

SILRAM-COR

Heat Pipe Design Guide



Mesh



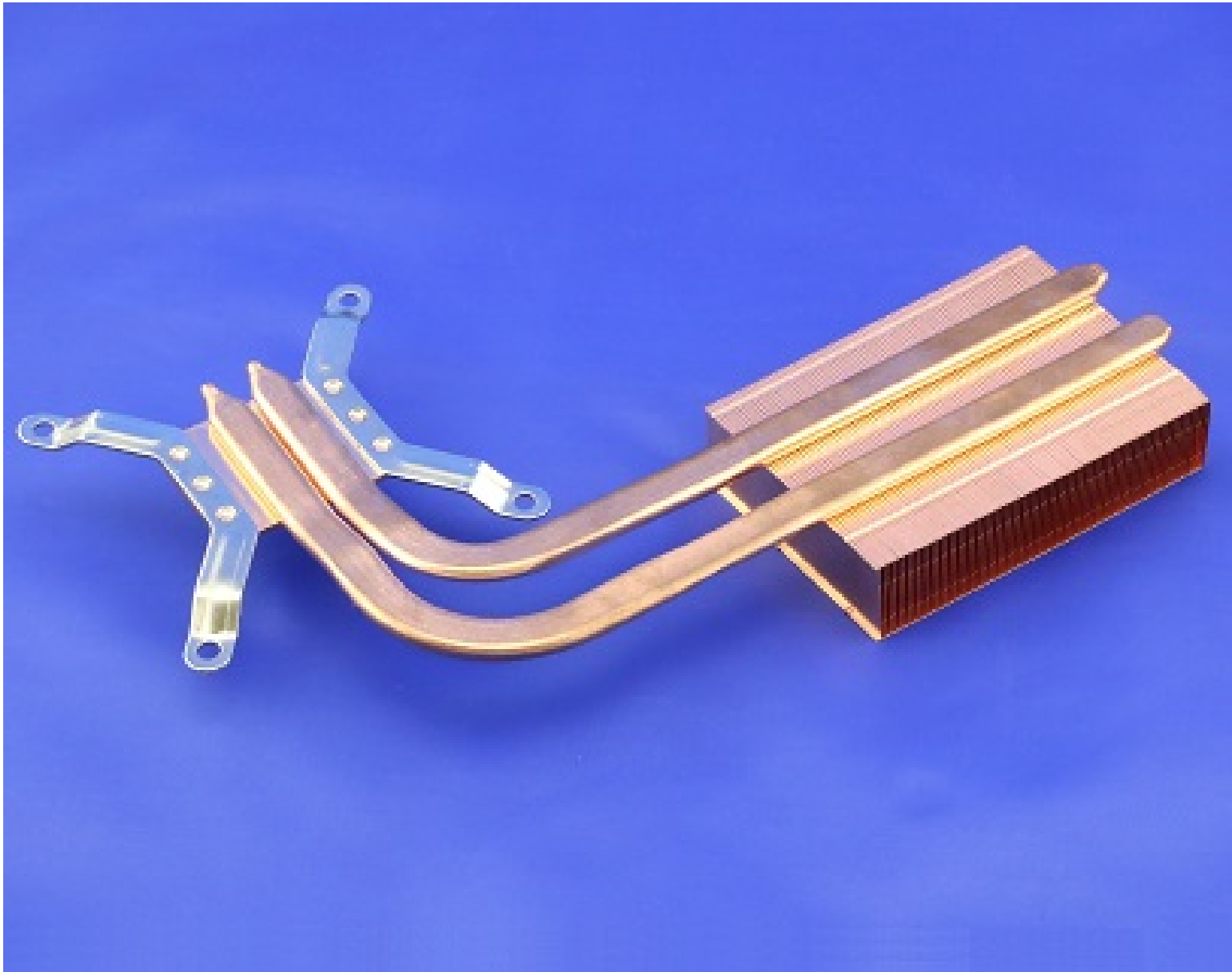
Grooved



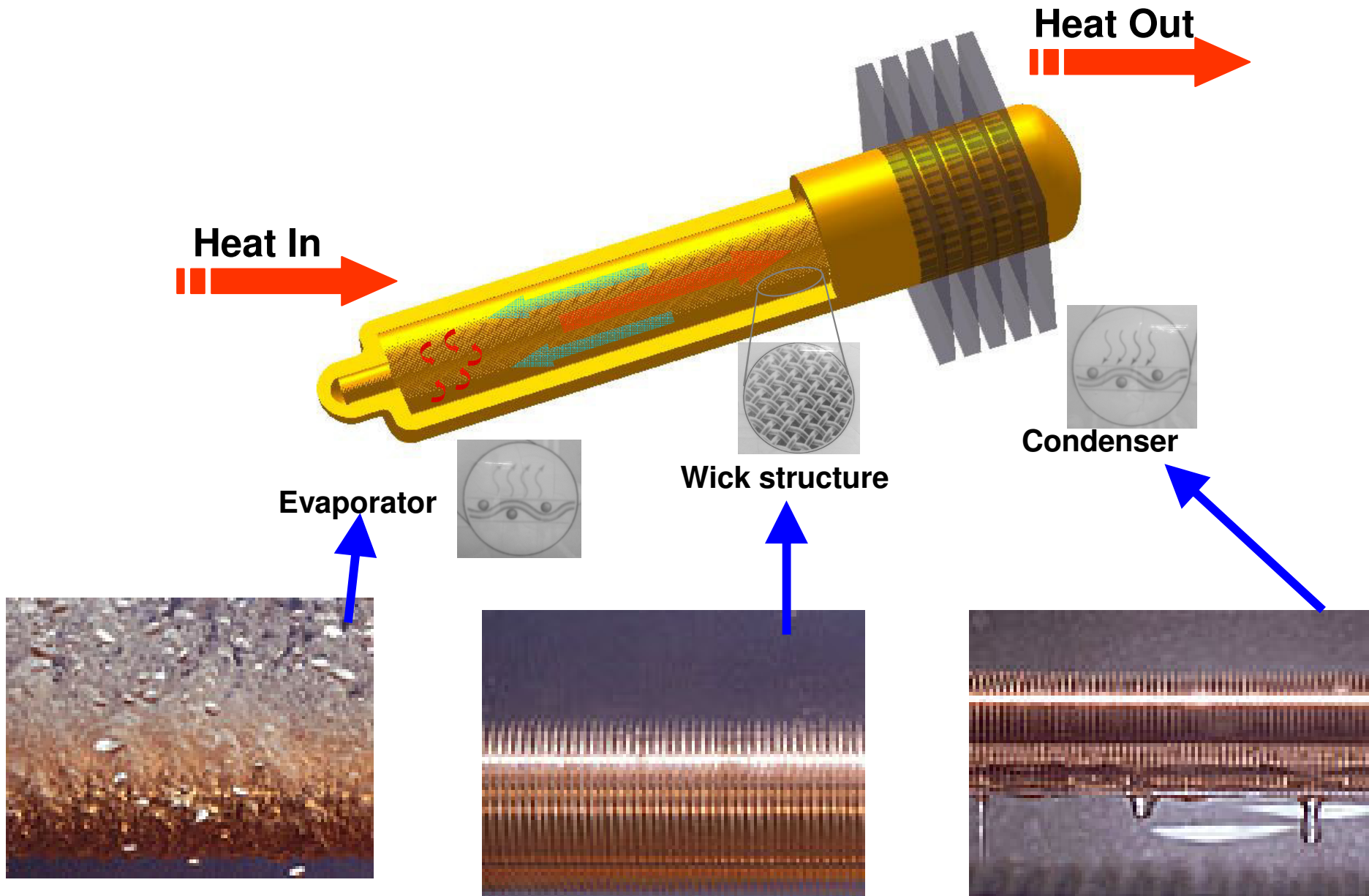
Sintering powder



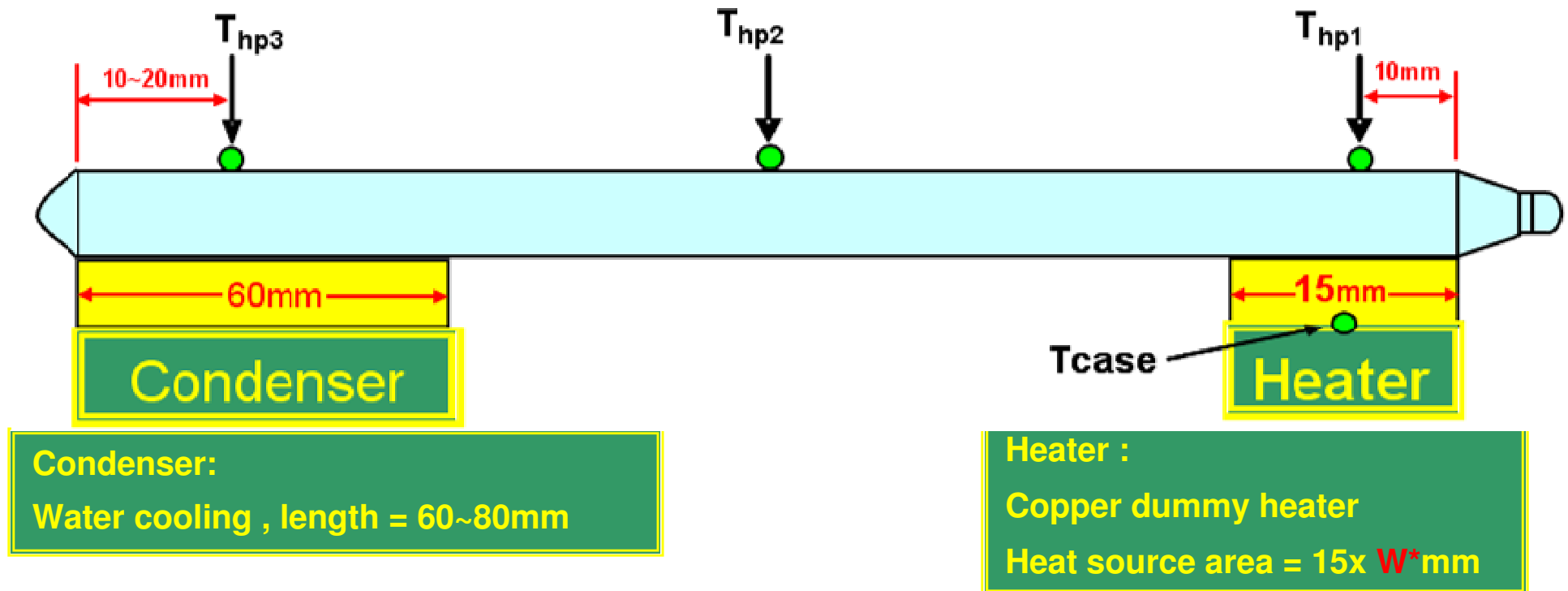
Fiber



Principle



Test Methodology



- T_{case} ($^{\circ}C$): Heater temperature, sensor is embedded in Heater.
- T_{hp1} ($^{\circ}C$): Evaporator temperature of heat pipe, measurement is on the top side of heat pipe evaporator.
- T_{hp2} ($^{\circ}C$): Adiabatic temperature of heat pipe, measurement is on heat pipe top side between evaporator and condenser, Keep this point at $45^{\circ}C \sim 70^{\circ}C$ by Water cooling control.
- T_{hp3} ($^{\circ}C$): Condenser temperature of heat pipe, measurement is on the top side of heat pipe condenser.

