ASAHI® SOLDER
SYMBOL OF QUALITY

Ref No: 1900032

# Test Report

Company : Singapore Asahi Chemical & Solder Industries Pte Ltd

Sample Description : SCS7 (CLF92) P3.5, 0.8mm

Date : 11 April 2019

Submission Identification:

One (1) solder wire sample identified as SCS7 (CLF92) P3.5, 0.8mm (Lot No.: 80874a) was tested to MS184-2 (Lead Free Solder Wire – for electronics parts) and statement of work as follows:

| Test Description | Test Method | Results |
|---|---|---|
| Alloy Composition Impurities Analysis | 4.2 | Pass (Type C) |
| Alloy Melting Point | 4.3 | Pass (Type C) |
| Halogen Content Test | 4.4 | Pass |
| Flux Content | 4.5 | Pass |
| Residue Dryness Test | 4.6 | Pass |
| Spreadability Test | 4.7 | Pass |
| Copper Plate Corrosion Test | 4.8 | Pass |
| Surface Insulation Resistance Test | 4.9 | Pass |
| Electrochemical Migration Test | 4.10 | Pass |
| Bond Strength Test | 4.11 | Pass |

Test Result (s) : Please refer to next page (s).

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**Sample Description**

| Sample Name | Type | Photo |
|---|---|---|
| Solder Wire | SCS7 (CLF92) P3.5, 0.8mm | Fig.1 |

Fig.1 SCS7 (CLF92) P3.5 0.8mm

**Alloy Composition  Impurities Analysis**

The test is to verify the alloy composition and impurity is conformed to MS184-2 (Type C) standard.

Method:

- The preprocessing method of test pieces is based on acid hydrolysis method or micro wave acid hydrolysis method.
- Analysis the sample pieces by using ICP OES (Inductively Coupled Plasma - Optical Emission Spectrometry).

Results:

| Elements | Specification (Type C) | Results (Wt %) |
|---|---|---|
| Sn | Rem | **Rem** |
| Pb | < 0.09 | **0.0163** |
| Sb | < 0.10 | **0.0028** |
| Bi | < 0.10 | **0.0350** |
| Cu | 0.50 – 0.90 | **0.6301** |
| Au | < 0.05 | **< 0.0001** |
| In | < 0.10 | **0.0251** |
| Ag | < 0.10 | **0.0242** |
| Al | < 0.001 | **<0.0001** |
| As | < 0.03 | **0.0018** |
| Cd | < 0.002 | **0.0003** |
| Fe | < 0.02 | **0.0003** |
| Ni | < 0.01 | **0.0096** |
| Zn | < 0.001 | **0.0005** |
| Si | - | **0.0133** |

