1.Introduction

1) Difference between die casting(DC) and gravity die casting(GDC)

< Casting condition >

	GDC	DC	Remark
Casting speed (m/ s)	2 ～ 3	30 ～ 60	DC is faster
Casting pressure (kg / c ㎡)	0.05 ～ 0.15	600 ～ 800	DC's pressure is higher
Pressure rising time (s)	————	0.05 ～ 0.1	No condition in GDC

GDC casting speed and pressure calculation

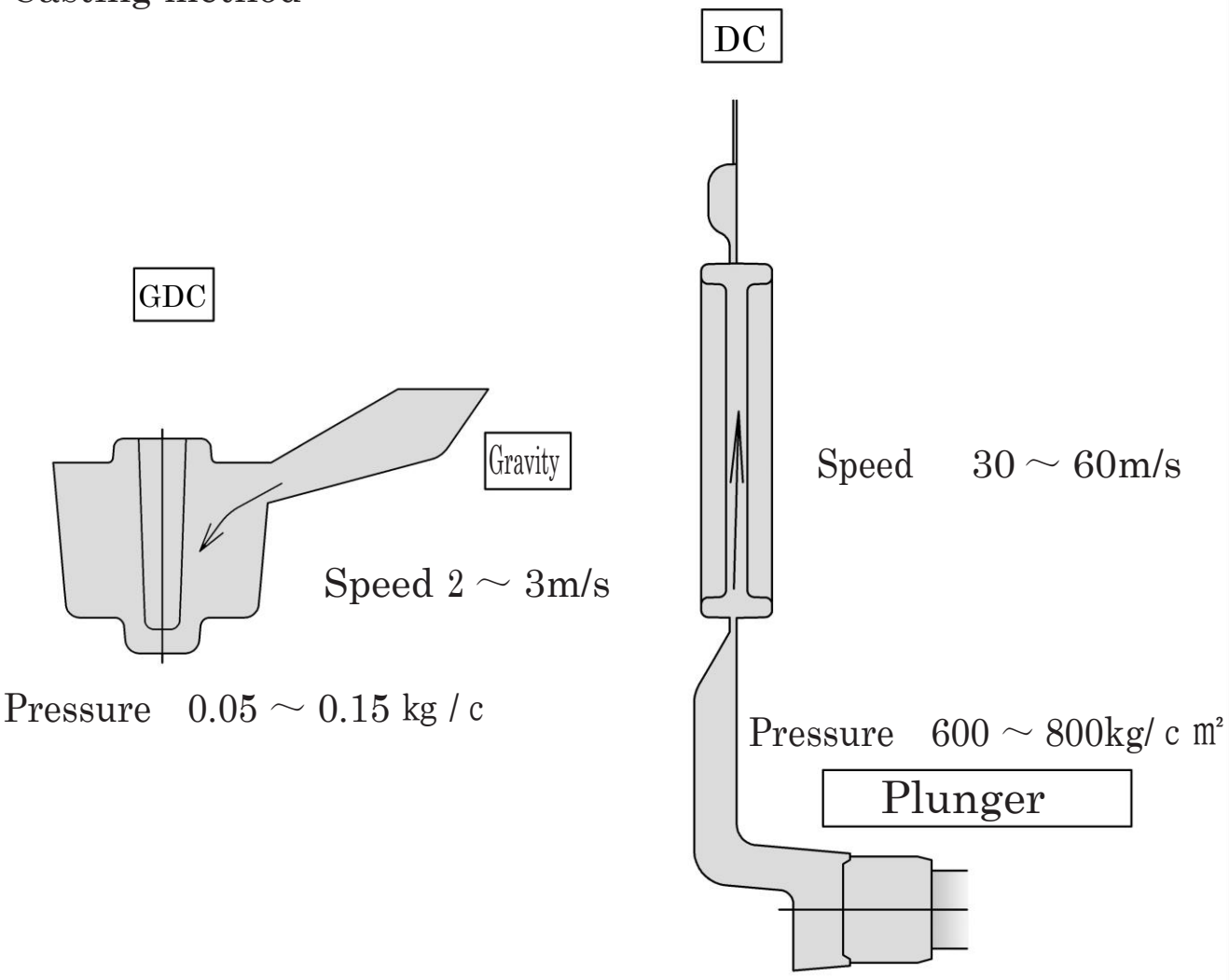
$V = \sqrt{2gh}$

$g = 9.8/s^2$

h = 20 cm～50 cm

AL molten metal density is 2.5.

