

## Control Values for the Substances Banned by RoHS

Shimadzu analyzes the content of substances banned under the RoHS Directive by appropriately selecting samples from all parts, assemblies, and secondary materials delivered as RoHS-compliant.

The samples are analyzed with an energy dispersive X-ray fluorescence spectrometer (EDX) to screen for Cd, Pb, Hg, hexavalent chromium, PBB, and PBDE. They are analyzed with a pyrolysis-gas chromatograph mass spectrometer (Py-GC/MS) to screen for DEHP, BBP, DBP, and DIBP. Compliance/non-compliance with RoHS requirements and whether precise analysis is required or not are determined based on those screening results.

Due to measurement error and variability included in EDX and Py-GC/MS screening results that cannot be eliminated by technical means, RoHS compliance/non-compliance cannot be decided based on RoHS threshold values alone.

Therefore, control values are specified to determine the “gray zone,” where RoHS compliance/non-compliance cannot be determined directly from EDX and Py-GC/MS analysis values.

Control values for EDX analysis are shown in **Table 1** and for Py-GC/MS analysis in **Table 2**.

Table 1 Upper and Lower Limit Control Values for EDX Analysis (Units: ppm)

Banned Substance	Polymer	Metal	RoHS Threshold Value
Cd	Lower limit control value = 40*, Upper limit control value = 160		100
Pb	Lower limit control value = 600, Upper limit control value = 1400		1000
Hg			
PBB	Lower limit control value = 300 (as total Br)	—	1000
PBDE			
Cr(VI)	Lower limit control value = 600 (as total Cr)		1000

\* Lower limit control value is 75 ppm for brass, which can contain Cd as an impurity.

**Note:** These control values were determined based on IEC 62321-3-1:2013 and EN 62321-3-1:2014.

Table 2 Upper and Lower Limit Control Values for Py-GC/MS Analysis (Units: ppm)

Banned Substance	Polymer	RoHS Threshold Value
Di(2-ethylhexyl) phthalate (DEHP)	Lower limit control value = 500 Upper limit control value = 1500	1000
Butyl benzyl phthalate (BBP)		1000
Dibutyl phthalate (DBP)		1000
Diisobutyl phthalate (DIBP)		1000

**Note:** These control values were determined based on IEC 62321-8:2017 and EN 62321-8:2017.

If the analysis value is below the lower limit control value, then it is judged RoHS compliant, whereas if the analysis value is greater than or equal to the upper limit control value, it is judged RoHS non-compliant. If the analysis value is greater than or equal to the lower limit control value, but also below the upper limit control value, then it is judged to be in a gray zone, which requires contacting/investigating the supplier or

precise analysis to determine RoHS compliance or non-compliance.

However, EDX analysis cannot directly determine the content of PBB, PBDE, and hexavalent chromium because they are compounds. Only the lower limit values for total Br and total Cr are displayed and no values are specified for the gray zone.

For PBB and PBDE, if the total Br quantitation result is greater than or equal to the lower limit control value, the supplier must be contacted/investigated or a gas chromatograph mass spectrometer (GC/MS) or other system must be used to analyze samples more precisely to determine RoHS compliance or non-compliance.

For hexavalent chromium, if the total Cr quantitation result is greater than or equal to the lower limit control value, then the following decision is made based on the substance being analyzed.

- Contained in a Polymer

Polymer samples are ground to a powder and quantitatively analyzed by alkaline extraction-diphenylcarbazide absorption spectrophotometry. If quantitated levels are greater than or equal to the RoHS threshold value (1000 ppm), it is considered non-compliant. If they are below the RoHS threshold value, then it is considered RoHS compliant.

- Chromate Coatings

Substances being analyzed are quantitatively analyzed by hot water extraction-diphenylcarbazide absorption spectrophotometry, the quantity in the coating ( $\mu\text{g}/\text{cm}^2$ ) calculated, and then compliance is determined based on **Table 3**.

Table 3 Criteria for Evaluating Hexavalent Chromium in Chromate Coatings

Cr(VI) Concentration by Absorption Spectrophotometry	Qualitative Evaluation Results
Less than $0.10 \mu\text{g}/\text{cm}^2$	Considered compliant
Within $0.10$ to $0.13 \mu\text{g}/\text{cm}^2$	Follow-up observation zone If possible, the sample surface is remeasured three times to evaluate the mean value.
Greater than or equal to $0.13 \mu\text{g}/\text{cm}^2$	Considered non-compliant

**Note:** Evaluation results are determined based on **IEC 62321-7-1:2015** and **EN 62321-7-1:2015**.

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