■Wattage calculation

①Calculate necessary wattage (W) for a heater to raise mold temperature up to a preset temperature.

Calculate by the formula below according to the weight, specific heat, temperature increase, and heating time to reach the mold set temperature of the heated object.

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

Though it is difficult to calculate accurately efficiency (η) because it varies on conditions of heat-retention, heat insulation, arrangement of the heater, etc., generally 0.2～0.5 is suitable.

●Specific gravity/Specific heat of main materials

Material	Specific gravity (g/cm³)	Specific heat (kcal/kg℃)
A7075P (Aluminum)	2.80	0.230
Steel	7.85	0.113
Stainless Steel	7.82	0.110
Brass	8.70	0.100

●Glossary

Specific heat : the amount of heat in kcal/kg°C required for the temperature of an object whose mass is M (kg) to increase by 1 (°C) within one time unit (sec). (kcal: kilo calorie).

When the temperature of an object whose mass is M (kg) and specific heat is C (kcal/kg°C) increases by T (°C), if the absorbed heat is Q (kcal), the relationship is Q=M·C·T.

Example) When controlling the temperature of an entire mold with a heater, suppose that the mold weight is 130kg, the ambient temperature is 21℃, the mold temperature setting is 110℃ and the heating time is 30 minutes.
The calculation of the required heater capacity in this mold using the above calculation formula is as follows

$$\text{Necessary wattage for heater (kW)} = \frac{130\,[\text{kg}] \times 0.11\,[\text{kcal/kg℃}] \times (110-21)\,[℃]}{860 \times 0.5\,[\text{h}] \times 0.5\,[\eta]^{*}} \approx 6\text{(kW)} \approx 6000\text{(W)}$$

*efficiency η =0.5

W_1	=130 (kg)
C	=0.11 (kcal/kg°C)
T1	=110 (°C)
T2	=21 (°C)
h	=0.5 (30 minutes)
(efficiency) η	=0.5

②Calculate number of heaters and wattage (W) for one heater.

Decide the number of the heaters depending on the size of object to heat, and get total wattage required to rise the temperature of it.

Example) Use six heaters of approximately 1000 (W) (Total 6000W)
※Heat loss is not taken into account.
Please consider approximately 20～30% increase for the calculated value in wattage.

■How to select a cartridge heater type

① Select a heater diameter and its length.

Example D L
C−MSCHN 8−150

② Select usable voltage.

Example D L V
C−MSCHN 8−150−V200

③ Select necessary wattage.

Example D L V W
C−MSCHN 8−150−V200−W400

④ Please select the appropriate heater diameter (D), length (L), voltage (V), and power (W).
The power (W) selected must be greater than the calculated value of the power.

Example D L V W
C−MSCHN 8−150−V200−W400

■Technical matters (watt density of heat generator)

1) Watt density (W/cm²)

$$\text{Watt density (W/cm}^2) = \frac{\text{Wattage}}{\text{Heat generator length} \times \text{Heater diameter} \times 3.14}$$

The heaters whose watt density (W/cm²) is low last long and steady in controlling.

2) Power calculation formula when used with less than the rated voltage

Please use the heater with less than the rated voltage.

W (Wattage) $= I^2$ (Square of current) × R (Resistance)

※When a 200V heater is used at 100V, the power is about 1/4 of the rated power.