Note*: W is base on heat pipe width after flatten

◆ **Q(watts) : Input power**

◆ **R_{heat pipe} (°C/W)**

$$= R_{\text{(Evaporator Local contact effect)}} + R_{\text{(pipe structure effect)}} + R_{\text{(Condenser Local contact effect)}}$$

$$= (T_{\text{case}} - T_{\text{hp1}})/Q + (T_{\text{hp1}} - T_{\text{hp3}})/Q + (T_{\text{hp3}} - T_{\text{sink}})/Q^*$$

$$= (T_{\text{case}} - T_{\text{hp3}}^*)/Q$$

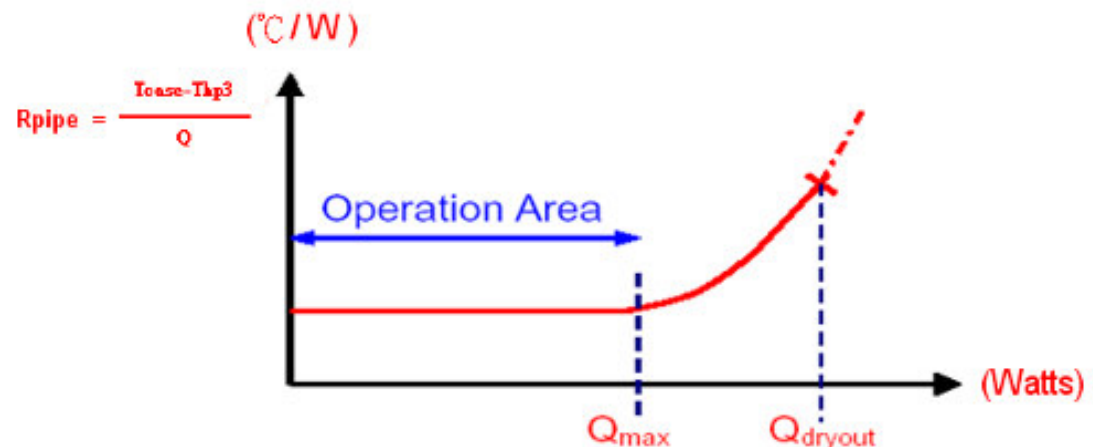
--- Term $R_{\text{(Evaporator contact effect)}}$ is concerned about “Local dry out” in case of sharp heat flux loading on heat pipe.

--- Term $R_{\text{(Pipe structure effect)}}$ is concerned about the capability limit of dimension and wick structure in heat pipe.

--- Term $R_{\text{(Condenser contact effect)}}$ is concerned about “Flooding” in case of over cooling on heat pipe.

◆ **Q_{max} (watts) : Thermal resistance R_{heat pipe} is significant increase when Power input is larger than a certain Power.**

◆ **Q_{dryout} (watts) : Thermal resistance R_{heat pipe} is ramp up and almost unsteady when Power input is larger than a certain Power.**



