laws of Japan. All dispute arising out of or in connection with this Warranty shall be subject to the exclusive jurisdiction of the Tokyo District Court as the court of first instance.