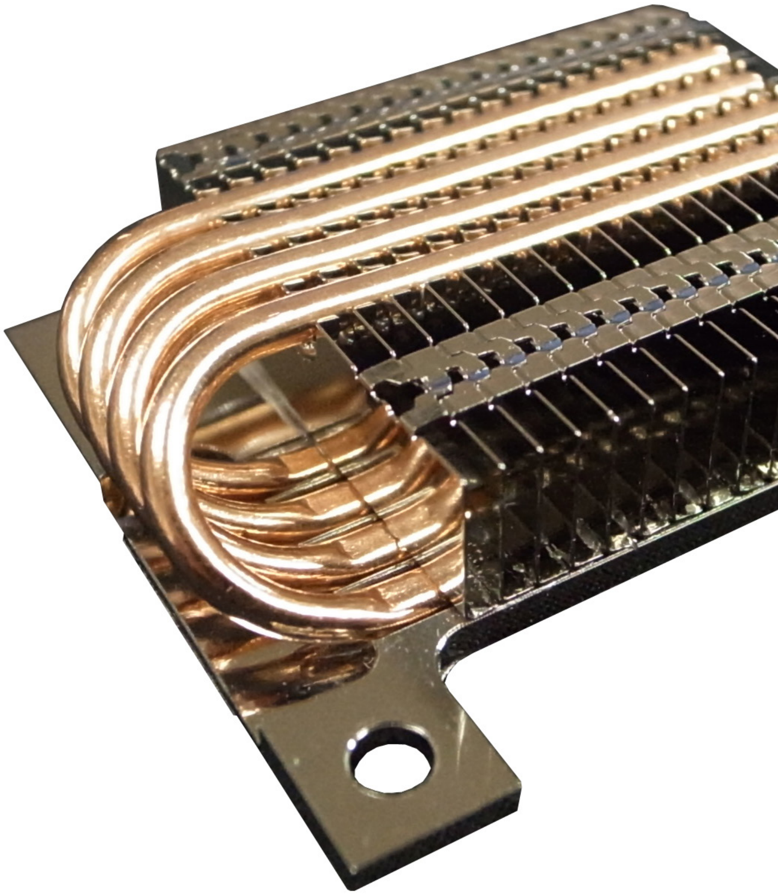
Heat Pipes



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Maximum Heat Transfer Table (Powder Type)

HEAT PIPE LENGTH = 150mm

Qmax / Out Diameter / Type	Out Diameter Φ3 mm	Out Diameter Φ4 mm	Out Diameter Φ5 mm	Out Diameter Φ6 mm	Out Diameter Φ8 mm
Flatten t=2.0mm	13.2 W	16.6 W	20.5 W		
Flatten t=2.5mm	13.2 W	19.8 W	23.6 W	34.0 W	51.5 W
Flatten t=3.0mm	13.1 W	19.8 W	28.4 W	39.2 W	67.5 W
Round Pipe	13.2 W	19.8 W	30.1 W	48.1 W	74.2 W

Maximum Heat Transfer Table (Powder Type)

HEAT PIPE LENGTH = 200mm

Qmax / Out Diameter / Type	Out Diameter Φ3 mm	Out Diameter Φ4 mm	Out Diameter Φ5 mm	Out Diameter Φ6 mm	Out Diameter Φ8 mm
Flatten t=2.0mm	9.2 W	13.1 W	16.0 W		
Flatten t=2.5mm	10.5 W	13.0 W	18.0 W	22.1 W	30.0 W
Flatten t=3.0mm	10.5 W	13.2 W	19.5 W	31.0 W	44.5 W
Round Pipe	11.5 W	14.5 W	22.5 W	39.0 W	55.6 W

Maximum Heat Transfer Table (Powder Type)

HEAT PIPE LENGTH = 250mm

Qmax / Out Diameter / Type	Out Diameter Φ3 mm	Out Diameter Φ4 mm	Out Diameter Φ5 mm	Out Diameter Φ6 mm	Out Diameter Φ8 mm
Flatten t=2.0mm	7.2 W	10.1 W	12.2 W		
Flatten t=2.5mm	8.1 W	11.2 W	13.1 W	16.5 W	23.0 W
Flatten t=3.0mm	8.2 W	12.1 W	14.1 W	22.0 W	37.0 W
Round Pipe	9.0 W	12.3 W	15.6 W	29.3 W	45.0 W

