

Reliability of SN100C

**24 Mar 2005
NIHON SUPERIOR CO., LTD.
ENGINEERING DEPT**

The reliability of SN100C

Tested items:

1. Tensile Strength
2. Expand and contract
3. Creep Strength
4. Thermal cycle (Surface and cross section)
5. Thermal cycle (Joint strength)
6. Tin Pest
7. Electric Resistance
8. Whisker

1. Tensile Strength (JISZ3198)

Equipment: AGIS-10kN (Shimazu)

Test method

Condition of making specimen

Temperature: Melting point + 100 degree Celsius (327 degree Celsius)

Shape of specimen: Round bar (based on JISZ3198)

Condition of heat treatment: $(0.87 \pm 0.01)T_m = 162$ degree Celsius, Air cooling after heat treatment for one hour.

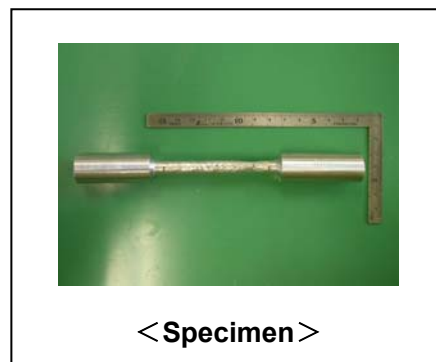
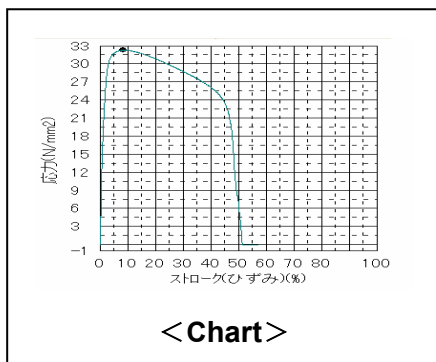
Condition of Tensile Strength

Tensile Speed: 10mm/min (20%/min)

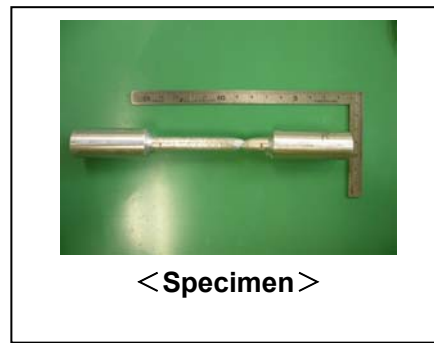
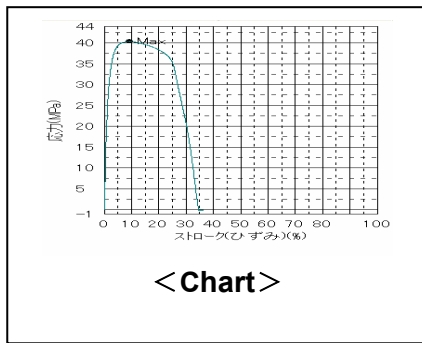
Target distance: 50mm

Temperature of atmosphere: 24 degree Celsius

Test Result



Alloy	Stress (MPa)	Distance	Elongation (%)
SN100C	32.4	72.1	44.2



Alloy	Stress (MPa)	Distance	Elongation (%)
Sn3.0Ag0.5Cu	40.4	64.5	29

2. Expand and contract

Test Method

Specimen is mounted Tensile Strength equipment. Specimen is pulled 5mm from original point and back to original position again. This process is repeated until breaking. Maximum load of pulling specimen is recorded.

Condition of making specimen:

It cuts from solder bar into 7×20×50mm and it makes it to the same volume.

After heating up to 400 degree Celsius,

it is poured into the mold of 12mm in width 160mm in length.

