

Cobalt Dichloride Free Humidity Indicator Cards

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ABSTRACT

Humidity Indicator Cards (HIC's) are used to determine when products have been exposed to moisture above recommended storage levels. Cobalt dichloride is a chemical that changes color when exposed to changing levels of moisture and is commonly used in HIC's for that purpose. Cobalt dichloride has been identified by European regulations as a substance of concern for the environment and for that reason some customers require its replacement. Alternatives have been identified and tested to ensure moisture indication is equivalent to the current requirements of the IPC/JEDEC J-STD-0.33B.1.

Note:

The HIC may utilize alternate colors than those shown in this document to indicate humidity changes. Cards that utilize a color change other than blue/pink are acceptable. The color change associated with each specified humidity level is defined on the printed surface of the HIC.

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INTRODUCTION

This paper describes the work performed to certify the replacement of the Humidity Indicator Cards (HIC) containing Cobalt dichloride (CoCl_2) with less concerning materials used when shipping moisture sensitive integrated circuits.

BACKGROUND

European REACH requirements identified CoCl_2 as a Substance of Very High Concern (SVHC) under Article 33. While this does not require elimination of use, some customers have decided to eliminate these uses based on the chemicals listing as an SVHC. More environmentally benign alternatives have been identified that perform equivalently.

JEDEC J-STD-033B is the specification Texas Instruments references to identify the requirements for moisture indication. Alternatives to CoCl_2 must meet the requirements of this standard before they can be used. Risks to detection of moisture can be alleviated by testing alternatives to ensure conformance to the standard.

PROCEDURE

This study evaluated four key performance and material composition elements of a new HIC (Humidity Indicator Card). The spots on the card were required to show a visually perceptible color change indicating variations of ambient humidity in the key ranges printed on the card.

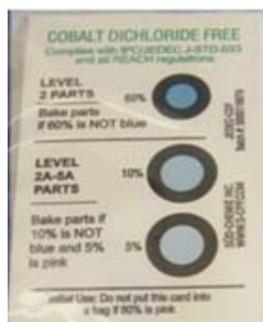
HIC MATERIALS CONTENT AND COLOR CHANGE VALIDATION

Sample Identification

Sample Name: MS 051060-CDF (TI Part #TI051060-CDF)

Material No.: 200014484

Batch No.: 116679 A



1. DETERMINATION OF METALS

Analytical Procedure

Analytical Instrument	ICP-OES
Model	Varian 720-ES
Sample Preparation	Acid decomposition using a closed vessel under high pressure combined with microwave.
Sampling	One whole card was used
Date of Analysis	October 2009

2. DETERMINATION OF HALOGENS

Analytical Procedure

Analytical Instrument	Ion Chromatography
Model	Metrohm 861 Advanced Compact IC
Sample Preparation	Water extraction
Sampling	One whole card was used
Date of Analysis	November 2009

3. COLOR CHANGE ACCURACY (JEDEC STD 033)

Test Method:

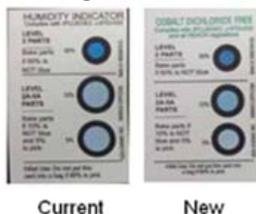
Accuracy Test: Place samples in a dry, sealed container to revert color to blue. Place samples in a container with desiccant. Place samples in RH chamber. Wait 24 hours, check for accuracy.

Colorimeter Test per JEDEC STD-033 Rev B.1: Place samples in RH chambers. Wait 24 hours, perform colorimeter test.

4. COLOR CHANGE RATE

Condition:

1. Compare the current HIC with the new Cobalt Dichloride Free HIC.
2. Expose the HIC to production environmental conditions.
3. Check the colors periodically up to one hour.
4. Evaluate HIC colors at typical room ambient conditions (45+/-15% RH and 23 +/-5 deg. C).



SUMMARY OF RESULTS

The Cobalt Dichloride Free indicator cards were evaluated for material content, color change accuracy, and color change rate.

1. ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry) was performed on an acid decomposed sample card. Elemental content was normal with 950 mg/kg Cobalt detected.

Element	Value [mg/kg]	Quantification Limit [mg/kg]
Cu	3	1
Ba	1	1
Sn	1	1
Co	950	1
Sr	1	1
P	16	1
S	92	1
Al	27	1
Fe	4	1
Ca	300	1
Mg	120	1
Na	165	1
K	10	1

2. Ion Chromatography was performed on water extracted from a sample card that was boiled in DI water. Bromine content was consistent with the knowledge that the new cards utilize Cobalt Dibromide as the color change indicator.