< Casting method >



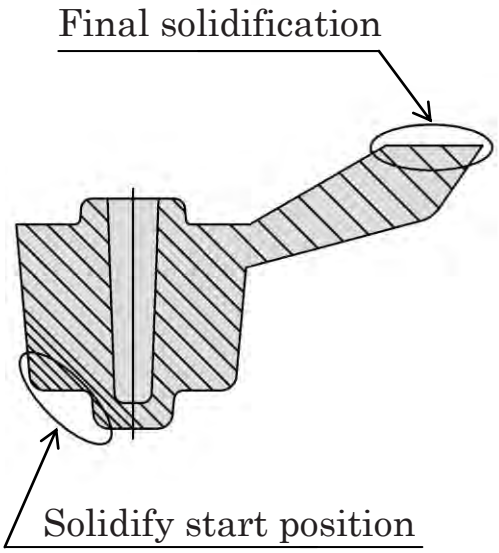
< Solidification method >

DC

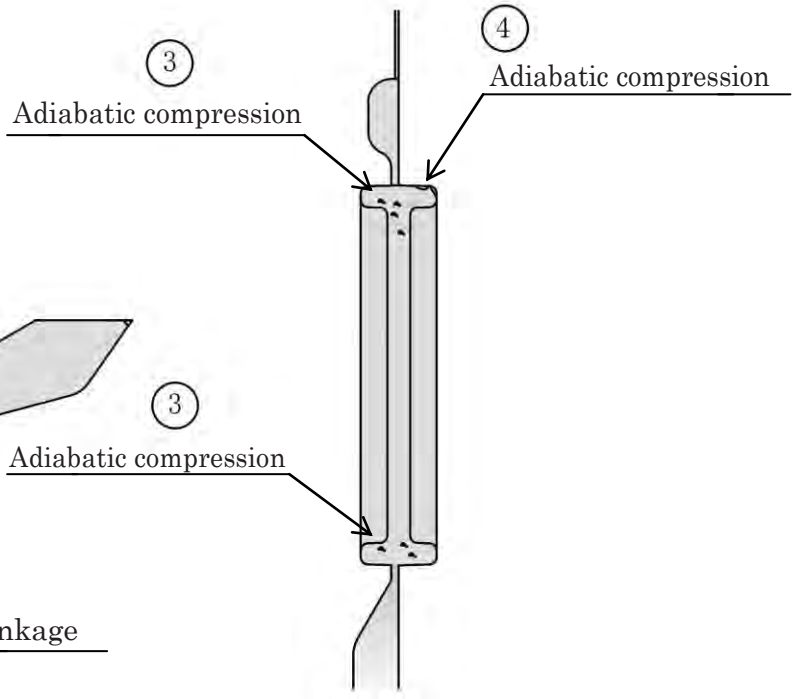
Outside and inside solidify at the same time

GDC

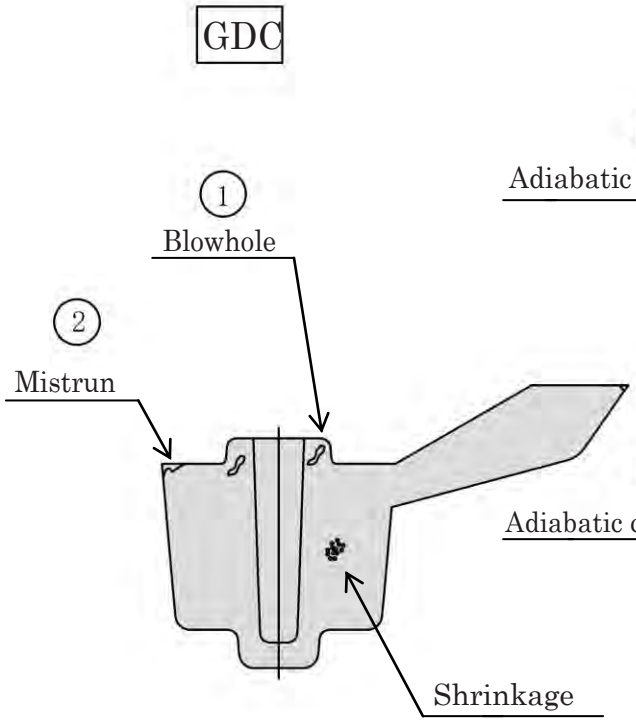
Directivity solidification



DC



GDC



① ② Gas causes defectivity.

③ ④ Adiabatic compression causes defectivity.