Test condition:

Specimen is mounted Tensile Strength equipment

Speed: 20mm/min

Distance: +/- 5mm

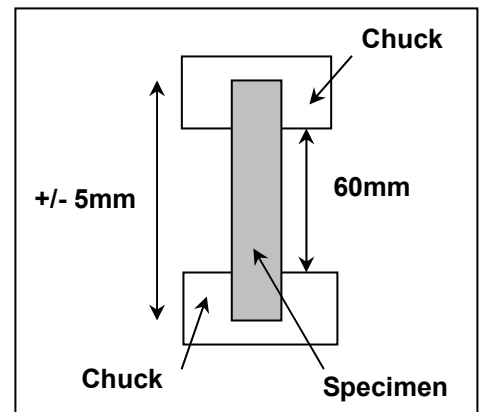
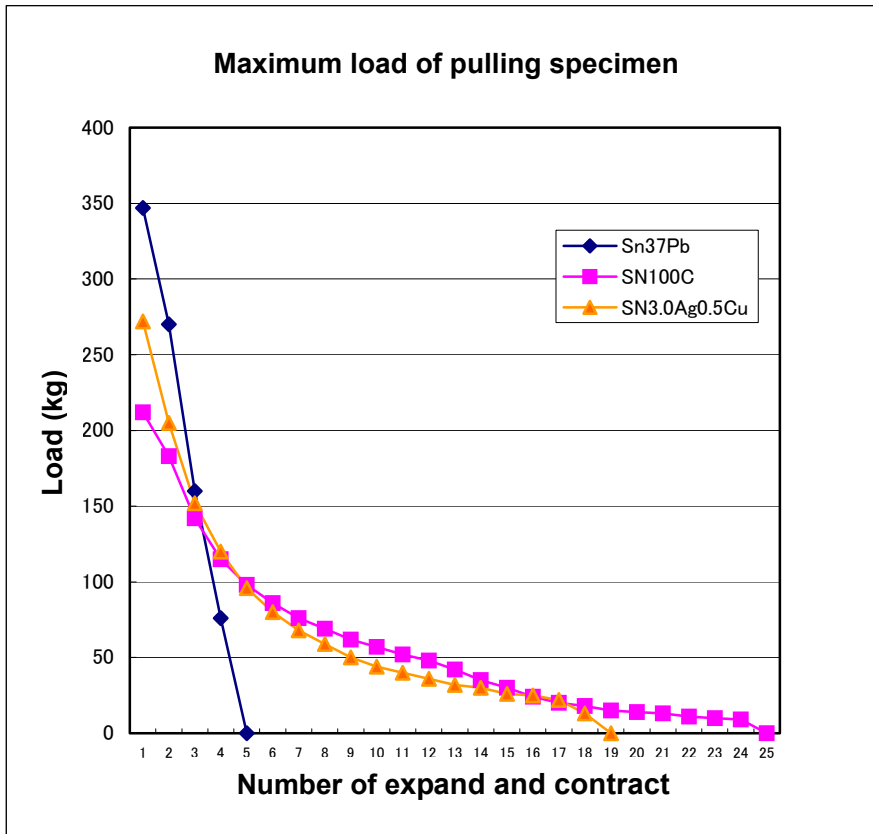


Figure: Specimen is mounted Tensile Strength equipment

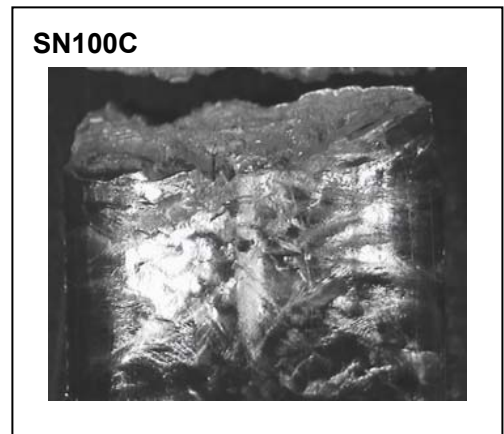
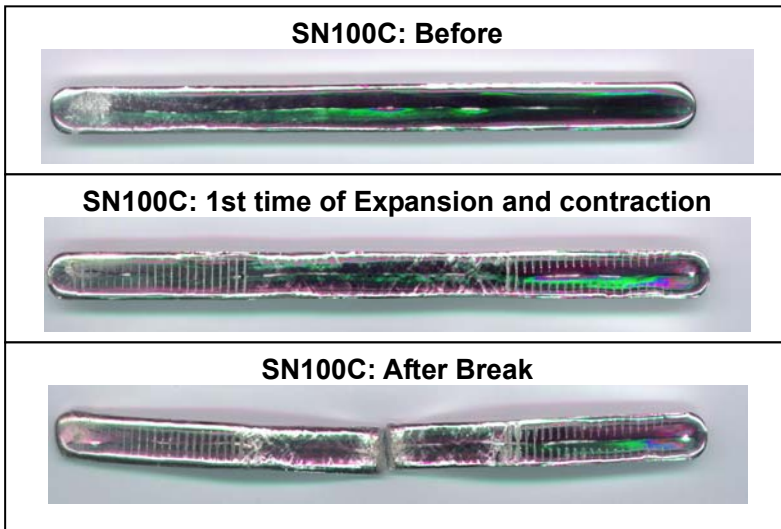
Test Result:



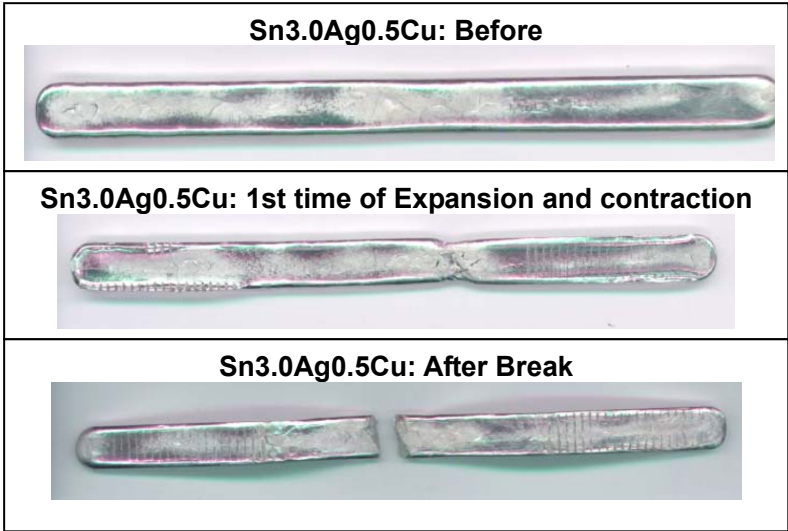
Number of times until breaking:

Alloy	SN100C	Sn3.0Ag0.5Cu	Sn37Pb
Number	25	19	5

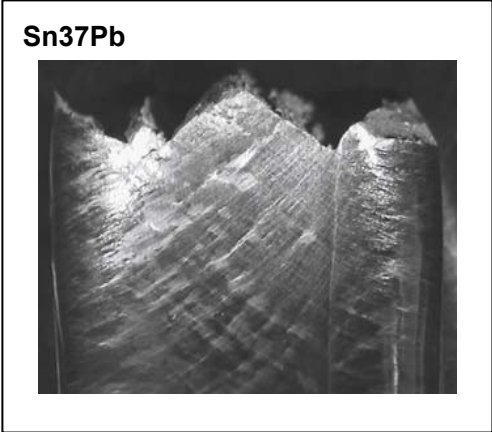
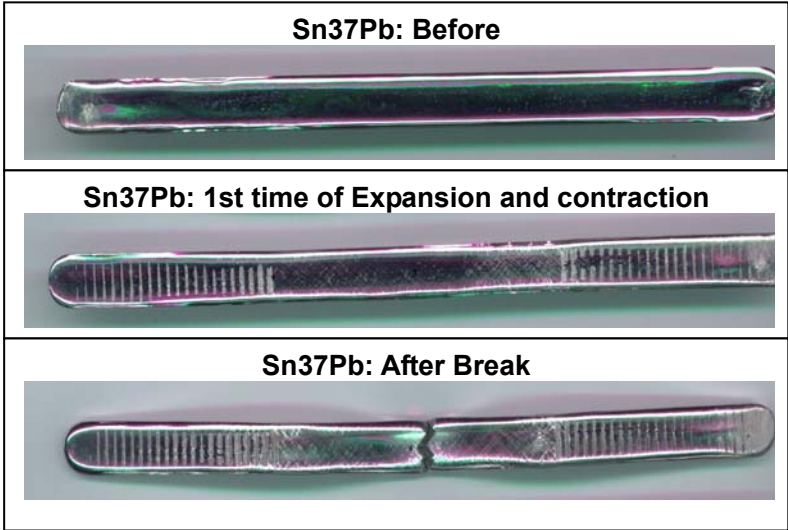
Observation of Specimen



Comment: SN100C has good ductility.



