

# MICRO HEAT PIPES

## for Cooling CPU

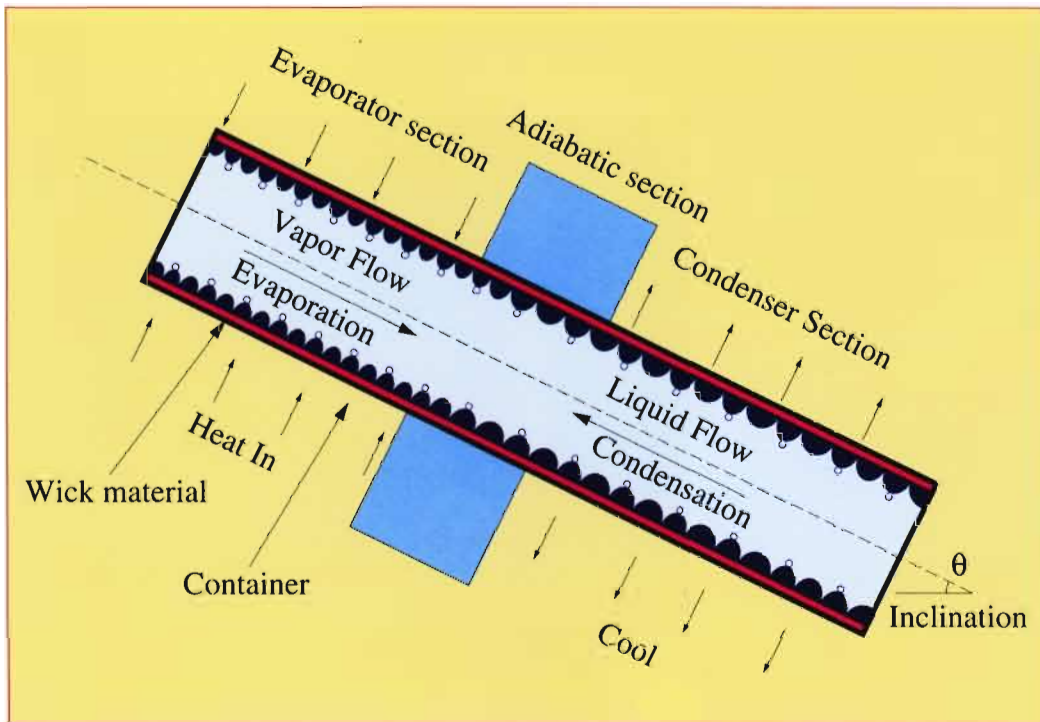


**Fujikura Ltd.**

# FUJIKURA'S MICRO HEAT PIPES for Cooling CPU

Remarkable Micro Heat Transfer Device like Super-conductor

## What is a HEAT PIPE? Principle & Structure?



### MICRO HEAT PIPE

Have you ever experienced FUJIKURA'S MICRO HEAT PIPE?

- 1. Super-high Thermal Conductivity**  
FUJIKURA'S HEAT PIPE has a superior thermal conductivity 500 times larger than that of a round copper bar.
- 2. Excellent Temperature Uniformity**  
Uniform temperature of each part in the FUJIKURA'S HEAT PIPE can be kept within 0.5 deg. C any time.
- 3. Good Thermal Response**  
Vapor in the heat pipe travels at nearly the sonic speed, so that heat can be super- rapidly transferred.
- 4. Possible to operate at the top heat mode**  
FUJIKURA'S HEAT PIPE can be operated at the top heat mode because of fine fiber wick installation to produce high capillary force.
- 5. Light Weight & Compact**
- 6. Freedom design**  
FUJIKURA'S HEAT PIPE can easily be bent, pressed, and added to such parts as aluminum plate, block, fins, etc.
- 7. Maintenance-free and no power in operation**  
FUJIKURA'S HEAT PIPE can be operated for a long term without any maintenance and it works passively by strong capillary force of the wicks without any power input.