Note*: In general, $T_{\text{hp3}} \approx T_{\text{sink}}$

Sintering type _ Dimension list

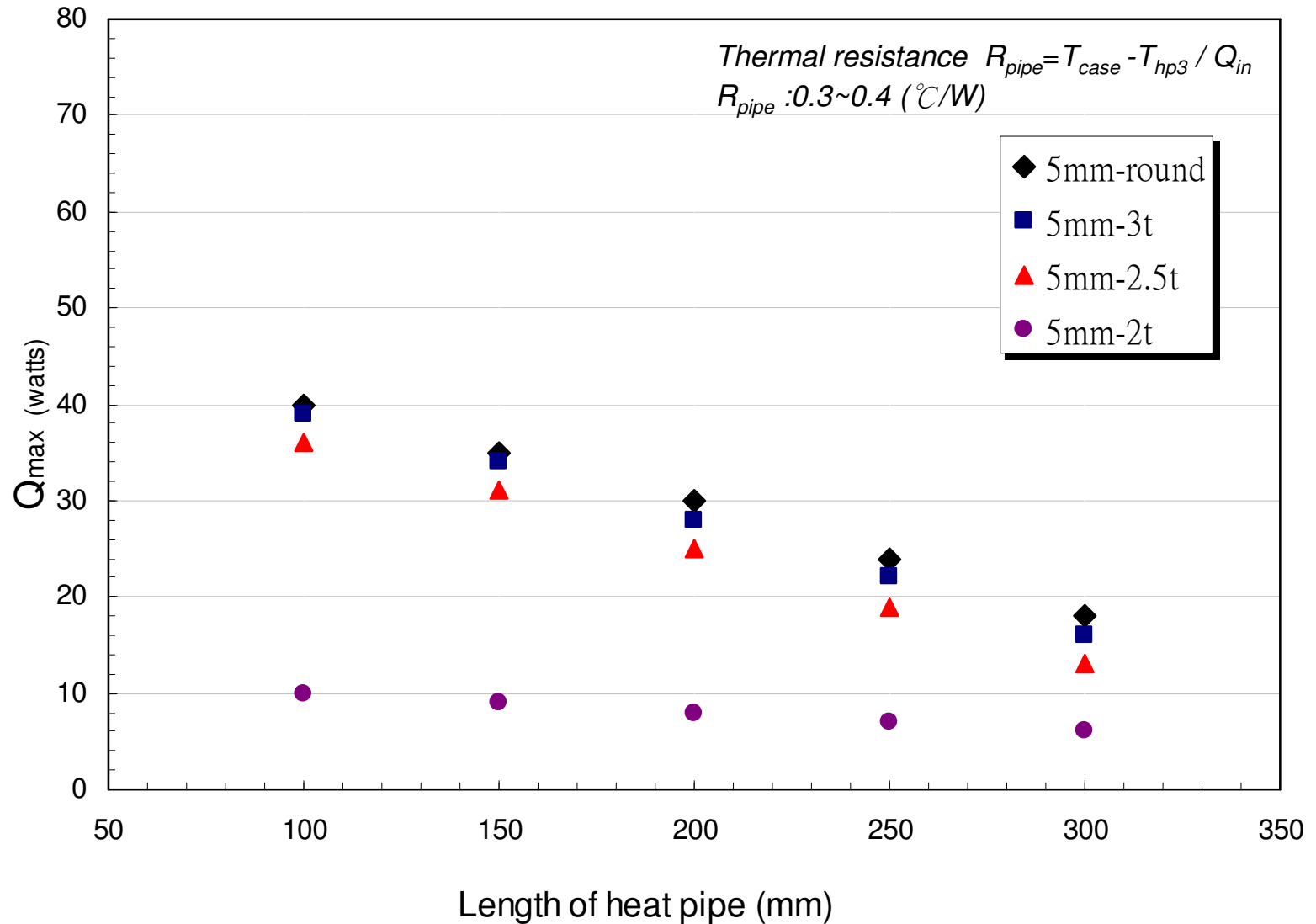
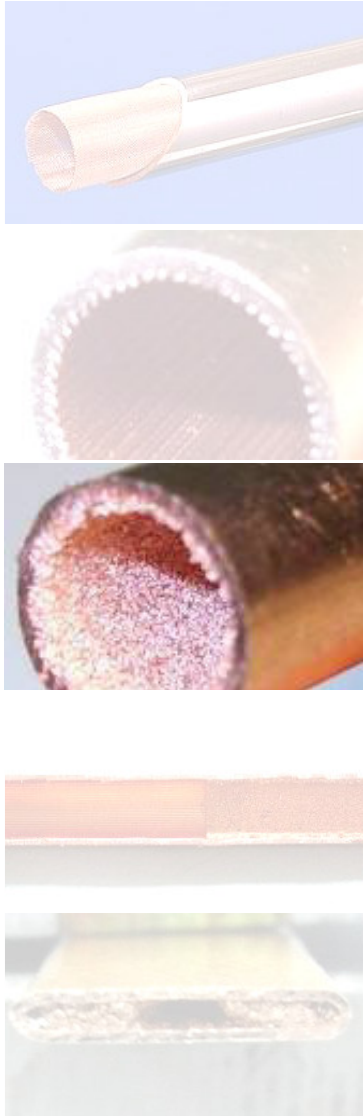
D	t	t :Tolerance	W	W:Tolerance	Rc	Shrinking length
φ4	3.0	±0.05	4.70	±0.15	Rc ≥ 12*	Head end: 7.0 Tail end: 3.0
	2.8		4.83			
	2.5		4.96			
φ5	3.0	±0.05	6.34	±0.15	Rc ≥ 15*	Head end: 10.0 Tail end: 3.0
	2.5		6.6			
φ6	4.5	±0.05	7.09	±0.15	Rc ≥ 18*	Head end: 11.5 Tail end:3.0
	3.5		7.66			
	3.0		8.00			
	2.8		8.12			
	2.5		8.30			
φ8	6.0	±0.05	9.54	±0.15	Rc ≥ 24*	Head end: 15 Tail end: 6.0
	4.5		10.37			
	4.0		10.62			
	3.5		10.89			
	3.2		11.02			
	3.0		11.12			
	2.5		11.39			

(Unit : mm)

Note*:Generally , sintering powder type heat pipe can be forming when Rc is larger/equal to 2 times pipe diameter but generate Wrinkle cosmetic issue probably

