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Adaptation to scientific and technical progress under Directive 2002/95/EC

Final report

Freiburg, 20 February 2009

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4.1 Exemption Nos. 1–4 General considerations on mercury in lamps

The 4 existing exemptions for the use of mercury in lamps are the first one listed in the RoHS Annex and thus among the ones having been valid for the longest time. Out of the 4, only the currently valid exemption 3 was subject to a public scientific and technical evaluation which has been reported by ERA [6].

The function of mercury in lamps lies within the light generating process to convert electricity into light. A detailed explanation is given by ELC:

"Electrons are emitted from a heated electrode colliding with mercury atoms and so transferring energy to the atoms which elevates them to an excited state. When these atoms fall back to their original status they emit photons (packages of energy), normally not in the range of visible light. Ultraviolet photons excite the fluorescent powders, which are coated on the inside of the tube, with a high degree of efficiency. As a result these emit visible radiation in a range of colours. Lamps based on these principles and operating at low internal gas pressure are called 'fluorescent lamps'".

In the context of the current contract, exemptions 1-4 have been subject to the first stakeholder consultation. A large number of stakeholder contributions have been received (cf. http://rohs.exemptions.oeko.info/index.php?id=61).

Following the consultation, stakeholders have been invited to participate in a technical stakeholder meeting on 10 June 2008. Further on, extensive exchange has taken place with stakeholders (mainly ELCF[3], environmental NGOs[4], JBCE[5], EICTA[6] and AeA[7]) before another meeting took place on 24 September with ELC, environmental NGOs, an independent Swedish expert representing the Swedish Consultant AF[8], Megaman[9], JBCE[10] and JELMA[11]. Prior to this latter meeting, the consultant had sent out a proposal for discussion to stakeholders including:

- Proposal on lamp type classification to be used as a basis for setting mercury content limits for certain groups of lamp types;

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3 European Lamp Companies Federation

4 Representing the European Environmental Bureau (EEB), the Zero Mercury Campaign and the Green Purchasing Institute.

5 Japanese Business Council in Europe

6 European Information & Communications Technology Industry Association

7 AeA Europe: association of high tech companies of American parentage doing business of more than € 100 billion in Europe.

8 AF has compiled a report on the use of mercury in lamps in light of the RoHS Annex review [AF report]

9 Megaman is a European lamp manufacturer of compact fluorescent lamps.

10 Japanese Business Council in Europe

11 Japan Electric Lamp Manufacturers Association

- Proposal on new mercury limit values on the basis of the classification proposal;
- Open points for discussion (interpretation of Hg limit values, front runner vs. BAT vs. large market segments, lifetime, diameter-dependent limit values for linear fluorescent lamps, LED as a possible substitute, application-specific provisions, category 8&9 issues, substitution at application level, need for a "miscellaneous" exemption, transition period, expiry date and spare parts).

As an outcome of the meeting, the consultant sent out open questions that stakeholders would need to answer in order to allow for a final assessment with regard to a proposal for amended exemptions on the use of mercury in lamps. The consultant has received very extensive feedback from stakeholders which has been used for the formulation of recommendations. An overview on stakeholder involvement and progress made during the course of the project is given in the Annex.

However, despite extensive stakeholder involvement and fruitful discussions, there are three very opposing and different views remaining on how new mercury limits should be set ([1], [3], [4]). As far as possible the consultant has tried to make an independent technical and scientific assessment but in some cases this is not possible in the context of a pure evaluation of available information. As a general outcome, the consultant would like to state that in the case of mercury use in lamps a more in-depth study as well as further discussion with relevant stakeholders are needed in order to evaluate all necessary aspects (although the amount of external research has already been very large).

4.1.1 Lamp classification and current exemptions

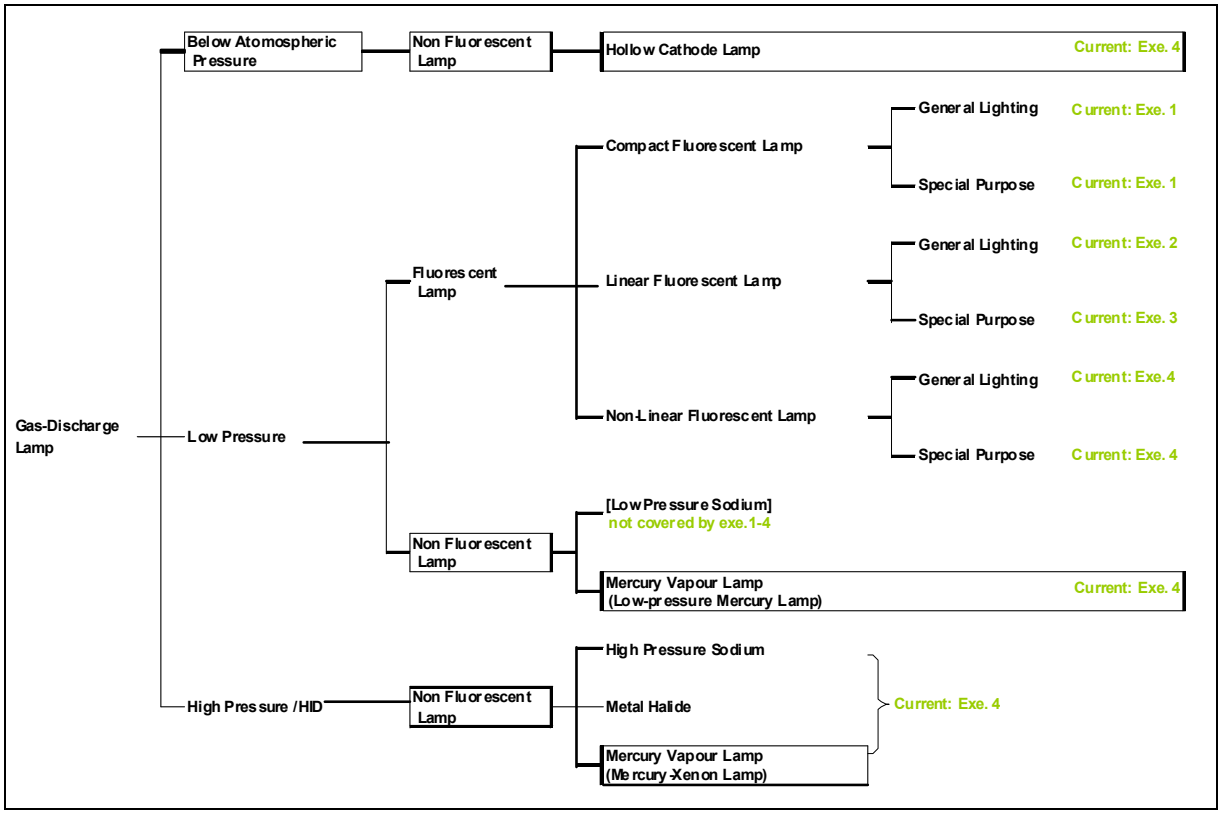

Figure 1 Overview on lamp type classification [4] + own modifications

Figure 1 shows the overall classification of gas discharge lamps to which mercury using lamps belong (as opposed to incandescent lamps). In general, the largest market shares of mercury-containing lamps include compact fluorescent lamps (CFLs) as well as linear and non-linear fluorescent lamps. High-intensity discharge lamps (HID) have until now not been given separate limit values but are an important lamp category that has been evaluated separately in this report. Fluorescent lamps can be divided into general lighting purpose and special purpose as well as compact (CFL), linear (LFL) and non-linear shapes.

Currently, the exemptions cover CFLs as one group, LFL for general purpose and LFL for special purposes as other groups and leaves all other lamps to be covered by exemption 4.

The exact wording being:

1. Mercury in compact fluorescent lamps not exceeding 5 mg per lamp.
2. Mercury in straight fluorescent lamps for general purposes not exceeding:
   a) halophosphate 10 mg;
   b) triphosphate with normal lifetime 5 mg;
   c) triphosphate with long lifetime 8 mg.

3. Mercury in straight fluorescent lamps for special purposes.
4. Mercury in other lamps not specifically mentioned in this Annex.

It should be noted that in the current wording “straight fluorescent lamp” does not correspond to the technically correct term but that “linear fluorescent lamp” should be used instead. Also, “triphosphate” is not the technically correct term and “tri-band phosphor” should be used instead [1].

4.1.2 Link to EuP

Under the EU regulatory instrument on eco-design of energy-using products (EuP), lighting has also been subject to preparatory studies and is subsequently followed by Commission Working Documents as well as Implementing Measures.

With regard to the use of mercury in lamps work on both tertiary sector lighting products (dealt with in Lot 8 and 9) as well as domestic lighting products (dealt with in Lot 19) includes recommendations that relate to the use of mercury in lamps. They have taken into account in the below discussion on mercury limits for the individual lamp types.

4.1.3 Category 8&9 aspects

Many stakeholders have given input on Category 8&9 specificities with regard to the use of mercury in lamps. The manufacturer Hamamatsu Photonics (represented within JBCE) has for instance introduced the use of mercury in special lamps using primary mercury line and continuous spectra [7]. These lamps are not fluorescent and not necessarily high pressure and can be marketed as Hollow Cathode Lamps and Electrodeless Discharge mercury lamps (e.g. used in atomic absorption spectroscopy), Low Pressure Mercury Lamp (e.g. used in absorption spectrometers) or Mercury-Xenon Lamps (e.g. used in water surface inspection systems and belonging to the category of high pressure lamps) – see Figure 1. Also, they can be used for UV Spot Light Source for UV Curing / disinfection. In general, they are used for very specific analytical / measurement applications in environmental, medical, control & measurement and industrial fields and contain very low amount of mercury (total of approximately 1 kg in the EU market) [7].

Until now such lamps were covered by exemption 4 and have thus not been reviewed within the ERA report on category 8&9 equipment [8]. No generally available substitutes exist for mercury in these applications since it is the specific spectral line that is required for those applications [7]. For some applications mercury-free alternatives exist (e.g. Excimer lamps which emit only within narrow wavelength ranges and are thus used only for certain medical applications) [9].

Category 8&9 equipment of course also uses mercury containing lamps as backlights for displays where inter alia colour accuracy is an important feature [9] [10]. Possible substitutes are discussed (e.g. Xenon lamps, LEDs and OLEDs) but all have disadvantages compared

to mercury containing backlights even though there might be single applications for which substitution is feasible [9].

As a conclusion it can be stated that mercury containing lamps used in category 8&9 equipment have a wide range of applications and are represented over the whole spectrum of the lamp classification. Until now they were covered by exemption 3 and 4 and thus need to be covered by a new exemption. Concerning current exemption 3, the same argumentation applying to mercury used in display backlights for other type of equipment applies. With regard to current exemption 4, the ELC proposal [1] includes such a new exemption 5. The proposal by environmental NGOs [3] does not cover these kinds of applications.