## Why is it necessary to cool current CPU of personal computer by a heat pipe?

Recently , increasing CPU power for personal computers

Impossible to apply traditional cooling methods such as aluminum heat sink or forced cooling by fan

Requirement by Computer manufacturers

1. More excellent heat dissipation performance than conventional method
2. Low cost
3. Keep the reliability
4. Reduce installation space and light weight
5. No movement parts

Solution

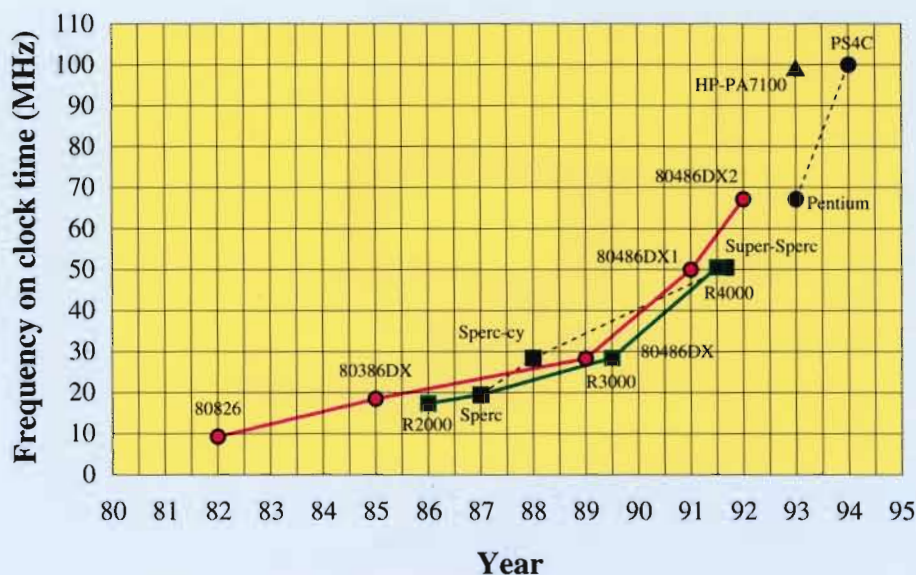
FUJIKURA's MICRO HEAT PIPE APPLICATION

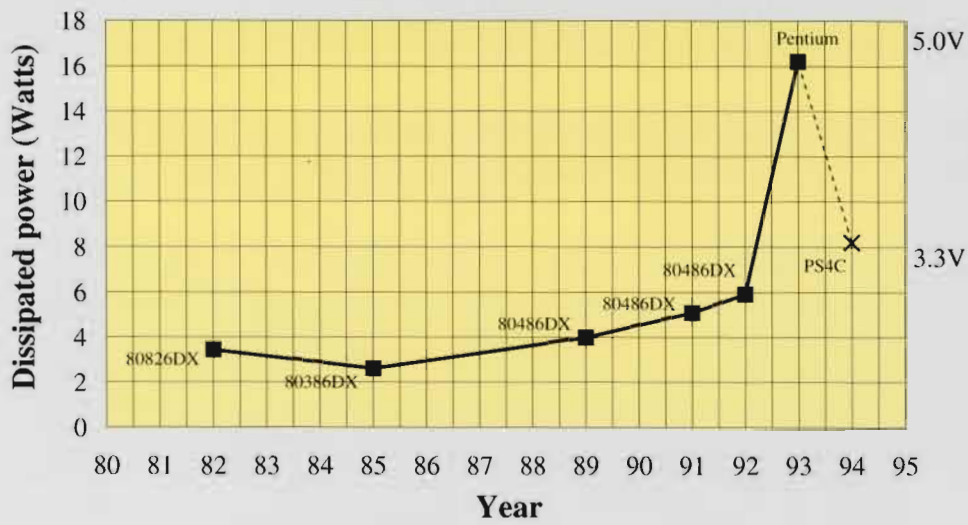
## Heat flux of current CPU has outrun an iron and hot plate.