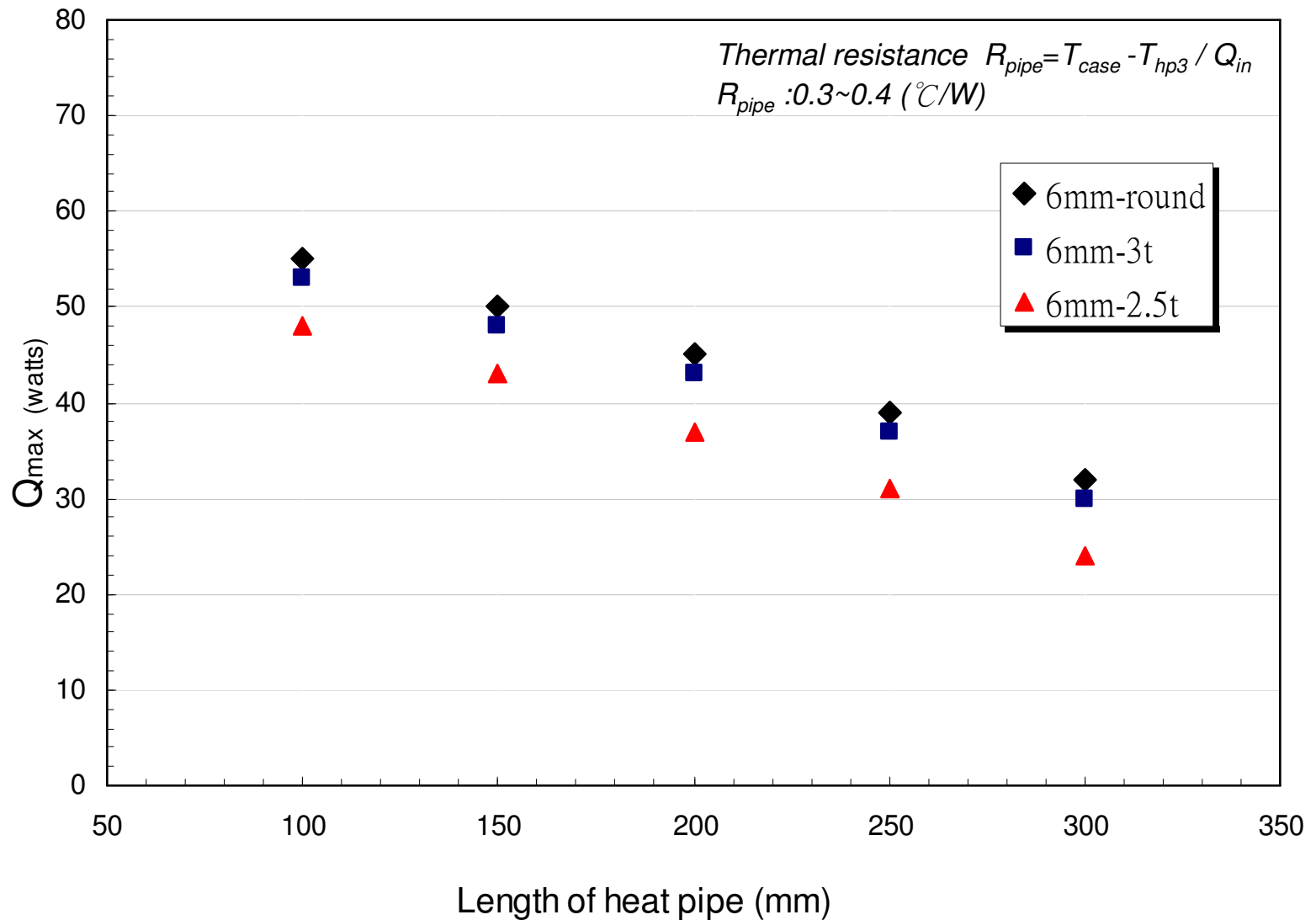
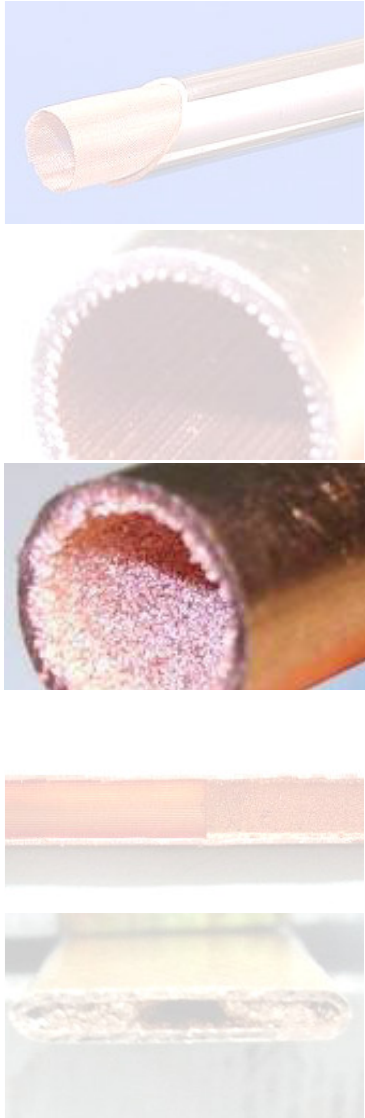
Sintering type _ 5mm

Performance of Powder type (straight)