Size of Flattened Heat Pipes

Diameter (mm)	Thickness (mm)	Width (mm)	Tolerance (mm)
4 mm	3	4.65	+/- 0.15
	2.5	5	+/- 0.15
	2	5.23	+/- 0.15
5 mm	3.5	5.97	+/- 0.15
	3	6.25	+/- 0.15
	2.5	6.55	+/- 0.15
	2	6.83	+/- 0.15
6 mm	4	7.3	+/- 0.15
	3.5	7.58	+/- 0.15
	3	7.84	+/- 0.15
	2.5	8.1	+/- 0.15
8 mm	6	9.35	+/- 0.15
	5	9.95	+/- 0.15
	4	10.5	+/- 0.15
	3	10.99	+/- 0.15

Heat Pipe Types And Comparison

Heat Pipe Type	Advantage	Disadvantage
Powder Type	1.The best for heat transfer. 2.Better quality reliability. 3.Workable for any operation direction. 4.Easy for bending & flatten.	1.Higher cost. 2.Difficult to produce. 3.Flattening limitation (2mm).
Mesh Type	1.Lower cost. 2.Quick heat response. 3.Workable for any operation direction.	1.Poor Heat transfer. 2.Uneasy for after-process of bending and pressing. 3.Quality may vary after bending. 4.Heat transfer rate is limited if pipe size larger than 5mm.
Groove Type	1.Lower cost. 2.Quick heat response. 3.Most workable for pressing.	1.Heat transfer is fair. 2.Not easy for after-process bending and flattening. 3.Not workable for negative operation direction.

R-Angle

	Min.R	Decline	Suggested	Decline	Min. Bending Angle	Suggested
4	10	20%	12	10%	> 90∞	> 120∞
5	12	20%	15	10%		
6	15	30%	18	15%		
6.35	18	30%	19	15%		
8	24	30%	32	15%		
9.6	29	40%	38	15%		

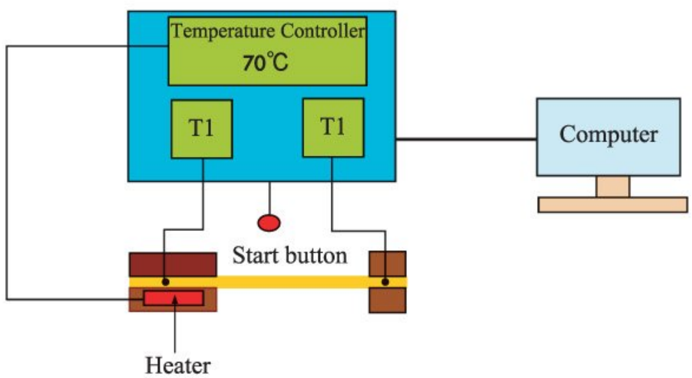
Standard Operation Procedure
The First △T Test in Test Fixture for the Round Heat Pipes

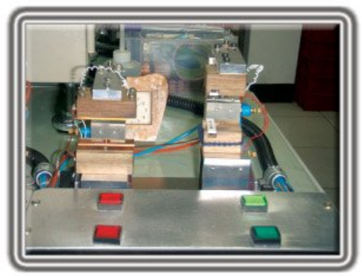
Test procedure:

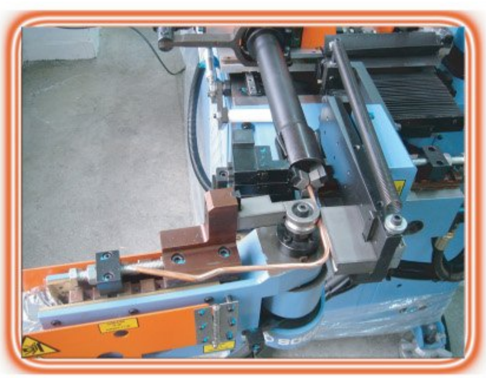
1. Adjust a test fixture interval of the tested heat pipe.
2. Turn on the power switch on the control panel.
3. Set the test temperature at 70℃.
4. Turn on the computer and input the △T (T1-T2), lot number, and length of the tested heat pipes.
5. Put the untested heat pipe on the test fixture.
6. Press the start button to test △T (T1-T2).

Acceptance Standard:

1. If a heat pipe length is less than 150 mm, △T ≦ 3℃ it passes.
2. If a heat pipe length is larger than 150 mm, △T ≦ 4℃ it passes.