### Heat Flux

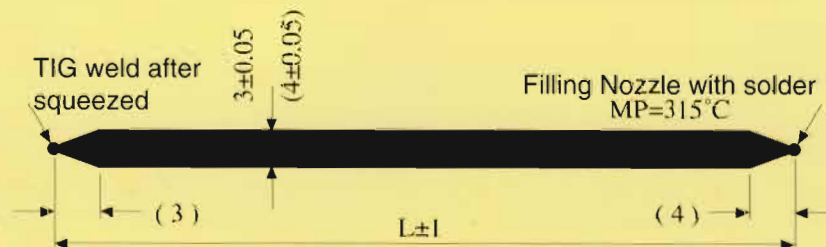
An iron : 5 watts/cm<sup>2</sup>, An hot plate for cooking: 4 watts/cm<sup>2</sup>

Intel Pentium (66MHz): 5.4 watts/cm<sup>2</sup>, HP-PA7100 (100MHz): 11.5 watts/cm<sup>2</sup>



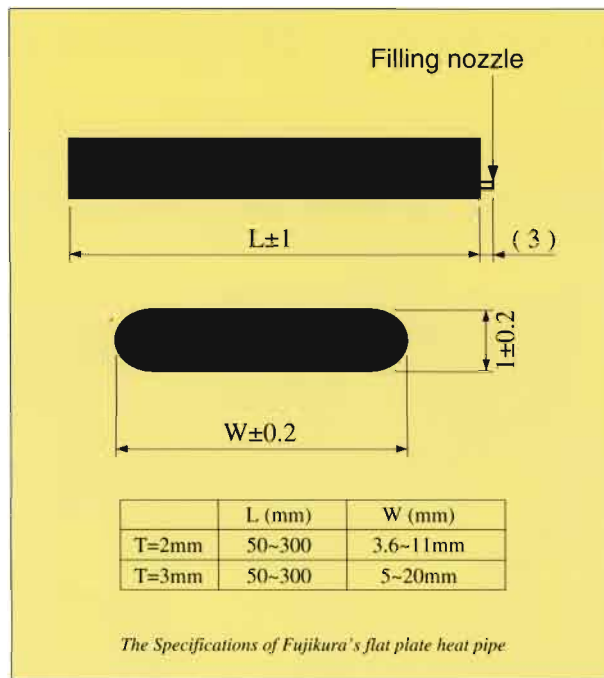


### Standard Specifications of Fujikura's micro-heat pipe



#### Standard Specifications of heat pipes

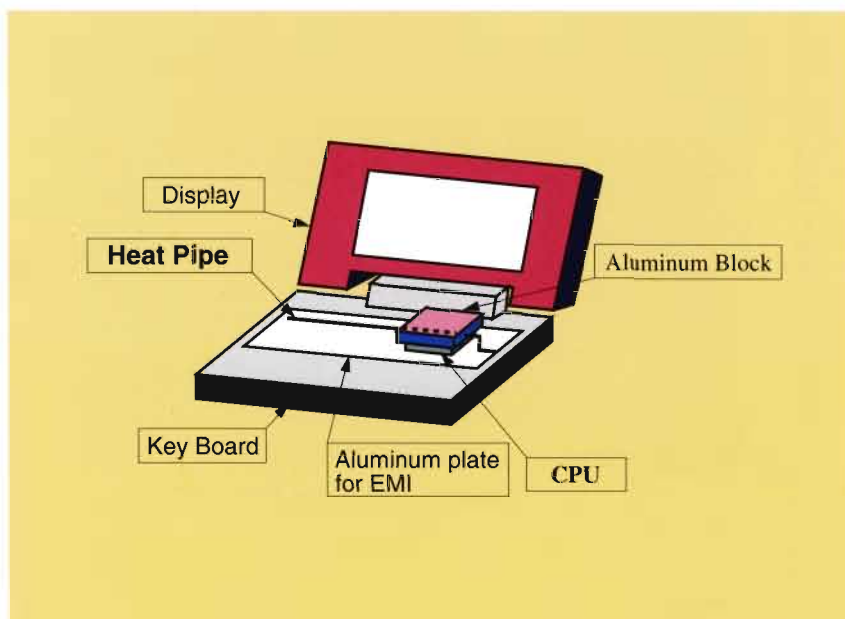
Container material	: Copper (JIS C 1020T)
Thickness of container	: 0.3 mm
Wicks	: Copper fine fiber bundle
Working fluid	: Pure water
Length	: 40~300 mm
Allowable operational temperature range	: $0 \sim 200^\circ\text{C}$
Allowable inclination angle	: $-5^\circ \sim +5^\circ$
Coating	: Ni coating or non.