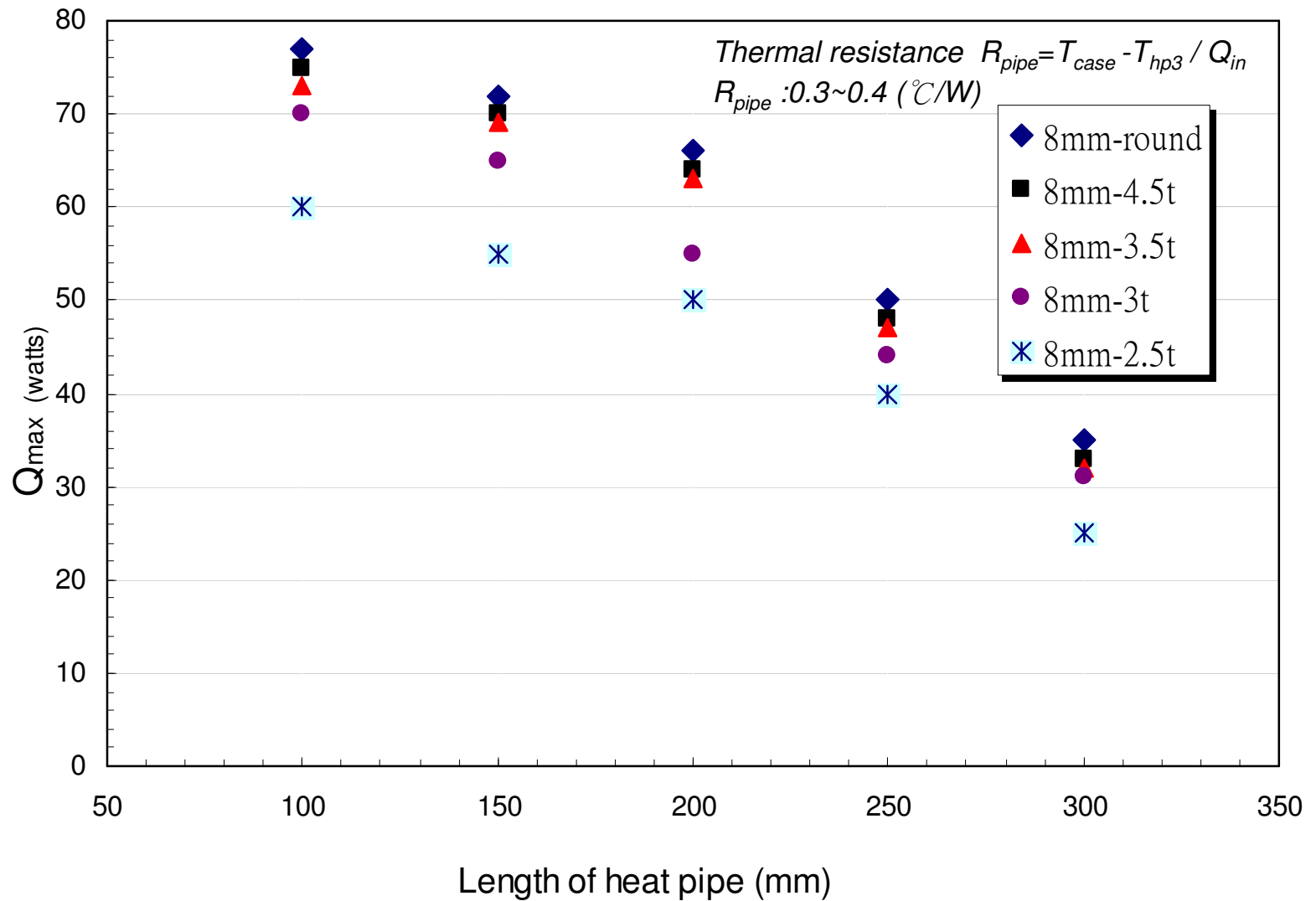
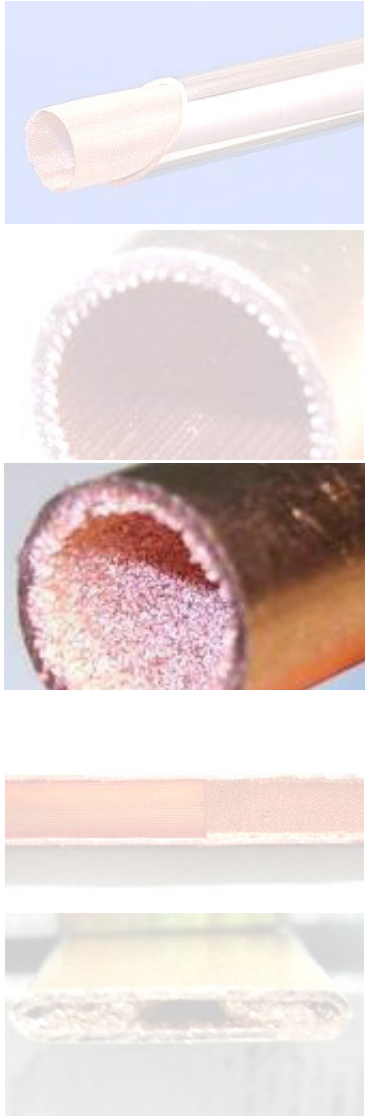
Sintering type _ 6mm

Performance of Powder type (straight)



Sintering type _ 8mm

Performance of Powder type (straight)



Composite type _ Dimension list

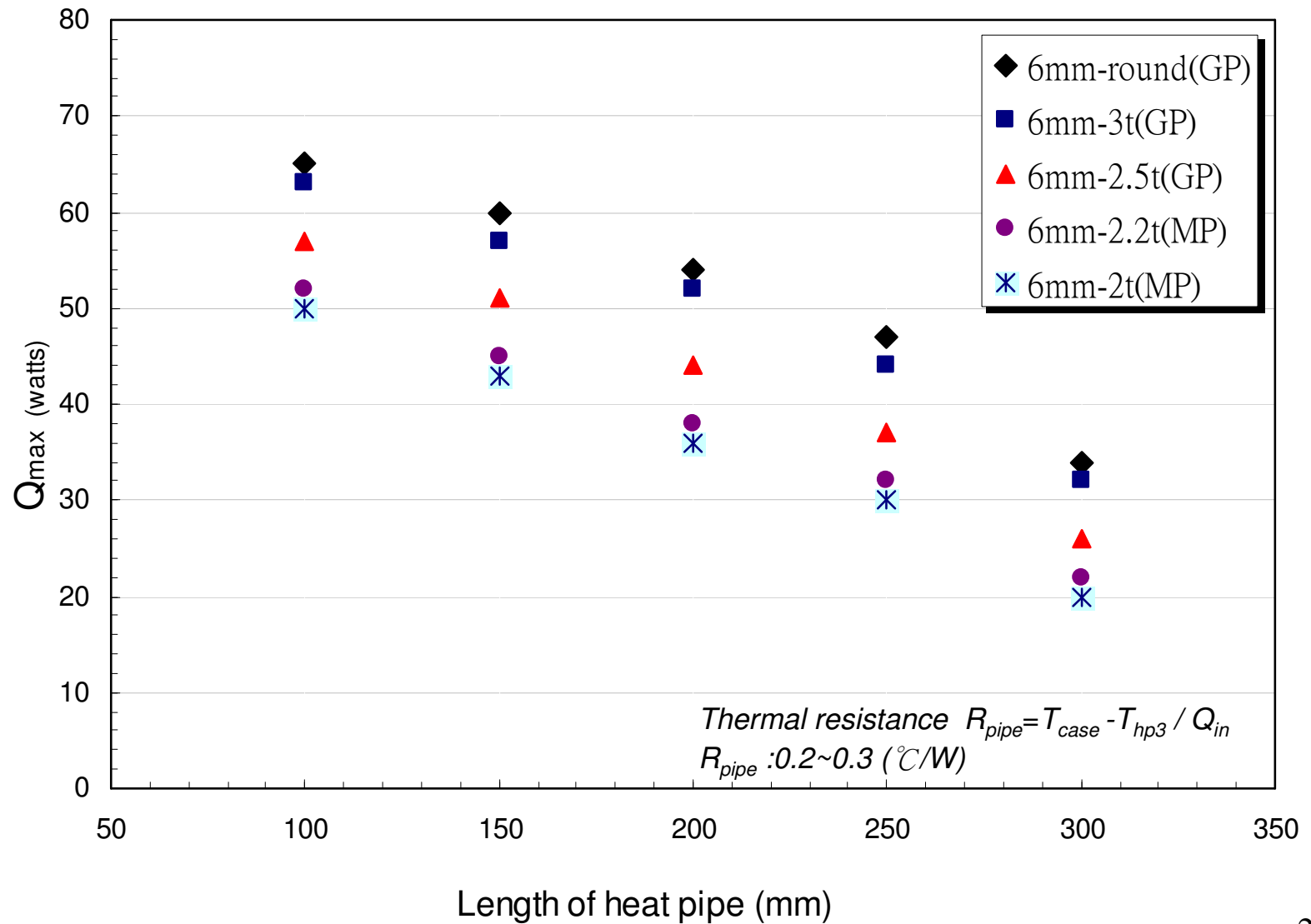
D	t	t :Tolerance	W	W:Tolerance	Rc	Shrinking length
φ6	4.0	±0.05	7.40	±0.15	Rc ≥ 27*	Head end: 11.5 Tail end: 3.0
	3.5		7.68			
	3.0		8.01			
	2.8		8.08			
	2.5		8.25			
φ8	5.0	±0.05	10.07	±0.15	Rc ≥ 36*	Head end: 15.0 Tail end: 6.0
	4.5		10.36			
	4.0		10.65			
	3.5		10.93			
	3.0		11.21			
	2.8		11.32			
	2.5		11.49			