Element	Value [mg/kg]	Detection Limit [mg/kg]
F	n.d.	1
Cl	180	5
Br	2300	5

n.d. = not detected, value below quantification limit

3. Color change accuracy measurements with a colorimeter showed that the new cards met JEDEC criteria for accuracy at the three critical humidity levels.

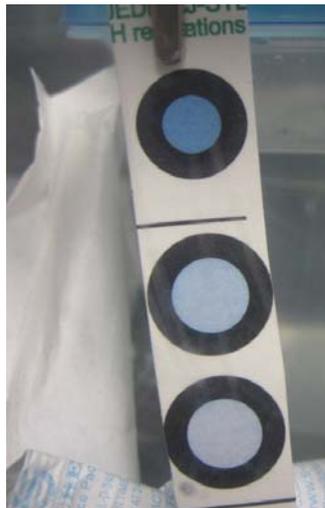
RH Chamber	Measured Chamber RH	Indicating Spots		
		5%	10%	60%
<5%	2.0	Blue	Blue	Blue
5%	5.1	Lavender	Blue	Blue
10%	10.3	Pink	Lavender	Blue
15%	14.7		Pink	Blue
55%	54.5			Blue
60%	60.1			Lavender
65%	65.4			Pink

Colorimeter Test	Dry To Wet Change in Hue Degrees	2% RH Environment	5% RH Environment	10% RH Environment	55% RH Environment	60% RH Environment	Pass/Fail
	$\geq \Delta 7\%$	Dry	at RH				
SCPP 5% spot	15.34%	97.57	112.54				Pass
	$\geq \Delta 10\%$		Dry	at RH			
SCPP 10% spot	12.45%		101.60	114.25			Pass
	$\geq \Delta 10\%$				Dry	at RH	
SCPP 60% spot	30.01%				128.00	166.50	Pass

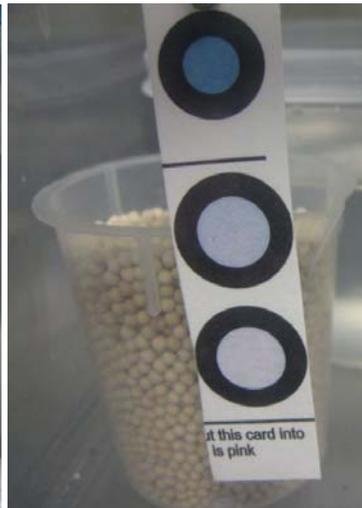
Documentation of the Accuracy Test:



2% RH chamber
All spots blue



5% RH chamber
5% spot is lavender
10 & 60% spots are blue



10% RH chamber
5% spot is pink
10% spot is lavender
60% spot is blue



15% RH chamber
5 & 10% spots are pink
60% spot is blue

55% RH chamber
5 & 10% spots are pink
60% spot is blue

60% RH chamber
5 & 10% spots are pink
60% spot is lavender

- The color change rate evaluations indicated that the appropriate color change occurred within an acceptable time interval.

Color Change Description

Exposed time (min)	Current use 4079043-0001	New
0	60% - blue 10% - blue 5% - blue	60% - blue 10% - blue 5% - blue
1	60% - blue 10% - blue 5% - blue	60% - blue 10% - blue 5% - blue
2	60% - blue 10% - blue 5% - blue	60% - blue 10% - blue 5% - blue
3	60% - blue 10% - blue 5% - blue	60% - blue 10% - blue 5% - blue
4	60% - blue 10% - blue 5% - lavender	60% - blue 10% - blue 5% - blue
5	60% - blue 10% - blue 5% - lavender	60% - blue 10% - blue 5% - blue
10	60% - blue 10% - lavender 5% - pink	60% - blue 10% - blue 5% - lavender
15	60% - blue 10% - pink 5% - pink	60% - blue 10% - lavender 5% - pink
20	60% - blue 10% - pink 5% - pink	60% - blue 10% - lavender 5% - pink
30	60% - blue 10% - pink 5% - pink	60% - blue 10% - lavender 5% - pink
60	60% - blue 10% - pink 5% - pink	60% - blue 10% - pink 5% - pink

Color spot Left: 5% / Center: 10% / Right: 60%

Color Change Photographs

Exposed time	Current use 4079043-0001	New
0		
1		
2		
3		
4		
5		
10		
15		
20		
30		
60		

Color spot Left: 5% / Center: 10% / Right: 60%

CONCLUSION

All tests conducted on the new Cobalt Dichloride Free Humidity Indicator card met JEDEC and TI standards for use. The humidity induced color change of the new card was readily detected optically and the change was confirmed with colorimeter data.

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GLOSSARY OF TERMS

Humidity Indicator Card: (HIC) – A card printed with a moisture sensitive chemical capable of a controlled color change in the presence of water vapor.

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