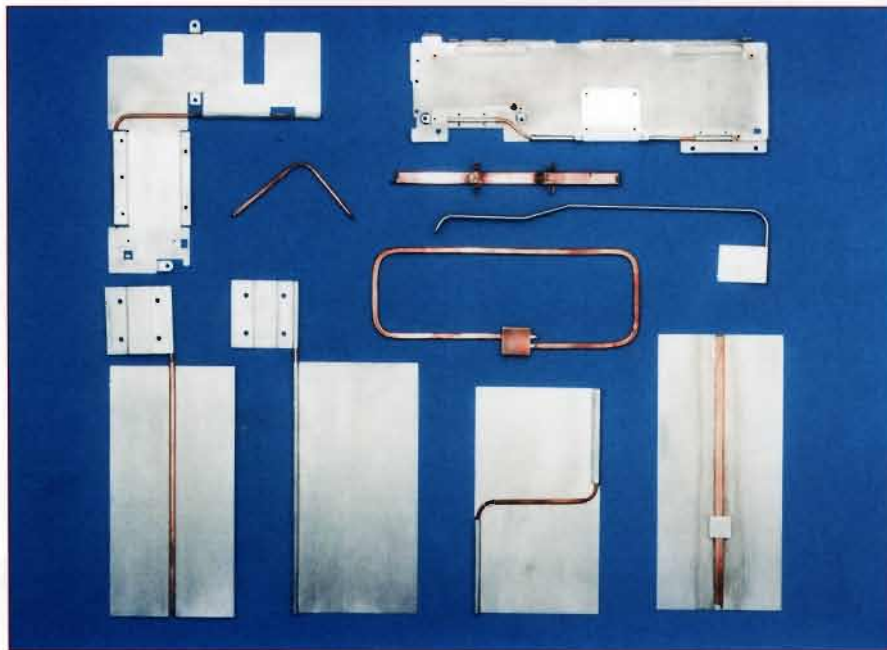
If you need any other lengths, diameters, and additional requirements, please feel free to contact us right now, without hesitation.

## Examples of FUJIKURA's MICRO HEAT PIPES for cooling CPU

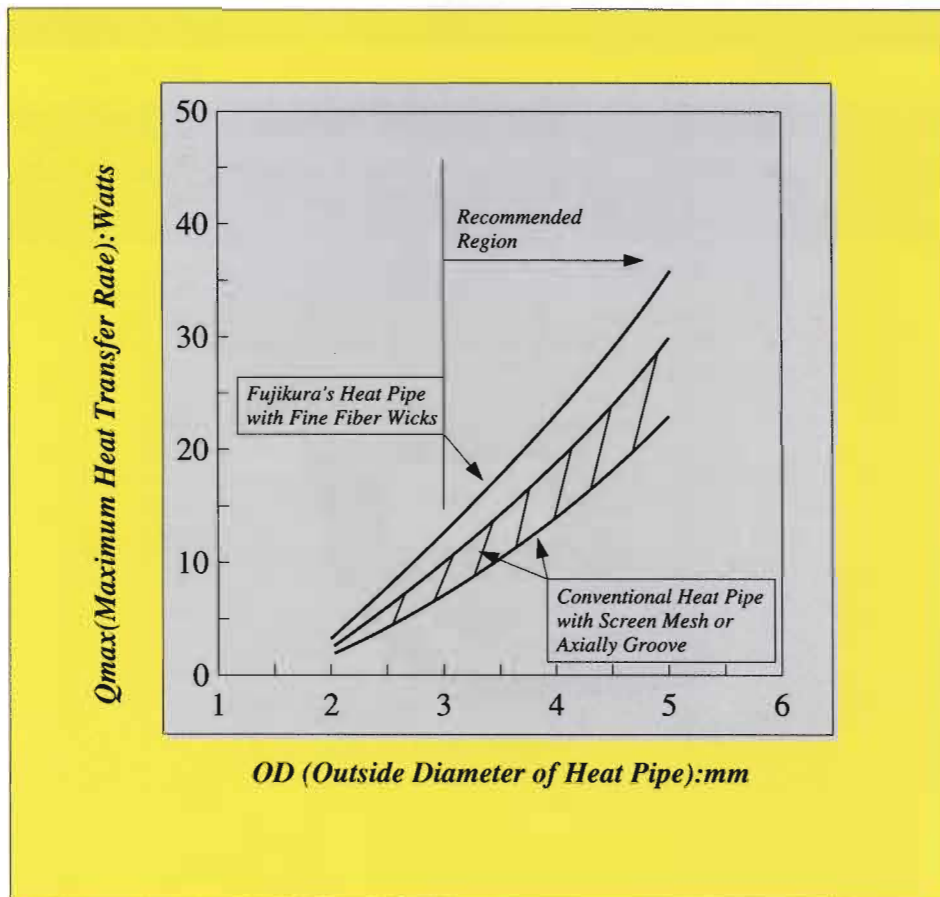
FUJIKURA's MICRO HEAT PIPE can completely remove the heat from CPU even if the heat pipe is installed in the top heat mode ( when the CPU position is higher than the position of the heat pipe heat dissipation area ).