In the section below, a new exemption 4b is recommended which would cover lamps for special purposes (cf. section 4.5.10) including those lamps belonging to category 8&9 which are not covered by the recommended exemptions 1-4a.

During the consultation process category 8&9 manufacturers represented by JBCE, COCIR, Test&Measurement Coalition have been involved. Their considerations as well as input by ERA have been taken into account. Nevertheless, it is not known to the consultant whether there are any other category 8&9 manufacturers that have particular considerations with regard to mercury content in lamps used in their equipment. Also, the consultant does not know which of these manufacturers considers the lamps used in its equipment as a component which would thus not be considered to fall under the current scope (cf. section 4.1.6).

When including category 8&9 equipment into the scope of RoHS new specific exemptions might thus become necessary. It is therefore recommended to foresee a sufficient transition period between inclusion into the scope and entry into force of the amended RoHS Annex allowing manufacturers to apply for an exemption if necessary.

4.1.4 General considerations on Hg limit values

In the course of discussions, questions arose what exactly is meant when setting a mercury limit in the RoHS Annex – would this refer to a nominal value, an average value or a maximum value including variances.

Environmental NGOs [3] state that the dosing accuracy of modern low-mercury dosing technologies allows for a dosing margin of 10% which is supported by a citation from a scientific journal. They have thus added this margin on market data found with regard to nominal values when putting together their proposal on new mercury limit values [3]: “We have further checked the status of the values indicated in different catalogues, and it seems that these are probably nominal. Nevertheless after recent communication with one major lamp manufacturer, they mentioned that there can be a small variation of +/- 0.3 mg in these nominal values.

This argument is further supported and in a stricter way, as with mercury capsule technology it is possible to achieve a high dosing accuracy and lamps with very low Hg content are pro-

duced; even amounts below 1.5 mg can be dosed with a variability lower than 10%. Our recommendations should be considered as maximum values since this margin is mostly built into our suggestions, and considering that there will be still enough time for industry to adapt to the new proposed values by utilising these new more accurate and safer dosing method."

The ELC explains the necessity to set higher limit values than those stated in product documentation as follows [1]:

"In practice, mercury from the discharge gets consumed over lamp life, meaning that it is not available anymore for the proper functioning of the lamp. The mercury gets mostly deposited and effectively bonded to the glass and the phosphor layer. This is reflected by the full curve (1) in Figure 2, which represents more or less a square root relationship with lamp life. The longer the burning time, the higher the amount of mercury needed. The variance in this mercury consumption, as depicted by the arrows, is considerable and depends on many factors (see below for counteracting measures). One could say that, in principle, a fluorescent lamp receives an overdosing of mercury, but that it is required to maintain lamp performance over time.

In order to maintain the properties over lamp life, one determines for a particular lamp design the amount of mercury needed (line 2 in Figure 2). The target mercury dosing (line 3) while taking its own variance into account, should be sufficient to allow for proper lamp life. Alternatively, this target value is called nominal or average value, and can be listed in catalogues.

The solid line 4 in Figure 2 is the line representing the RoHS limit (expressed as mg per lamp), the value of which has to take into account both variances of mercury consumption and of mercury dosing. On the one hand, we like to have this value as low as possible, but on the other hand, it should be safely chosen to (1) eliminate the customer risk of a non-performing product over the designed lamp life and (2) to be able to demonstrate in internal manufacturer's tests and in market surveillance tests, with the least effort, that products comply with the RoHS Directive. This leads to a built-in safety margin on top of the target mercury dose, finally leading to RoHS content limit."

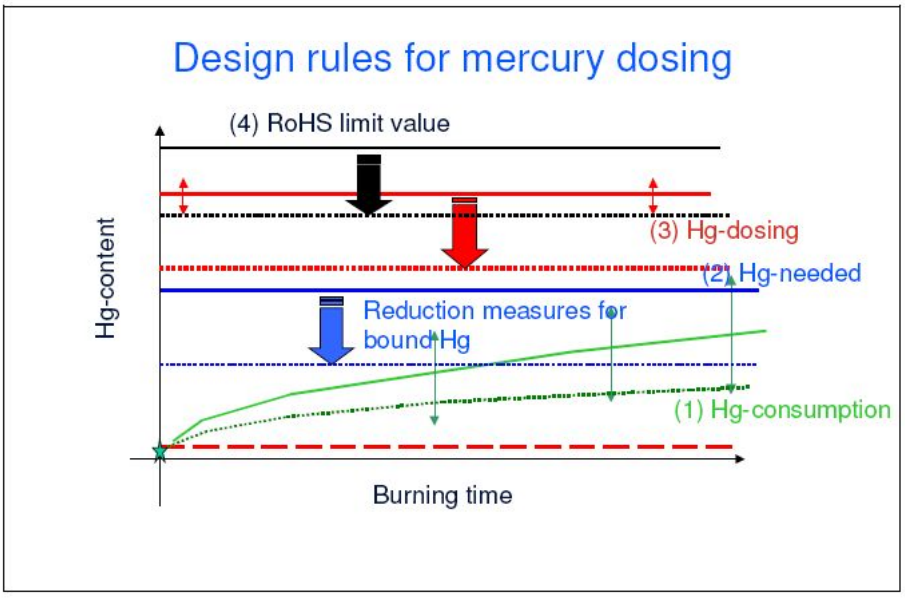

Figure 2 Explanation on how mercury is dosed [1]

Furthermore, ELC states that even with modern dosing technologies such as caps, pills and amalgams, “there is a certain distribution of the amount of mercury per single dose. The different dosing techniques have different variances. So for example the effective mercury content of lamps with a target or average value of 2.5 mg can vary between 1.5-3.5 mg. For manufacturers, an additional “safety margin” (as explained above) is essential to have legal certainty that a product is within the limit. So while in practice the average value may be 2.5 mg, the needed RoHS value in this example may be as high as 3.5 or higher.”

As last element influencing the setting of limit values, ELC mentions market surveillance. Currently, according to ELC, market surveillance regarding mercury content in lamps is not addressed in an appropriate way. Therefore, ELC has proposed a sampling procedure where a maximum of 10 lamps need to be tested [1] and concludes: “If the limit value is too close to the mean value, much higher numbers of lamps have to be tested in order to have statistical and legal certainty that a certain product is within the limit.”

The Swedish study [4] in this context has made the following proposal: “An alternative strategy is to relate the Hg content to efficacy and lifetime, i.e. amount Hg/lumenhour. The shorter lifetime and efficacy the lamps have, the lower amount of Hg content should be allowed. It might be cheaper and easier to improve the lifetime of the lamps than decreasing the Hg content. A fluorescent lamp with a lifetime of 20000 h compared with one of 100000 h and the same content of Hg and efficacy have a polluting relation of 1:5.”

Regarding market surveillance experts from lamp industry argue that currently there is no common standard on sampling Hg in lamps. Accordingly, reported data have to be assessed carefully to avoid misinterpretation.

Conclusion

The two main stakeholders involved in the process have no common position with regard to the interpretation of how a maximum limit value for mercury content should be set. While ELC states that dosing variances are of +/- 2 mg, environmental NGOs state they are of +/- 0,3 mg respectively +/- 10%.

The consultant is not in a position to judge which variances are "right". ELC has not provided hard fact data supporting its request for a high variance compared to the NGO information which is at least supported by a scientific source. More time and resources as well as independent research and data on maximum mercury content and application specific variances are needed in order to judge whether the limit values proposed by each of the parties are realistic maximum values with regard to mercury consumption, dosing and margins needed for market surveillance.

4.1.5 Front runner vs. BAT vs. large market segments

The justification of the revised exemptions 1–4 as laid down in Article 5 (1) (b) of the RoHS Directive does not include the consideration of economic aspects. However, it can not be the goal of RoHS exemptions to harm industry without environmentally justified grounds. Nevertheless, it is the aim of the RoHS Directive to only allow exemptions in cases where substitution has more negative effects, or in cases where substitution is technically not practicable.

The latter is subject to very differing interpretations – what exactly is "technically practicable"? The following problems arise:

1. Lamp industry has objected proposals by experts (EEB and AF Consult) with the argument that the lowest Hg content only refers to certain front-runners, and that large parts of the EU lamp market would be harmed if such strict values were set as limit.
2. Here again, Article 5 (1) (b) does not contain any guidance on how to evaluate such an issue. However, in the past, evaluation has been done in the sense that if there is technology available on the market which can cover the demand and has lower hazardous substance content, then an exemption is not justified. Meaning, the goal of an exemption cannot be to protect all manufacturers from being kicked out of the market, but rather to allow the marketing of products for which no suitable alternative is available.
3. As a rule mercury dosing technologies is intellectual property of single manufactures and there is no common access to specific dosing technologies due to competition. Furthermore, changes in the dosing technology may cause the replacement of the whole production line. Against this background, achievements from one manufacturer can not be adopted easily by other manufacturers. Consequently, substitution may be technically practicable only under the provision of long transition periods.

4. Against the background of current discussions and due to lack of data, the consultant has not been able neither to identify what the best available technology (BAT) is for certain lamp types, nor to get an idea on where the lamp market is able to fulfil this BAT.
5. Information on mercury contents from both parties (ELC and environmental NGOs) leads to the question what market share would be covered if those limit values were to come into force.
6. Taking into account that it is an environmental policy goal to allow marketing of enough energy efficient lamps in order to cover the increasing demand, a detailed market research is needed in order to evaluate the consequences of the proposed limit values on the availability of energy efficient lamps. This however is out of the scope of this study.

Environmental NGOs [3] have stated that their recommendations on limit values have been based on extracts of findings from the US and EU market. “For high volume lamps we have in general chosen a maximum limit value which two or more of the main lamp manufacturers are meeting already today; for the smaller volume lamps we consider that the best/lowest level reached today by at least one main lamp manufacturer could be sufficient indicator to show what technology can allow for. For all cases it has to be considered however that new maximum limits will be required after a transition period, which will suffice for such a change.”

Furthermore, their approach is that mercury limits “should be set to represent best in class for each lamp type based on a technological evaluation of what has and can be achieved, without undermining the energy efficiency criteria that will be set. Combining different types of technologies is likely to result in weaker standards designed to accommodate all models in a category.”

