Knowles (UK)
Limited

Hethel Engineering
Centre, Hethel,

IPC/JEDEC J-STD-020D

Moisture/Reflow Sensitivity Classification for Non-hermetic Solid State Surface Mount Devices
Knowles (Syfer) Surface Mount Capacitor Test Results

1.0 Introduction

The purpose of J-STD-020 is to identify the moisture sensitivity classification level of non-hermetic solid state surface mount devices (SMDs). The classification level enables proper packaging, storage and handled to prevent potential damage as a result of moisture-induced stress during soldering operations and/ or repair operations.

The background of this standard is that the vapour pressure of moisture inside a component during high temperature reflow can cause internal delamination's and cracks, which may cause performance or reliability failures.

Moisture Sensitivity Levels defined by J-STD-020

Level	Floor Life	
	Time	Condition
1(1)	Unlimited(2)	≤30ºC/ 85%RH
2	1 year	≤30ºC/ 60%RH
2a	4 weeks	≤30ºC/ 60%RH
3	168 hours	≤30ºC/ 60%RH
4	72 hours	≤30ºC/ 60%RH
5	48 hours	≤30ºC/ 60%RH
5a	24 hours	≤30ºC/ 60%RH
6	Time On Label (TOL)	≤30ºC/ 60%RH

Notes:

(1) If a device passes level 1, it is classified as not being moisture sensitive and does not require dry pack.

(2) Unlimited floor life refers specifically to moisture sensitivity related to components cracking during soldering operations. Other factors may affect, for example, component solderability. Knowles (Syfer) recommended shelf life and storage conditions are available at www.knowlescapacitors.com Copies of J-STD-020 are available at http://www.jedec.org

2.0 Moisture Sensitivity Classification Process

2.1 Initial Electrical Test

Capacitors tested for:

- Capacitance.
- Dissipation Factor.
- Insulation resistance.
- Dielectric Withstand Voltage.

2.2 Initial Visual

Capacitors externally visually examined using 50x magnification.

2.3 Bake

Capacitors subjected to minimum 24hours at 125ºC +5/-0ºC.

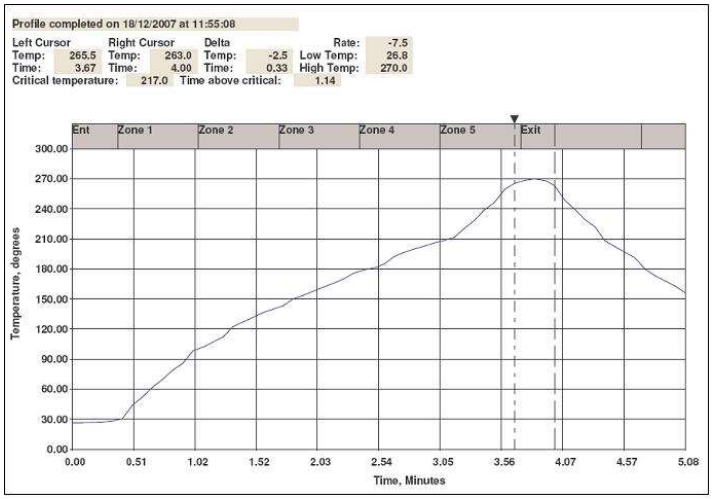
2.4 Moisture Soak

Capacitors placed in a humidity chamber at 85ºC/ 85%RH for 168 hours.

2.5 Reflow x 3

Within 15 minutes to maximum 4 hours after the moisture soak, capacitors subjected to 3x reflow soldering profile.

Reflow soldering profile used by Knowles (Syfer):



2.6 Final External Visual

Capacitors externally visually examined using 50x magnification.