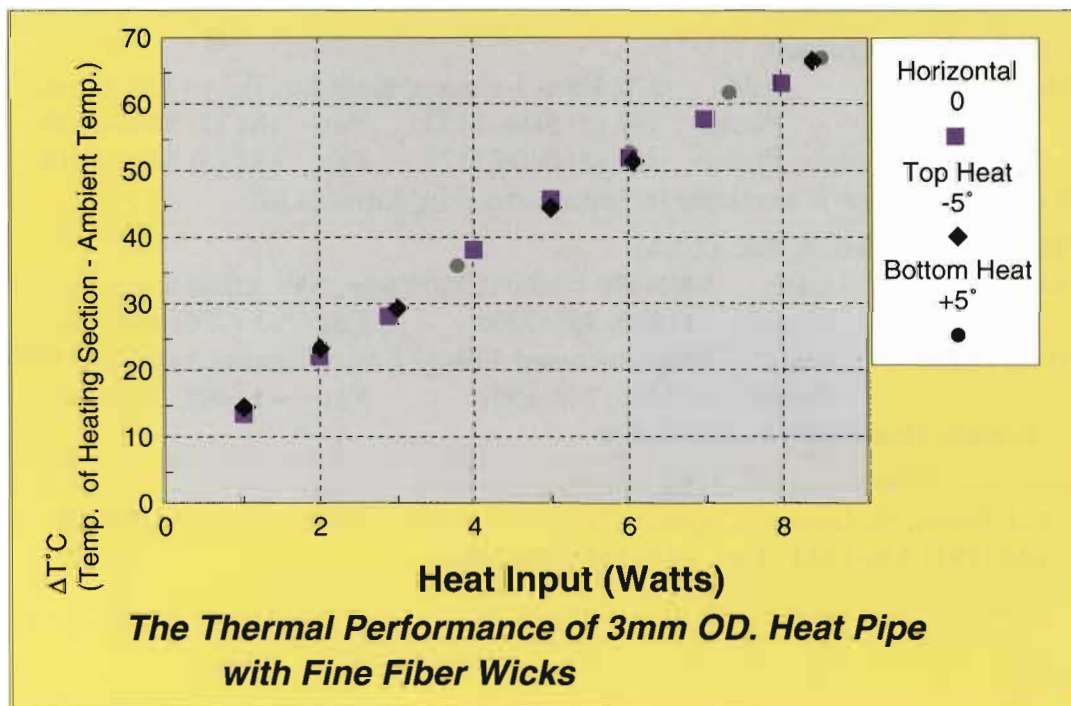
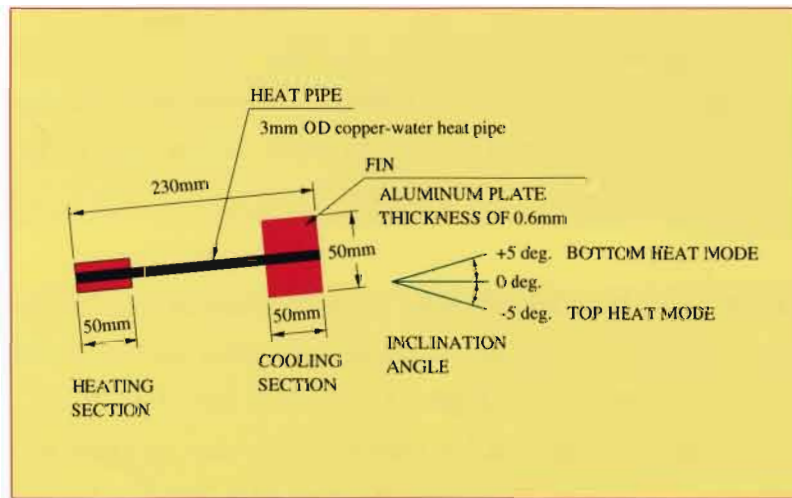
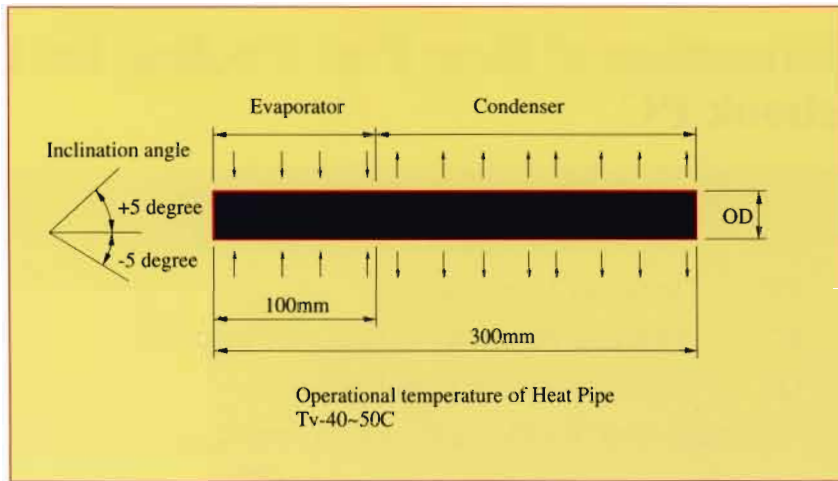
## Heat Pipe Cooling by Heat Dissipation to EMI Aluminum plate