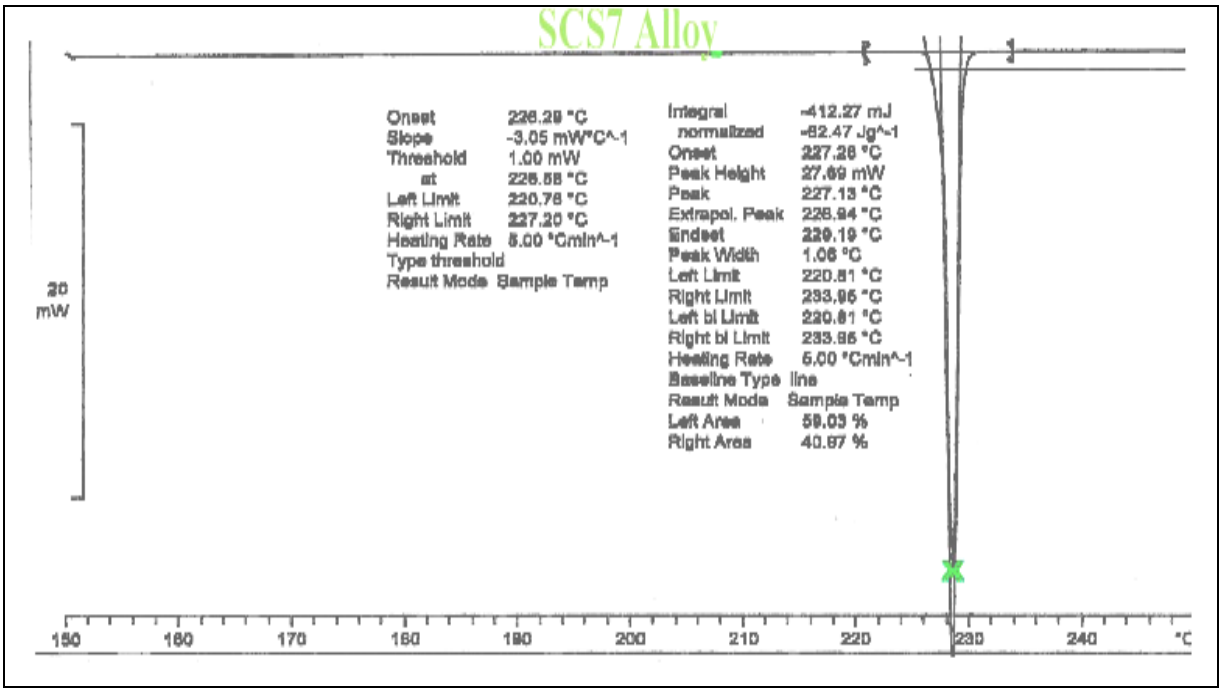
**Alloy Melting Point**

The test to measure the melting point of the alloy, and conforming to MS184-2 (Type C) standard.

Method:

- The solder alloys were cast into thin sheets and a small piece of mass between 5 to 7mg was cut from each of these sheets.
- The pieces were weight to an accuracy of 0.1mg and placed into aluminum crucibles.
- The DSC (Differential Scanning Calorimeter) was then used to measure the melting range of these alloys.

Results:




**There is only a single peak as shown in the graph at 227.13°C (~227°C).**

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## Halogen Content Test

The test method is to measure the amount of chlorine and bromine compounds in base material.

Method:

- The preprocessing method of test pieces is based on Oxygen combustion in closed system and determination methods (EN14582).
- Analysis by using Ion Chromatography.

Results:

Tested by SGS Singapore, dated 24Jan2018, report no.: 10440670(a).

| Test Item(s): | Unit | Method | Results | MDL |
|---|---|---|---|---|
| **Halogen** | | | | |
| Halogen - Bromine (Br) | mg/kg | With reference to BS EN 14582. Analysis was performed by IC | n.d. | 50 |
| Halogen - Chlorine (Cl) | mg/kg | With reference to BS EN 14582. Analysis was performed by IC | n.d. | 50 |
| **Total (Br + Cl)** | **mg/kg** | **---** | n.d. | --- |

Note: (1) mg/kg = ppm ; 0.1wt% = 1000ppm
(2) n.d.= Not Detected
(3) MDL = Method Detection Limit

## Flux Content Test

The test is to determine of flux percentage in the solder wire.

Method:

- 1m of sample is measured and weighed (w1).
- The sample is placed in an aluminum boat and melted on the hot plate to separate the flux from the solder wire. The temperature of the hot plate is set to 50$^{o}$C above the melting point of the alloy used.
- Remove the melted solder bits and clean the solder in IPA to remove any form of flux.
- The melted solder bits are weighed (w2) accurately.
- The flux percentage (F%) is calculated by the following equation:

  F% = [(w1-w2)/w1] x 100

Results:

| Weight of Cored Wire (g) | Weight of Solder (g) | Flux Content (%) |
|---|---|---|
| 20.0561 | 19.3521 | 3.51 |
| 20.1621 | 19.4564 | 3.50 |
| 20.0869 | 19.3798 | 3.52 |
| 20.2264 | 19.5084 | 3.55 |
| 20.5468 | 19.8133 | 3.57 |
| **Average** | | **3.53** |

