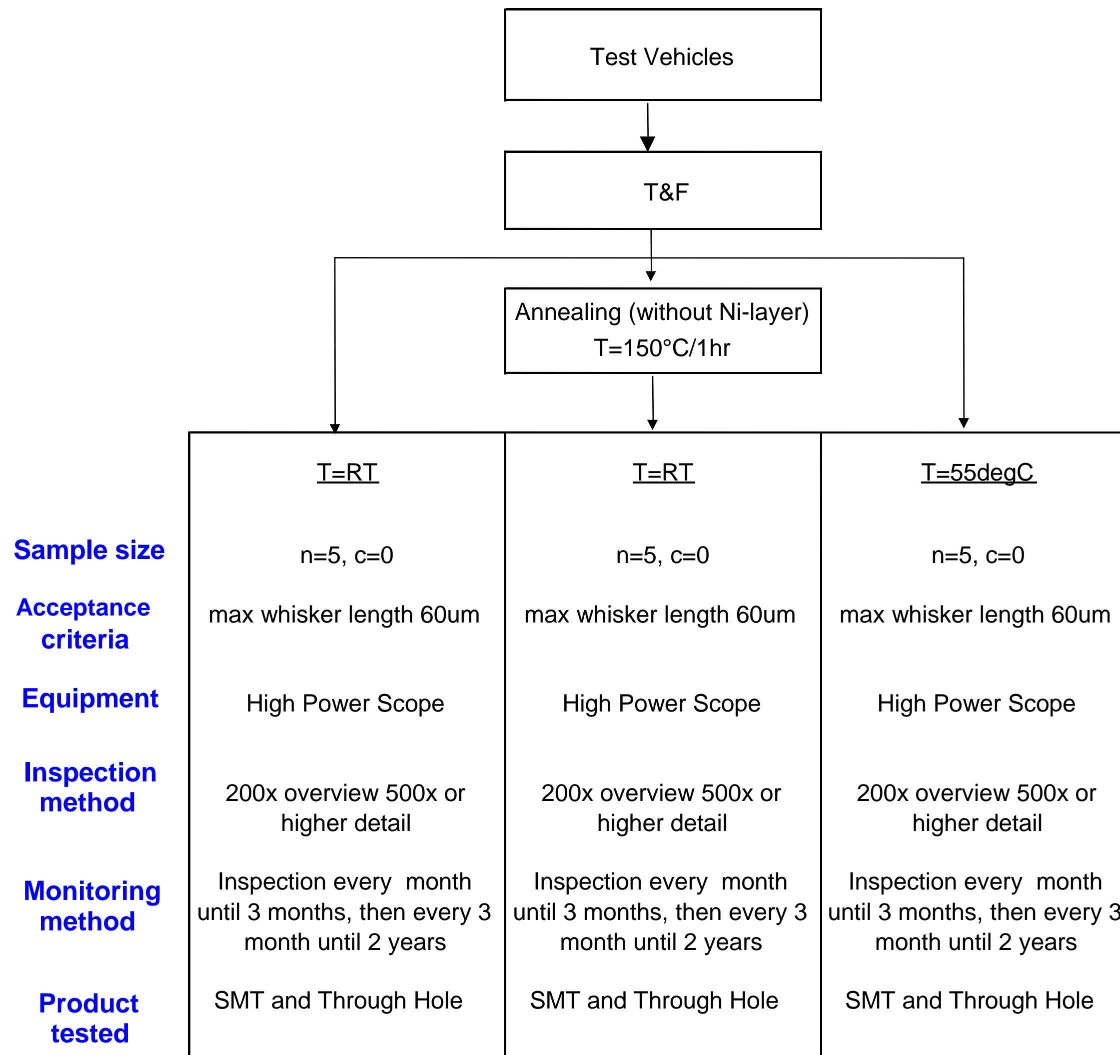
RoHS - Whisker Test

Testflow



Note:
RT=20~30degC and humidity level = 30%rh~60%rh

RoHS - Whisker Test

Classification:
Length

Length 0	non observable whisker growth
Length 1	< 25µm
Length 2	< 60µm
Length 3	< 100µm
Length 4	> 100µm

Maximum allowed length for whisker is 60µm.

Frequency (within field of view by 200x)

Frequency 1	less or equal 2 whiskers
Frequency 2	3 to 10 whiskers
Frequency 3	more than 10 whiskers

Shape

Shape 1	nodular stubs
Shape 2	filaments (thin needles)

RoHS - Whisker Test

Results after 12 months (Dec. 03)

Classification

3
2,5
2
1,5
1
0,5
0

Whisker
Length 1: < 25µm
Frequency 3: n > 10

TOPLED Cu base Ag plated
TOPLED Cu base
Radial CuZn base Cu plated
Radial Fe base Cu plated

Frequency Without Ni
Length Without Ni
Frequency With Ni
Length With Ni

with Sn surface finish (8µm +/- 2µm)

With Ni underlayer NO Whisker found

RoHS - Whisker Test

Theory

Influencing factors for whisker - growth

- Diffusion effects between tin layer and base material due to formation of intermetalic layers (IMV)
- Orientation of the tin crystals (texture)
- Grain size of the tin deposit (prefered grain size to prevent whisker-growth is 2 - 5 µm)
- Internal stress of tin deposit (tensile strength prevent whisker-growth)
- Thickness of tin deposit

OS Solution

Osram OS actions to prevent whisker - growth

- Plating of nickel underlayer to prevent diffusion (between base material and tin deposit)
- Proven in studies of NASA, ESA, Technic Inc., Shipley, that a nickel layer with thickness > 0,5µm prevent whisker-growth
- Increase of Sn-layer thickness to 8µm
- Selecting of optimized pure Sn plating chemistry (texture, grain size, internal stress, co-deposition of carbon)

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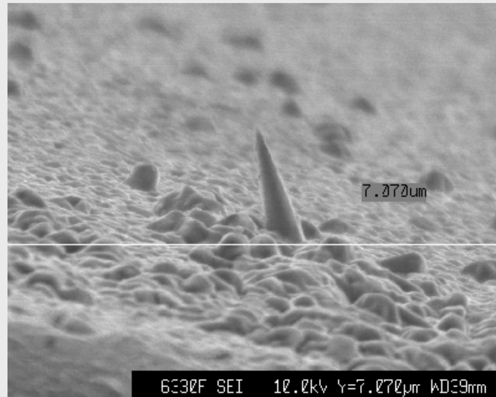
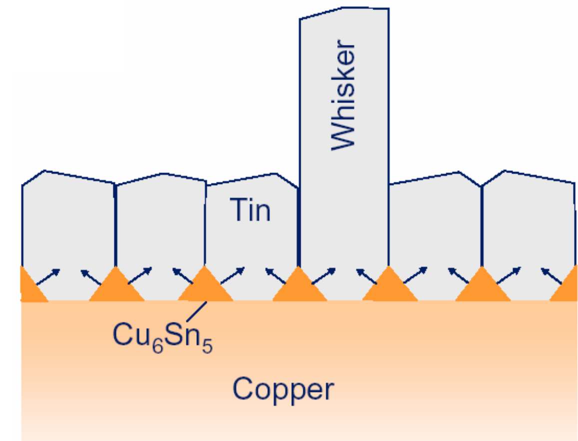
Whisker after 3 months without Ni - underlayer



Only very small whisker < 10 µm length



Main working hypothesis for whisker growth is the grain boundary diffusion between Cu and Sn.