Japan Business Council in Europe

Date : 1 April 2008

Dear Madam/Sir,

Please find enclosed the JBCE reply to the Öko Institut questionnaires concerning existing ROHS exemptions.

The reply consists of two parts:

- **Part 1: Reply to the exemptions questionnaires from the specific perspective of Category 8 & 9 equipment**

- **Part 2: Reply to the exemptions questionnaires**

- No. 3: Mercury in strait fluorescent lamps for special purpose
- No. 4: Mercury in other lamps not specifically mentioned in this Annex
- No. 5: Lead in glass cathode ray tubes, electronic components and fluorescent tubes
- No. 7(a): Lead in high melting temperature type solders (i.e. lead based alloys containing 85% by weight or more lead)
- No. 7(c): Lead in electronic ceramic parts (e.g. piezoelectronic devices)
- No. 13: Lead and cadmium in optical and filters glass

Please note that JBCE submitted a joint response with EICTA to the questionnaire concerning No. 6: Lead as an alloying in steel containing up to 0.35% lead by weight, aluminium containing up to 0.4% lead by weight and as a copper alloy containing up to 4% lead by weight.

Finally, JBCE is of course willing and ready to make further contributions and explanations.

Yours sincerely,

Lars Brückner
Chairman Environment Committee
Japan Business Council in Europe (JBCE)

General questionnaire

The following questions can be used in two different ways:
1. To support an **exemption request** (the applicant's exemption request which is posted on the consultation website should already contain answers to these questions) or to argue why an exemption request is not justified.
2. To support an **existing exemption** or taken as a basis for requesting an amendment or the discontinuation of an existing exemption.

- For which substance(s) or compound(s) should the requested exemption be valid?
- What is the application in which the substance/compound is used for and what is its specific technical function?
- What is the specific (technical) function of the substance/compound in this application?
- Please justify why this application falls under the scope of the RoHS Directive (e.g. is it a finished product? is it a fixed installation? What category of the WEEE Directive does it belong to?).
- What is the amount (in absolute number and in percentage by weight) of the substance/compound in: i) the homogeneous material1, ii) the application and iii) total EU annually for RoHS relevant applications?
- Please check and justify why the application you request an exemption for does not overlap with already existing exemptions respectively does not overlap with exemption requests covered by previous consultations.
- Please provide an unambiguous wording for the (requested) exemption.

Documentation provided by stakeholders including replies to the questions above should take the following points into consideration:

- Please justify your contribution according to Article 5 (1) (b) RoHS Directive whereas:
  - Substitution of concerned hazardous substances via materials and components not containing these is technically or scientifically either practicable or impracticable;
  - Elimination or substitution of concerned hazardous substances via design changes is technically or scientifically either practicable or impracticable;
  - Negative environmental, health and/or consumer safety impacts caused by substitution are either likely or unlikely to outweigh environmental, health

and/or consumer safety benefits thereof (If existing, please refer to relevant studies on negative or positive impacts caused by substitution).

- Please provide sound data/evidence on why substitution / elimination is either practicable or impracticable (e.g. what research has been done, what was the outcome, is there a timeline for possible substitutes, why is the substance and its function in the application indispensable or not, is there available economic data on the possible substitutes, where relevant, etc.).
- Please also indicate if feasible substitutes currently exist in an industrial and/or commercial scale for similar use.
- Please indicate the possibilities and/or the status for the development of substitutes and indicate if these substitutes were available by 1 July 2006 or at a later stage.
- Please indicate if any current restrictions apply to such substitutes. If yes, please quote the exact title of the appropriate legislation/regulation.
- Please indicate benefits / advantages and disadvantages of such substitutes.
- Please state whether there are overlapping issues with other relevant legislation such as e.g. the ELV Directive that should be taken into account.
- If a transition period between the publication of an amended Annex is needed or seems appropriate, please state how long this period should be for the specific application concerned.

1 Please refer to the FAQ document on RoHS and WEEE Directives available at http://www.europa.eu.int/comm/environment/waste/weee_index.htm

Answers to General Questionnaire (No.13)

We request Exemption 13 continuation of lead and cadmium contained in the optical glass and filter glass.

Exemption 13 is used for optical equipments classified in Categories 3, 4, and other as final products to which the RoHS directive is applied and in Categories 8 and 9 to which the RoHS directive is not applied at this stage, in some cases, and provides functions to ensure optical performance based on sophisticated or specific specifications required.

Although there is no statistical data, Exemption 13 may possibly be used for less than a few percent of optical components contained in products marketed in EU.

We indicate that Exemption 13 is basically independent of other exemptions, but it may overlap with Exemption 5 (Lead in glasses of electronic components), in some cases.

A large amount of materials which are classified into Exemption 13 have so far existed, and many substitute materials for them have already been developed. Health and environmental problems involving substitute materials which are being used now have been sharply reduced, and are in tolerable levels although the relevant costs have increased.

However, optical characteristics of some substitute materials are inferior to conventional materials.

In addition, it is very difficult to develop substitute materials for some materials.

Scientific/ technical problems concerning optical functions performed by lead and cadmium contained in optical glass and filter glass are explained in detail in ERA Technology's report at the time of evaluation in 2004. Optical characteristics of optical materials basically comes from the composition of materials, the value of this report is considered the same in the future as well.

For most optical components of many products, existing substitute materials can be used, and most products have already used such materials, but for some optical components of various types of products, substitution is impossible.

In the optical equipment market where there are various types of products, products like cameras are desired to provide clear images, whereas special optical equipments with advanced functions/ performance, which are used at laboratories or industrial/ medical sites, are desired to support social infrastructure.
For such optical equipment products, their optical specifications/ performance are the most important characteristics, and determine the value of products.
Existence of various types/ a variety of optical materials with good optical characteristics coupled with good optical design technology and processing technology/ measuring technology for high precision optical components, which make good use of such optical materials, is the most important requirement for the achievement of advanced optical specifications/ performance.
Application of Exemption 13 to optical equipments is necessary in the future as well depending on required specifications of equipments.

Japanese optical equipment industry has promoted an activity to reduce hazardous substances of optical glasses on a voluntary basis in cooperation with the optical glass industry for many years, with complete discontinuation of the use of cadmium in the 1970s, and has achieved dramatic reduction of lead and arsenic after the 1980s until now.
We have achieved very good results by the method which is irrelevant to legal impediments, and would like this fact more appreciated.

In view of the above, we consider it appropriate to continue Exemption 13 in the future as well.

Answers to Specific Questions Exemption 13

"Lead and cadmium in optical and filter glass"

Note:
In the context of the previous evaluation in 2004, it was concluded that "most optical glass and optical filters do not require lead or cadmium" although for a small number of specific applications lead and cadmium were required since substitutes could not meet all necessary characteristics provided by lead and cadmium.

1. Please specify these small number of applications (differentiate between applications using optical glass and those using filter glass): which applications currently fall under the scope of the RoHS Directive? Please provide a **comprehensive list** with allocation to WEEE (Directive 2002/96/EC) categories. Which applications fall under category 8 & 9 of the WEEE Directive? Which applications are covered by exemption 5 ("lead in glass of cathode ray tubes, electronic components and fluorescent tubes")?

Exemption 13 is used for a small number of components contained in the following wide range of image equipment, optical equipment:

	Category	Optical glass	Filter glass
1	Large home appliances	Probably no use.	Probably no use.
2	Small home appliances	Probably no use.	Probably no use.
3	IT, communication equipment	Copy machine, projector, scanner, Fax, printer, other image equipment, and so on	
4	Consumer appliances	TV (projection type), other image equipment, and so on	
5	Lighting equipment	Lighting equipment for special purposes of use (may be used as a possibility)	
6	Power tools	Probably no use.	Probably no use.
7	Toy, leisure, exercise	Possible use.	Possible use.
8	Medical equipment	Endoscope, other medical service optical goods, and so on	
9	Monitor,	Measuring, weighing or adjusting appliances for as laboratory	

	controller	equipment, other monitoring and control instruments used in industrial installations, and so on (*As it is especially difficult to specify the scope of this category, specification cannot be easily made.)	
10	Vending machine	Probably no use.	Probably no use.