ELC has the following position concerning front-runner approach [1]:

1. “The ELC believes that a frontrunner approach should not be taken as the leading principle in setting new mercury content limits. Instead, the ELC proposes reduction per lamp family based on collective assessment of technical process, while taking into account the practicability aspect and also other relevant aspects.”
2. “A realistic mercury reduction limit can be achieved by judging its potential in relation to entire product families, based on manufacturers’ collective understanding, instead of basing it on a product-by-product comparison.”
3. “So far, it has not been fully taken into account that there is a huge variety within each product family, regarding purpose, technology, wattage, current density, size, life time, internal phosphor coating, production process etc. Mercury is intentionally added because it is necessary for fluorescent lamps. Mercury is “consumed” by different factors during lifetime, as explained before. It would be practically impossible to take the whole

product catalogue and do one-to-one comparisons of all lamp types, as proposed by other stakeholders."

4. "Lamp manufacturers fear that too severe reduction of limit values will lead to many cases of underperforming lamps." E.g. through reduced lifetimes.
5. "Product-by-product detailed data sharing and analysis (market volume, content details, manufacturing information etc.) might be seen as infringing on competition law)".

Conclusion

1. Mercury limits should not be based on a collective understanding by manufacturers but on hard fact data. If data sharing infringes competition law than manufacturers could provide data on a confidential basis.
2. Information should thus be made available by industry on market share of lamps below the proposed limit values in order to identify whether the increasing demand can be met.
3. BAT should be interpreted as "lamp containing lowest Hg content without reducing the lifetime and luminance efficacy". In principle this position is agreed on by both NGO's and manufacturers. However, there is no common standard to determine lifetime.
4. Also, lamp industry should be requested to submit data on maximum mercury content of lamps as well as exact dosing and consumption variances for each type of lamp put on the market in order to identify what sensible limit values are to be set.
5. Since there is no agreement on how market surveillance should take place in order to verify compliance with maximum mercury content it is not yet possible to identify a certain variance / safety margin that needs to be taken into account. Therefore, the Commission and Member States are urged to agree on a market surveillance procedure.
6. As for other exemptions and following Article 5 (1) (b) RoHS Directive, an exemption is not justified if substitution is scientifically and technically practicable. Thus, in cases where environmental NGOs have provided data on such substitutes the consultant has based his recommendation on these facts in those cases where no other data have been available.

4.1.6 Lamps under RoHS scope

In order to evaluate whether category 8&9 equipment falls under the scope of an amended RoHS Annex it first has to be clarified how the RoHS scope applies to lamps. Furthermore, the specificity of lamps as covered by RoHS has to be understood.

According to ELC [1], RoHS covers category 5 WEEE Directive ("lighting equipment") as well as electric light bulbs and luminaires in households. Annex IB WEEE Directive lists a number of examples for lighting equipment:

1. luminaires for fluorescent lamps with the exception of luminaires in households;
2. straight fluorescent lamps;
3. compact fluorescent lamps;
4. high intensity discharge lamps, including pressure sodium lamps and metal halide lamps;
5. low pressure sodium lamps;
6. other lighting or equipment for the purpose of spreading or controlling light with the exception of filament bulbs.

Against this background ELC concludes the following:

"From the above definitions, the ELC believes that nearly all lamps are within the scope of RoHS. However there is an important difference between Cat. 5 lighting equipment and other products under the scope of RoHS, and that is that lamps cannot be operated alone but need a fixture. These fixtures can be simple and cheap household luminaires but can also be expensive electrical and electronic equipment like medical or scientific devices. Lamps therefore also reveal the character of consumables.

Most of the lamps regarding market share put on the European market are used for general lighting purposes. But also lamps for special purposes are in most cases regarded to fall within the scope of RoHS. […]

Characteristics or usage scenarios which could lead to the conclusion that a lamp is not covered by RoHS are the following:

- Equipment concerned is part of another type of equipment that does not fall within the scope of WEEE Directive (according to the Art. 2 of WEEE), e.g. in vehicles.
- Purpose of the lamp is not "spreading or controlling light" and the lamp is part of an electrical or electronic equipment not falling within the scope (e.g. cat. 8&9 lamps), e.g. radiation sources for medical (therapeutic, diagnostic), scientific, industrial purposes.

Examples are:

- Automotive lamps;
- Lamps for skin treatment in medical equipment;
- Spectral lamps in scientific measuring equipment;

[…].

If a manufacturer comes to the conclusion, that a certain "lamp" does not fall in the scope of RoHS but is rather considered as a "component" of another type of equipment he has to be aware, that the equipment in which it is used might fall into the scope, in one of the Categories, and that then an extra exemption for the use of mercury in this equipment might be necessary."

Conclusion

With regard to category 8&9 it is concluded that lamps which are not considered by the manufacturer to be a component already fall under the scope of the RoHS Directive now. Hence, any amendment to the RoHS Annex will have an effect on lamps used in this equipment.

4.1.7 LED as a possible substitute

LEDs are electronic components that can be used to manufacture lamps. LED-based lamps are currently under strong technological development and are said to be able to replace current lighting applications in future [4]: "LEDs are today used in for example instrument panels, traffic signs, vehicle backlights, and coloured lights. Development is fast and white LED is more and more used in general lighting. Other areas available today are emergency lighting and decorative lighting. Among application areas to expect in the future are spotlights, torches and street lights. Time for developed products for most applications is estimated to around 2012." LED-based lamps are said to have the advantage of small size and higher energy efficiency as well as higher lifetime compared to current lighting applications. However, information on how far the technology is currently developed and for which applications LED are suited varies greatly.

When analysing the possibilities of using LED as a Hg-free substitute for current Hg-containing lamps, the following question needs to be answered: on a life-cycle based approach, what are the environmental impacts of LED-based lamps compared to current lighting applications (e.g. energy needed for production, efficacy, lifetime, …)? Since currently there seems to be no reliable data and information available in this respect, it is not possible to evaluate whether or not LED-based lamps can be considered as substitute with overall environmental benefit.

This statement may not be fully valid for some applications as stated by environmental NGOs [2]:

"LEDs are definitely applicable as replacements for exit signs and other applications for illuminating pathways. It can often replace low-wattage CFLs and linear fluorescents such as T2s used in exit signs. Increasingly, LEDs are replacing high-pressure sodium (HPS) lamps in street lights.[…]

As it has been mentioned above, in areas of low wattage applications where LEDs exist, last longer and are as or more efficient than fluorescent lamps, these should be preferred and no exemption should be granted for those applications."

This is supported by the Swedish study [4]: "There are different techniques to replace mercury in back lights in LCD screens but it appears though as the LED technology is the leading alternative in the question of quality issues and performance. Also for other imaging equipment such as scanners and projectors there are mercury free products on the market.

For several applications like for example exit signs, mobile phones, refrigerator lamps and commercial street signs there are already mercury free LED alternatives that are similar in capacity and quality."

It thus seems that LED-based lamps as from today are suited to be used in specific applications such as spot lights, decorative lighting, and displays to a certain extent[12]. Technological development for other areas of application is said to take about 5 years before sufficiently efficient and long-lasting lamps will be available on the market.

Conclusion

The consultant thus proposes not to consider LED as a possible substitute for lighting applications in general due to unknown environmental effects. Since overall environmental policy goal is to both reduce the amount of hazardous substances in EEE and at the same time to ensure high efficiency in order to reduce energy consumption, LED are considered as possible substitutes, only once they have reached higher or equal efficiency and lifetime. Therefore, this technology should be evaluated again during the next RoHS revision cycle in 4 years.

As LEDs are considered suitable substitutes for certain applications the next section will analyse whether a restriction of certain exemptions in this respect is feasible.

4.1.8 Substitution on application level

Some important questions that have arisen relate to substitution at application level, i.e. the questions whether e.g. halophosphate lamps could be replaced by tri-band phosphor lamps or whether LED-based lamps could replace mercury-containing lamps.

Should these substitutions at application level be considered as possible by stakeholders, there would be no justification for exempting these applications from the provisions of the RoHS Directive. From the information available so far, the consultant has concluded that halophosphates can be substituted by tri-band phosphor lamps as stated by the environmental NGOs [3]:

"Halophosphate fluorescents, which largely include older type fluorescent lamps such as linear and U-shaped T12s and circular T9s, are being phased out in the EU (and elsewhere) due to energy efficiency and light quality concerns. Many of these lamp types also have higher mercury content than equivalent tri-band phosphor models such as high-efficiency T8s and T5s. […] Often, low-mercury dosing technology is not used on older models because

[12] E.g. Dell Driving Transition to Energy-Efficient LED Displays - Announces 12-Month, 100 Percent Mercury-Free Target for New Laptops (cf. http://www.marketwatch.com/news/story/dell-driving-transition-energy-efficient-led/story.aspx?guid=%7BDC160909-8AC6-4C74-85B6-C5A694B76FF6%7D&dist=hppr)

manufacturers don't feel that it is economically beneficial to retool lamps that are less popular or in the process of being phased out.)"

This has been confirmed by ELC [1]:

"It is important to understand that the focus has been on the most innovative fluorescent products, like T5 or CFL, and not on the older, less energy efficient lamp categories. For example, no major steps have been taken for halophosphate lamps (application to be restricted in implementing measures of the EuP directive), or for T12 lamps (due to rapidly declining market relevance in the EU)."

According to ELC, substitution at application level can only be considered practicable if retrofit applications allowing substitution in existing luminaires exist. It claims that since this is not the case for halophosphates, other lamps cannot be considered as substitutes. However, if a provision on spare parts is introduced (cf. section 4.1.9), the existing exemption for halophosphates could be withdrawn since a substitution with less mercury containing lamps could take place for newly installed luminaires.

During the current evaluation process, information has been gathered on possibilities to restrict exemptions for certain specific applications where substitute technologies are available (e.g. use of LED in exit signs, use of Xenon lamps for certain applications etc.).

Since the lamps themselves are in the scope of the RoHS Directive, such a restriction would not lead to the effect that mentioned applications can only be used with a certain type of lamp, since in theory it would be possible to sell the corresponding luminaire without lamp, and the matching lamp separately without infringement to RoHS provisions.

The environmental NGOs [3] however mention the following: considering, that all these products/applications are electronic equipment and fall under the RoHS Directive, an exemption from the Hg-lamp exemption could be proposed in cases where certain applications can use mercury free and more energy efficient lamps. For example for exit signs, neon signs, laptop and LCD screens, the following text could be proposed: Exemptions 1-X of this annex shall not apply to *exit signs (containing housing, fixture and light source) and exit sign retrofit kits, neon signs, laptop and LCD screens.*

Conclusion

Unlike other exemptions, current exemptions for the use of mercury in lamps are not application-specific but refer to certain lamp types. Thus, even if there are substitute technologies for certain applications it is difficult to explicitly exclude these applications from existing exemptions while keeping the current exemption structure.