Average flux content in the cored wire = **3.53%**

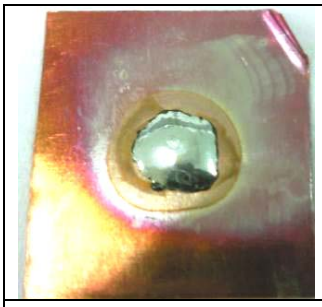
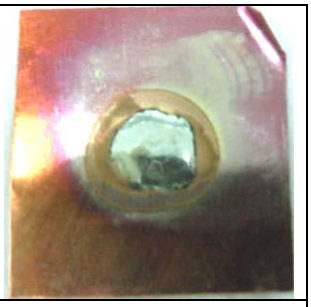
**Residue Dryness Test**

The test is to determine the tackiness of residue after soldering.

Method:

- Place the flat coil of wire at the center of copper coupon.
- Place the copper coupon on the hot plate. The temperature of the hot plate is set to 50°C above the melting point of the alloy used.
- Leave the copper coupon on the hot plate for a further 5 sec after the solder is melted.
- Carefully remove the test piece and allow it to cool for about 30 mins.
- Dust the surface of the flux residue on the test piece liberally with the powdered talc.
- Brush the surface of the residue in the same direction twice and inspect the test piece.

Results:

| | | |
|---|---|---|
|  |  |  |
| After soldering | Talc addition | After brushing |

**Talc was easily brushed off from the surface and there is very little or no talc left.**

**Spreadability Test**

The test to measure the spread capability of the core wire.

Method:

- Copper coupons are pretreated by washed with copper cleaning solution then rinsed off under running water followed by rinsing with IPA.
- The cleaned coupons are placed into over at 150$^{o}$C for 1 hour.
- Placed the flat coil of wire at the center of the treated copper coupon.
- Place the copper coupon on the hot plate for 30 sec. The temperature of the hot plate is set to 50$^{o}$C above the melting point of the alloy used.
- Lift the test piece from hot plate and cool to room temperature, and flux residue shall be removed by IPA.
- The spreadability is calculated by the following equation:

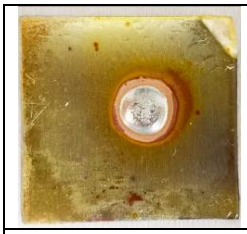
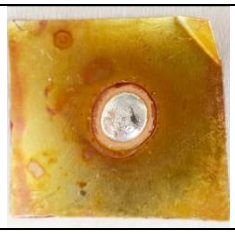
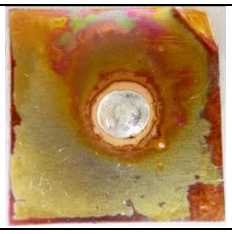
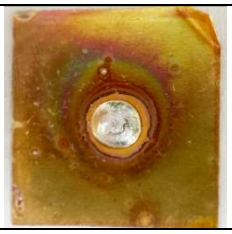
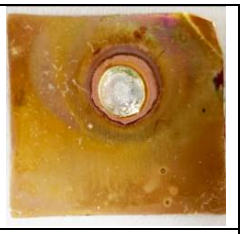
$$\text{Spreadability} = (D-H)/D \times 100\%$$

where $D = 1.24 \times V^{1/3}$

$V$ = Mass / Specific Gravity

$H$ = Height of Spread Solder

Results:

| | | | | |
|---|---|---|---|---|
|  |  |  |  |  |
| 76.47 | 75.15 | 77.26 | 75.58 | 76.16 |

**Average spreadability is 76.12%.**

**Copper Plate Corrosion Test**

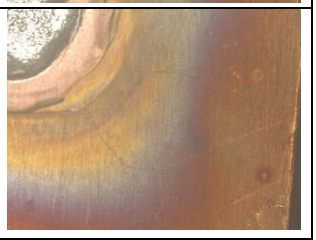
The test provides a visual check on the corrosive effect of the flux on the substrate after high humidity.

