# 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±0.01)Tm＝162 degree Celsius, Air cooling after heat treatment for one hour.

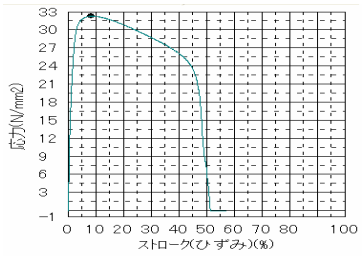
Condition of Tensile Strength

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

Target distance: 50mm

Temperature of atmosphere: 24 degree Celsius

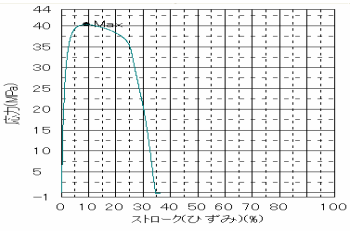
Test Result




＜**Chart**＞

＜**Specimen**＞

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




＜Chart＞

＜Specimen＞

| 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

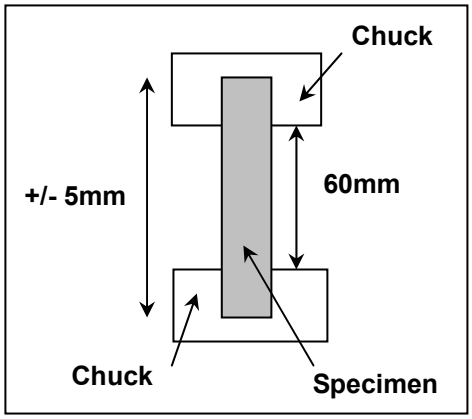
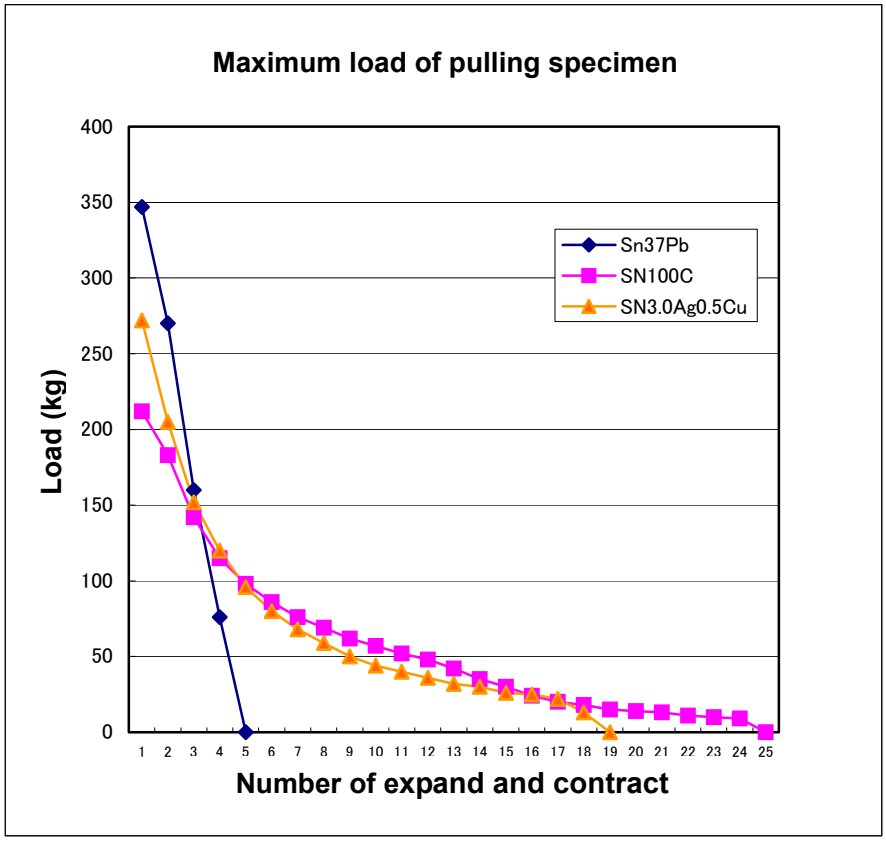



**Figure: Specimen is mounted Tensile Strength equipment**

Test Result:

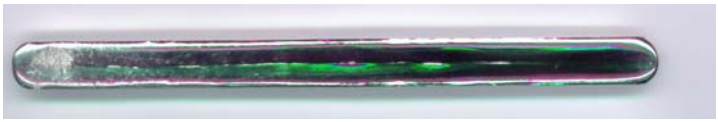



**Number of times until breaking:**

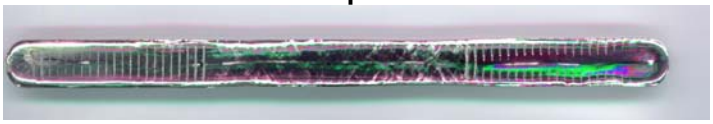
| Alloy | SN100C | Sn3.0Ag0.5Cu | Sn37Pb |
|---|---|---|---|
| Number | 25 | 19 | 5 |

Observation of Specimen

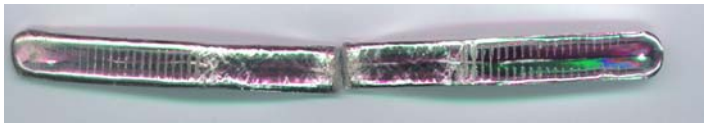
**SN100C: Before**



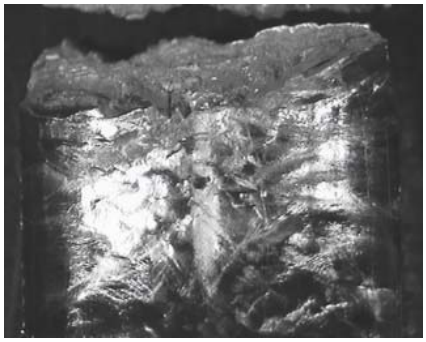
**SN100C: 1st time of Expansion and contraction**



**SN100C: After Break**



**SN100C**



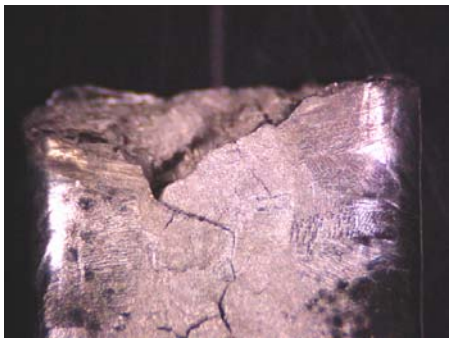
Comment: SN100C has good ductility.

**Sn3.0Ag0.5Cu: Before**

**Sn3.0Ag0.5Cu: 1st time of Expansion and contraction**

**Sn3.0Ag0.5Cu: After Break**

**Sn3.0Ag0.5Cu**

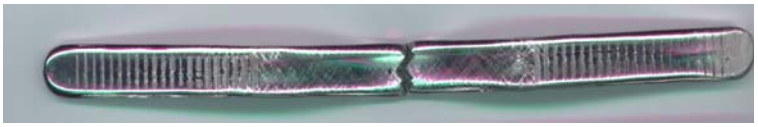


Comment: Crack occurs from shrinkage cavity.

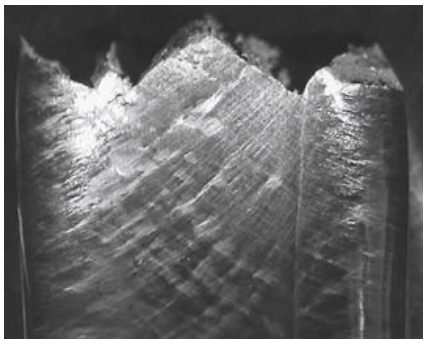
**Sn37Pb: Before**

**Sn37Pb: 1st time of Expansion and contraction**

**Sn37Pb: After Break**



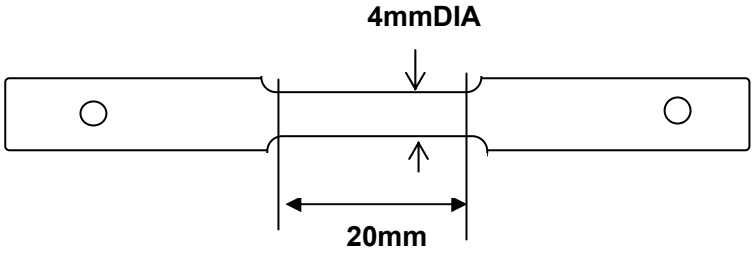
**Sn37Pb**



## 3. Creep Strength

Specimen:

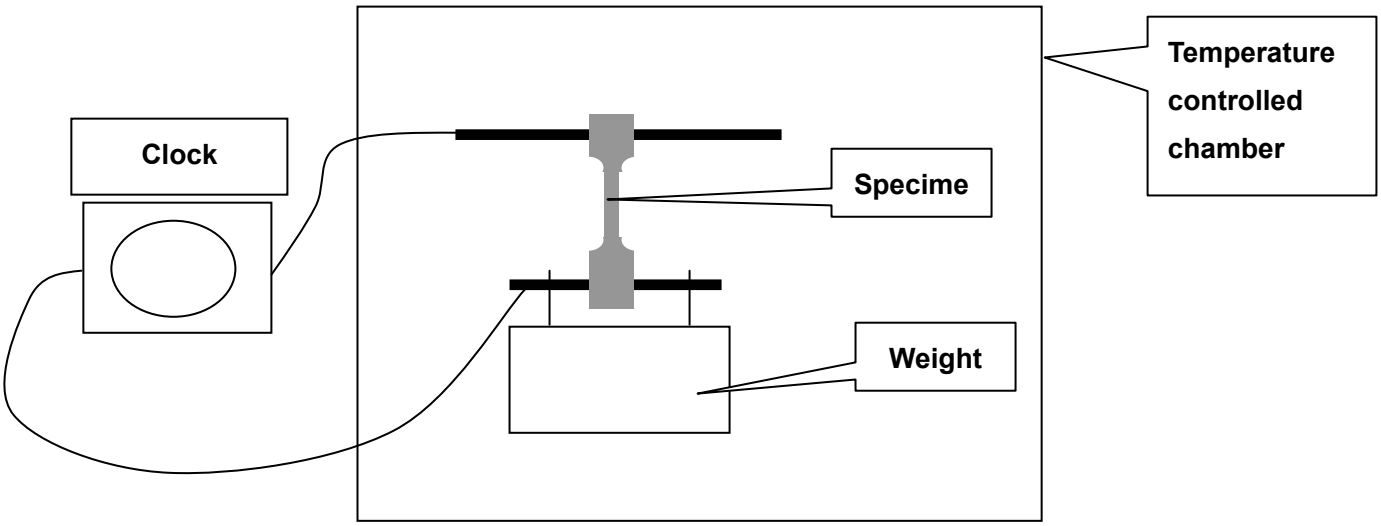
After heating up to 300 degree Celsius, it is poured into the mold. Specimen is made with the lathe as shown in following figure




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:

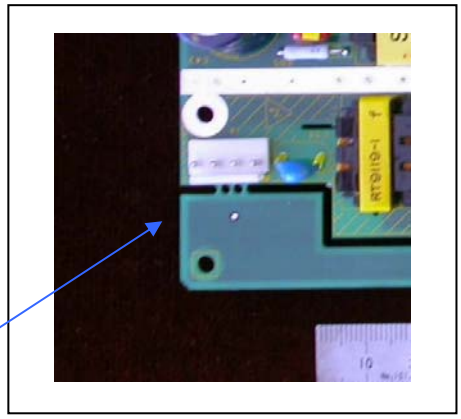
125 degree Celsius x 30 minutes

－40 degree Celsius x 30 minutes

PCB: FR4, Double side PCB

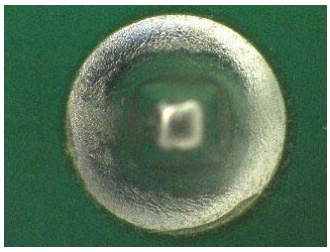
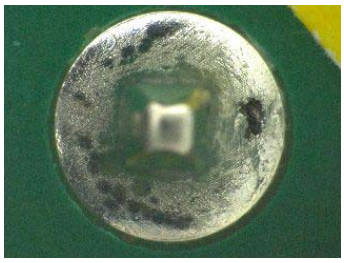
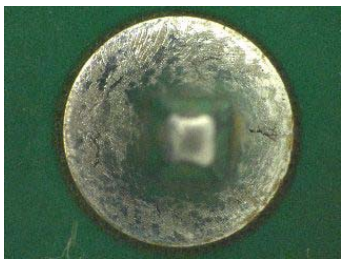
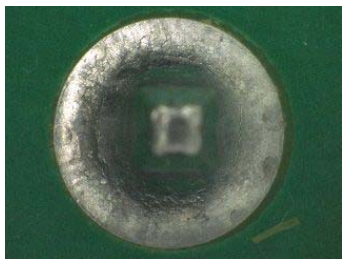
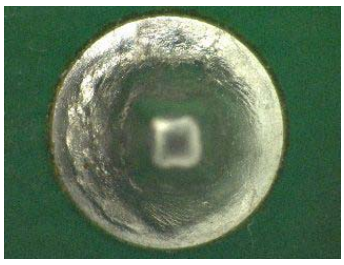
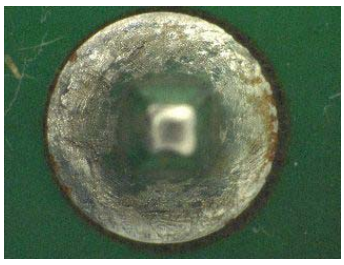
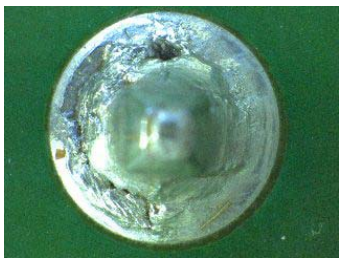
Observation parts:

Connector（Brass/Ni/SnCu coated）

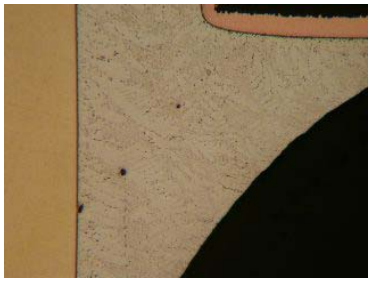
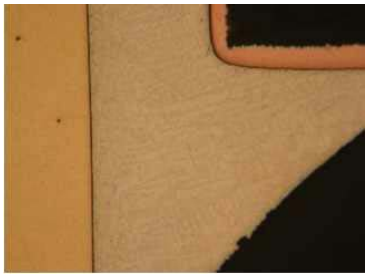
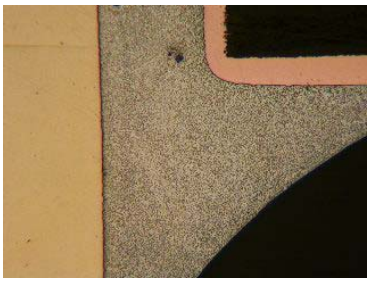
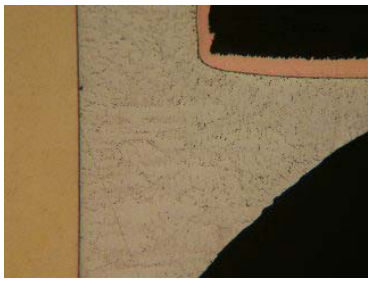
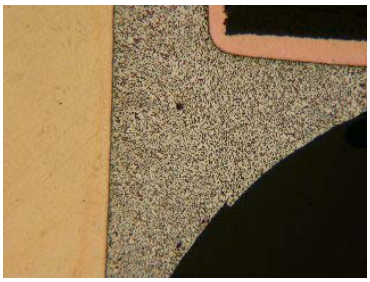
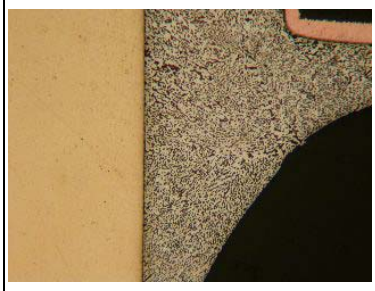
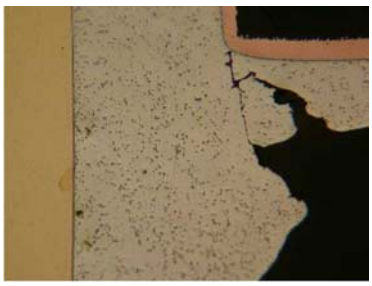
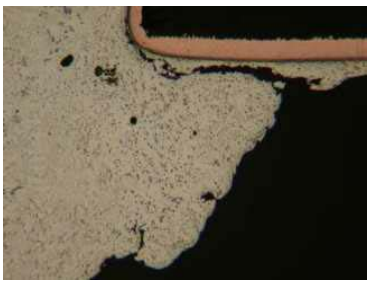
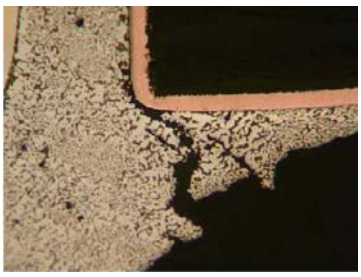