［Relation with Exemption 5］

Materials classified in Exemption 13 may be used for some electronic parts, but electronic parts manufacturers in general do not disclose related information.
Such electronic parts may be used in Categories 3, 4, 8, 9, and so on.

2. Which of the applications covered by exemption 13 are available as RoHS **compliant products** (i.e. without lead and cadmium) on the EU market? Which applications are currently not available as RoHS compliant products?

On the EU market, RoHS compliant products are now available in all categories, but it is unknown whether there are products which are believed to not use Exemption 13 (due to existence of electronic parts described in Item 1 and other causes). It is estimated, however, that most cameras and interchangeable lenses do not use Exemption 13.
For products using Exemption 13, please refer to Item 1.

3. Are there different **technical characteristics** between optical and filter glass? If so, what are the different technical functionalities of lead and cadmium in these types of glasses?

Difference exists.
For optical glass, cadmium can contribute as composition with high refractive index and low dispersion, whereas lead significantly contributes as composition with high refractive index and high dispersion, as well as component with high transmittance of the near ultra violet light, low photoelasticity coefficient, and abnormal partial dispersion.
Optical glass containing lead, which makes good use of such advantages, is used as core material of high-performance optical fibers, and also applied to SELFOC lens.
For filter glass, lead and cadmium can contribute to transmission or absorption of the light of the specific wavelength in harmony with other various types of composition.
In the melting process of both glasses, lead and cadmium contribute to the melting

characteristics with the other compositions or stability of production, and especially lead sharply contributes to reduction of melting temperature.

4. Which are the technical characteristics related to the use of lead and cadmium that are essential for the **technical functionalit**y of applications / products related to exemption 13? List those applications named under point 1 for which substitution is technically not feasible and justify.

The following technical characteristics are utilized for various applications as respectively exemplified below. In addition, related specifications are required, those technical characteristics will be used in the future as well.
Various types of data on such optical technical characteristics are entered in ERA Technology's report at the time of the previous research, and can be referred to.

* Attached document (1) ; extract of TAC presentation by ERA (Oct 2004)

・Low photoelasticity coefficient:
Projection equipment using high-performance PBS (polarization beam splitter) (some of TVs and projectors, etc.), optical equipment installing optical systems applying polarization characteristic, and so on;

・Transmission / absorption of the specific wavelength light:
some image equipment using various types of filter, and so on;

・Combination of high refractive index, high dispersion, high transmittance of the near ultra violet light and abnormal partial dispersion:
special optical equipment and the like/ medical service optical goods/ measuring equipment installing optical systems which require sophisticated optical design, optical equipment requiring special specifications, and so on;

* Attached document (2) ; Related data of abnormal partial dispersion of optical glass

・High-performance optical fiber, SELFOC lens:
copying machine, endoscope, scanner, optical equipment installing high-performance optical fiber requiring flexibility without reducing refractive index and transmittance, and so on.

5. What has changed since the **last evaluation** in 2004? What is the current status of **R&D effort**s towards substitution of lead and cadmium in the different applications?

The content of ERA Technology's report at the time of the last evaluation is based on the essence of optical materials, which is therefore considered to have the general value, and is effective still now and in the future as well.
Many optical glass manufacturers have almost completed development of optical materials not using lead and cadmium at the time, and thereafter have produced poor results although they continue to make efforts.
In this connection, Japanese optical glass manufacturers have completely discontinued the use of cadmium in the 1970s.
It is difficult to develop substitute materials for filter glass for technical reasons, so substitute materials are not developed.
Substitution of many filter glasses has proceeded due to transition to digital processing of the color tone data with the digitization of cameras, and move for interference filter using thin film coating.
However, interference filter is inferior to filter glass materials at incidence angle characteristic of the light, durability, and so on.
For infrared absorption filter glass which is increasing for various types of image sensors using silicon semiconductors, substituted material without cadmium have been developed, and substitution has been promoted.
While development of substitutes for fiber glass and SELFOC lens has been attempted after that, no substitute materials have been developed.
Equipment manufacturers, which achieved technically possible substitution to the considerable extent in most product areas at the time, have subsequently accelerated substitution based on their further devising or improvement of optical design, and at least Japanese corporations are likely to have completed substitution for products that can be substituted in all product areas.
It is necessary to make continued efforts over the very long period of time from commencement of development of optical materials to their use for optical equipment as well as general use, and the Japanese industry spent more than 20 years in this process.
Optical equipment manufacturers will in the future as well carefully analyze optical characteristics of new substitute materials to be provided, and likely utilize such materials, if usable, as much as possible, considering specifications of equipment,

through tests of optical performance, processing nature, and durability at the time of use for products and other tests.

6. Are manufacturers still **investigating alternatives**?
   a. If yes, please provide a **roadmap** or similar evidence showing until when they intend to replace lead in glass in the applications mentioned above.
   b. If no, please explain and justify why no further research has been undertaken against the background that the RoHS Annex is subject to regular revisions.

Please refer to Item 5.
Although manufacturers continue investigation of alternatives, they have already faced the limits that cannot be passed, which come from the essence of materials and technology, so further results cannot be expected in materials areas where substitution has proceeded. Even though equipment manufacturers request for manufacturers of SELFOC and filter glass to conduct development substitute materials, but substitute materials are not developed successfully.
Manufacturers considered that Exemption 13 should be maintained in the future.

7. Please state for applications name under point 1 the **amount of lead and cadmium** used per application, the lead content in the homogeneous material, the annual production volume as well as the number of applications related to exemption 13 put on the EU market annually.

We cannot obtain any available statistical data to fully answer this question.
However, the amount of lead used in connection with Exemption 13 has sharply dropped primarily due to contribution of substitution for camera lenses, among others, in the past ten years, and the move was accelerated with RoHS directive.
The amount of cadmium used is much smaller than lead.
It is assumed that materials in Exemption 13 now exist in a variety of optical equipments by a small amount, each.
Efforts made by the optical glass industry and optical equipment industry to reduce lead and cadmium contained in optical materials are very extensive, and we would like this fact to be highly appreciated.

Abnormal partial dispersion of optical glass

Abnormal partial dispersions of lead contain optical glasses are absolutely necessary for the removal of the chromatic aberration secondary spectrum, as for a case of designing high N.A apochromat lens.
Show samples of the chromatic aberration at pin-hole images

(Apochrmat lens)

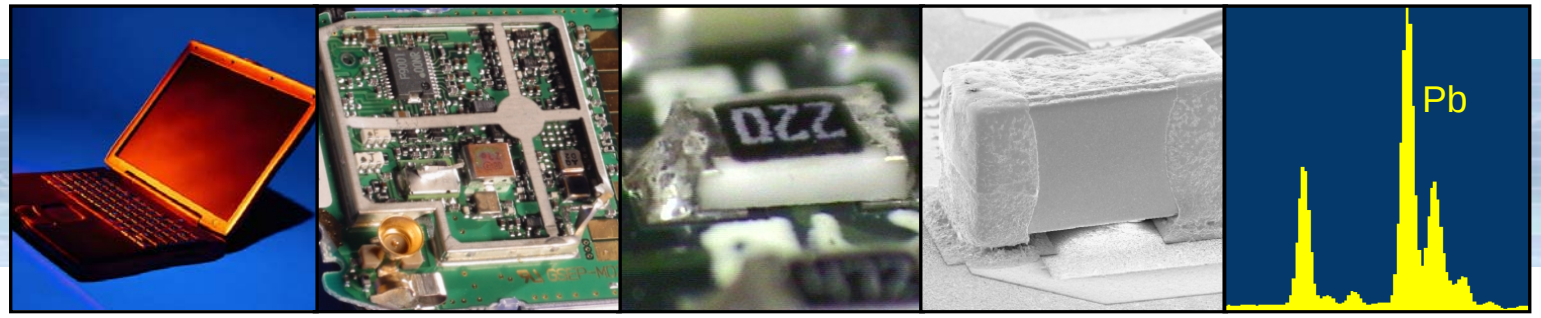
(Non-Apochromat lens)