Method:

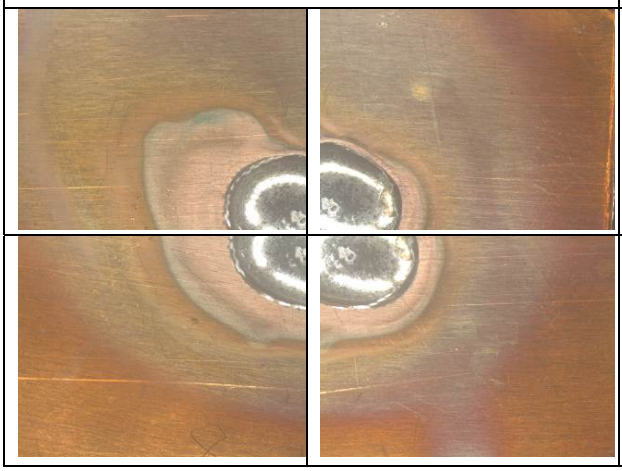
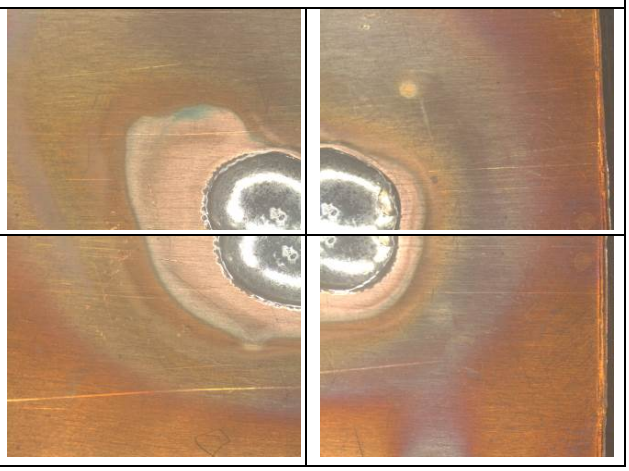
- Copper coupons are pretreated by washed with copper cleaning solution then rinsed off under running water followed by rinsing with IPA.
- The cleaned coupons are placed into over at 150°C for 1 hour.
- Placed the flat coil of wire at the center of the treated copper coupon.
- Place the copper coupon on the surface of solder bath. The temperature of the hot plate is set to 50°C above the melting point of the alloy used.
- After fusing of solder, leave it for further 5 sec.
- Lift the test piece from solder bath and cool it for 15 min.
- Placed the specimen in a preset humidity chamber 40 ± 2°C and 90 ± 5 %RH for 96 hours.
- Remove test specimen from humidity chamber, examine the test piece under microscope and compare with observation.

Results:

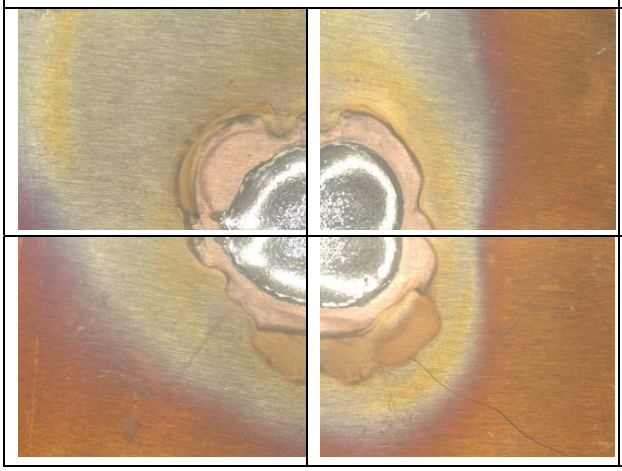
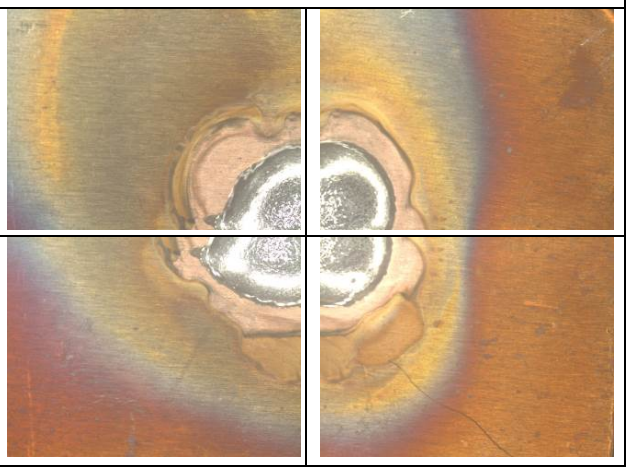
Specimen 1