2.7 Final Electrical Test

Capacitors tested for:

- Capacitance
- Dissipation Factor
- Insulation resistance
- Dielectric Withstand Voltage

2.8 Final Internal Visual Examination

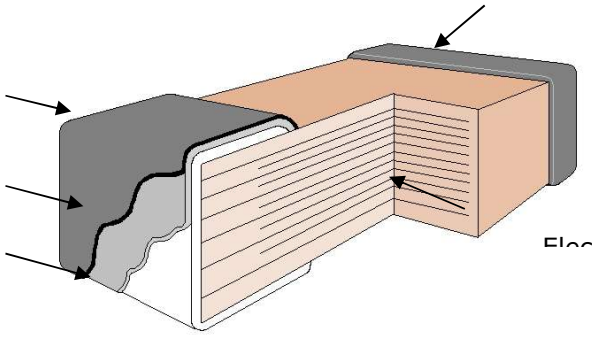
J-STD-020 includes a final acoustic microscopy stage after the final electrical test with any component identified with a crack being evaluated by sectioning.

Acoustic microscopy may not identify all cracks within capacitors and to verify that no cracks are present, Knowles (Syfer) has sectioned all capacitors tested.

Sectioning is conducted by mounting capacitors in high edge retention potting compound and then grinding through the capacitors. During the grinding process, the capacitors have been frequently examined using up to 200x magnification checking for cracks.

Ceramic

Top layer. Plated with either Tin/ Lead or 100% Tin.



Elec

Figure 1 - Capacitor

3.0 Failure Criteria

If 1 or more capacitor in the test sample fails then the whole family group is considered to have failed the tested MSL (Moisture Sensitivity Level).

A capacitor is considered to have failed if it exhibits any of the following after the 168 hour moisture soak and subsequent 3x reflow processes:

- Crack observed in the ceramic body during the Final External Visual examination
- Final Electrical Test failure
- Crack observed in the ceramic body during the Final Internal Visual examination

4.0 Knowles (Syfer) Test Summary

Moisture/ reflow sensitivity classification has been conducted by Knowles (Syfer) based on a family sampling approach in relation to:

- Capacitor case size
- Dielectric classification
- Termination type

Results

Capacitor Case Size	Dielectric Type	Termination Type(1)	Sample Size	Pre Moisture Soak and 3x Reflow		Post Moisture Soak/ 3x Reflow			Appendix 1 Photo Ref
				2.1 Initial Electrical Tests	2.2 Initial Visual	2.6 Final External Visual	2.7 Final Electrical Tests	2.8 Internal Visual Examination	
0603	C0G	J	25	Pass	Pass	Pass	Pass	Pass	1 and 2
0603	X7R	J	25	Pass	Pass	Pass	Pass	Pass	3 and 4
0603	X7R	Y	25	Pass	Pass	Pass	Pass	Pass	5 and 6
1210	C0G	J	25	Pass	Pass	Pass	Pass	Pass	7 and 8
1210	X7R	J	25	Pass	Pass	Pass	Pass	Pass	9 and 10
1210	X7R	Y	25	Pass	Pass	Pass	Pass	Pass	11 and 12
2225	C0G	J	25	Pass	Pass	Pass	Pass	Pass	13 and 14
2225	X7R	J	25	Pass	Pass	Pass	Pass	Pass	15 and 16
2225	X7R	Y	25	Pass	Pass	Pass	Pass	Pass	17 and 18

Notes:

(1) Termination type refers to the code letter used in Knowles (Syfer) part numbers.

J: Silver base with Nickel Barrier (100% matte tin Plating).

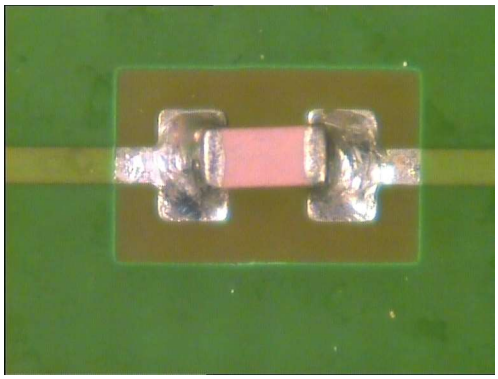
Y: FlexiCap™ termination base with Ni Barrier (100% matte tin plating).