Nevertheless, following Article 5 (1) (b) the availability of substitutes needs to be taken into account. Hence, if applicable the consultant has decided to follow the environmental NGOs' proposal in this respect.

4.1.9 Transition period / expiry date / repaired as produced

ELC [1] has stated that for exemptions on the use of mercury in lamps no expiry date is feasible:

"There is no scientific or technical evidence to prove that there is a real alternative to the application of mercury in lamps. In the past much R&D has been devoted to finding a substitute for mercury. In most, if not all, cases this led to lamps with much lower energy-efficiency (at least 10% lower). Due to this appreciably[13] lower energy efficiency, mercury-free discharge lamps have only found niche applications in the field of general lighting. At this moment in time, product design changes, aimed at substitution of mercury, should be seen as scientifically and technically impracticable."

This statement does not take into account that substitution is not only considered as replacing mercury as a substance in lamps but can also be the substitution of mercury containing lamps with other mercury-free lamps if there are no negative environmental, health and consumer safety effects (cf. discussion under section 4.1.8).

Concerning the transition period ELC has proposed 1 July 2012 as timeline for entry into force of the new Hg limit values. Environmental NGOs propose a transition period until 2010 and an expiry date by 2014.

ELC [12] has commented that "as a matter of principle, the review date of RoHS exemptions must precede their date of expiry" since otherwise there is "legal uncertainty, ban of products leaving no alternatives if the exemption review was not done on time" and "de facto ban of products if no technical solution is available." ELC therefore proposed to "have the expiry date minimum two years after a review period is concluded".

With regard to the spare parts issues, the consultant considers that there is no need for such a provision for lamps since these are applications that are usually not maintained as such. This would rather apply to the luminaire, which, however, is not subject to the exemptions for mercury content.

Conclusion

Assuming a publication of an amended RoHS Annex in the Official Journal by the end of 2009, a transition period until 1 July 2012 would mean a little more than two years of transition period. Since not all stakeholders have been involved in the process and especially category 8&9 equipment manufacturers have not foreseen the current revision as necessary to request new exemptions in the light of upcoming amendments, a two year transition period is considered necessary.

[13] "appreciably lower energy efficiency" appears to be a mistake

Even though industry does not consider an expiry date feasible, it is proposed to set the expiry date before the next revision cycle which would be approximately 2014. In principle the consultant agrees to the ELC request that the review should be finalised before the expiry date is reached.

It is considered useful to set an expiry date in order to give industry an incentive to deliver more data on mercury content in lamps put onto the EU market. As described above a lack of data availability made it difficult to evaluate what mercury limits were practicable (cf. section 4.1.5).

4.2 Exemption 1

"Mercury in compact fluorescent lamps not exceeding 5 mg per lamp"

4.2.1 Summary of contributions

ELC has provided a proposal on single capped fluorescent lamps depending on wattage, on general and special lighting purpose and on shape for smaller diameters (T4 and T5):

- General lighting purpose < 50 W: 3,5 mg;
- General lighting purpose ≥ 50 and < 150 W: 5 mg;
- General lighting with circular or square structural shape and tube diameter ≤ 17 mm (e.g. T4, T5): 7 mg;
- For special purpose: 5 mg.

In the Annex of their 15 October contribution [1] ELC has stated that single capped fluorescent lamp classification according to standard EN 60901 does not fit the current RoHS classification and that thus the wording "compact fluorescent lamp" (CFL) should not be used. Rather the CFL category should be referred to as "single capped fluorescent lamp". The following picture has been added as illustration of a subdivision by topology and cap:

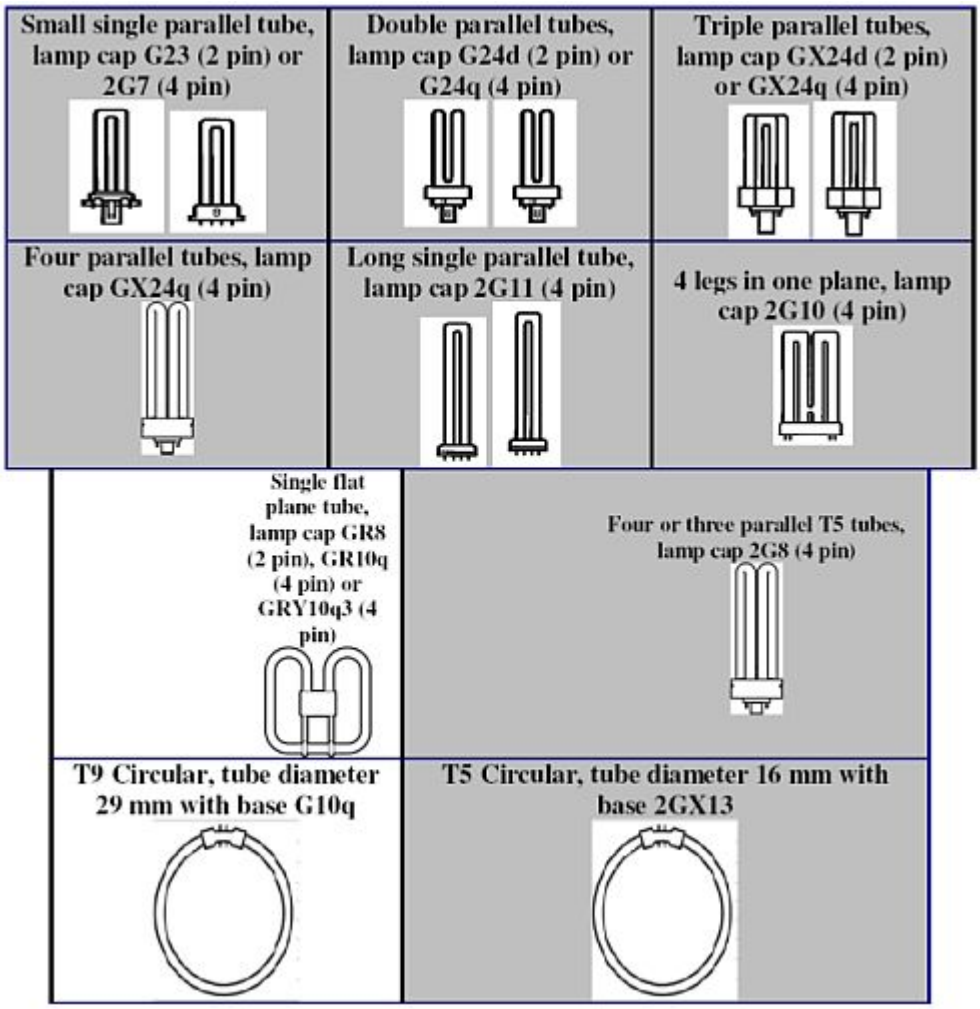

Figure 3 Overview on single capped fluorescent lamps [1]

Single capped fluorescent lamps with a wattage ≥ 150 W have not been included here since they are said to be newly entering the market without clear necessary mercury amount. ELC thus proposes to include them into another exemption with a limitation of 15 mg.

The lamp manufacturer Megaman (producing such high wattage single capped fluorescent lamps) has stated that their “Clusterlite” model cannot be considered as single-capped fluorescent lamp since they are not covered by the relevant standard (IEC 61199) and are thus currently covered by exemption 4 without any mercury limit [2].

Based on the extract of findings from the US and EU market, environmental NGOs have proposed the following limits for CFLs [3]:

- CFL for general purpose: 2 mg;
- CFL for special purpose: 3 mg.

These proposals are based on a different classification than the one provided by ELC and which is based on US technology analysis:

- CFL models that have an integrated ballast;
- CFL models that have a separate ballast.

Furthermore, environmental NGOs request their proposed values to enter into force by 2010 when the expected EU ban on incandescent lamps will take effect in order to ensure availability of low mercury CFLs. Also, they claim that ELC has not provided data to support the proposed limits.

The report on Mercury in lamps commissioned by the Swedish Chemical Agency (KEMI) [4] claims that "several source from the industry has expressed that technology is available to produce lamps with a mercury content of below 1 mg. […] A number of manufacturers declare it may be possible in the time perspective of 1-3 years to comply with a lower limit of 2 mg or even 1mg for many fluorescent and metal halide applications without significant reduction of lifetime and efficacy. For other manufacturers, which today have no access to the best technology, it may not be possible."

An additional comment sent by KEMI [5] states the following:

"The fluorescent tubes need very small amounts of mercury in the lamp to ignite and then sustain the discharge producing enough UV-photons for the light creating process. In the T5 25 W tube the specific needed amount is 0.01 to 0.05 mg mercury and it is comparatively about the same in the other tubes and CFLs. The tube also consumes mercury during life. It is mostly the glass envelope and the phosphors which absorbs mercury during the discharge. The light source companies have developed methods declining the absorptions of mercury. For example special sheltering layers have been attached on the glass and phosphors decreasing the mercury consumption. Also some problems is connected to the dosing of the mercury stuff but as we have been told the best methods here make it possible to limit the uncertainty to about 0.2 mg of mercury. Probably Philips and some other stakeholders already have the technology to delimit the necessary amount to 1 mg. Concerning the time for the new legacy 2012 it should be possible for the producers to meet the new proposals when they have three years extra from now[14]."

Under the corresponding EuP Lot 19 an indicative benchmark is given for non-directional household lamps: "the energy efficient compact fluorescent lamps with the lowest mercury content include not more than 1 mg mercury."[15] In this context the lamp mercury content is the mercury contained in the lamp and is measured according to the Annex of Commission Decision 2002/747/EC[16].

[14] I.e. until 2012

[15] Working document on a possible commission regulation implementing directive 2005/32/ec with regard to non-directional household lamps.

[16] In this regulation the mercury content is the average content of 8 lamps out of a 10 lamps sample and where the highest and lowest value have been deleted.

The EuP proposal for requirements on mercury content in CFLi lamps is included in the table below. It is the current value in the RoHS Directive for Tier 1 and on the value of the Community Decision (2002/747/EC) for Tier 2. For Tier 3, it is based on measurements made by VITO on CFLi's that are currently available on the market and confirmed by the statement of ELC at the stakeholder meeting in Brussels on 23rd November 2007 that 'a maximum of 1mg of mercury for CFLi's is possible'.[17]

Tier 1[18]	Tier 2	Tier 3	Benchmark
Hg ≤ 5,0 mg	Hg ≤ 4,0 mg	Hg ≤ 2,0 mg (or 3,0 mg if lamp life > 15000 h or 4,0 mg if lamp life > 20000 h)	Hg ≤ 1,0 mg

This is contradictory to what ELC has requested in [1]. ELC has been confronted with this contradiction and stated the following [13]:

"The wattage differentiation in the ELC contribution takes into account that high wattage CFL, which are normally not used for domestic lighting, need more mercury than those with lower wattages. […] Our ELC Working Group ET is not aware of this confirmation [referring to the above citation in the EuP report] and where the citation comes from. If this confirmation has been given, it was not correct from technical point of view. If there are really such lamps on the EU market this value addresses the average value per lamp (vs. a limit value) and does not take the variances within single mercury doses into account. Even if this value can be realized for some of the above mentioned lamp types/wattages this value can not be regarded as THE ONE general BAT regarding mercury amount […]."