Sample data of abnormal partial dispersion of optical glass

	BPH5	S-NBH5(Pb-free)
nd	1.65412	1.65412
ν d	39.7	39.7
Abnormal partial dispersion $\Delta\theta$ ig : G(435nm)／i(365nm)	-0.0287	-0.0132

	LAM7	S-LAM7(Pb-free)
nd	1.74950	1.74950
ν d	35.3	35.3
Abnormal partial dispersion $\Delta\theta$ ct : C(656nm)／t(1013nm)	-0.0098	0.0056

ERA TECHNOLOGY



Investigation into proposed exemptions to directive 2002/95/EC (RoHS)

Dr. Paul Goodman, ERA Technology Ltd, UK

Exemptions

- Item 10 of Annex
  1. Deca BDE – not included in study
  2. Mercury in straight fluorescent lamps for special purposes
  3. Lead in solders for servers, storage and storage array systems, network infrastructure equipment for switching, signalling, transmission as well as network management for telecommunications (with a view to setting a specific time limit for this exemption)
  4. Light bulbs – should these be included?

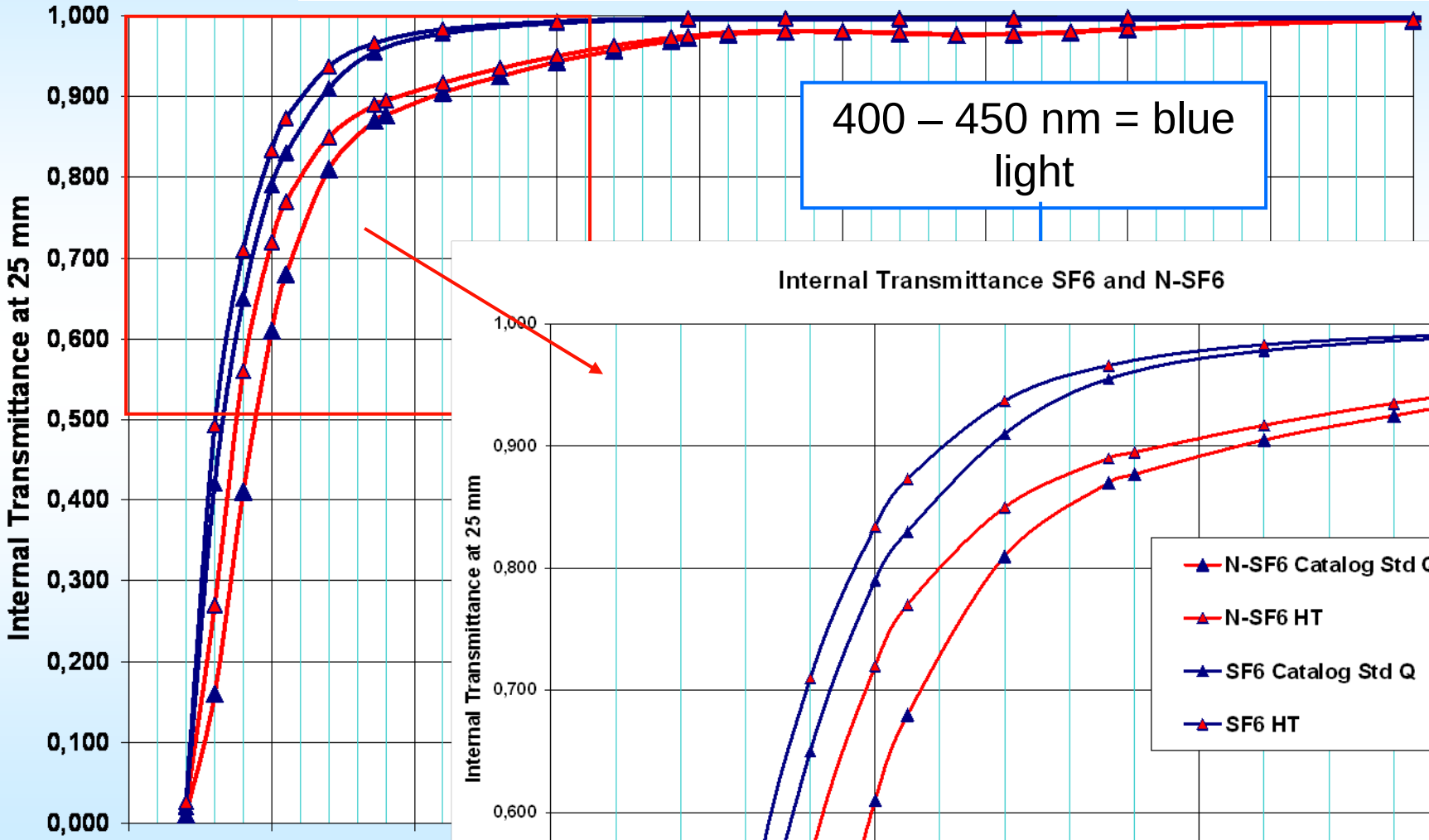
Proposed new exemptions

5. Compliant pin VHDM (Very High Density Medium) connector systems
6. Lead as a coating material for the thermal conduction module c-ring
7. Lead and cadmium in optical and filter glass
8. Optical transceivers for industrial applications (not complete)
9. Lead in solders consisting of more than two elements for the connection between the pins and the package of microprocessors with a lead content of more than 85% in the proportion to the tin-lead content (exemption until 2010)
10. Lead in high melting temperature type solders (i.e. tin-lead solder alloys containing more than 85% lead) and any lower melting temperature solder required to be used with high melting temperature solder to complete a viable electrical connection
11. Lead in solders to complete a viable electrical connection internal to certain integrated circuit packages (Flip Chips) (exemption until 2010)
12. Safety equipment for fire and rescue services (not complete)

Lead and cadmium in optical and filter glass

- Lead in optical glass
  - Most optical glass is lead-free
  - But for some applications there is no alternative to lead
  - Important glass properties
    - High refractive index
    - Low Abbe number
    - High transmission at all visible wavelengths
    - Stress-birefringence
  - Some applications need a combination of properties which all cannot be met without lead