All capacitors tested passed Moisture Sensitivity Level (MSL) 1 and are not classified as being moisture sensitive. The capacitors supplied by Knowles (Syfer) do not require dry pack.

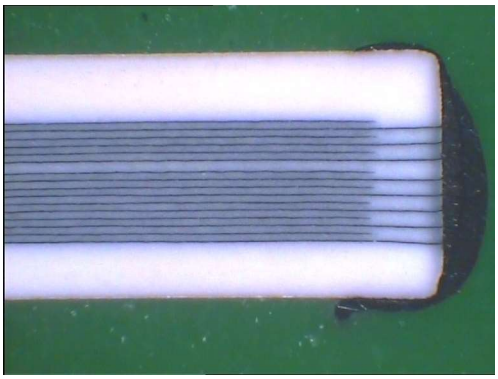
Appendix 1 – Capacitor Photographs

The following photographs have been taken after the moisture soak and 3x reflow processes and are representative of the capacitors subjected to the moisture/ reflow sensitivity classification tests.

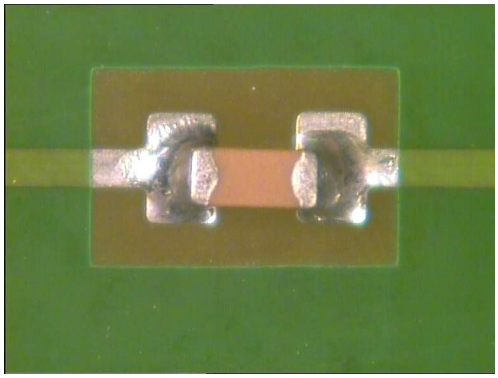
0603 C0G J Termination
Ref 1. Final External Visual



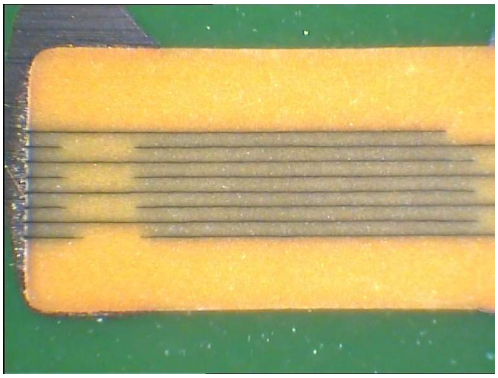
Ref 2. Final Internal Visual (100x mag)



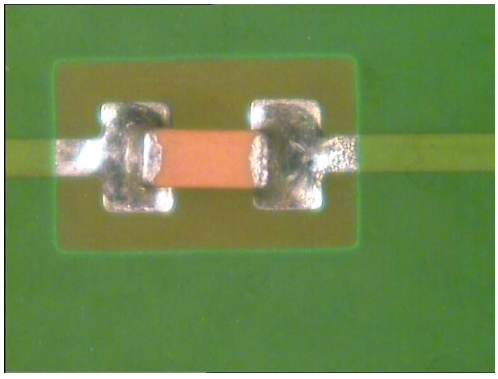
0603 X7R J Termination
Ref 3. Final External Visual



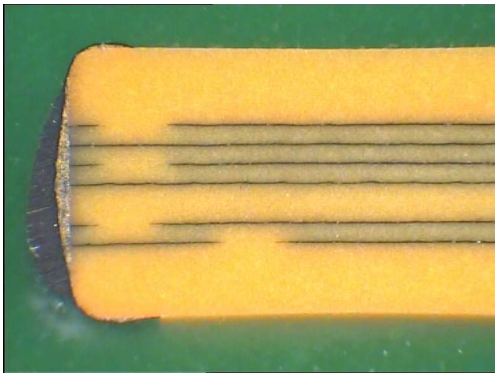
Ref 4. Final Internal Visual (100x mag)