## Thermal Performance of FUJIKURA's MICRO HEAT PIPE







## Rough Estimation of Heat Pipe Cooling for CPU of Notebook PC

$$Q=(T_c-T_a)/R$$

T<sub>c</sub>: Allowable maximum temperature of CPU

T<sub>a</sub>: Ambient Temperature

R : Thermal resistance of heat pipe assembly

Q : Heat dissipation from CPU

For example, assuming that T<sub>c</sub>=95 deg.C, T<sub>a</sub>=35 deg.C, and R=8 K/W (for a 3 mm heat pipe connected to an aluminum plate attached to CPU and transferring heat to the EMI aluminum plate)

$$Q=(95-35)/8 =7.5 \text{ watts}$$

The CPU can dissipate only 2 to 3 watts by natural heat dissipation , but using a heat pipe the heat dissipation will increase to 7.5 Watts. The thermal resistance of heat pipe system will be estimated in the range of 2 to 10 K/W when heat is dissipated to EMI plate.

### To customers

FUJIKURA LTD. has a long history with over 20 years in manufacturing heat pipes and has been engaged in important activities in industrial and scientific fields such as International Heat Pipe Conference, Japan Association for Heat Pipes, JSME, ASME, etc. You can freely utilize FUJIKURA's technical service on heat pipe and thermal management technology. For further information on MICRO HEAT PIPES, please feel free to contact us as mentioned below.

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