| After soldering | | After 96 hours in 40°C 90% RH | |
|---|---|---|---|
|  |  |  |  |
|  |  |  |  |

Specimen 2

| After soldering | After 96 hours in 40°C 90% RH |
|---|---|
|  |  |

Specimen 3

| After soldering | After 96 hours in 40°C 90% RH |
|---|---|
|  |  |

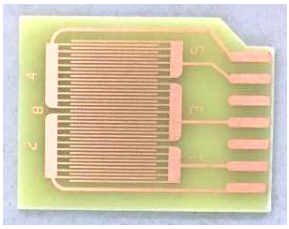
- **No corrosion was observed after 96 hours in 40°C 90% RH test condition.**

## Surface Insulation Resistance Test

It determines the surface insulation properties of the flux on the finished product. Thus, it determines the reliability of the residue if left on board without cleaning.

Test Method:

- Use the JIS C 6480, has 0.318mm lines and 0.318mm spacing.
- Test coupons will be tested at 85±2°C and 85±5%RH relative humidity for 168 hours.
- The insulation resistance shall be measured at DC 48V in the condition where the test coupons is placed in the chamber at the time of 24, 96, 168 hour. All SIR measurements shall exceed $1.0\times10^{8}\Omega$.



JIS C 6480 Test Board

Results:

| Sample | Surface Insulation Resistance (Ω) | | |
|---|---|---|---|
| | 24hr | 96hr | 168hr |
| 1 | $5.28\times10^{11}$ | $3.83\times10^{11}$ | $2.98\times10^{11}$ |
| 2 | $3.21\times10^{11}$ | $2.39\times10^{11}$ | $1.94\times10^{11}$ |
| 3 | $3.75\times10^{11}$ | $2.80\times10^{11}$ | $2.30\times10^{11}$ |
| 4 | $2.73\times10^{11}$ | $1.32\times10^{11}$ | $1.67\times10^{11}$ |
| 5 | $2.06\times10^{11}$ | $1.33\times10^{11}$ | $1.07\times10^{11}$ |

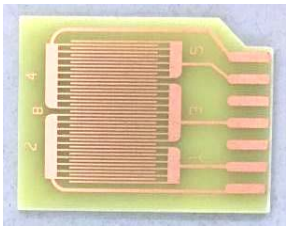
- **All surface insulation resistance results are $>1.0\times10^{8}\Omega$.**

## Electrochemical Migration Test

This test determines the existence of migration due to flux residue after soldering

Test Method:

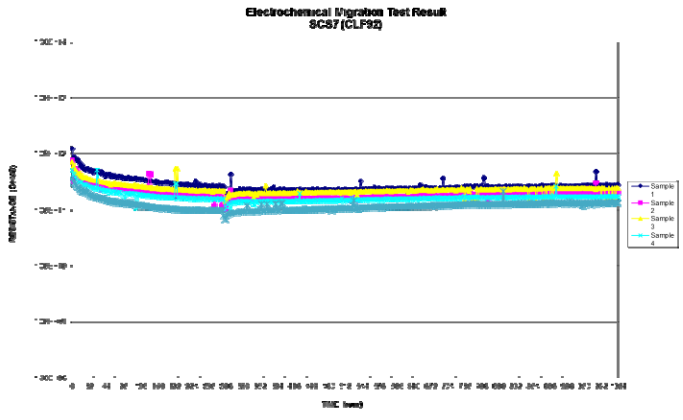
- Use the JIS C 6480, has 0.318mm lines and 0.318mm spacing.
- Test coupons will be tested at 85±2°C and 85±5%RH relative humidity for 1000 hours.
- Measurements are taken using test voltage of 48V DC.
- Examined using a 30x microscope to see if there is any electrochemical migration.