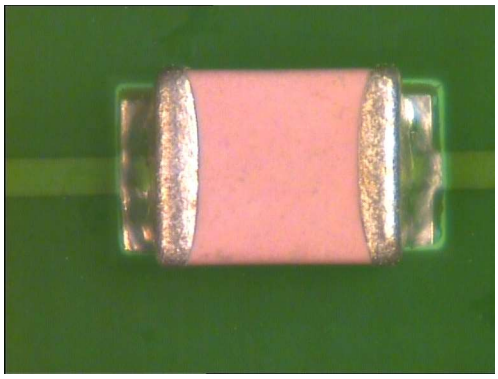
0603 X7R Y Termination
Ref 5. Final External Visual



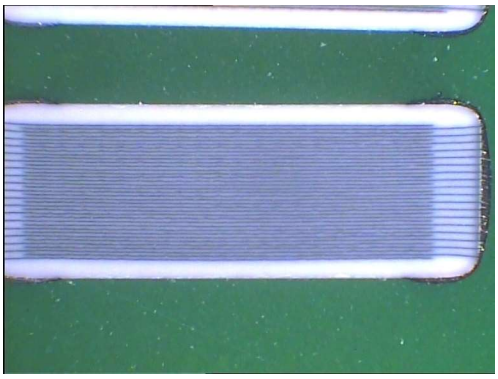
Ref 6. Final Internal Visual (100x mag)



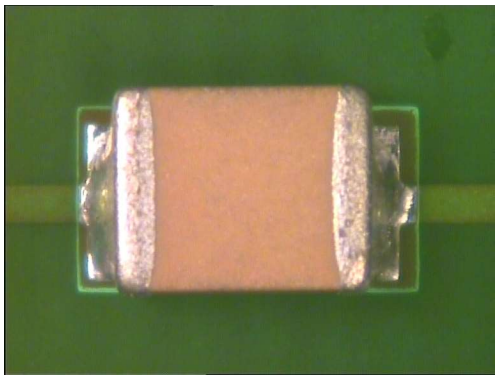
1210 C0G J Termination
Ref 7. Final External Visual



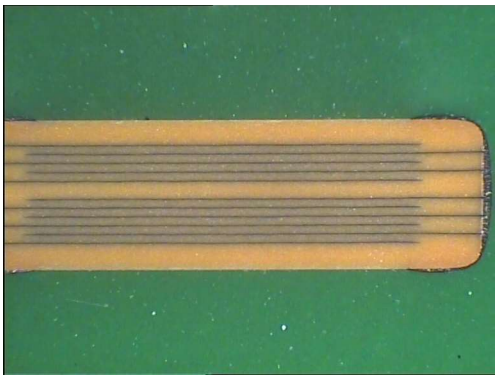
Ref 8. Final Internal Visual (50x mag)



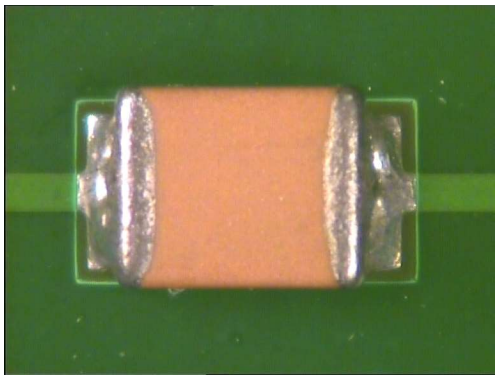
1210 X7R J Termination
Ref 9. Final External Visual



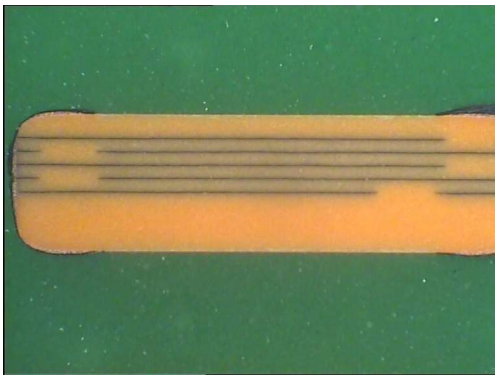
Ref 10. Final Internal Visual (50x mag)