4.2.2 Critical review

From the above it can be seen that many different stakeholders argue from many different point of views and that many different limit values are proposed. A comparison and the finding of a compromise are hindered due to the fact that hard fact data is lacking in most of the cases. Only environmental NGOs have done extensive data research, however not being able to trace back the specific technical requirements for the use of mercury in depth. Data provided in the context of the EuP preparatory study and forming the basis of the recommended limit values is not publicly available and can thus not be traced-back. Same accounts for the proposed limits by ELC which are not based on publicly available data. In [4] it is clearly stated that "an overall problem during this study has been to obtain unanimous

[17] Vito 2008: Lot 19: Domestic lighting, Final Task Report, Task 8: scenario- policy- impact and sensitivity analysis, October 2008.

[18] The working document includes the following dates: stage 1: 1st October 2009, Stage 2: 1st October 2011, Stage 3: 1st October 2013.

information about the situation of the mercury containing lamps on the EU market and what is reasonable to accomplish."

The overall environmental policy goal is to reduce energy consumption thus reducing GHG emissions from power generation. Energy efficient lamps can support this overall need. Even if mercury is contained in such lamps, mercury-related emissions through electricity generation are relatively higher. Scientific data has proven that mercury emissions are reduced more when the lamp itself consumes less electricity for the generation of light then when using mercury-free less efficient lamps[19].

From an overall environmental perspective it is more important to satisfy market demand and reduce mercury emissions due to electricity generation than to reduce the mercury content of the lamps themselves. It should thus be a goal of mercury limits set under RoHS not to hinder meeting the increasing market demand on energy-efficient lamps.

Concerning high wattages, long lifetime, CCFL, special purpose and non-linear CFLs (square and circular) different values have been brought forward (see above). Most of them are not supported by market data. Environmental NGOs have questioned ELC's statement that there is a correlation between lamp wattage and mercury content since their market data does not show such a correlation. However, it has to be stated that environmental NGOs have only looked at lamps up to 80 W. The correlation of long lifetime and mercury content as stated in the above EuP table is also not supported by market data.

Furthermore, ELC uses a different definition / classification than other stakeholders making a comparison between the different proposed values impossible. Also, the scope of the EuP values refers to domestic lighting only which is not necessarily equivalent to "general purpose" as used by ELC and environmental NGOs.

4.2.3 Recommendation

For general purpose CFLs a limit value of 2 mg – as proposed by environmental NGOs and by the EuP preparatory study on Lot 19 – is supported by market data. Environmental NGOs request this limit to be set by 2010, while EuP sets end 2013. However, the overall consequences on lamp market and its availability to meet increased demand are not known since currently only one lamp manufacturer is able to produce CFLs for general lighting purposes

[19] This is described as follows in [5]: "Because mercury-containing lighting is more energy efficient than conventional incandescent lighting, less energy is needed to make the required electricity, thus translating to reduced mercury emissions from coal-burning power generating plants. The amount of mercury pollution that is offset using more efficient lighting depends on the type of lamps used and the fuel mix of the power plant generating the electricity. As analysed recently at the EEB conference, June 2008, by Peter Maxson, according to the US EPA, CFL is a "drop-in" substitute for incandescent, consumes up to 75% less electricity, causes the generation of substantially less CO_2, has up to 10 times longer lifetime, is a quick return-on investment, according to some USA estimates only 11% of Hg content would be released when a CFL is landfilled, and the total Hg release may be far lower when using a CFL than when using equivalent incandescent."

with a 2 mg Hg content. Additionally, CFLs for special purposes cover a very brought range of different lamps. These lamps with different range of performances can be classified by their wattage. Hence, the contractor recommends to follow the ELC proposals based on wattage classification in order to ensure the coverage of market demands.

For CFLs for general lighting purposes with a wattage higher than 150 W a mercury limit of 15 mg is recommended, following the ELC proposal and acknowledging that in this class development of CFLs is in an early stage. However, a revision of this limit in two years is strongly suggested as these lamps are newly entering the market.

For special shape CFLs smaller or equal to T5 a limit value of 7 mg as proposed by ELC is recommended. Market data cited by environmental NGOs supports a limit value of a maximum of 8 mg for any non-linear fluorescent lamp. The 7 mg limit value is thus considered to be feasible at least for those lamps smaller or equal to T5.

Concerning special purpose lamps environmental NGOs have proposed a 3 mg limit for those lamps that have been registered as being of special purpose. ELC requests a 5 mg limit and delivers a qualitative description of what is to be considered of special purpose (cf. section 4.5.10). For both limit values comprehensible market data is missing. It is recommended to request from manufacturers to clearly identify special purpose lamps together with a justification on why they cannot be covered by any of the existing limit values and to deliver according market data in order to allow setting an appropriate limit value.

Recommended wording exemption 1:

Mercury in single capped fluorescent lamps not exceeding (per burner[20])

- *For general lighting purposes < 50W: 3,5 mg*
  For general lighting purposes ≥ 50W and < 150: 5 mg
  For general lighting purposes > 150W: 15 mg
- *For general lighting purposes with circular or square structural shape and tube diameter ≤ 17 mm: 7 mg*
- *For special purposes: 5 mg*

As the development of the market and of the technology for CFLs for general lighting purposes >150W within the next years is especially difficult to assess, a revision of the Hg limit value two years after publication is recommended (31. December 2012).

For all other lamps covered by exemption 1 “Mercury in compact fluorescent lamps“ the 31 July 2014 is recommended as expiry date. Furthermore, the contractor recommends notifications for special purpose CFLs in order to collect data and information for future revisions of the Annex.

[20] This has been added by ELC in [12] and is explained as follows: “In case of one lamp containing more discharge vessels / burners (meaning the light giving unit, not yet assembled into a final product). […] E.g. so-called 3-way lamps, where 2 fluorescent discharge vessels are contained in one lamp.”

4.3 Exemption 2

The current wording of the exemption is:

"Mercury in straight fluorescent lamps for general purposes not exceeding: halophosphate 10 mg, triphosphate with normal lifetime 5 mg, triphosphate with long lifetime 8 mg".

The contractor recommends the subdivision into two parts of the current exemption:

2a covers double-capped linear fluorescent lamps for general purposes;

2b covers halophosphates, non-linear tri-band phosphor lamps and induction lamps.

4.3.1 Summary of contributions for new exemption 2a

In its 15 October contribution [1] ELC states that linear fluorescent lamps are referred to as "double capped" and sub-divided by diameter. The limits that ELC proposes are:

- Tri-band phosphor with normal lifetime and a tube diameter of < 9 mm (e.g. T2 lamps): 4 mg;
- Tri-band phosphor with normal lifetime and a tube diameter of > 9 and ≤ 17 mm (e.g. T5 lamps): 3 mg;
- Tri-band phosphor with normal lifetime and a tube diameter of > 17 mm and ≤ 28 mm (e.g. T8 lamps): 3,5 mg;
- Tri-band phosphor with normal lifetime and a tube diameter of > 28 mm (e.g. T10, T12 lamps): 5 mg;
- Tri-band phosphor with long lifetime[21]: 5 mg.

According to ELC double-capped lamps with a smaller diameter (e.g. T2 lamps) need slightly more mercury than T5 lamps. This correlation is explained by one lamp manufacturer as follows:

"The diameter of T2 lamps is much smaller than for T5, so that a different mercury dosing technology is necessary due to size restrictions. Mercury in T2 lamps is applied with dispensers, so called "flags" while T5 lamps have a "roof" construction mercury dispenser. The small distance between electrode and glass tube leads to impurities of the phosphor during operation originating from electrode material. These impurities lead to higher mercury "consumption" in our lamps. There is no room to "shield" the phosphor with construction elements like in T8 lamps."

[21] Long lifetime is defined as ≥ 25.000 where the installed luminous flux (lamp survival in % times lamp luminous flux in % or service life) is higher than 80% at 25.000 hours with an electronic ballast using the standardised 3 hour cycle.

Furthermore, ELC explains [1] that the Hg content of fluorescent lamps depends on the dosing technology used by the manufacturer. For T5 currently only one manufacturer is producing these lamps with 2 mg Hg content. It appears rather probable that a change-over within the production process which meets the market demands will take several years.

Environmental NGOs [3] state that instead of using diameter-defined classifications, usual denominations such as T5, T8 etc. should be used. In their data research they have looked at different kinds of linear fluorescent lamps but not at T2 lamp mercury content. The NGO proposal is as follows:

- Tri-band phosphor normal lifetime ≤ T5: 2 mg;
- Tri-band phosphor normal lifetime T8 < 6 foot[22]: 2 mg;
- Tri-band phosphor normal lifetime T8 > 6 foot: 8 mg;
- Tri-band phosphor normal lifetime > T8: 0 mg;
- Tri-band phosphor long lifetime[23]: 3 mg.

Environmental NGOs [3] claim that data they have found rather lies in the area of a 1,5 mg. Assuming a 10% tolerance, they conclude that a 2 mg should be able to be met for both T5 and T8. Also they argue that ELC has not provided any evidence on the fact that mercury is the limiting factor for long lifetime. However, the need for a higher mercury content in long life lamps can technically be explained: during the lifetime of the lamps mercury is consumed because it is deposited or bonded to the glass and the phosphor layer (detailed explanation see 4.1.4).

The Swedish study comes to the conclusion that “also for long lifetime lamps, low amounts of mercury is available […]. 1 mg should be reasonable limit in a proper time perspective” [4].

4.3.2 Critical review for exemption 2a

Here again, just as with the case of compact fluorescent lamps, a detailed market research would be needed in order to better compare the existing mercury limit proposals. This is especially valid for T2 and lamps bigger than T8.

However, as explained above, the mercury dosing technology for T2 differs and the argumentation can be followed. Therefore, the contractor recommends a 4 mg mercury limit for T2 lamps. For T5 lamps a 3 mg mercury limit is recommended since otherwise the market possibly can not be supplied as explained above.

