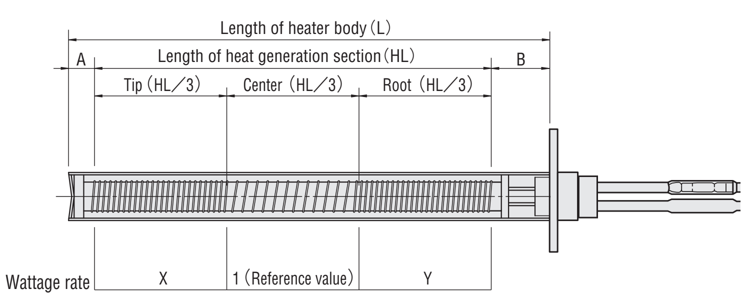
# GUIDE FOR CARTRIDGE HEATER SOAKING TYPE

## ■Characteristic

The heater wattage of a cartridge heater soaking type is divided and set into three zones according to the shape and size of the object being heated, and also the amount of heat dissipated, resulting in a more uniform heat distribution than that of a general cartridge heater.

This type is suitable for when the temperature of a general cartridge fails to stabilize, and the molded product is warped, its dimensions vary randomly, problems related to luster occur, or when more accurate die temperature distribution control is demanded such as when molding liquid silicone rubber (LSR) or thermosetting resin.

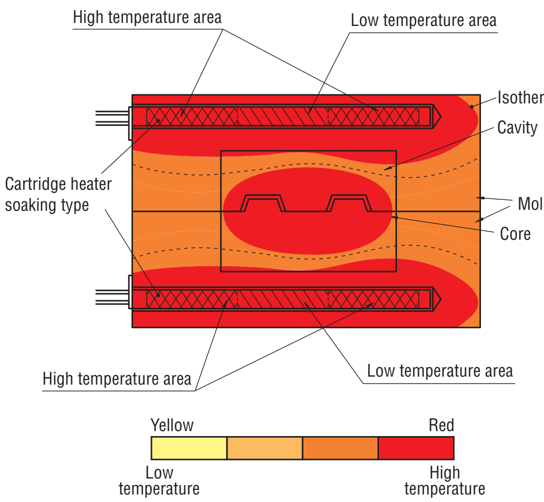
## ■Basic Structure Drawing



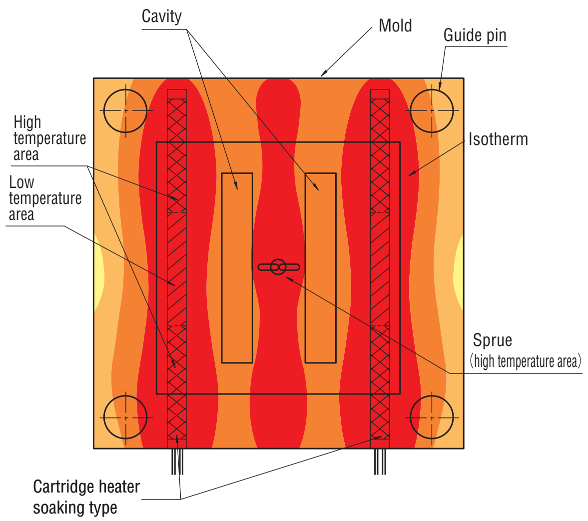

●Wattage rate
This means the distribution ratio with respect to the total wattage of the entire heater (W).
It is possible to specify the wattage rates of the tip and root as multiples with respect to the wattage of the center as the reference value of 1.

X＝Wattage rate of tip
1 (Reference value)＝Wattage rate of center
Y＝Wattage rate of root
A＋B＝Length of non-heat generating section

Isotherm distribution for the case where a cartridge heater soaking type is installed on the mold (outline drawing)




Isotherm distribution for the case where a cartridge heater soaking type is installed on the cavity die (outline drawing)




## ■Installation method and precautions for use

It is possible to install this type in the same way as an ordinary cartridge heater. For the method of installation and precautions for use, refer to "Outline of Cartridge Heater"

## ■Selection method

①**To raise mold temperature up to a preset temperature, calculate a necessary wattage to heater.**
It's calculated according to below calculation formula.

$$\text{Necessary wattage for heater (kW)} = \frac{\text{Weight of heated object (kg)} \times \text{Specific heat of heated object (Kcal/kg℃)} \times \text{Temperature increase (℃)}}{860 \times \text{Heating time (h)} \times \text{Efficiency } (\eta)}$$

Though it is difficult to calculate accurately efficiency ($\eta$) because it varies on conditions of heat insulation, insulation, arrangement of the heater, and etc., generally 0.2～0.5 is suitable.
Example) Necessary wattage (21℃) when controlling stainless mold of 130kg with heater and raising mold temperature up to 110℃ in 30 minutes

$$\text{Necessary wattage for heater (kW)} = \frac{130\,[\text{kg}] \times 0.11\,[\text{kcal/kg℃}] \times (110-21)\,[℃]}{860 \times 0.5\,[\text{h}] \times 0.5\,[\eta]}$$

●**Specific gravity/Specific heat of main materials**

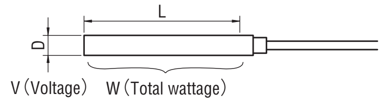
| Material | Specific weight (g/cm³) | Specific heat (kcal/kg℃) |
|---|---|---|
| Aluminum (7075) | 2.80 | 0.230 |
| Steel | 7.85 | 0.113 |
| Stainless steel | 7.82 | 0.110 |
| Brass | 8.70 | 0.100 |

②**Calculate number of heater and wattage for one heater.**
Decide the number of the heaters depending on the size of heated object, and get total wattage (W) required to rise the temperature of the heated object.
Example) Use six heaters of 1000 (W) (Total 6000W)
※The above calculation method does not concern heat loss.
Please consider approximately 20～30% increase for the calculated value in kW.

