



Integrated Photonics, Inc.

RoHS Compliant

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RoHS Compliance Update

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RoHS Exemption for Lead in Faraday Rotators Set to Expire at the End of 2009

Many customers have asked about the status of Exemption 22 "Lead as impurity in RIG (rare earth iron garnet) Faraday rotators used for fibre optic communications systems" of the European Union's Restriction of Hazardous Substances (RoHS) Directive 2002/95/EC. A full review of all the RoHS exemptions has been completed by the Öko-Institut (see Adaptation to Scientific and Technical Progress under Directive 2002/95/EC http://ec.europa.eu/environment/waste/weee/pdf/final_reportl_rohs1_en.pdf, Section 4.28). It was recommended that this exemption be given an expiry date of December 31, 2009, which is imminent. To be assured of a solution that will pass RoHS specifications for your inventory and your customers' now and in the future, a six-of-six compliant Faraday rotator is required. Integrated Photonics' thick film Faraday rotator products have always met all the Maximum Concentration Values (MCVs) stipulated by the Directive without having to rely on any exemption.

Integrated Photonics' RoHS compliance assurance consists of the following elements.

1. **Methods Development.** Our third party independent testing laboratory, Shiva Technologies (now a subsidiary of Evans Analytical), undertook an extensive program of methods development, comparison, calibration, and validation to assure that lead (Pb) levels can be accurately determined relative to the RoHS MCV of 1000 ppm. A few points from this methods program are notable.
 - a. Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) has been demonstrated to have the best combination of high sensitivity, high reproducibility, and high accuracy both with and without a matrix-matched standard. Because of the high dilution of solutions required for ICP-MS, interference between elements was not detectable.
 - b. Inductively Coupled Plasma-Atomic Emission Spectrometry (ICP-AES, also known as ICP-OES) showed a significant tendency to yield a Pb concentration in excess of the actual value unless calibrated with a matrix-matched solution standard of the same composition as the material under test. The inaccuracy of this method is the result of background interference from the optical lines of the major constituents with the Pb lines. This error could not be detected with conventional ICP-AES calibration methodology. Any ICP-AES data not calibrated with a matrix-matched standard should not be regarded as valid.
 - c. When matrix-matched standards were used, all techniques employed produced similar results.
 - d. The microwave digestion technique used is consistent with IEC 62321.
2. **Initial Certification.** This was accomplished by testing of all IPI thick film garnet Faraday rotator products by our independent third party analytical vendor, Shiva Technologies.
 - a. *Lead (Pb).* FLM, FLL FLT and MGL products were shown to be in RoHS compliance for Pb by ICP-MS and Glow Discharge Mass Spectrometry (GDMS). MGL was shown to be lead-free.
 - b. *Cadmium (Cd) and Mercury (Hg).* Cd and Hg are below the limit of detection in all samples by ICP-MS and GDMS, and therefore well below their respective 100 ppm and 1000 ppm MCVs.
 - c. *Hexavalent chromium (Cr⁶⁺).* Because the total Cr (all valences) as determined by ICP-MS and GDMS was below the limit for hexavalent Cr in all materials, compliance to the limit for hexavalent chromium is assured. However, as an example, the FLT material was further tested for Cr⁶⁺ by EPA Method 3060A. Hexavalent Cr was below the limit of detection in this sample and similar results are expected on all materials.
 - d. *Polybrominated biphenyls (PBBs) and polybrominated diphenyl ethers (PBDEs).* No PBBs or PBDEs are used in the manufacture of Faraday rotators. Because the total Br as determined by ICP-MS was below the limit of

detection (well below the RoHS MCV for PBBs and PBDEs) in all materials, compliance to the limit for these bromine compounds is assured. For verification a sample of the FLT material was analyzed for PBBs and PBDEs by EPA method 8270 and was found to be below the limit of detection (well below the MCV) for all these restricted substances. This analysis for PBBs and PBDEs and our statement of materials stands for all types of Faraday rotators.

3. **Second Source Verification.** Samples of all four Faraday rotator materials were also analyzed by a second independent third party vendor, SGS Hong Kong, and shown to be in compliance for Pb, Hg and Cd. It is well understood and confirmed by the analyses above that Pb is the only RoHS substance of concern in Faraday rotators—Hg and Cd were below the limit of detection as in previous analyses.
4. **Process Control and Improvement.** With our third party independent analytical vendor, IPI has undertaken a proprietary process capability and variability study to minimize the lead content in Faraday rotators and the variation in the lead content. Process control to optimal growth conditions has resulted from this study.
5. **New Melt Qualification.** A sample from each new melt is tested to show consistency and compliance.
6. **Product Surveillance.** Based on the process capability study and an intensive surveillance study, samples from each melt are tested at routine intervals to prove that they remain in compliance.
7. **Recertification.** All four materials were recently re-certified by ICP—MS for all six RoHS substances using total Cr and total Br to prove the materials in compliance for hexavalent Cr, PBBs and PBDEs. These certifications are posted on our web site.

Accordingly all of IPI's garnet Faraday rotator materials are proven to be below the RoHS Maximum Concentration Values for all six listed substances. Be assured that Integrated Photonics will continue our due diligence at an industry-leading high level to assure that will continue.