For T8 lamps environmental NGOs propose two mercury limits according to the length of the lamp. Since lamps longer than 6 foot (>183 cm) do not exist on the European market no

[22] corresponds to approximately 245 cm

[23] > 25.000 h, 3 h starts

exemptions for those lamps is needed. For T8 ≤ 6 foot the NGO proposal is based on one manufacturer having developed a technology to produce these lamps with a 2 mg mercury content. Again, it is unsure whether this manufacturer alone can meet the market demands in case the NGO proposal would be followed. ELC proposes a 3,5 mg mercury content which allows more manufacturers to supply the market. Given the current situation, the contractor therefore recommends to follow the ELC proposal. Additionally, the contractor indicates that currently it is technically not advisable to replace T8 lamps with T5 lamp, as there are reasonable concerns regarding the safety of adapters being necessary to adopt T5 lamps in existing .installation [17].

For lamps bigger than T8 (T10 and T12) environmental NGOs have requested 0 mg limit and ELC has requested 5 mg. Both proposals are not based on specific technical arguments. These lamps are considered as phase-out models and the market is relatively small. Moreover, these lamps can be replaced by T8 lamps. Therefore, a mercury limit of 3,5 mg - as for T8 lamps - is recommended in order to accelerate the phase out of T10 and T12 lamps.

Concerning tri-band phosphor with long lifetime the contractor recommends to follow the proposal of ELC as for technical reasons long lifetime lamps need a higher mercury content. However, it is also recommended to define a European standard for long life (e.g. 25 000h or 30 000h lifetime) including a cycling standard.

4.3.3 Recommendation for exemption 2a

Taking available proposals into account and the support given by market data, the following wording is proposed:

Mercury in double-capped linear fluorescent lamps for general purposes not exceeding

- *Tri-band phosphor with normal lifetime T2: 4 mg*
- *Tri-band phosphor with normal lifetime > T2 and ≤ T5: 3 mg*
- *Tri-band phosphor with normal lifetime > T5 and ≤ T8 and < 183 cm: 3,5 mg*
- *Tri-band phosphor with normal lifetime > T8 and ≤ T12: 3,5 mg*
- *Tri-band phosphor with long lifetime: 5 mg*

The contractor recommends setting the 31 July 2014 as expiry date.

4.3.4 Halophosphates (exemption 2b)

Concerning halophosphates the corresponding EuP process comes to the following conclusion:

“It is recommended to set limits on the lamp mercury (Hg) content. According to information, provided by industry, it is not possible to produce halophosphate lamps with less than 10mg Hg. As a consequence, halophosphate fluorescent lamps could be excluded from the market by repealing in the RoHS-directive the exemption that was made on the mercury content of 10mg for certain fluorescent lamps. The maximum mercury content should be limited at an

absolute maximum of 8 mg instead of 10 mg. Also imposing that the lamp lumen maintenance factor (LLMF) should meet at least the values listed in Table 100 would exclude halophosphate lamps from the market."[24]

Based on this, the environmental NGOs [3] have requested to adopt the proposed limit value for all halophosphate lamps (linear ones and also circular and u-bent ones). Environmental NGOs believe that halophosphates will be phased-out under EuP implementing measure on tertiary lighting for efficiency reasons and that the high mercury content should be a further reason to phase them out faster.

The Swedish study commissioned by KEMI [4] comes to the conclusion that "halophosphate lamps are generally exchangeable for triphosphor lamps."

In its October contribution [1] ELC proposes 10 mg mercury for Halophosphate phosphor lamps. However, some manufacturers can already produce these lamps with 8 mg mercury.

4.3.5 Other non-linear fluorescent lamps (exemption 2b)

Other non-linear fluorescent lamps (those not covered by exemption 1 and 2) have been requested the following values:

- ELC [1]: non-linear structural shape (e.g. circular (e.g. T9), U-bent, induction lamps): 15 mg;
- Environmental NGOs [3]: non-linear tri-band phosphor lamps: 8 mg;
- Environmental NGOs [3]: induction lamps: 7 mg.

4.3.6 Critical review for exemption 2b

Considering that halophosphates are low-efficiency and high-mercury containing lamps there is an agreement on environmental policy level that these should be phased-out. Taking into consideration that EuP addresses energy efficiency aspects and will regulate the phase-out under these considerations, RoHS needs to – in accordance with Article 5 (1) (b) – allow an exemption for the use of mercury in halophosphates only if there are no practicable substitutes. Since – as the Swedish study states – halophosphates can be retrofitted with tri-band phosphor lamps substitutes are available. There is no information whether this is valid for all shapes. Furthermore, since the EuP process came to the conclusion that a limit of 8 mg should be set for halophosphates which is supported by environmental NGOs, it is recommended to set such a limit for all halophosphate lamps which would lead to a phase-out just as the EuP lumen maintenance factor does. Additionally, as halophosphate lamps with 8 mg mercury content can already be produced in a way that the market demand is met, the lower mercury value seems feasible.

[24] Vito 2007: Final Report Lot 8: Office lighting; April 2007

For non-linear tri-band phosphor lamps the contractor recommends to distinguish between T5 and T9 lamps. Since T9 lamps can not be replaced by T5 lamps, which have a lower mercury content, and T9 lamps are still needed, the ELC proposal for these lamps is followed. For T5 lamps the environmental NGO proposal seems feasible.

"Induction lamps" include a wide spectrum of different lamps. Since the NGO proposal of 7 mg is probably based on the BAT value of only one specific induction lamp type, the contractor recommends to follow the ELC proposal in order not hinder meeting the market demand.

4.3.7 Recommendation for exemption 2b

The recommended wording for exemption 3 would thus be:

Mercury in other fluorescent lamps not exceeding
- *Halophosphates all shapes: 8 mg*
- *T5 non-linear tri-band phosphor lamps: 8 mg*
- *T9 non-linear tri-band phosphor lamps: 15 mg*
- *Induction lamps: 15 mg*

As expiry date the contractor recommends 31 July 2014.

4.4 Exemption 3

The current wording of the exemption is

"Mercury in straight fluorescent lamps for special purposes".

Taking into account that the contractor adjusted the lamp classification compared to the current RoHS Annex, this exemption therefore only covers **"Mercury in cold cathode fluorescent lamps (CCFLs)"**.

CCFLs are used as backlight lamps in displays as well as in scanners and projectors. Currently, for some applications, mercury-free alternatives using LED are available. Although there is no sound hard fact based scientific analysis available, environmental NGOs and the authors of the Swedish study claim that LED-based backlights are a valid substitute for CCFLs [3] [4].

ELC [1] and JELMA [14] have proposed the following limit values for CCFLs:

1. mercury in short length (not over 500 mm) cold cathode fluorescent lamps and external electrode fluorescent lamps (CCFL and EEFL) not exceeding 3.5 mg per lamp;

2. mercury in medium length (over 500 mm and not over 1500 mm) cold cathode fluorescent lamps and external electrode fluorescent lamps (CCFL and EEFL) not exceeding 5 mg per lamp;
3. mercury in long length (over 1500 mm) cold cathode fluorescent lamps and external electrode fluorescent lamps (CCFL and EEFL) not exceeding 13 mg per lamp;

It is important to note that JELMA requests the explicit mentioning of EEFLs (they are a type of CCFL) and that upon request of the consultant JELMA has proposed a limit value for CCFLs and EEFLs bigger than 1.500 mm (which was not taken into account by ELC in its proposal since the JELMA input was given after the last stakeholder meeting). Lamps of these dimensions are currently under development and a mercury threshold value was difficult to determine since the maximum length of the lamps is not yet known. Nevertheless, JELMA has proposed 13 mg as limit value.

AeA [16] and EICTA [15] have both requested a limit value of 5 mg – independently what length the lamps have.

Environmental NGOs request a limit value of 2 mg for CCFLs. They justify the 2 mg limit due to the fact that CCFLs should be considered as linear fluorescent lamps and should thus be given the same limit. NGOs further suggest that given the recent developments laptop computer and LCD screens should be mercury free by 2012.

The Swedish study comes to the conclusion that LED are “already been used some time in small displays but are successively introduced in larger displays. LCDs with LED are already available, especially for notebooks with small (13 inches) displays.” Environmental NGOs confirm that “very recently Dell has announced that all new laptops will be 100 percent mercury-free by October 2009. […] Soon after Dell, HP announced that by 2010 their laptops will be mercury-free.” They thus request that exemptions under RoHS should not be valid for these areas of application by 2012 at the latest.

For other areas of application (such as commercial signs / neon signs, exit signs and scanning devices), the Swedish study comes to the conclusion that there are also mercury-free alternatives existing.

4.4.1 Critical review

In the case of CCFLs no reliable market data is available. The industry proposal on limit values has been well justified on a qualitative level. Currently, no limit is set at all for these types of lamps. At this point of time it cannot be evaluated whether a 2 mg limit would be feasible for all CCFLs and no data has been provided either to support this request.

Penetration of LED as a substitute technology is taking place independently of RoHS exemptions. It is mercury-free but no evidence has been provided whether there are or not environmental drawbacks associated with this technology when used as a substitute.

Currently it is unclear whether the announced introduction of LED-based backlights in displays will be successful on the market. Furthermore, until now there seems to be no reliable data and information available on the environmental impacts of LED-based lamps compared to current lighting applications (e.g. energy needed for production, efficacy, lifetime, etc.) on a life-cycle based approach. Therefore, the consultant recommends to observe the further technological development and to review the applicability of this technology by 31.12.2012.

4.4.2 Recommendation

Concluding on the above the recommended wording would thus be:

- *Mercury in short length (not over 500 mm) cold cathode fluorescent lamps and external electrode fluorescent lamps (CCFL and EEFL) not exceeding 3,5 mg per lamp until 31.12.2012;*
- *Mercury in medium length (over 500mm and not over 1500 mm) cold cathode fluorescent lamps and external electrode fluorescent lamps (CCFL and EEFL) not exceeding 5 mg per lamp until 31.12.2012;*
- *Mercury in long length (over 1500 mm) cold cathode fluorescent lamps and external electrode fluorescent lamps (CCFL and EEFL) not exceeding 13 mg per lamp until 31.12.2012.*

Since for the application of CCFLs in the different areas of application substitute technology like LED-based backlights is already available, but without reliable data on the environmental impacts, it is recommended to restrict the exemption in time and to review the applicability of the new technologies by 31.12.2012.

Mercury in long length (over 1500 mm) cold cathode fluorescent lamps and external electrode fluorescent lamps (CCFL and EEFL) are not yet in development. In order to give industry legal guarantees for future developments, a limit value for this type of lamps is recommended by the consultant. The consultant, however, proposes a notification process for these lamps to collect data and information for future revisions of the Directive.

4.5 Exemption 4

The current wording of this exemption is:

“Mercury in other lamps not specifically mentioned in this Annex”.

The contractor recommends the subdivision into two parts of the current exemption:

4a covers “Mercury in High Intensity Discharge Lamps”

4b covers “Mercury in other discharge lamps for special purposes not specifically mentioned in this Annex”.