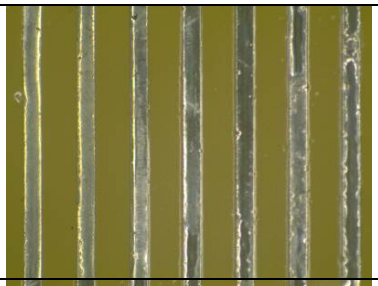
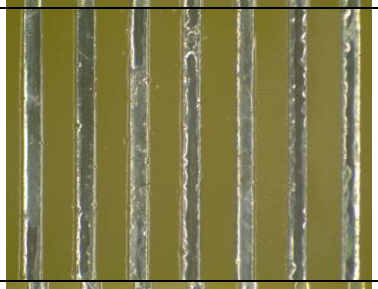
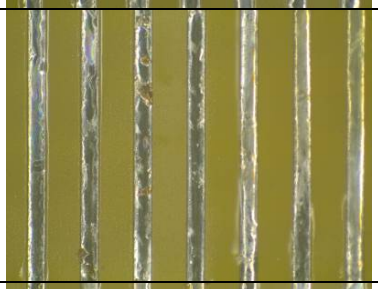
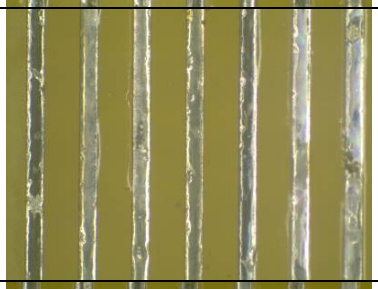
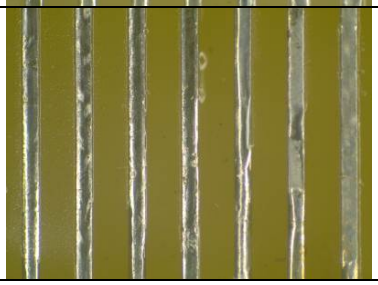


JIS C 6480 Test Board

Results:

| Sample | Surface Insulation Resistance (Ω) |
|---|---|
| | 1000 hour |
| 1 | $2.74\times10^{11}$ |
| 2 | $2.05\times10^{11}$ |
| 3 | $1.49\times10^{11}$ |
| 4 | $1.72\times10^{11}$ |
| 5 | $1.32\times10^{11}$ |



| | |
|---|---|
| Sample 1 |  |
| Sample 2 |  |
| Sample 3 |  |
| Sample 4 |  |
| Sample 5 |  |

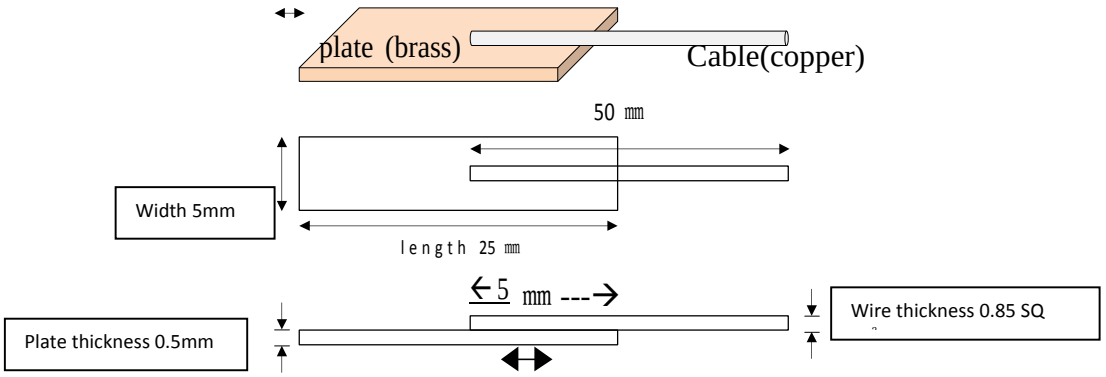
- **All surface insulation resistance results are >1.0×10$^4$Ω, and there is no electrochemical migration were found.**