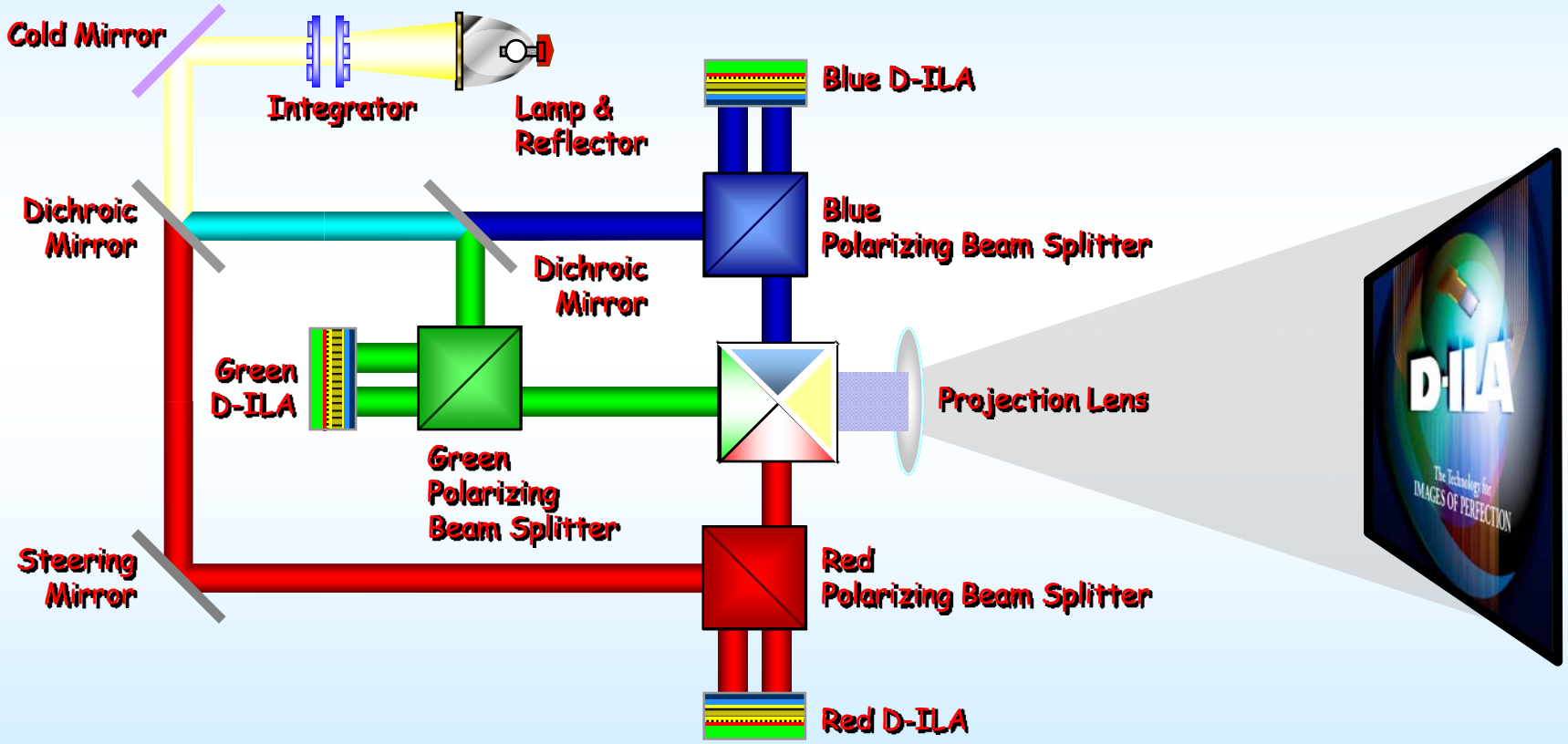
Light transmission through SF6 lead- and N-SF6 lead-free glass



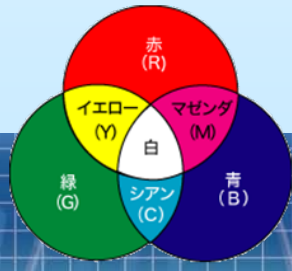
400 – 450 nm = blue light

This difference for high refractive index

Resistance to Stress-birefringence
Example of use in projectors, back-light TV
Projection principle



D-ILA "Polarise light to switch beam on/off
Beam splitters made of glass containing lead



Glass requirements for beam splitter

- High light transmission
- Low TCE
- Robust
- Easy to fabricate
- High refractive index
- Low stress birefringence

Birefringence test on Real Projected Image

Test results from JVC using stressed beam splitter

K=2.77

BK7 lead-free glass

Non-uniform Black !