## ■Selection of soaking cartridge heater

①Determine the heater diameter (D), length (L), voltage (V) and the total wattage of the heater (W) in the same way as for a conventional cartridge heater.

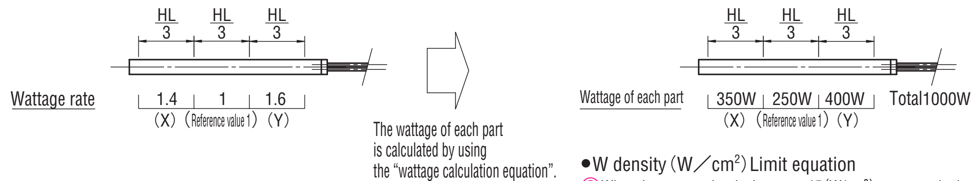
(Example) **MKCHA12－300－V220－W1000**
(D) (L) (V) (W)




②Determine the wattage rate of the tip (X) and the wattage rate of the root (Y) for the case where the wattage rate of the center is the reference value of 1.
＊Because the center is defined as the reference value of 1, there is no need to specify it.

(Example) **MKCHA12－300－V220－W1000－X1.4－Y1.6**
(D) (L) (V) (W) (X) (Y)

(Following example of wattage rate: When X and Y are specified based on reference values of a one-sided horizontal insertion die.)




●Wattage calculation equation of each part

$$\text{Wattage of tip} = W\,(\text{Total wattage}) \times \frac{X\ (\text{Wattage rate of tip})}{X+Y+1\ (\text{Total wattage rate})}$$

$$\text{Wattage of center} = W\,(\text{Total wattage}) \times \frac{1\ (\text{Wattage rate of center})}{X+Y+1\ (\text{Total wattage rate})}$$

$$\text{Wattage of root} = W\,(\text{Total wattage}) \times \frac{Y\ (\text{Wattage rate of root})}{X+Y+1\ (\text{Total wattage rate})}$$

●W density (W/cm²) Limit equation
When the wattage density becomes 15 (W/cm²) or more, wire breakage is liable to occur, so specify the W density of each part within the range 2～15 (W/cm²).

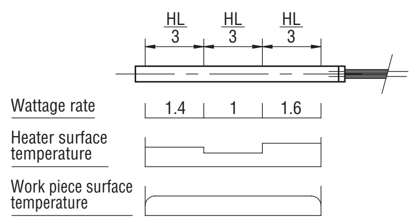
$$\text{Wattage density of tip (W/cm}^2) = \frac{\text{Wattage of tip}}{\frac{HL}{3} \times D \times 3.14 \div 100}$$

$$\text{Wattage density of center (W/cm}^2) = \frac{\text{Wattage of center}}{\frac{HL}{3} \times D \times 3.14 \div 100}$$

$$\text{Wattage density of root (W/cm}^2) = \frac{\text{Wattage of root}}{\frac{HL}{3} \times D \times 3.14 \div 100}$$

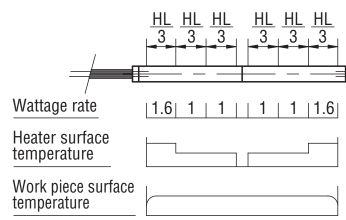
## ■Example of wattage rate (reference value)

One-sided horizontal insertion die



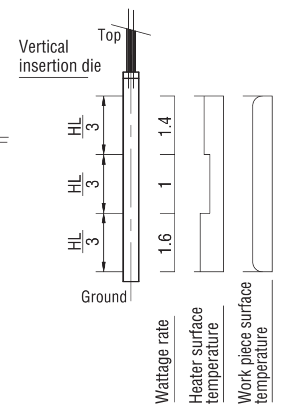

(Ordering example) **MKCHA12－200－V200－W300－X1.4－Y1.6**
(D) (L) (V) (W) (X) (Y)

Double side horizontal insertion die




(Ordering example) **MKCHA12－200－V200－W300－X1－Y1.6**
(D) (L) (V) (W) (X) (Y)

Vertical insertion die




(Ordering example) **MKCHA12－200－V200－W300－X1.6－Y1.4**
(D) (L) (V) (W) (X) (Y)

＊In the above wattage rate example, the wattage rate, heater surface temperature and surface temperature of the work piece are reference values. The temperature distribution of the heated work piece varies with the characteristics of the work piece (shape, size, material, heat dissipation), heater distribution and various other conditions, so the actual value will be different from the above.