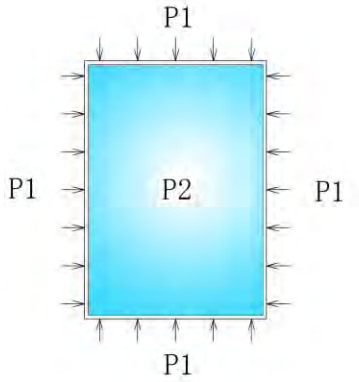
2.Basis of vacuum die casting

1) Vacuum industrial definition

Pressure of specific space is lower than atmospheric pressure. (JISZ8126)

(Vacuum die casting belongs to low vacuum of industrial definition)

< Reference Vacuum unit >

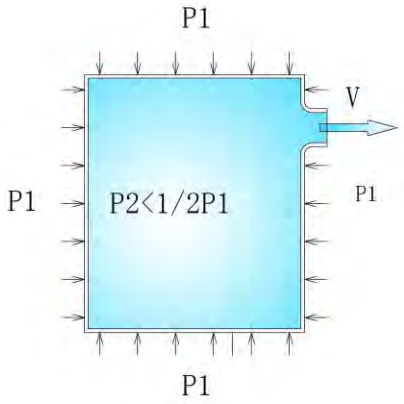


P2(Specific space)<P1(Atmospheric pressure)

1atm=760Torr=1.01325×10^5 Pa=1.01325×10^{2}kPa

Low Vacuum 100kPa ～ 100Pa (Common vacuum die casting)
Medium Vacuum 100Pa ～ 0.1Pa
High Vacuum 0.1Pa ～ 10^{-5} Pa

< Reference Gas exhaust speed >



Please refer to left picture, cross section of valve is decided by following condition.

Exhaust speed V=250 ～ 280m/s

(Sound velocity 340m/s)

$V \times S > V_1 \times S_1$

V : Exhaust speed S : Valve cross section

V_1 : Plunger speed S_1 : Plunger cross section

2	Productive vacuum die casting way of thinking 5/10
	Exhaust gas of cavity by using vacuum die casting.
	(It is a very effective way to exhaust gas by this way)
3	Nonproductive vacuum die casting way of thinking
	Exhaust gas of cavity can ensure fill of molten metal more easily.
4	Reason of defective products
	It is adiabatic compression which causes defective products in die casting.
	When it happens outside of product, it causes soldering.
	When it happens inside of product, it causes blowhole or porosity.
5	Gas of die casting produce and solution
	-1 Gas of mold cavity and sleeve
	Vacuum die casting can solve this gas completely.
	-2 Gas of release agent
	Please use water soluble release agent or make sure temperature of mold is higher than 120 degree Celsius.
	-3 Gas of chip lubricant
	If chip lubricant is not used any more, no such gas happens .
6	Relationship between gas value and product quality
	We judge quality by gas value CC/100g .

Gas value	Quality evaluation
Less than 2cc/100g	T6 is possible，very good quality
5cc/100g~10cc/100g	Very good quality
10cc/100g~15cc/100g	Good quality
15cc/100g~25cc/100g	Unstable quality
Higher than 25cc/100g	Defective percentage is high

Gas value of vacuum die casting is 7cc~13cc/100g

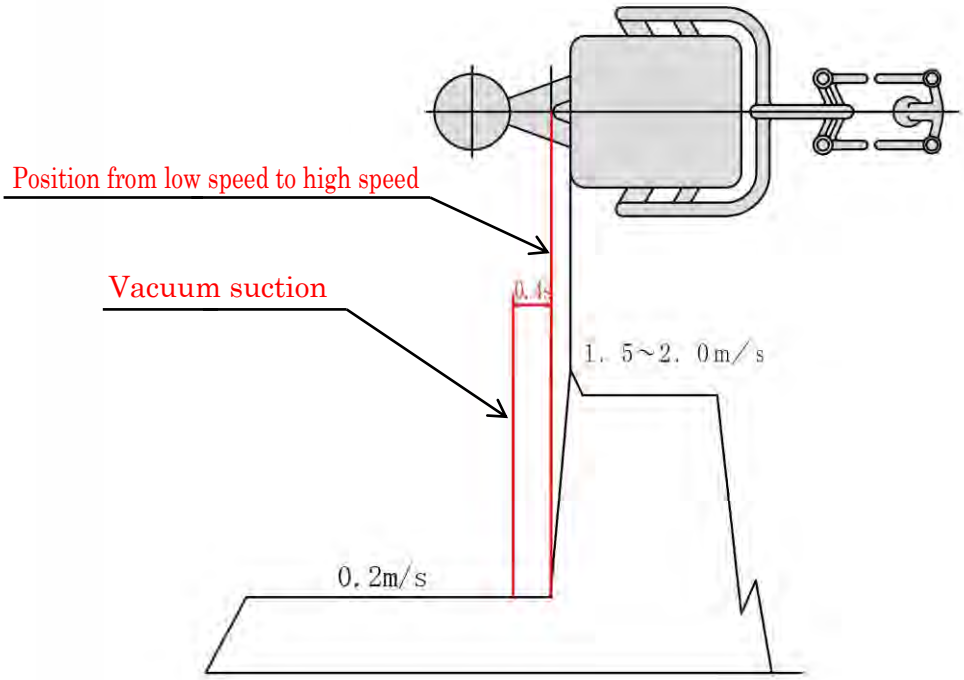
Reference density value and quality evaluation