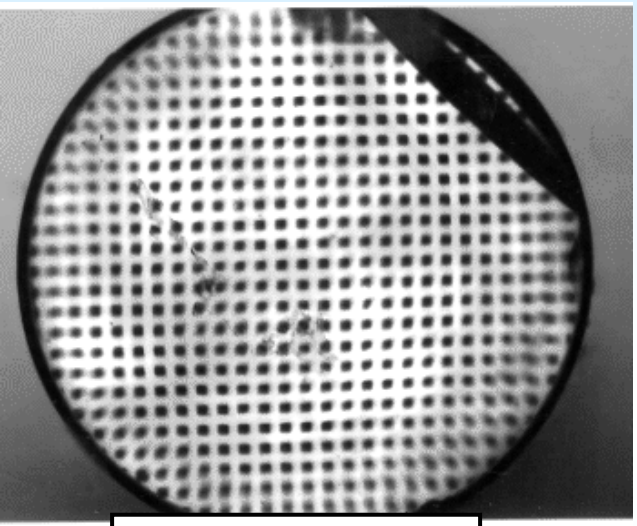
K=0.06

SF57 lead glass

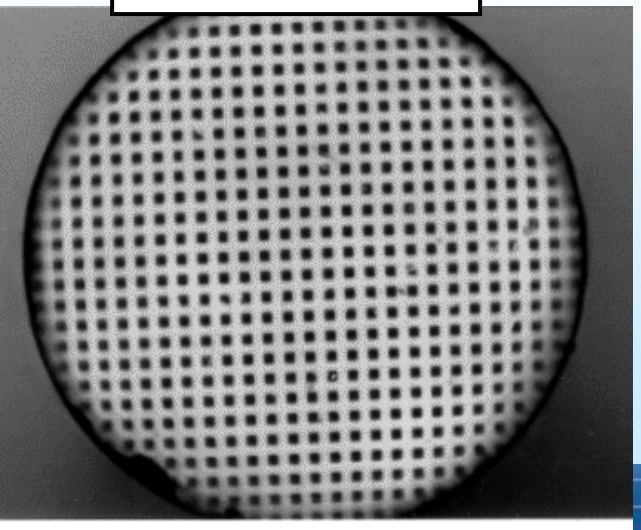
Uniform Black

K = Stress optical constant

Index gradient "SELFOC" lenses



Lead-free



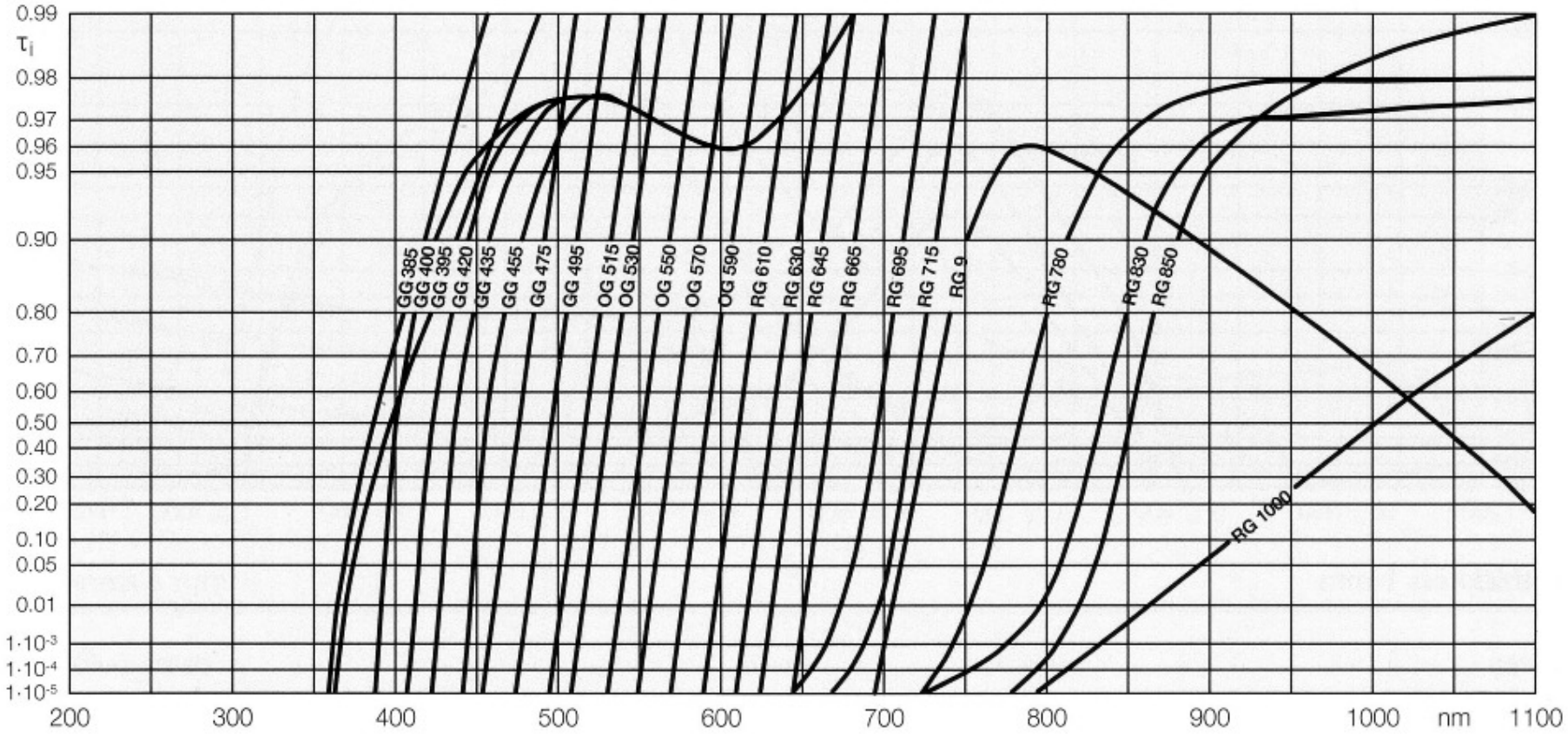
With lead

- Cylindrical glass lens with refractive index gradient
  - Used in scanners, fax, printers and copiers
  - Lead in glass
    - controls ion exchange production process
    - Provides high refractive index
    - Prevents crystallisation
  - Alternatives (Ba, Sr, control ion exchange but cause crystallisation)

Lead and cadmium in filters

- Essential for certain colours
  - Coloured plastics unsuitable at high temperature or if exposed to sunlight/UV
- Gives steep cut-off – not possible with alternatives. Essential for some applications
  - For example:
    - Runway lighting
    - Lighting for infra-red security cameras
    - Professional camera filters
    - Television cameras
    - Many applications not currently covered by RoHS

Long pass filter transmittance curves for Lead or cadmium containing filters



Glass thickness 3 mm

Lead and cadmium in optical and filter glass

- There are some applications where there are no alternatives to lead or cadmium in optical glass

Part 1 Exemptions for Categories 8 and 9 Equipment

A. General requirement

JBCE member companies producing equipment covered by the WEEE categories 8 and 9 fully support the conclusions and recommendations of the relevant ERA report[1]. Importantly, the study behind the report was carried out on the basis of the existing exemptions. Therefore, category 8 & 9 equipment that will be ROHS compliant in near future will include hazardous substances which are exempted now. It would be impossible to change the design in the short term so that the equipment did not contain the currently exempted hazardous substances.

Indeed, category 8 and 9 equipment differs markedly from equipment covered by the other eight WEEE categories (see pp 27-33 of ERA report). For example, many types of equipment are safety critical and technically demanding, and it therefore takes a much longer time to evaluate substitutes. Furthermore, this type of equipment is produced in relatively small quantities, but the diversity is great. Checking the chemical content of all parts from the complete supply chain is more time-intensive than is the case with equipment covered by the other WEEE categories. Finally, category 8 and 9 equipment typically has a very long lifetime, lifecycle, and development time.

JBCE therefore proposes that equipment covered by categories 8 and 9 should be considered separately in the study of the need to maintain or withdraw existing exemptions.

B. Specific requirements

The following items are application specific and they are essential for the corresponding products/product groups (we need much longer time for exemption than mentioned in A):

4. Mercury in other lamps not specifically mentioned in this Annex
13. Lead and cadmium in optical and filter glass

Attached you will find the technical data and detailed discussion concerning each individual item.

Part 2 Exemptions for Questionnaires

Please refer to following attachments with regards to Exemption No. 3, 4, 5, 7(a), 7(c) and 13.

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[1] ERA Report 2006-0383 "Review of Directive 2002/95EC (RoHS) Categories 8 and 9" http://ec.europa.eu/environment/waste/pdf/era_study_final_report.pdf

Exemption #13: Lead and cadmium in optical and filter glass General questionnaire

- ✓ **For which substance(s) or compound(s) should the requested exemption be valid?**

Lead and cadmium

- ✓ **What is the application in which the substance/compound is used for and what is its specific technical function?**

Substances which are used for optical filters transmit or absorb light in a specific wavelength range. The followings are some examples:
Cadmium;
Color filter R-72 (include CdS)
Color filter Y-52 (include $CdCO_3$ and CdS)
Color filter IR-76 (include CdO)
Lead;
Color filter B-460(include PbO)

They are used for the following products;
Ultraviolet(UV)/Visible(VIS)/Near-infrared(NIR) spectrophotometer,
Infrared radiation thermometer,
Light applied ingredient meter, and
Thickness meter.

- ✓ **What is the specific (technical) function of the substance/compound in this application?**

Color filters transmit (or absorb) the light in a specific wavelength range. The function of CdS, CdO and PbO is as follows:
CdS and CdO are coloring materials for glass and determine a limit of the transmission wavelength with a steep characteristics.
Adding PbO to glass changes its refractive index. This is used for the fine adjustment of a limit of the transmission wavelength.

✓ **Please justify why this application falls under the scope of the RoHS Directive (e.g. is it a finished product? is it a fixed installation? What category of the WEEE Directive does it belong to?).**

Filter glass is installed in EEE as the components of the other equipments fallen into category. In this request form, it especially explains used with category 9 product.

✓ **What is the amount (in absolute number and in percentage by weight) of the substance/compound in:**

i) the homogeneous material,

Amount of Pb in a filter glass at the maximum is 31.2wt%.

Amount of Cd in a filter glass at the maximum is 2.55wt%

ii) the application and

The maximum weight in the filter glass used for the instrument is 0.6g.

iii) total EU annually for RoHS relevant applications?

Delivery to the EU zone is about 100g per year.

✓ **Please check and justify why the application you request an exemption for does not overlap with already existing exemptions respectively does not overlap with exemption requests covered by previous consultations.**

There are no overlaps with the already existing exemptions and requests on the previous consultations.

✓ **Please provide an unambiguous wording for the (requested) exemption.**

Lead and cadmium in filter glass

Exemption #13: Lead and cadmium in optical and filter glass Specific questionnaire

1. Please specify these small number of applications (differentiate between applications using optical glass and those using filter glass):

For example, filter glass is used with the following products in this request form;
Ultraviolet(UV)/Visible(VIS)/Near-infrared(NIR) spectrophotometer,
Infrared radiation thermometer,
Light applied ingredient meter, and
Thickness meter.

Which applications currently fall under the scope of the RoHS Directive?

Products which currently fall outside the scope of the RoHS Directive,

Please provide a comprehensive list with allocation to WEEE (Directive 2002/96/EC) categories. Which applications fall under category 8 & 9 of the WEEE Directive?

These products belong to category 9.

Which applications are covered by exemption 5 (“lead in glass of cathode ray tubes, electronic components and fluorescent tubes”)?

It cannot be covered by exemption 5

2. Which of the applications covered by exemption 13 are available as RoHS compliant products (i.e. without lead and cadmium) on the EU market? Which applications are currently not available as RoHS compliant products?

At present it is not available, because currently category 9 is out of the scope of RoHS.

3. Are there different technical characteristics between optical and filter glass? If so, what are the different technical functionalities of lead and cadmium in these types of glasses?

Optical glass is used as material for optical lenses, etc. for the purpose of condensing light. On the other hand, filter glass is used for the purpose of transmitting only a specific wavelength of light. Therefore, one needs a transmission/absorption characteristics for the specific wavelength of the filter glass.
To obtain such a characteristic feature for the transmission/absorption properties specific chemical compounds (CdS, CdO and PbO) are used. The function of CdS, CdO, PbO are as follows:
CdS and CdO are coloring materials for glass and determine a limit of the transmission wavelength with a steep a steep characteristics.
Adding PbO to glass changes its refractive index. This is used for the fine adjustment of a limit of the transmission wavelength.

4. Which are the technical characteristics related to the use of lead and cadmium that are essential for the technical functionality of applications / products related to exemption 13? List those applications named under point 1 for which substitution is technically not feasible and justify.