Test Result

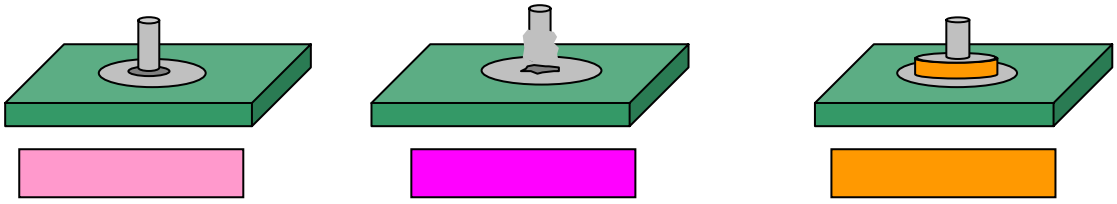
Surface photograph

| | 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



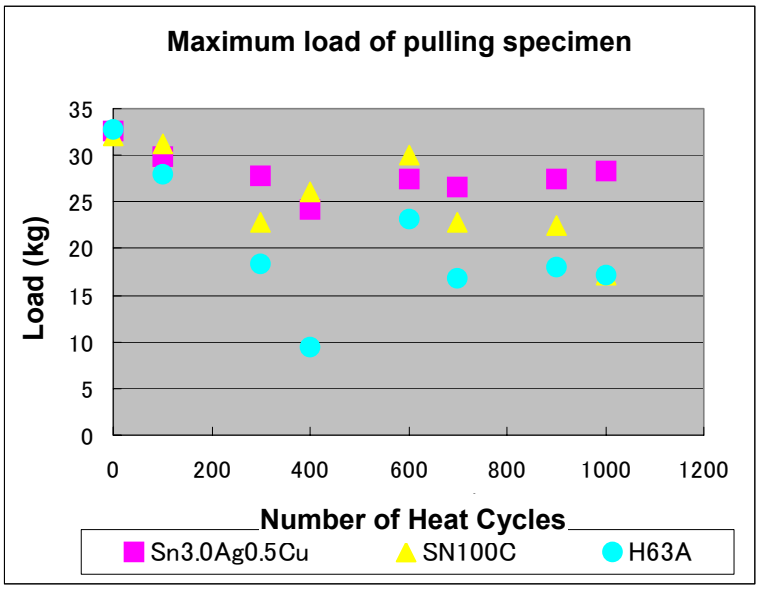
Failure at boundary of Lead and Solder

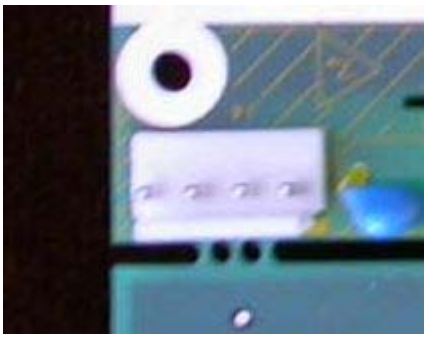
Failure at solder filet

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

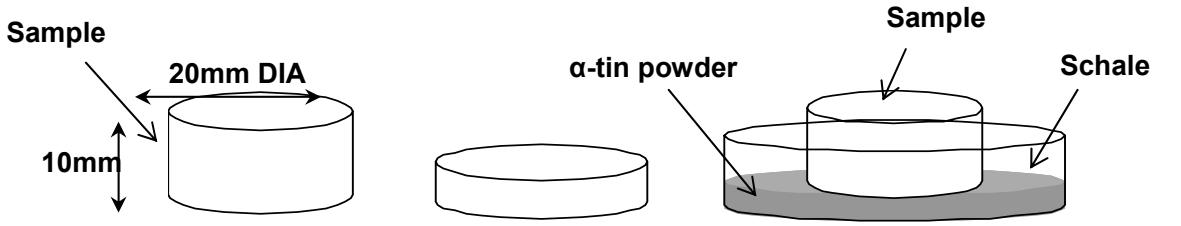
## 6. Tin Pest

Test method

Specimens:

Accelerate condition: Compressed 50%

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




**Condition 1: Lathe of surface** **Condition2: Compressed 50%** **Condition3: 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 (μΩm) | 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.