ELC has stated in their 15 October contribution [1] that "mercury limits in High Intensity Discharge Lamps are only feasible and justified for the specific case of High Pressure Sodium Lamps."

4.5.1 High Pressure Sodium (Vapour) discharge Lamps (HPS) (4a-I)

Concerning mercury content in HPS lamps, ELC states the following in [1]:

"Mercury and sodium are usually overdosed in HPS lamps. […] In Europe, R&D efforts are devoted to an optimization of the efficacy. […] In order to realise this a certain dose of mercury is required. There is a risk that reduction of this dose leads to a shorter life of these products. […] Because of the higher operating temperature of low wattage and improved CRI lamps, they require relatively higher mercury contents."

Based on this argumentation the following values are proposed:

Mercury in High Pressure Sodium (vapour) lamps for general lighting purposes:

- not exceeding in lamps with improved colour rendering index > 60
  - P ≤ 155 W: 30 mg per burner;
  - 155 < P ≤ 405 W: 40 mg per burner;
  - P > 405 W: 40 mg per burner;
- not exceeding in other High Pressure Sodium (vapour) lamps
  - P ≤ 155 W: 25 mg per burner;
  - 155 < P ≤ 405 W: 30 mg per burner;
  - P > 405 W: 40 mg per burner.

ELC further on states that HPS lamps "cannot be exchanged by other technologies without having to change the fixture or to accept major changes like colour spectrum."

The proposed limit values are not supported by any data delivered by ELC.

Environmental NGOs on the other hand argue in [3] that setting such limits for HPS lamps is already an improvement compared to the current complete exemption but that mercury limits should be put on all HID lamps. Concerning HPS, they state the following:

"We understand that, as with other HIDs, the mercury content of HPS lamps tends to increase with wattage. We also understand that specialty HPS lamps – such as models that have a high colour rendering index, which enable them to deliver a white (rather than yellow) light – may require a higher mercury content and are justified because they offer safety improvements. […] According to data provided by the US lamp manufacturers Philips, Sylvania and GE, HPS lamps (with a typical CRI in the 20s) can meet much lower mercury levels than those proposed by the ELC […].The only models that we have seen with substantially higher mercury content are dual arc models (i.e., those with two burners). […] We understand that those types of HPS lamps […] need to have a higher mercury content." Nevertheless,

environmental NGOs propose to set the ELC limits for low CRI models for these dual arc models since this is supported by their data research.

Furthermore, they state the following:

"Rather than watering down the single-burner HPS lamps for which substantial progress has been made to develop models with very low mercury content (which are offered by three major lamp manufacturers), this type of HPS lamp should be evaluated separately and given its own limits. Consequently we don't support that low CRI single burner models should fall under the proposed ELC limits, and we propose lower separate limits for these latter models.

So for low CRI single burner models we would propose:

- P ≤ 155 W: 5 mg;
- 155 < P ≤ 405 W: 10 mg;
- P > 405 W: 25 mg".

With regard to high CRI models, environmental NGOs state that "Our limited data on high-CRI HPS lamps shows that the mercury limits proposed by the ELC (30 mg for lamps <155 watts) may also be high. […] More data is needed on this lamp type to set a limit that reflects the upper end of the market."

Limits proposed by NGOs are mainly based on data from the US market where HPS lamps can meet much lower mercury levels that those proposed by ELC. NGOs state that "the use of US HPS data seems applicable to this product category." In contrast ELC argues that US "lamps have a lower efficacy than the latest generation of European lamps. In Europe, R&D efforts are devoted to an optimization of the efficacy. This is the reason why in the US one can find HPS lamps with a lower mercury dose. In Europe, HPS lamps with lower energy efficiency ("standard" types and mercury-free types) will be prohibited after 2012 (EuP IM). European HPS lamps are the most energy efficient in the world. In order to realize this efficacy a certain dose of mercury is required. There is risk that reduction of this dose leads to shorter life of these products. The amount of overdosing in European lamps is determined by the rate at which sodium is lost from the discharge. In modern processing and technology this rate can be limited. Therefore, the lamp industry is prepared to accept maximum limits for the amount of Hg in HPS lamps and proposes the values given above. Because of the higher operating temperature of low wattage and improved CRI lamps, they require relatively higher mercury contents".

The following comparison of some EU and US lamps was provided by one European lamp manufacturer supporting their argument that EU lamps are more energy efficient by which higher Hg are justified:

Hg content	Phi	Lamp-type EU	PL	Lamp-type US	Phi	Hg content
[mg] max	[1000 lm]	NAV-	[W]	LU	[1000 lm]	[mg]
21.2 (average)	6.6	-T Super 4Y	70	LU Plus (non cycling	6.3	0.90
	10.7	-T Super 4Y	100	LU Plus (non cycling	9.8	0.90
20.4 (average)	17.5	-T Super 4Y	150	LU Plus (non cycling	16.0	1.81
	33.2	-T Super 4Y	250	LU Plus (non cycling	29.0	2.95
	56.4	-T Super 4Y	400	LU Plus (non cycling	50.0	2.95

The Swedish study [4] concludes that “due to colour rendering and mercury content this light source is no longer being further developed. […] adapters make it possible to change light source to metal halides which improves colour rendering.”

4.5.2 Critical review (4a-l)

There is agreement among stakeholders that there are high and low CRI HPS lamps as well as single and double burner HPS lamps. Data on mercury content is only available for double-burner low CRI HPS lamps as well as single-burner low CRI HPS lamps. There is neither enough data on high CRI HPS lamps nor on the fact whether these are single or double-burner.

Data have been provided by one lamp manufacturer indicating that lower Hg levels in HPS lamps (as can be found in US lamps) result in efficacy losses of about 5-10%. This lower energy efficiency is not in line with the EuP Implementing Measures. According to EuP IM, HPS lamps with lower energy efficiency will be prohibited after 2012.

Substitution with other lamp technologies seems to be technically feasible but leads to changes in colour rendering and there is no information on whether this is beneficial in total.

4.5.3 Recommendation (4a-I)

Concluding from the above it is recommended to take over the limit values as proposed by ELC. The recommended wording is thus:

Mercury in High Pressure Sodium (vapour) lamps for general lighting purposes
not exceeding in lamps with improved colour rendering index > 60
- *– P ≤ 155 W: 30 mg per burner*
- *– 155 < P ≤ 405 W: 40 mg per burner*
- *– P > 405 W: 40 mg per burner*

not exceeding in other High Pressure Sodium (vapour) lamps
- *– P ≤ 155 W: 25 mg per burner*
- *– 155 < P ≤ 405 W: 30 mg per burner*
- *– P > 405 W: 40 mg per burner*

As expiry date the contractor recommends 31 July 2014.

4.5.4 High Pressure Mercury (Vapour) lamps (HPMV) (4a-II)

In HPMVs, the mercury in the discharge tube generates the light and provides the required electrical resistance. The mercury is completely evaporated under normal operating conditions. In its 15 contribution [1] ELC states that “reduction of the amount of mercury always leads to sub-optimal performance. The lamp dimensions and pressures are optimized for maximum efficacy at the existing gear. Hence if the discharge tube dimensions were to be changed to allow for a lower Hg content at the same voltage, then the luminous efficacy would be sub-optimal. For these reasons the position of the ELC is that a mercury limit for HPMV lamps is not possible.”

Environmental NGOs state in their contribution [3] that HPMV lamps can be replaced by more efficient and less mercury containing HPS lamps and there is thus no justification to continue an exemption for these types of lamps. HPS lamps are available as retrofit kits as has been the result of NGOs’ research. With regard to specialty lamps that might require higher mercury contents, environmental NGOs request that those lamps be labelled accordingly and granted an exemption under a separate heading for “lamps for special purposes”.

The corresponding EuP activities came to the following conclusion:

“The proposed ecodesign requirement is to set minimum efficacy targets for street lighting lamps or for 'all' lighting applications so that HPM lamps are actually banned and HPS retrofits are used instead of them in installed luminaires. Even self ballasted (mixed light) HPM lamps could be excluded, because these can be replaced by CFL’s with integrated ballast.”[25]

[25] Vito 2007: Final Report Lot 9: Public street lighting, January 2007

With regard to retrofit HPS lamps, ELC states that “HPMVs can not generally be substituted by retrofit HPS lamps. This is only the case for certain applications, and only where colour rendering is not an essential requirement. Substitution is not at all possible for technical lamps like for example HBO lamps”.

According to the lamp industry, recycling rates for HPMV lamps used in special applications are high as these speciality lamps are only applied by professional users. Data supporting the high recycling rates have, however, not been provided.

The Swedish study [4] comes to the conclusions that HPMV lamps have “low price, but a considerable higher amount of mercury and are now being replaced by metal halides and linear fluorescent lamps.”

4.5.5 Critical review (4a-II)

Three different sources indicate that retrofit technologies are available for HPMV lamps used in general lighting. According to the criteria laid down in Article 5 (1) (b) this means that substitutes are available and that there is thus no justification for an exemption. There is no information available whether these substitutes have negative effects in the sense of Article 5 (1) (b).

For technical lamps that are used in special applications (e.g. in the production of semiconductors) a substitution of HPMV lamps by retrofit HPS lamps is not possible up to now.

4.5.6 Recommendation (4a-II)

Concluding on the above the following wording is recommended:

Mercury in High Pressure Mercury (Vapour) lamps except for general lighting (HPMV).

The consultant, however, proposes a notification process for those exempted special purpose HPMV lamps to collect data and information for future revisions of the Directive. As expiry date the contractor recommends 31 July 2014.

4.5.7 Metal halide lamps (MH) (4a-III)

In MH lamps, the mercury in the discharge tube generates only a minor part of the light. Its major role is to provide the required electrical resistance. The mercury is completely evaporated under normal operating conditions. MH lamps come in an enormous variety of shapes, caps, colour temperatures, colour rendering and wattages depending on the specific application. ELC states in its contribution [1]: “In all MH lamps, the amount of mercury dosed is such that the target lamp voltage is reached. Either over- or under dosing brings the lamp out of

electrical specification. The only way to reduce the Hg content and still reach the required lamp voltage is a change in discharge tube dimensions. This however inevitably brings the lamp out of its photometric specification. For these reasons the position of the ELC is that imposing mercury limits for Metal Halide lamps is not feasible and not justified."

