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Subcommittee on Electronic Components Environment
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Views on the Use of Quantitative Analysis for Demonstrating Non-Inclusion of the Specific Phthalates Added as Restricted Substances to the EU RoHS Directive

Annex II of the EU RoHS Directive (2011/65/EU) establishing restricted substances and their maximum concentration values was amended by the EU Commission Delegated Directive (EU) 2015/863 published in June 2015 and the 4 types of phthalates*1 shown below were added as restricted substances. (Hereinafter, the 4 types of phthalates will be generically mentioned as “specific phthalates”.)

Bis(2-ethylhexyl) phthalate (DEHP)
Butyl benzyl phthalate (BBP)
Dibutyl phthalate (DBP)
Diisobutyl phthalate (DIBP)

Quantitative analysis of the restricted substances has been used as one kind of confirmation data (evidence) for ensuring conformity with the requirements of the RoHS Directive Annex II.

The views of the electronic component industry concerning its practical use to the specific phthalates are presented below.

1. Main Applications and Subparts Including the Specific Phthalates

The specific phthalates are substances mainly used as plasticizers for organic polymeric materials.

Plasticizers are substances that have the function of softening (“plasticizing”) and giving adequate plasticity to stiff and brittle organic polymeric materials.

Plasticization occurs when molecules of plasticizers dissolve and slip into organic polymeric materials elongating the interstices and weakening the mutual cohesive forces of molecular chains present within.

This is similar to the principle that movement becomes easier if “rollers” are inserted between two objects.

From this kind of principles, plasticizers have compatibility to dissolve into the organic polymeric materials and present useful characteristics when possessing bulky structures that elongate the interstices of the molecular chains.

Also from the viewpoint of practical use, it is required for plasticizers to be chemically stable in a wide range of use conditions and physically non-volatile.

The specific phthalates combine the above characteristics. Particularly typical is DEHP, which has good compatibility with polyvinyl chloride (PVC), cellulose nitrate, methacrylic acid, chlorinated rubber, etc. and has been used as plasticizer in a wide variety of fields.

Furthermore, due to these characteristics, it can also be used as hydraulic oil or stable solvent under high temperatures.

As a special application, it can also be used as inductive oil in oil-filled capacitors.

N.B. It should be noticed that for each of the specific phthalates there are application uses and subparts where they are included other than the ones mentioned above as the items covered in this document are simply representative examples.

On the other hand, the specific phthalates almost do not dissolve into water, and as simple substances do not have good affinity (wettability) with inorganic materials such as metals, glasses, ceramics, etc.

For this reason, subparts of electrical and electronic equipment (EEE) containing the specific phthalates are limited to components and materials containing organic polymers in their composition or subparts filled with the specific phthalates in a liquid state.

2. Views on the Validity of Quantitative Analysis for Demonstrating Compatibility with the RoHS Directive for the Specific Phthalates*2

Quantitative analysis*3 of homogeneous materials is implemented as one method to confirm the compatibility to the RoHS Directive of materials and components that constitute EEE. Based on the results, it can be used as evidence of compatibility by showing that the inclusion amount of the restricted

substances is below the maximum concentration permitted.

The use of this method is appropriate for components and materials containing organic polymers that may intentionally include the specific phthalates in their composition as well as for subparts enclosing organic liquids.

On the other hand, the use of quantitative analysis for demonstrating compatibility to the RoHS Directive concerning the specific phthalates for components and materials, composed only of inorganic substances such as metals, glasses and ceramics*4 etc. (e.g. lead wires of leaded resistors, glass resistive elements and ceramic substrates of chip resistors, ceramic main bodies of MLCC, etc.), which present no possibility of intentional inclusion, cannot be claimed to effectively fulfill the function for which it is performed.

As the burden employed for the analysis implementation and management of the results does not match their effectiveness, the electronic component industry does not recommend the quantitative analysis for these components and materials.

Footnotes

*1. In Annex II of the RoHS Directive only the substance name is mentioned. However as the specific phthalates have a large number of different names, it is useful to utilize the CAS numbers shown in the table below for identifying the substances.

Substance	Abbreviation	CAS. No.
Bis (2-ethylhexyl) phthalate	DEHP	117-81-7
Butyl benzyl phthalate	BBP	85-68-7
Dibutyl phthalate	DBP	84-74-2
Diisobutyl phthalate	DIBP	84-69-5

*2. European Standard EN50581 (Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances), concerning the RoHS Directive, can be referenced as support to this document.

*3. Methods for quantitative analysis have been standardized by IEC 62321 “Determination of certain substances in electrotechnical products”. Similarly, quantitative analysis was standardized for the specific phthalates by IEC 62321-8, published in March of 2017.

*4. In the documents drafted by Environment Agency Austria (Umweltbundesamt) and the Oeko Institut as final reports (dossiers) when examining the addition of restricted substances to the RoHS Directive, “use in ceramics of electronic components” was mentioned as an application of the specific phthalates. However, this is used in molding applications of ceramics in the manufacturing process before firing, and as specific phthalates are ultimately burnt during the firing/sintering process, they do not remain in the product.

Reference Notes

(i) It is known that the specific phthalates have migration characteristics, and therefore unintentional inclusion by mixing, contamination, etc. is easier to occur than for the original restricted substances of the RoHS Directive.
The electronic component industry considers that the detection and prevention of the above is realized through the Quality Control structure of the entire supply chain.

(ii) According with the literature survey carried out by the U.S. Toxicology Excellence for Risk Assessment (TERA) concerning four specific resins, namely, polypropylene (PP), polyethylene (PE), high-impact polystyrene (HIPS), acrylonitrile butadiene styrene (ABS), it has been found that there are no applications of the specific phthalates involving those resins.
Even if we consider effects of recycled material and contamination, inclusion is considered to be far below the legal threshold (1000ppm).
https://www.cpsc.gov/s3fs-public/pdfs/ReportonPhthalatesinFourPlastics.pdf