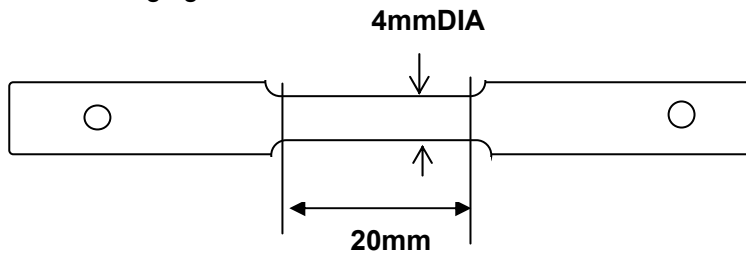
Comment: Crack occurs from shrinkage cavity.



3. Creep Strength

Specimen:

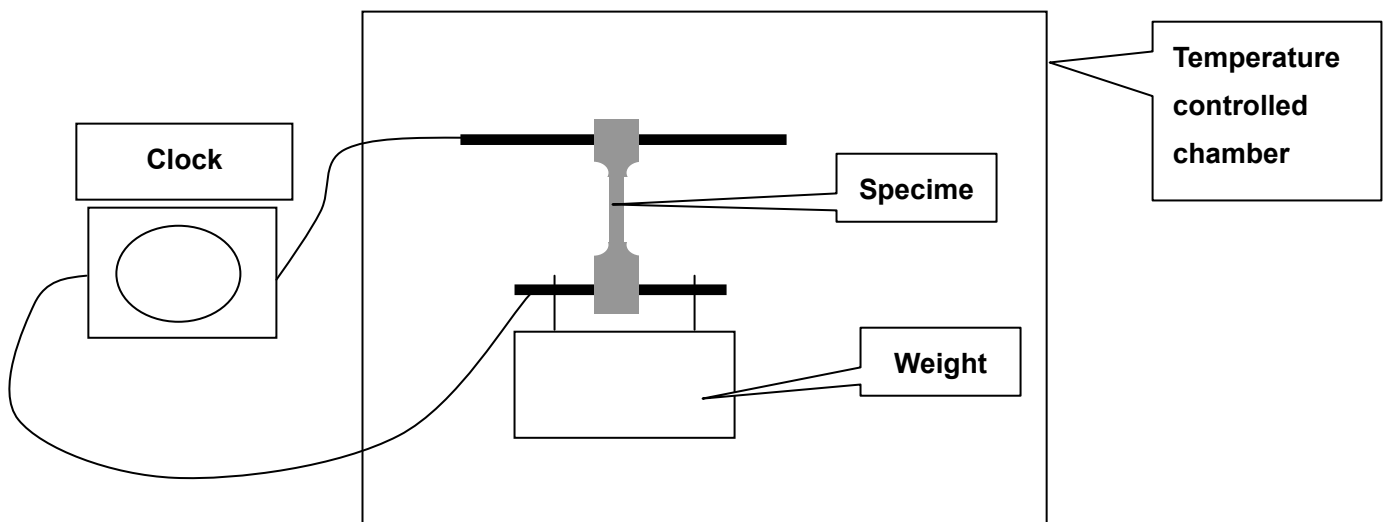
After heating up to 300 degree Celsius, it is poured into the mold. Specimen is made with the lathe as shown in following figure



Test Method

Temperature controlled chamber: MO-3 (OSAKA YOSHIDA)

Specimen is heat up to 100 degree Celsius. After Specimen is heat up to 100 degree Celsius, Time from applying the load to Specimen to breaking of Specimen is recorded.



Test Result

Alloy	Time until breaking (hr)		Average
SN100C	28.7	66.8	47.8
H63A	2.3	2.1	2.2

4. Thermal cycle

Equipment: ES – 106L(HITACHI)

Test Method

Condition:

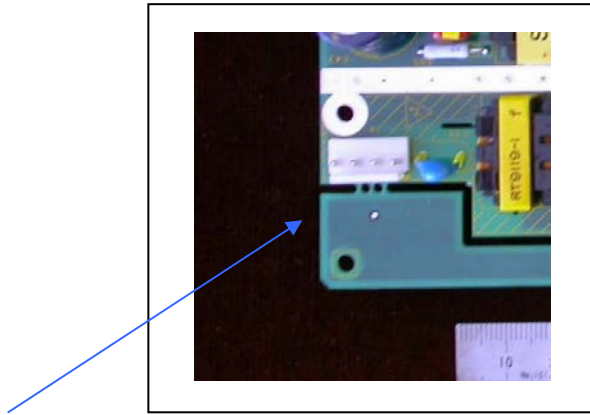
125 degree Celsius x 30 minutes

-40 degree Celsius x 30 minutes

PCB: FR4, Double side PCB

Observation parts:

Connector (Brass/Ni/SnCu coated)

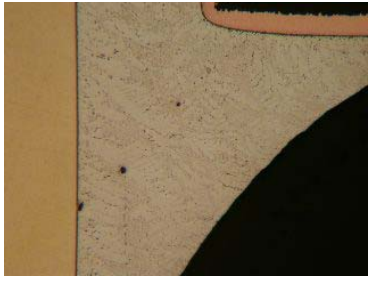
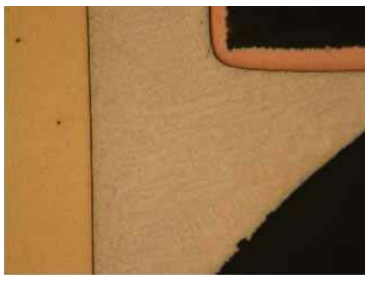
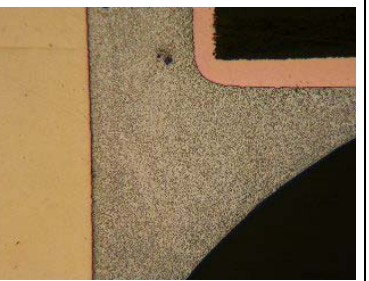
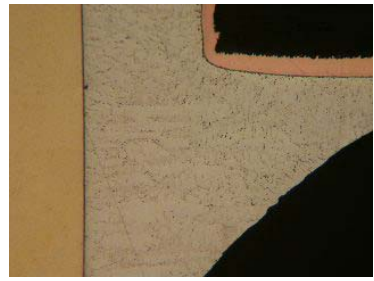



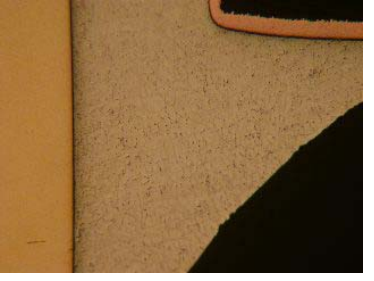
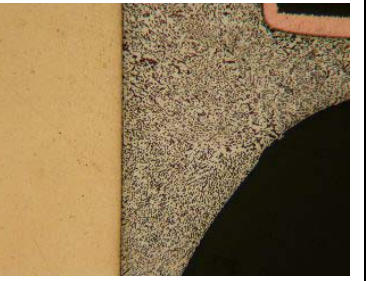