(a) In case of Ultraviolet (UV)/Visible (VIS)/Near-infrared (NIR) spectrophotometer

A diffraction grating is used in UV/VIS/NIR spectrophotometers with high resolution to obtain monochromatic light. As shown in Fig. 1 this light is composed of several different orders. In applications one is interested in selecting only one specific order. For this purpose one can insert various kinds of optical filters into the light path.

In general, UV/VIS/NIR spectrophotometers cover the wavelength range from 170 nm to 3500 nm. In order to suppress the higher order light in each wavelength range an appropriate optical filter should be selected. The optical characteristics of some filters are shown in Figs. 2, 3 and 4. Fig. 5 shows one example of the filter combinations in a UV/VIS spectrophotometer.

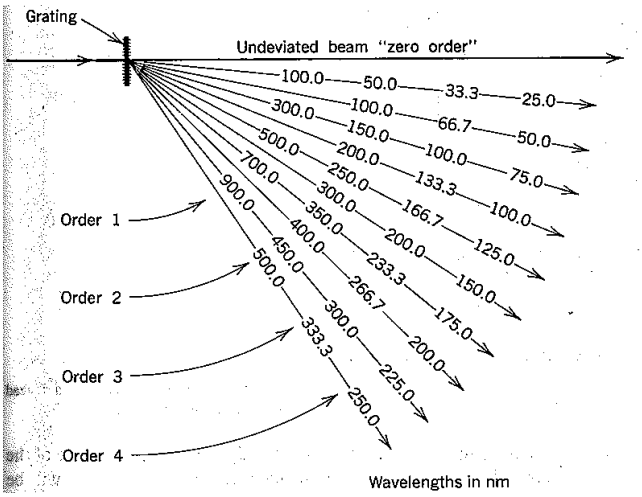

Figure 1 Overlapping orders in the spectrum formed by transmission grating. [1]

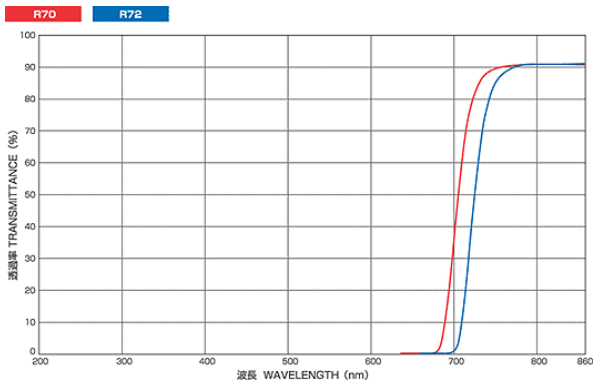

Figure 2 Transmittance of color glass filters R-72. [2]

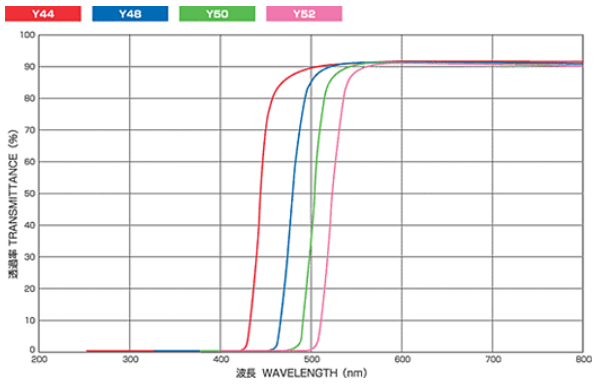

Figure 3 Transmittance of color glass filters Y-52.[2]

[1] Galen W. Ewing, INSTRUMENTAL METHOD OF CHEMICAL ANALYSIS Fifth Edition, McGraw-Hill Book Company
[2] HOYA CANDEO OPTRONICS Corp.
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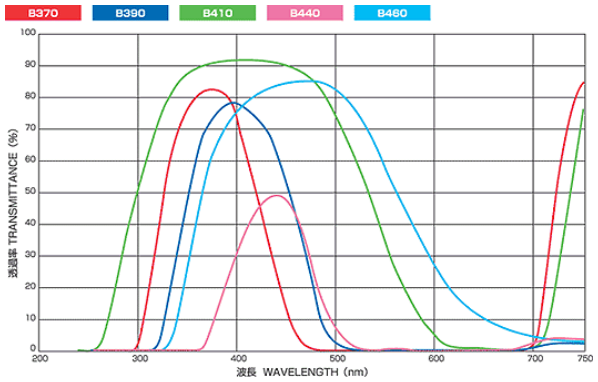

Figure 4 Transmittance of color glass filters B-460.[2]

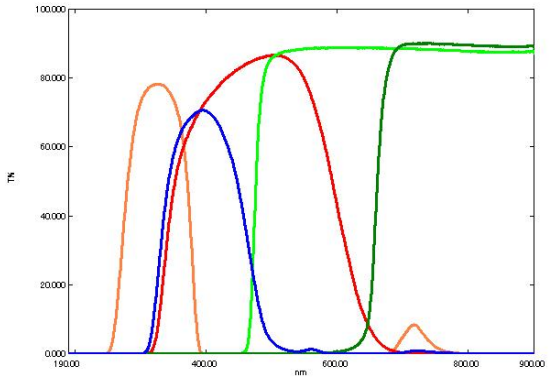

Figure 5 Example in the UV/VIS spectrophotometer.

Moreover, the steepness of the transition wavelength is important for optical filters in order to keep the high S/N. (The noise of the measurement data will increase when the transmittance of the target wavelength is low.) Such characteristics of the optical filters is determined with the chemical compounds mixed in the glass.

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(b) In case of Infrared radiation thermometer, Light applied ingredient meter, and Thickness meter.

The filter glass is used as measurement wavelength splitting use of infrared radiation thermometer, which can measure the temperature up to 3000degC, light applied ingredient meter, and thickness meter which can measure the moving objects with non-contact.

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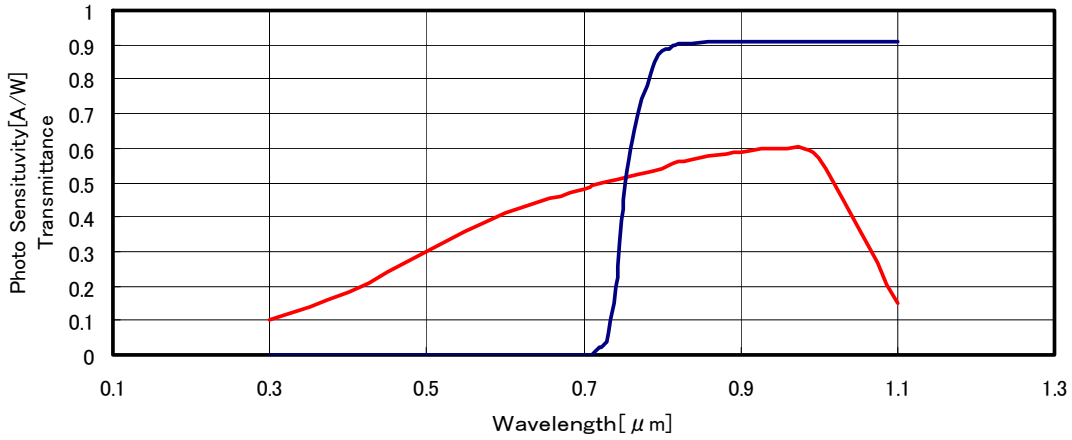

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As for the thin filter, the thickness changes depending on the temperature, which cause drift to the transmitting limit wavelength.