(Unit : mm)

Note*: Generally , composite type heat pipe can be forming when Rc is larger/equal to 3 times pipe diameter but generate wrinkle cosmetic issue probably

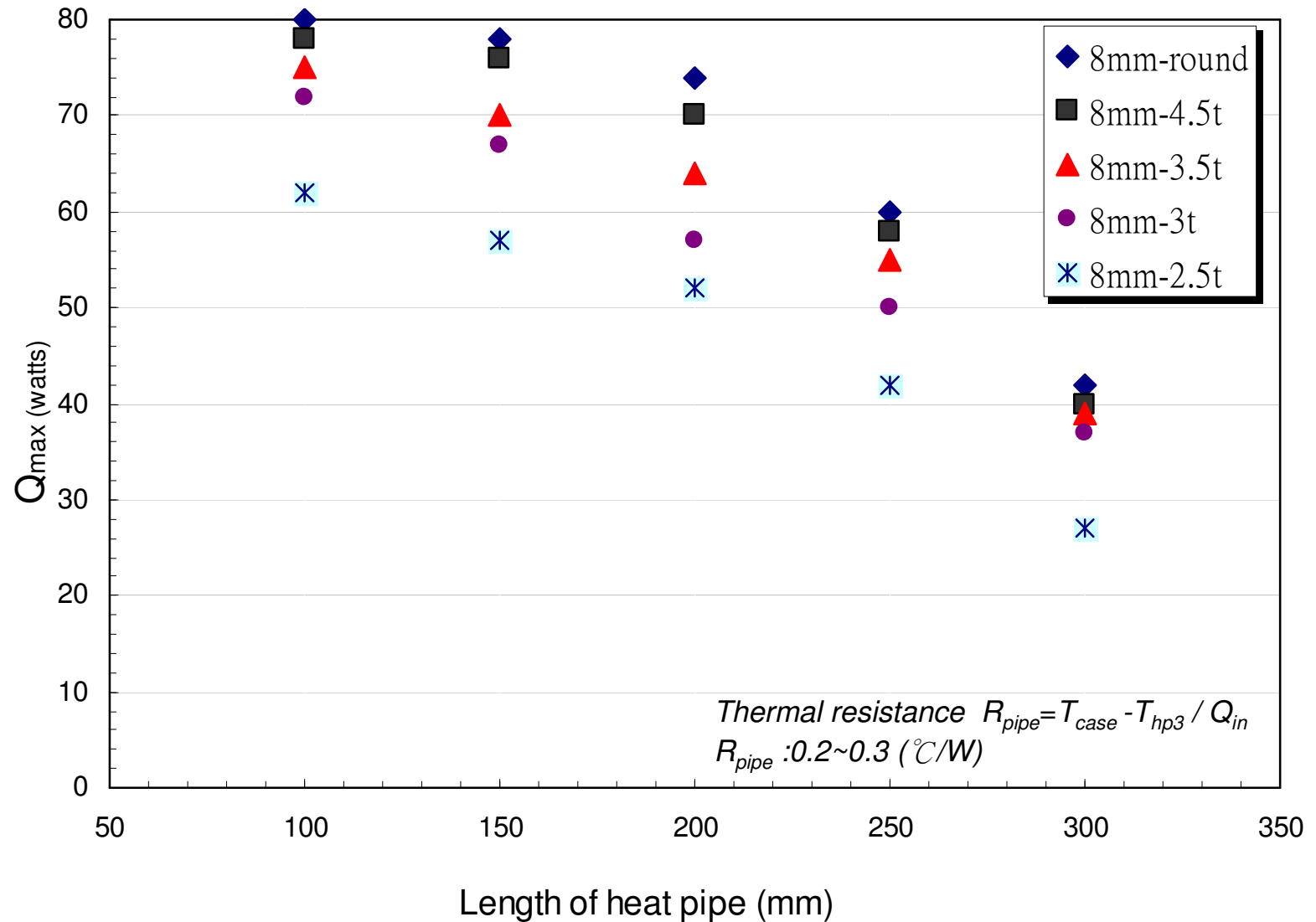
Composite type _ 6mm

Performance of Composite type (straight)