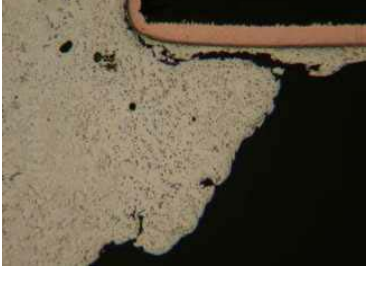



Test Result

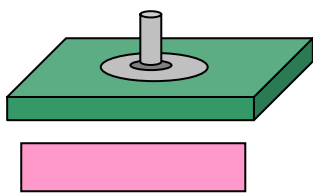
Surface photograph

	SN100C	Sn3.0Ag0.5Cu	Sn37Pb
0 cycles			
100 cycles			
400 cycles			
1000 cycles			

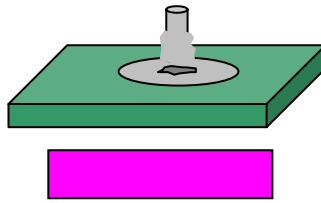
Cross Section photograph

	SN100C	Sn3.0Ag0.5Cu	Sn37Pb
0 cycles			
100 cycles			
400 cycles			
1000 cycles			

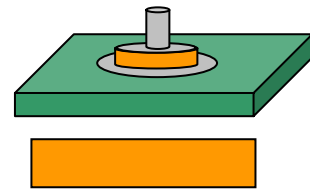
5. Joint strength



Failure at boundary of
Lead and Solder



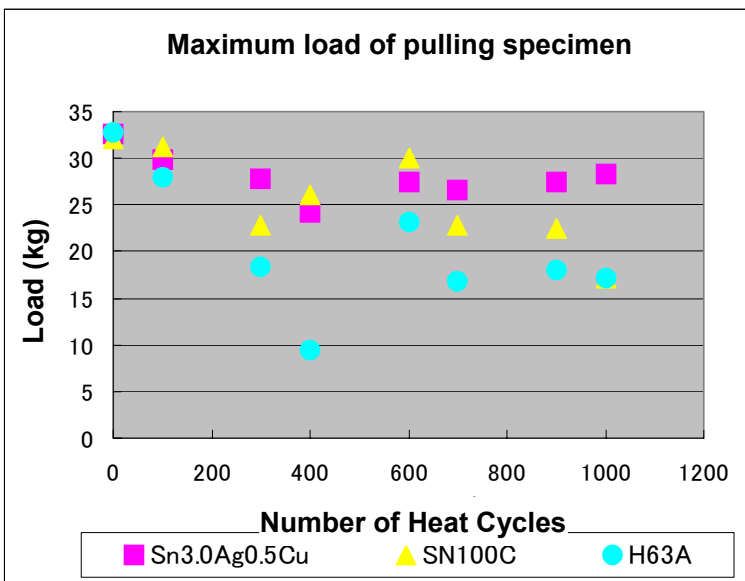
Failure at solder fillet



Failure at through
hole

Joint strength (kg) and failure mode

Number of Heat Cycles	0	100	300	400	600	700	900	1000
Sn3.0Ag0.5Cu	32.6	29.9	27.8	24.2	27.5	26.6	27.4	28.3
SN100C	32.1	31.3	22.9	26.0	30.0	22.9	22.4	17.2
H63A	32.8	28.0	18.3	9.4	23.2	16.8	18.1	17.1



Connector Lead: Brass / Ni /SnCu coated

PCB: FR4, SnAgCu HASL

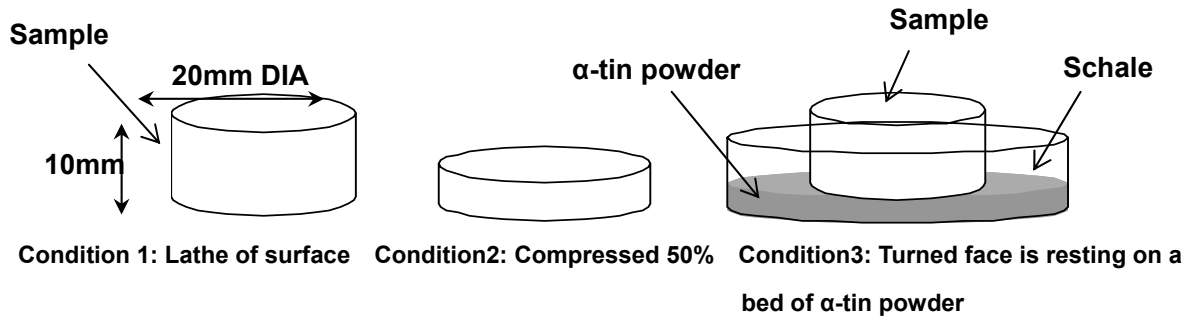
6. Tin Pest

Test method

Specimens:

Accelerate condition: Compressed 50%

Accelerate condition: Turned face is resting on a bed of α -tin powder



Conditions under which specimens were exposed to -45°C (6months)

Test Result

Alloy	Condition 1	Condition 2	Condition 3
99.99%Sn	X	X	X
SN100C	O	O	O
H63A	O	O	O

X=tin pest occurred O= no evidence of tin pest

7. Electric resistance

Test Method

Specimen: Solder wire: 0.8mmDIA x 1meter

Solder wire is measured with milli ohmmeter by four terminal method.

Test Result

Alloy	SN100C	H63A
Electric Resistance ($\mu\Omega\text{m}$)	0.13	0.17

8. Whisker Test

Test Method:

Specimen: Single side board / Paper phenol

Soldering condition: Solder temperature 255 degree Celsius

Observation surface, after Conditions under which specimens were exposed to 50°C (Temperature controlled chamber) x 1000hours.

Result

It was not discovered though it observed with the light microscope.