Heat Pipe Bending Machine
熱管折彎機

Reflow Oven 回焊爐車間

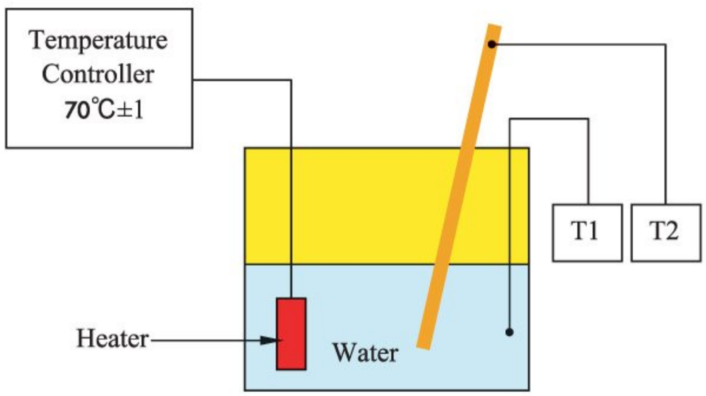
The Second△T Test in Water Container for the flatten or Bend Heat Pipes

Test procedure:

1. Turn on the switch of the temperature controller and set test ing temperature at 70℃
2. Put a thermal couple into the water (T1).
3. Attach a thermal couple (T2) below soldering end of a heat p ipe 10~15 mm.
4. Put 1/3 length of the untested heat pipe into water of 70℃ t o test its △T (T1-T2).
5. If heat pipe passes △T test, submerse heat pipe in alcohol.
6. Take out and let air dry.

Acceptance Standard:

1. If a heat pipe length is less than 150 mm, △T ≦ 4℃ it passes.
2. If a heat pipe length is larger than 150 mm, △T ≦ 5℃ it passes.



Heat Pipe & Stamping Fin Process
熱管組合鰭片

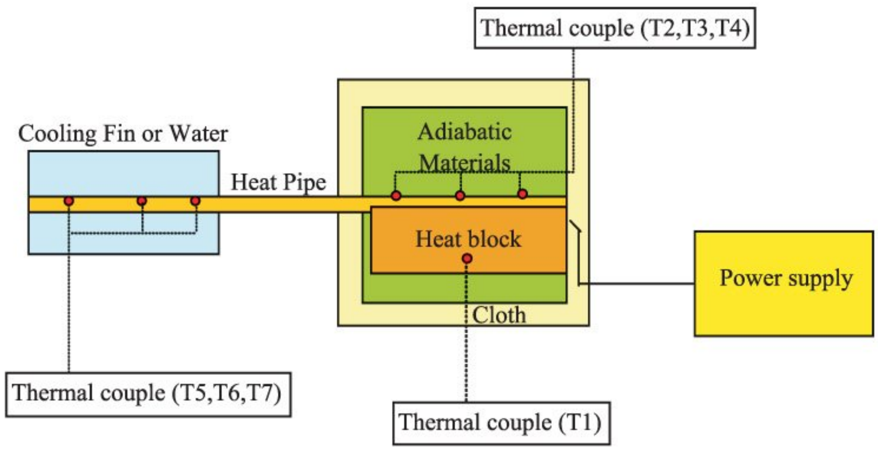
Sinter 熱管燒結

QMAX Test Procedure for Vette Heat Pipes

Purpose:

Check QMAX of a heat pipe at specific temperature.

Test apparatus:



Power supply: Provide power for heaters to heat the heat block.

Heat block: Simulated CPU to heat the heating end of a heat pipe.

Cooling Fin or Water Jacket: Disperse heat energy to surroundings.

Adiabatic material and cloth: Prevent heat energy from disappearing to surroundings.

Thermal couple: Measure the point temperature at a designated location.
In this test apparatus, three point temperatures including heat block (T1), heating end (T2) and cooling end (T7) of the heat pipe are measured.

△T= T2 T7: Temperature difference between the heating end and cooling end of a heat pipe.

Air Pressure Jar 氣壓缸

QMAX Test Procedure for Vette Heat Pipes

Procedure:

1. Put the heating end of a heat pipe on a heat block with heaters.
2. Use adiabatic materials to surround the heat block and the heating end.
3. Wrap a cloth around the adiabatic materials.
4. Provide the test power for the heaters by a power supply.
5. Heat up the heating end of the heat pipe to temperature 70℃ and dissipate heat generation at another end of heat pipe by a cooling fin or water jacket.
6. Measure the temperature difference (△T) between two ends of the heat pipe.
7. While the △T=4℃, the maximum power (QMAX) of heat transfer of the heat pipe is obtained.

* Pass/Failure:

QMAX ≧ Customer requirement then heat pipe is passed

* Test frequency:

One piece per lot or according to customer request

Note:

In our test apparatus, this material is to ensure maximum heat transfer through the heat pipe.