ADC12

Density value	Quality evaluation
Low than 2.68	Low quality
2.68~2.70	Unstable quality
2.70~2.72	Good quality
2.72~2.74	Very good quality
2.765	So far, this is the best density by using our company's vacuum system

Bad gas of castings and reason

Gas type	Reason
N_2	If no vacuum suction, nitrogen of air is involved.
H_2	When mold temperature is too low, water of release agent is involved.
CH_4	Gas from release agent is involved
C_2H_6	Gas from chip lubricant is involved
CO	Not involved normally
CO_2	Not involved normally
O_2	Not involved

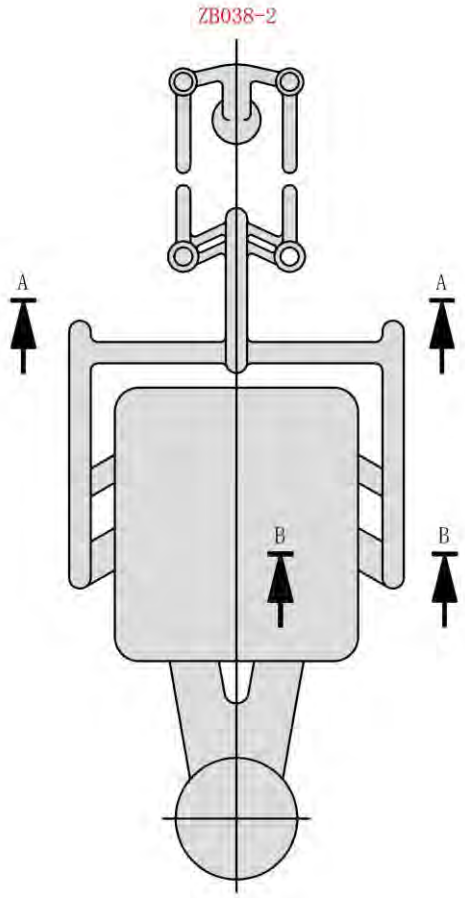


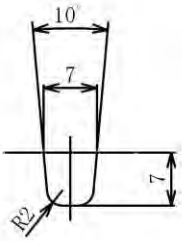
Vacuum casting design

Picture-1

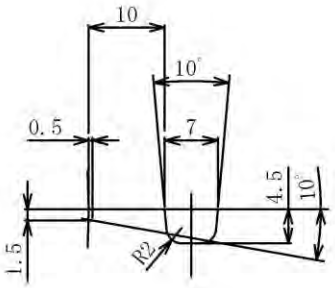
Picture-2

10）Vacuum casting design -1



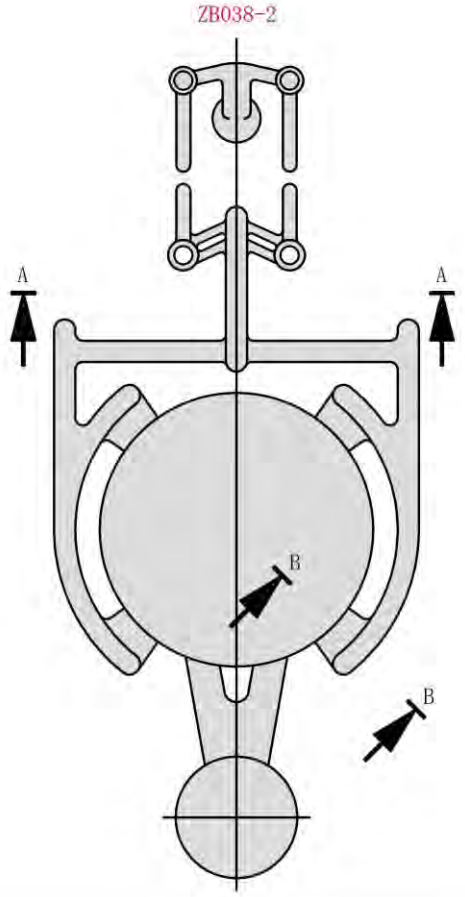


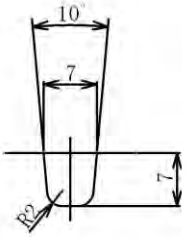
SEC. A-A



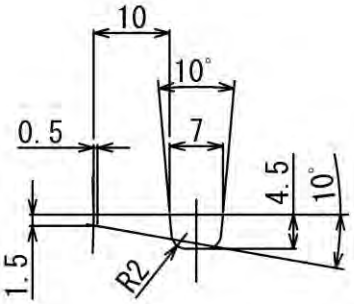
SEC. B-B

Vacuum casting design -2



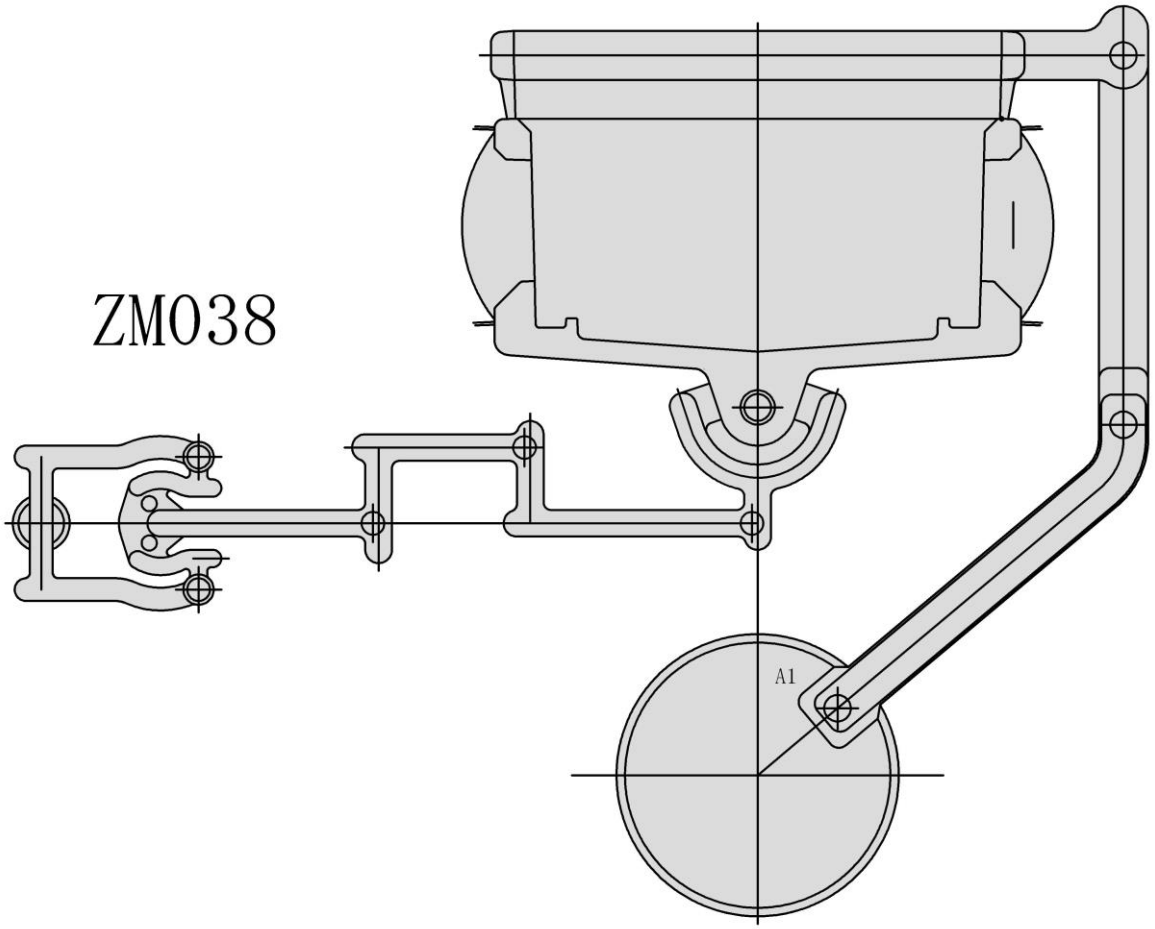


SEC. A-A



SEC. B-B

Vacuum casting design -3



Vacuum casting design -4

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