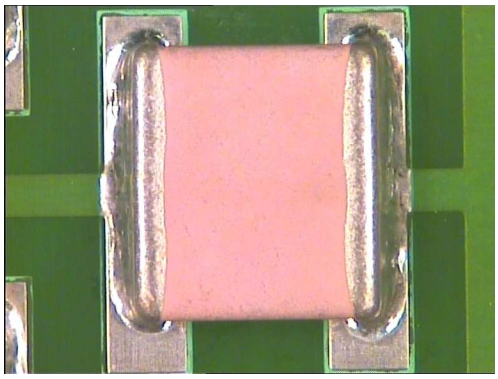
1210 X7R Y Termination
Ref 11. Final External Visual



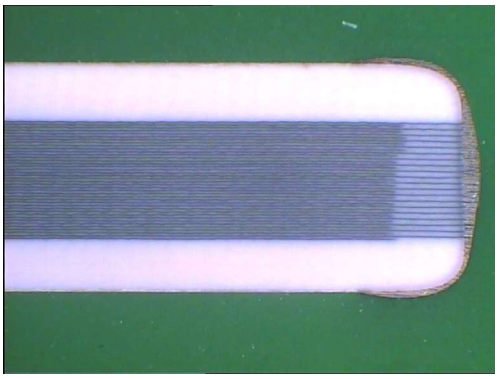
Ref 12. Final Internal Visual (50x mag)



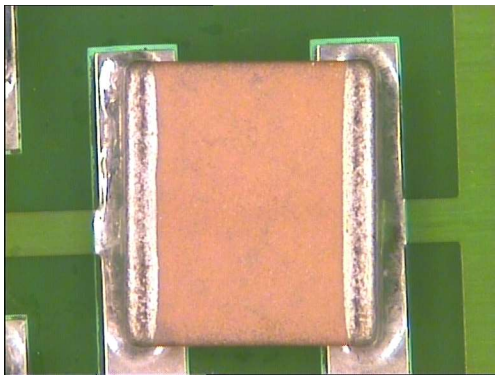
2225 C0G J Termination
Ref 13. Final External Visual



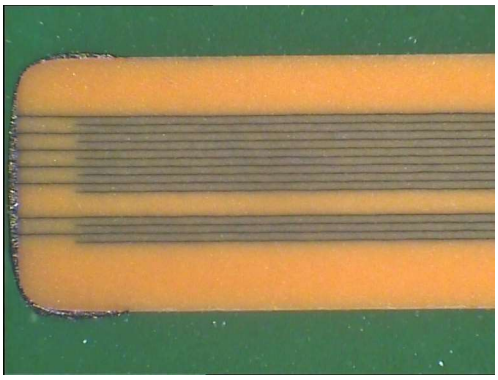
Ref 14. Final Internal Visual (50x mag)



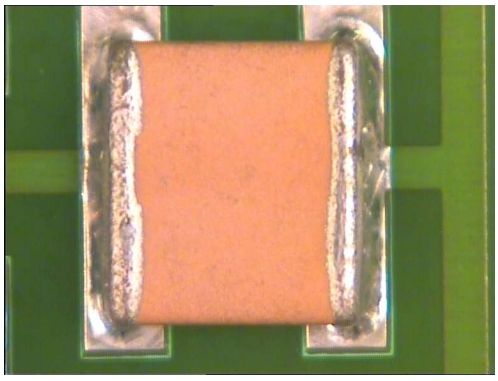
2225 X7R J Termination
Ref 15. Final External Visual



Ref 16. Final Internal Visual (50x mag)



2225 X7R Y Termination
Ref 17. Final External Visual



Ref 18. Final Internal Visual (50x mag)