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The drift causes a big factor for measuring error in the measuring instruments which calculate the measuring value by logarithmic operation of the light quantity.
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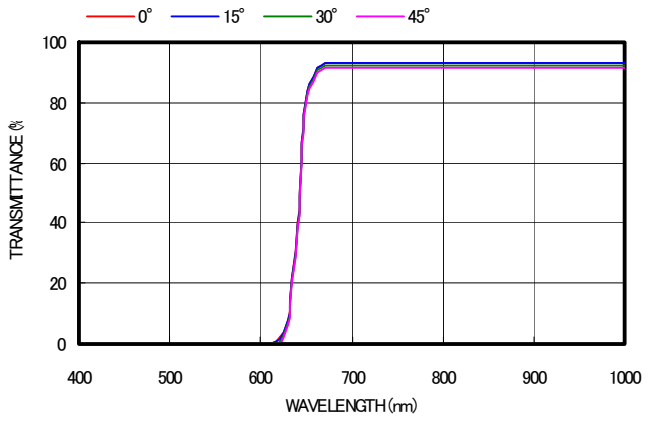

Figure 7 Angle dependence of filter glass

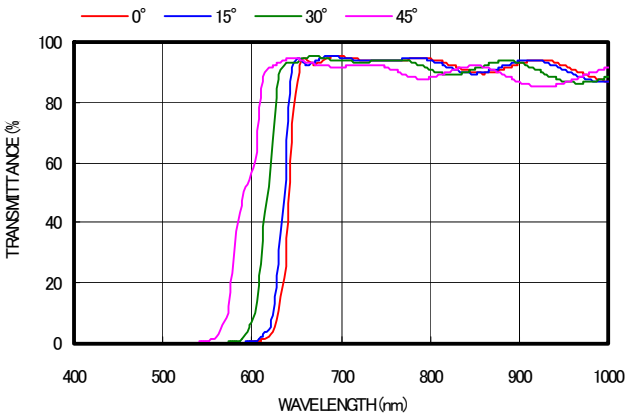

Figure 8 Angle dependence of thin film filter

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5. What has changed since the last evaluation in 2004? What is the current status of R&D efforts towards substitution of lead and cadmium in the different applications?

The other materials with similar performance cannot be found for thin filter, etc

6. Are manufacturers still investigating alternatives?

a. If yes, please provide a roadmap or similar evidence showing until when they intend to replace lead in glass in the applications mentioned above.

Yes. However, HOYA CANDEO OPTRONICS Corp. of the filter glass manufacturer mentioned that in the current condition, the study are continued as an optical glass material, but the materials having equal performance other than Pb, Cd cannot be found.

b. If no, please explain and justify why no further research has been undertaken against the background that the RoHS Annex is subject to regular revisions.

No substitutes

7. Please state for applications name under point 1 the amount of lead and cadmium used per application, the lead content in the homogeneous material, the annual production volume as well as the number of applications related to exemption 13 put on the EU market annually.

(a) In case of Ultraviolet (UV)/Visible (VIS)/Near-infrared (NIR) spectrophotometer

The maximum amount of Cd in filter glasses using for one instrument is 17.30mg.
The maximum amount of Pb in filter glasses using for one instrument is 5.73mg.
Annual quantity of total hazardous materials for UV/VIS/NIR spectrophotometer is the order of magnitude of 10^2 g.

(b) In case of Infrared radiation thermometer, Light applied ingredient meter, and Thickness meter.

The maximum filter glass using for one instrument is 0.6g.
Amount of Pb in a filter glass at the maximum is 31.2wt%.
Amount of Cd in a filter glass at the maximum is 2.55wt%.
The number of instruments including Pb or Cd that deliver to EU zone is about 30 units per year.

Exemption #13: Lead and cadmium in optical and filter glass General questionnaire

- ✓ **For which substance(s) or compound(s) should the requested exemption be valid?**

Lead and cadmium

- ✓ **What is the application in which the substance/compound is used for and what is its specific technical function?**

Substances which are used for optical filters transmit or absorb light in a specific wavelength range. The followings are some examples:
Cadmium;
Color filter R-72 (include CdS)
Color filter Y-52 (include $CdCO_3$ and CdS)
Color filter IR-76 (include CdO)
Lead;
Color filter B-460(include PbO)

They are used for the following products;
Ultraviolet(UV)/Visible(VIS)/Near-infrared(NIR) spectrophotometer,
Infrared radiation thermometer,
Light applied ingredient meter, and
Thickness meter.

- ✓ **What is the specific (technical) function of the substance/compound in this application?**

Color filters transmit (or absorb) the light in a specific wavelength range. The function of CdS, CdO and PbO is as follows:
CdS and CdO are coloring materials for glass and determine a limit of the transmission wavelength with a steep characteristics.
Adding PbO to glass changes its refractive index. This is used for the fine adjustment of a limit of the transmission wavelength.

✓ **Please justify why this application falls under the scope of the RoHS Directive (e.g. is it a finished product? is it a fixed installation? What category of the WEEE Directive does it belong to?).**

Filter glass is installed in EEE as the components of the other equipments fallen into category. In this request form, it especially explains used with category 9 product.

✓ **What is the amount (in absolute number and in percentage by weight) of the substance/compound in:**

i) the homogeneous material,

Amount of Pb in a filter glass at the maximum is 31.2wt%.

Amount of Cd in a filter glass at the maximum is 2.55wt%

ii) the application and

The maximum weight in the filter glass used for the instrument is 0.6g.

iii) total EU annually for RoHS relevant applications?

Delivery to the EU zone is about 100g per year.

✓ **Please check and justify why the application you request an exemption for does not overlap with already existing exemptions respectively does not overlap with exemption requests covered by previous consultations.**

There are no overlaps with the already existing exemptions and requests on the previous consultations.

✓ **Please provide an unambiguous wording for the (requested) exemption.**

Lead and cadmium in filter glass

Exemption #13: Lead and cadmium in optical and filter glass Specific questionnaire

1. Please specify these small number of applications (differentiate between applications using optical glass and those using filter glass):

For example, filter glass is used with the following products in this request form;
Ultraviolet(UV)/Visible(VIS)/Near-infrared(NIR) spectrophotometer,
Infrared radiation thermometer,
Light applied ingredient meter, and
Thickness meter.

Which applications currently fall under the scope of the RoHS Directive?

Products which currently fall outside the scope of the RoHS Directive,

Please provide a comprehensive list with allocation to WEEE (Directive 2002/96/EC) categories. Which applications fall under category 8 & 9 of the WEEE Directive?

These products belong to category 9.

Which applications are covered by exemption 5 (“lead in glass of cathode ray tubes, electronic components and fluorescent tubes”)?

It cannot be covered by exemption 5

2. Which of the applications covered by exemption 13 are available as RoHS compliant products (i.e. without lead and cadmium) on the EU market? Which applications are currently not available as RoHS compliant products?

At present it is not available, because currently category 9 is out of the scope of RoHS.

3. Are there different technical characteristics between optical and filter glass? If so, what are the different technical functionalities of lead and cadmium in these types of glasses?

Optical glass is used as material for optical lenses, etc. for the purpose of condensing light. On the other hand, filter glass is used for the purpose of transmitting only a specific wavelength of light. Therefore, one needs a transmission/absorption characteristics for the specific wavelength of the filter glass.
To obtain such a characteristic feature for the transmission/absorption properties specific chemical compounds (CdS, CdO and PbO) are used. The function of CdS, CdO, PbO are as follows:
CdS and CdO are coloring materials for glass and determine a limit of the transmission wavelength with a steep a steep characteristics.
Adding PbO to glass changes its refractive index. This is used for the fine adjustment of a limit of the transmission wavelength.

4. Which are the technical characteristics related to the use of lead and cadmium that are essential for the technical functionality of applications / products related to exemption 13? List those applications named under point 1 for which substitution is technically not feasible and justify.

(a) In case of Ultraviolet (UV)/Visible (VIS)/Near-infrared (NIR) spectrophotometer

A diffraction grating is used in UV/VIS/NIR spectrophotometers with high resolution to obtain monochromatic light. As shown in Fig. 1 this light is composed of several different orders. In applications one is interested in selecting only one specific order. For this purpose one can insert various kinds of optical filters into the light path.

In general, UV/VIS/NIR spectrophotometers cover the wavelength range from 170 nm to 3500 nm. In order to suppress the higher order light in each wavelength range an appropriate optical filter should be selected. The optical characteristics of some filters are shown in Figs. 2, 3 and 4. Fig. 5 shows one example of the filter combinations in a UV/VIS spectrophotometer.