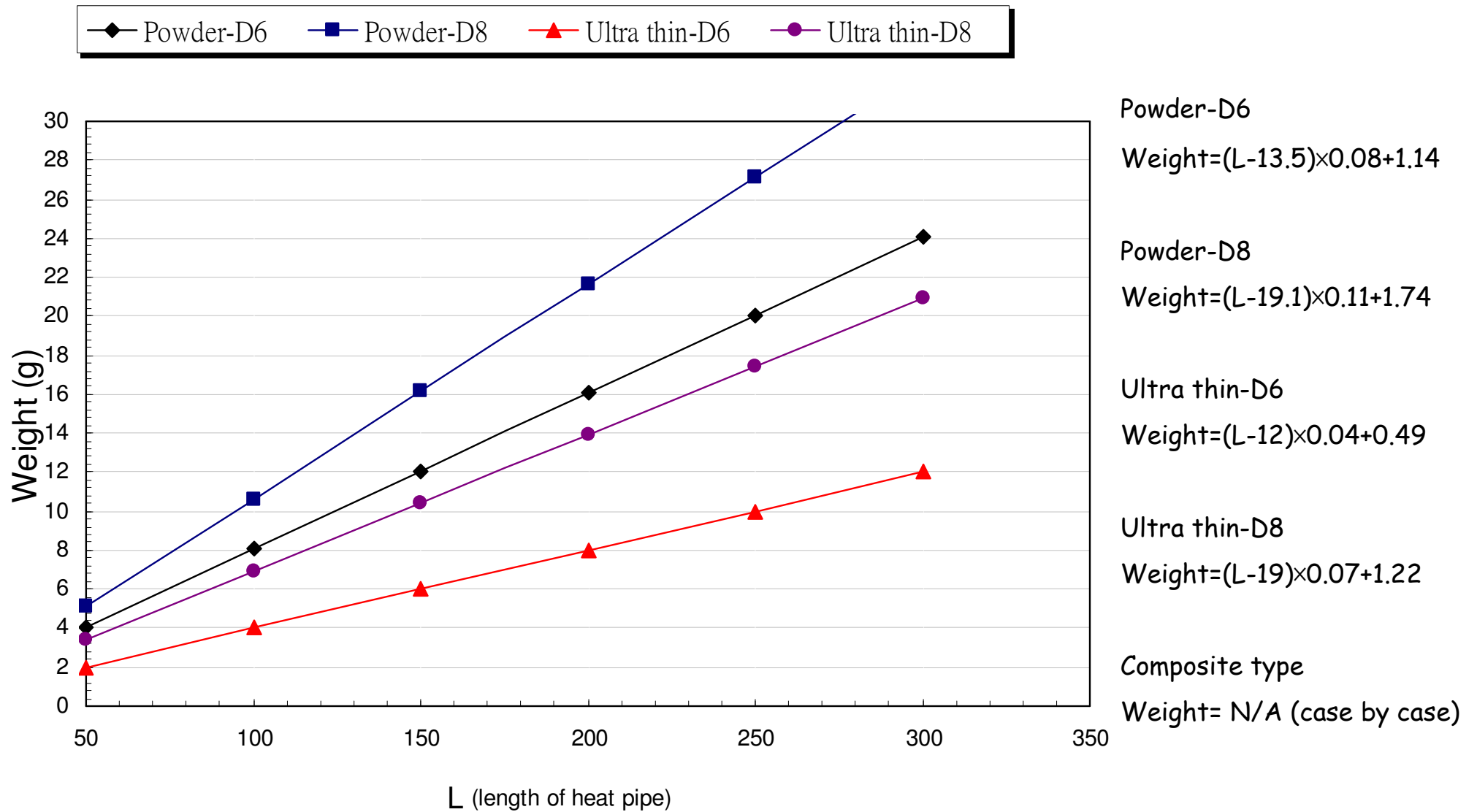


Composite type _ 8mm

Performance of Composite type (straight)



Unit weight of Heat pipe



Note*: Unit weight is not fixed, the tolerance $\pm 20\%$ base on wick thickness/ charge volume

Approval List

ITEM		SPECIFICATION
SHAPE	ROUND	$\phi 2 \sim \phi 8$
	FLAT	T = 0.6~4.0 mm
BENDING / SHAPE		Drawing
MATERIAL OF CONTAINER		C1020
WORKING FLUID		DI Water
WICK STRUCTURE		Grooved / Screen Mesh / Ultra thin Powder / Composite
FAIL TEMP (No cooling)	ROUND	250 °C Leakage
	FLAT	110~140 °C Inflation
MAX. HEAT TRANSFER RATE		0~80 W
APPLICATION INCLINATION		Horizontal
GUARANTY		3 Years

Quality Control Procedure

Heat Pipes after
bended and flatten



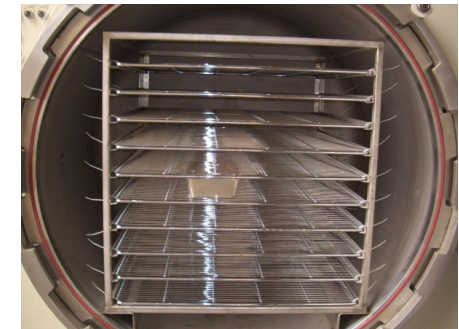
120°C, 48hrs
Thermal Oven Burn in Test

(100%)



2 kgf/cm², 3hrs
Micro Leakage Test

(Sampling)



Cosmetic treatment
Finished



Burst Temp. Test
(Sampling)



Qmax Go/NG Test
(100%)