**Bond Strength Test**

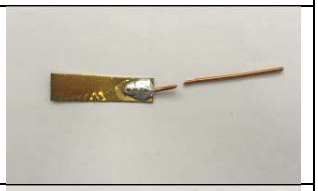
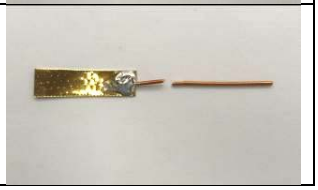
This test determines the bond strength of the solder joint.

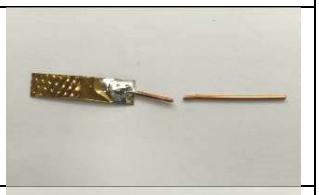
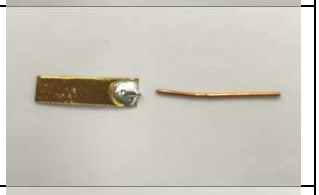
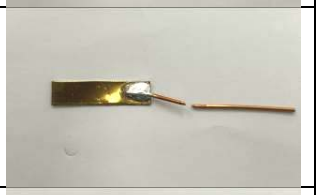
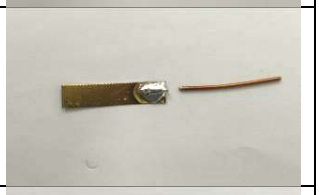
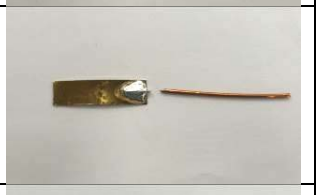
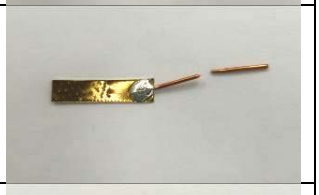
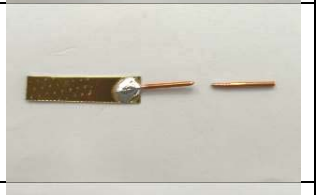
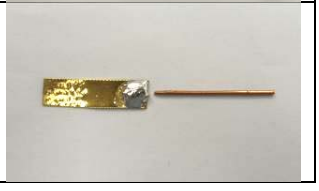
Test Method:

- Structure and dimension of test sample is showed as below. The quantity of solder is 0.1±0.01g.
- Test method is as per metallic material tension test, test speed is 5mm/min.




Results:

| Test Sample | Strength (N) | Failure Mode | Photo |
|---|---|---|---|
| Sample 1 | 256.6 | Wire Broken |  |
| Sample 2 | 225.6 | Wire Broken |  |

| Test Sample | Strength (N) | Failure Mode | Photo |
|---|---|---|---|
| Sample 3 | 276.5 | Wire Broken |  |
| Sample 4 | 240.4 | Wire Broken |  |
| Sample 5 | 254.7 | Wire Broken |  |
| Sample 6 | 243.3 | Wire Broken |  |
| Sample 7 | 227.4 | Wire Broken |  |
| Sample 8 | 235.1 | Wire Broken |  |
| Sample 9 | 228.9 | Wire Broken |  |
| Sample 10 | 231.2 | Wire Broken |  |

========== End of Report ==========