One lamp manufacturer provided the following overview on Hg levels in their MH lamps:

MH with ceramic burner: HCI lamps (max values)

Wattages	Mercury content
20 W	< 4 mg Hg
35 W	< 5.5 mg Hg
70 W	< 8.5 mg Hg
100 W	< 9.5 mg Hg
150 W	< 17.5 mg Hg
250 W	< 27.5 mg Hg

MH with quartz burner: HQI lamps

Wattages	Mercury content
70 W	< 19 mg Hg
150 W	< 26 mg Hg
250 W	< 33 mg Hg

Environmental NGOs in [3] state that "Metal halide (MH) lighting technology, like fluorescent lighting technology, has improved over time with respect to energy efficiency, rated life and mercury content. […] metal halide lamps can be divided into conventional standard MH models […] and more advanced metal halide pulse start technology (which includes ceramic metal halides). Standard metal halides not only have more mercury than pulse start metal halides, they also are less efficient and have a shorter lamp life. The Commission can help hasten the transition to more efficient, lower-mercury metal halides by establishing limits that this BAT can meet. It is important to note that all of the major manufacturers offer lines of these lower-mercury, energy-efficient metal halides; therefore, the availability of these technologies are widespread." Based on their data research they propose the following limit values:

Wattages	Proposed Mercury Limit
<25	2.5 mg
>25 <100	10 mg
>100 <200	15 mg
>200 <400	25 mg
>400	No limit

The Swedish study [4] comes to the conclusion that for "metal halide, which is a developing technology with many advantages, mercury content is decreasing. […] Regarding the metal halides there seems to be a good possibility to reduce the mercury content below 1 mg."

4.5.8 Critical review (4a-III)

Due to the fact that the function of mercury in the discharge tubes is to provide the required electrical resistance, it is only dosed in such concentrations that the target lamp voltage is reached. Either over- or under dosing brings the lamp out of electrical specification. Therefore, a misuse of mercury can be excluded.

A differentiation of limit values on basis of the wattages of MH lamps seems impracticable due to large variety of MH lamps: both MH lamps with quartz and ceramic burners are offered with different wattages, and each lamp type is produced with specific mercury contents.

4.5.9 Recommendation (4a-III)

Concluding on the above the recommended wording would thus be:

Mercury in Metal halide lamps (MH).

The consultant, however, proposes a notification process for those exempted special purpose HPMV lamps to collect data and information for future revisions of the Directive. As expiry date the contractor recommends 31 July 2014.

4.5.10 Exemption 4b "Mercury in other discharge lamps for special purposes not specifically mentioned in this Annex"

Since there is a huge variety of lamps, probably not all lamps are covered by the above proposed exemptions. ELC requests an exemption for "mercury in other discharge lamps not specifically mentioned in this Annex" and justifies it as follows [1]: "The ELC believes that this exemption is absolutely necessary and justified due to the fact, that discharge lamps today need mercury for the generation of energy efficient light. Mercury limits in other than fluorescent and High Pressure Sodium (vapour) lamps would severely limit the development of new, better light sources in the future, if slightly more mercury would be necessary than allowed by an ambitious exemption.

Other discharge lamps include:

- Low or medium pressure mercury lamps for special purposes, like Hollow Cathode Lamps and pen-ray lamps
- High Pressure Sodium lamps for special purposes
- High Pressure Xenon lamps
- Projector lamps etc.

The ELC is also aware of the fact, that numerous very special lamps from other manufacturers, importers, equipment producers exist with small market shares for very special applications, that might be in the scope of RoHS. A narrow wording would exclude such lamps from the market making fixtures like measurement equipment unusable."

Environmental NGOs [3] are in favour of further exemptions for special purpose lamps if there is a justified need. They request individual identification of such special purposes lamps and a maximum limit of 10 mg. For any higher mercury content they propose prior approval.

ELC has in [1] provided a definition of special purpose lamps:

"Lamps for special purposes are needed where application specific characteristics are prescribed. They generally have the following characteristics:

- Special purpose lamps are manufactured basically in accordance with a general-purpose lamp making technology.
- The use of special design, materials and process steps provide their special features.

Fluorescent and other discharge lamps for special purposes include for instance:

- Where the non-visible radiation has highest importance, including:
  - Black light lamps;
  - Disinfection lamps;
  - Medical/Therapy lamps;
  - Lamps designed for UV emission like sun tanning lamps;
  - Pet care lamps i.e. aquaria lamps.
- Where different looking lamp designs are relevant for use, including:
  - Long length lamps (length ≥ 1800 mm);
  - Lamps with special components like integrated reflectors or with external ignition strip;
  - Lamps with special ignition features for example those designed for low temperatures.
- Where different applications require specific lamps, including:
  - Technical lamps for colour comparison;
  - Coloured lamps (incl. saturated colours);

– Lighting applications for food, such as bakeries etc.;
– Lamps used in horticultural lighting;
– Lamps designed for eye-sensitivity of birds and other animals".

Environmental NGOs argue that there is no justification why such lamps would need a blanket exemption.

The Swedish study [4] has come to the conclusion that lamps for special purpose are estimated to have a small market relevance in comparison to other lamps discussed above.

As stated in section 4.1.3 also lamps belonging to category 8&9 would fall under this heading.

4.5.11 Critical review exemption 4b

Since in the ELC examples of lamps that could fall under a potential "miscellaneous" exemption most are of special purpose it appears to be a good approach to provide a general exemption for such types of lamps (this would also include e.g. high-wattage CFLs that are not used for general purposes). Over-regulating these types of lamps may not lead to environmental benefits since their market relevance is considered to be low. However, as the proposed definition is a non-exhaustive list and since there is no data available on such lamps and their mercury content, manufacturers should be requested to clearly identify such lamps when put on the market as "for special purpose" and at the same time disclose the maximum mercury content in a notification process in order to collect data and information for future revisions of the Directive.

4.5.12 Recommendation exemption 4b

Concluding on the above it is recommended to grant an exemption for lamps for special purposes. The recommended wording is thus:

Mercury in other discharge lamps for special purpose not specifically mentioned in this Annex.

The consultant, however, recommends a notification process for those exempted special purpose lamps to collect data and information for future revisions of the Directive. As expiry date the contractor recommends 31 July 2014.

4.6 General recommendation

Environmental NGOs [3] as well as the Swedish study [4] have requested that manufacturers should disclose the maximum mercury content of all mercury-containing lamps and lighting equipment sold in the EU and mark their products accordingly. Environmental NGOs

furthermore recommend to require information on the dosing method used as well as on the margins / accuracy of dosing.

This is not part of the RoHS exemption process as such but could be a valuable prerequisite for future evaluations and revisions.

4.7 References

[1] ELC contribution to Öko-Institut regarding RoHS exemptions 1-4 review (follow-up after the stakeholder meeting on 24 September 2008 in Brussels); 15.10.2008

[2] Megaman: Follow-up input stakeholder meeting 24 September 2008; 28/9/2008 ("Megaman_Clusterlite Classification_28.09.2008.ppt")

[3] Revised Environmental NGOs Response to Stakeholder consultation on mercury-containing lamps (EEB, Zero Mercury Campaign, Green Purchasing Institute); 10.11.2008

[4] AF-Consult AB: Mercury in lamps – reviewing the RoHS exemptions; report commissioned by the Swedish Chemicals Agency (KEMI); Stockholm, 3.10.2008 ("Final Mercury Report 081003.pdf")

[5] KEMI: Additional comment provided on 11/11/2008 ("Comments Kemi Hg in lamps_11.11.2008.doc")

[6] ERA-Report 2004; Dr. Paul Goodman et al.: Technical adaptation under Directive 2002/95/EC (RoHS) – Investigation of exemptions; final report Dec. 2004; Document "ERA Report 2004-0603.pdf"

[7] JBCE / Hamamatsu; input as follow-up of stakeholder meeting on 10 June 2008; 4 July 2008 ("JBCE RoHS exemption No4_Follow-up_Document draft 3.pdf")

[8] Goodman, Paul: review of Directive 2002/95/EC (RoHS) Categories 8 and 9; final report, 19 September 2006

[9] ERA: stakeholder input concerning mercury in lamps used in the medical sectors; 16 June 2008 ("RoHS exemption 3 technical information final.pdf" and "RoHS exemption 4 technical information final.pdf")

[10] Test&Measurement Coalition: stakeholder input from 1 April 2008 ("Exemption-1_Test-Measurement-Coalition_31_March_2008.pdf")

[11] JBCE: Comments for RoHS " Exemption 1-4 "Mercury in lamp" – Proposal for discussion " for Stakeholder Meeting on 24 September, 2008. 23 September 2008 ("JBCE comments for exemprion1-4 Stakeholder Meeting_final.pdf")

[12] ELC comments to draft recommendation; 10.11.2008 ("Draft rec exemptions 1-4_8 including ELC comments 081106.doc")

[13] ELC reaction with regard to proposed 1 mg limit value for CFL; 18.11.2008 ("ELC reaction EuP 1mg.msg")

[14] Proposal on CCFL & EEFL from JELMA; 19 September 2008 ("Material for the stakeh meeting on 24th Sep.-JELMA.ppt" updated by "2008-10-15 JELMA Proposal for CCFLs.ppt")

[15] EICTA Position on Exemptions 1-4 "Mercury in lamps"; 23 September 2008 ("EICTA Position on Exemption 1-4 23rd September 2008.pdf")

[16] AeA position on exemptions 1-4; 23 September 2008 (e-mail from 23.09.2008 11:31)

[17] LIF Lighting Industry Federation; Technical statement No. 41 "T5 Lamp Adaptors for T8 Luminaires: Do they ensure energy saving and conformance with relevant standards and legislation?"(2007)

4.8 Exemption No. 5

"Lead in glass of cathode ray tubes, electronic components and fluorescent tubes"

4.8.1 General approach

The current exemption covers three fields of applications with quite different requirements. Therefore this exemption will be described in the following sections for each field of application separately.

4.8.1.1 Lead in glass of cathode ray tubes

Due to the basic functionality, in CRT displays electrons are accelerate toward a luminescent material deposited at the front panel. As the decelerating electrons produce radiation, lead as lead oxide is added to the glass matrix in CRTs to act as a shield against radiation. Thus lead as lead-oxide in the glass matrix is used due the ability to absorb gamma rays and other forms of harmful radiation. Furthermore lead oxide is used as sealing frit between funnel, panel and nec glass.

During stakeholder consultation and in the follow-up process, several contributions were received covering this field of application [5], [15], [16]. All of them agree that lead in the cone glass were the only effective method to shield x-rays emanated from the electron beam in CRTs. Only in the front glass barium could be used [5]. This position corresponds to descriptions available in literature.

Basically one could object that meanwhile other display technologies are available, notably LCD and PDP and that therefore substitution at a system level would be feasible. However, there are applications where the specific functionality of CRTs is superior to the new technologies, especially in the case of low and high ambient temperatures [17] as well when fast