



## Definition of “Green” IC Packages

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Both legislative and market conditions are driving the electronics industry towards more environmentally friendly packages and final assemblies. Amkor is fully committed to providing “Green” semiconductor packages as a service to our customers, and as a globally responsible corporation. One of the important questions that arise is, what defines an environmentally friendly package? Terms like “Pb Free”, “Halogen Free”, “RoHS<sup>1</sup> compliant” and “Green” are commonly used in the industry. However, no legislated limits on the restricted and banned materials have been officially released. However, some de facto standards have emerged, and the European Commission is drafting concentration limits for compounds banned by the RoHS Directive. Realistically, some finite level of the targeted compounds will remain in packaging materials. Within this paper we will state Amkor’s position regarding the definition of “Green” packages, and the materials that constitute those packages.

Amkor is experiencing demand for environmentally friendly packages that meet one of three different requirements, Pb free, RoHS compliant and “Green”. For Pb free, the definition is fairly straightforward. Pb must be reduced below a certain level. In addition, it is also implied that the package must survive Pb free assembly processes. RoHS compliancy expands on the basic Pb free requirement to include five other substances. Current industry interpretation says that a package only has to reduce those substances below certain limits in order to be classified as “RoHS compliant”. The “Green” level encompasses an even wider range of restrictions, and the requirements vary from region to region, and among customers. To be considered “Green”, the actual number of restricted substances could be in the hundreds. However, many of the listed substances have never been used in packaging materials, and are only listed due to previous linkage to health or environmental problems.

Amkor will use one basic premise to guide our determination if a material is qualified as “Green”.

**“Any material used in the assembly process of semiconductor packages is considered to be free of any restricted elements or compounds if none of those elements or compounds were intentionally or willfully added during the manufacturing process. Amkor will also attempt to eliminate and/or minimize the use of environmentally harmful materials in our assembly processes”**

For practical purposes, as an example, a Pb free solder leadfinish or BGA solder ball would be considered free of Pb as long as Pb was not added at any point in the manufacturing process. It also implies that Pb impurities were removed to the extent of existing technological capabilities. Amkor acknowledges that there are

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trace levels of Pb in the soldering materials, but only as determined by the limits of manufacturing capabilities. This same philosophy will apply to the other materials used in the assembly process, and impurity levels of the banned substances.

An additional consideration to the impurity levels of restricted elements and compounds will be analysis and detection methods. Where possible, Amkor will use and define methods typical to the particular industry, or as determined by published industry standards. Impurities in materials will be determined in an “as assembled” condition, as they would be for shipment to our customers. Which means that mold compounds will be tested in a molded and cured state, and epoxies will also be monitored in a fully cured condition. Therefore, Amkor’s proposed “Green” definition and monitoring methods will both be based upon current industry capability and accepted methodologies.

Amkor will define impurity limits and impurity determination methods for all assembly related materials. The impurity levels defined will be for all pertinent elements and compounds restricted by the RoHS Directive, or legislation enacted in Japan and other countries. The basic requirements for the three levels of “Green” are shown below.

### Defined Limits for “Green” Assembly Materials:

	Element/Compound	Limit
<b>Pb free</b>	Pb	1000 ppm
<b>RoHS Compliant</b>	Pb	1000 ppm
	Hg	1000 ppm
	Cd	100 ppm
	Cr <sup>+6</sup>	1000 ppm
	Polybrominated biphenyl	1000 ppm
	Polybrominated diphenyl ether	1000 ppm
<b>Fully Green</b>	All of the above requirements plus:	
	Bromine	900 ppm
	Chlorine	900 ppm
	Antimony <sup>2</sup>	900 ppm
	TBTO <sup>3</sup>	Not used
	Phosphorus	Not used

1) RoHS = European Directive for **R**estriction **o**f **H**azardous **S**ubstances

2) Limit expressed as elemental Antimony, not oxides of Antimony

3) Tributyltin oxide