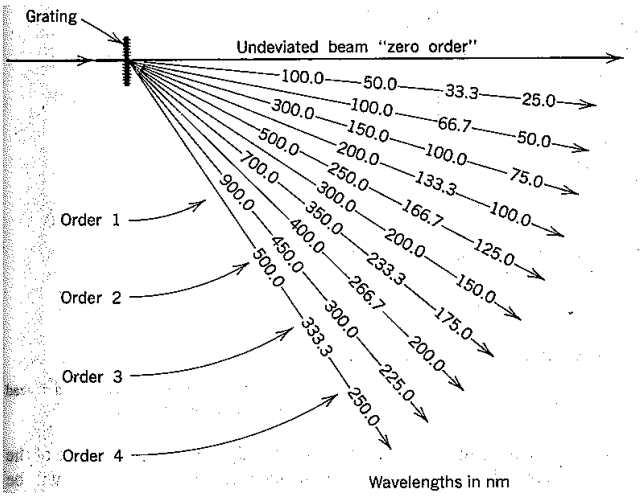


Figure 1 Overlapping orders in the spectrum formed by transmission grating. [1]

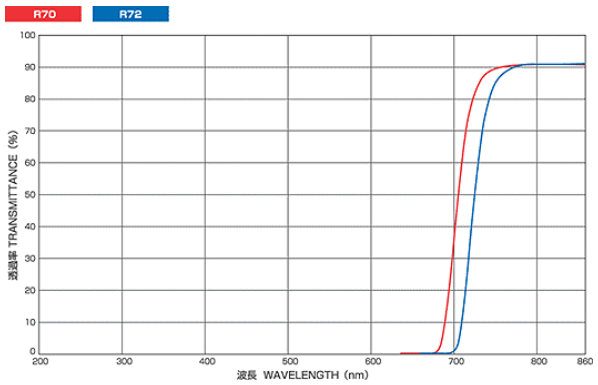
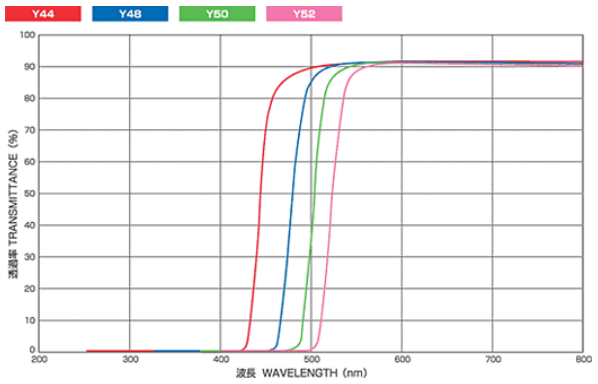


Figure 2 Transmittance of color glass filters R-72. [2]



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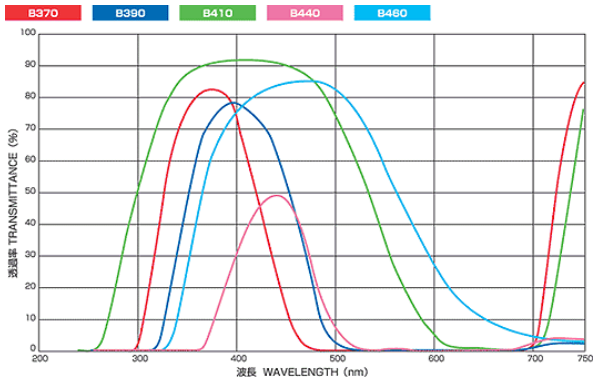

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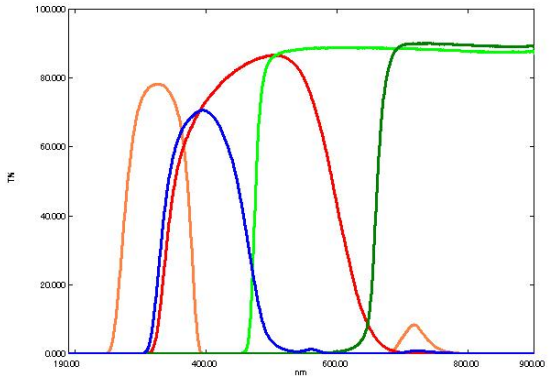

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Moreover, the steepness of the transition wavelength is important for optical filters in order to keep the high S/N. (The noise of the measurement data will increase when the transmittance of the target wavelength is low.) Such characteristics of the optical filters is determined with the chemical compounds mixed in the glass.

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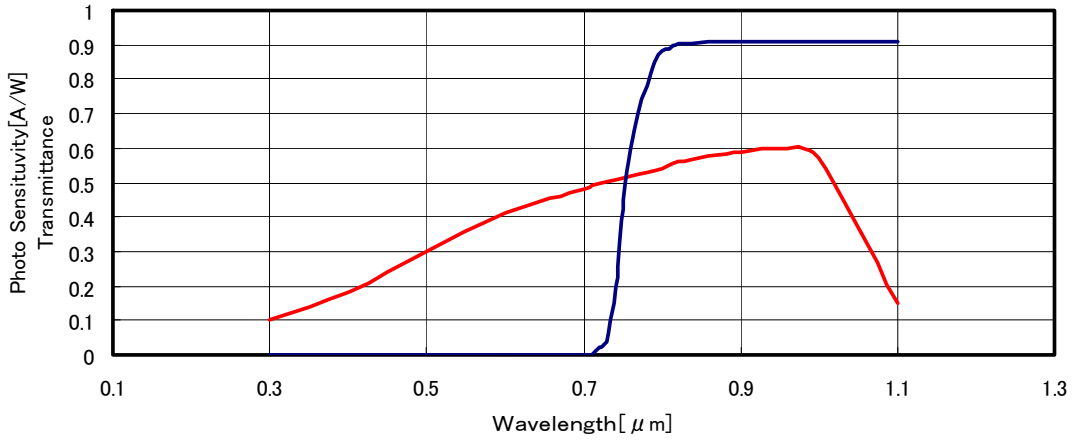

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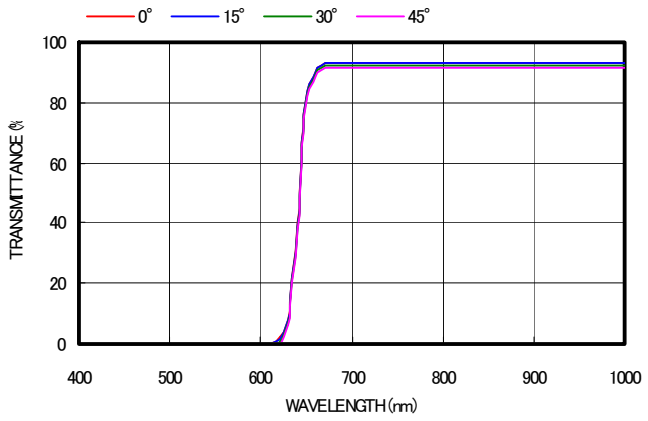
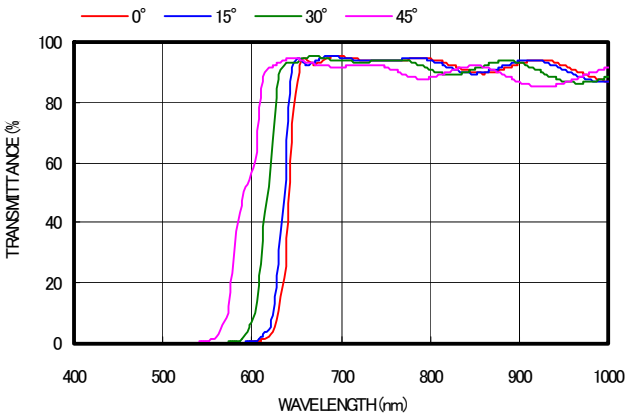


Figure 7 Angle dependence of filter glass



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