Second Meeting of the Sub-Committee on Standards and Conformance (SCSC)

Agenda Item Number 6 (a)

Discussion paper entitled "Environmental regulations on the electrical and electronic equipment by European Union (EU)" **for the promotion of active participation and cooperation in the international standardization activities by the APEC member economies**

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Desired Outcome: For Information	
Recommendations: Members are encouraged to provide input to the dialogue channel	
Summary: A discussion paper entitled "Environmental regulations on the electrical and electronic equipment by European Union (EU)" **is prepared as a partial fulfillment of a dialogue channel for the promotion of active participation and cooperation in the APEC member economies in the international standardization activities**	

August 23, 2004

Discussion paper: Environmental regulations on the electrical and electronic equipment by European Union (EU)

Concerns over sustainable society in recent years led to strict environmental regulations on the industrial products, namely automotives and electrical and electronic equipment (EEE). Since early 1990s environmental regulation has shifted from the end of pipe concept to the front of the pipe concept. In other words, preventing pollution from the beginning by regulating the source of pollution, product, has been the prime environmental policy tool.

One of the policy principles is that polluter pays. Here, polluter indicates manufacturer or distributor of the product, neither the product user nor the municipalities. This principle led to the development of a concept termed extended producer responsibility. Since product is envisaged as a prime source of resources consumption and environmental emissions to air, water and land, the manufacturer of the product must bear the responsibility for the wastes resulting from their products including collection, recycling, treatment and ultimate disposal.

It has also been recognized that resources consumption as well as environmental emissions from the product stem not only from the manufacturing and disposal of the product but more importantly from the resources acquisition and processing of them to the raw materials, and the product use. In short, the entire life cycle of a product must be taken into account for reducing the environmental impact from the product. Here, environmental impact encompasses resources consumption and emissions to air, water and land. The view of the entire life cycle of a product is based on holistic thinking.

EU is the most active region in the world, enforcing the holistic view of a product and adopting the polluter pays principle based on the extended producer responsibility concept. The integrated product policy (IPP) is a prime example of the EU's policy on the environmental regulations on products.

EU has passed directives on the environmental regulations for the products in the field of automotives and EEE. They include: End of Life Vehicle (ELV), Waste Electrical and Electronic Equipment (WEEE), Restrictions of the use of certain hazardous substances in EEE (RoHS), among others. In addition, EU is in the process of finalizing a framework directive for setting eco-design requirements for energy using products (EuP). Of these directives, we will discuss in depth the existing directives including WEEE and RoHS, and upcoming EuP directive.

One of the major differences between the two existing directives and the upcoming one is that the former was based on so called old approach, while the latter was based on new approach. The old approach means that all the implementation measures of the requirements are already delineated in the directive. Thus, there is less room for misinterpretation of the directives. The new approach, however, does not stipulate details of the implementation measures in the directive. Rather the implementation measures will later be determined by the individual member state and by references such as standards. That is why the EuP directive is called framework directive.

Since the detailed implementation measures will be the responsibility of each member

state of the EU, this could create chaotic situation for the foreign manufactures who export products to the EU. To alienate the anticipated chaotic situation, the EU commission requested the CEN, CENELEC, and IUTT to produce standards for the implementation measures of the EuP. This means that the European standard on eco-design will be the basis for implementing the EuP directive. Since European standards can be challenged as technical barriers to trade, the EU standardization bodies want to have international standards for the eco-design implementation measures.

IEC currently has charged ACEA (Advisory Committee on Environmental Aspects) to develop eco-design guide for the EEE'. ACEA is actively working to publish the guide by November, 2004, if the draft is approved by the SMB of the IEC. The title of the ecodesign guide is "ECD for EEE". There are eleven members in ACEA. Out of 11, only four came from the APEC economies, USA (2), Japan (1) and Korea (1). If the ECD guide is approved, it will be published as an IEC guide on eco design of EEE. Any future standards in the eco design of EEE within IEC should then follow the ECD guide.

Related activities in the environmental regulations on EEE are the standardization of material declaration. DIN of Germany submitted German standard on material declaration to the IEC for the fast tract standardization. TC 3 will handle the fast tract process. The ballot for CDV (committee draft for vote) will be closed by June 18th,2004. If approved, the DIN standard will become IEC standard within six months.

In ACEA, an ad hoc task force was created in early April to develop analytical methods for six banned substances in the RoHS directive. They will complete the report by early November, 2004. They have produced draft in July and currently are being reviewed by the task force members.

ECMA (European Computer Manufacturing Association) submitted their eco-design guide, ECMA 341, to the IEC SMB for fast tract standardization. TC 108 of IEC would be the one who handles the fast tract standardization. TC 108 expressed their reservation of the fast tract quoting that they do not posses expertise in eco design. IEC SMB recommended the standardization of ecodesign not through the fast tract route but by starting from the scratch by submitting a new work item proposal.

Italy proposed a creation of a new environmental TC to handle ecodesign, material declaration and analytical methods, all related to EEE. The proposal is supported by Germany, the Netherlands, Denmark, and Japan, while UK and USA oppose to it. Final decision as to the creation of the new TC is expected to be made sometime in 2004.

The purpose of this discussion paper has two folds: One is to inform recent development in the field of environmental regulations on the EEE in the EU, the other is to seek means to providing input to the standardization processes in the IEC by the APEC member economies. Your input in the form of comments on this paper as well as suggestions how to actively take part in the IEC standardization processes of the ecodesign standards would be highly appreciated.

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Annex I

Waste Electrical and Electronic Equipment (WEEE) Directive (2002/96/EC)

[Source **:** http://www.environment-agency.gov.uk/netregs/legislation/380525/473094/?lang=_e]

Who does it affect?

Those involved in manufacturing, selling, distributing, recycling or treating electrical and electronic equipment (including household appliances, IT and telecommunications equipment, audiovisual equipment, lighting equipment, electrical and electronic tools, toys, leisure and sports equipment, medical devices and automatic dispensers)

Purpose

The Directive aims to:

- reduce the waste arising from electrical and electronic equipment; and
- improve the environmental performance of all those involved in the life cycle of electrical and electronic equipment.

Key elements

The Directive covers WEEE used by consumers and for professional purposes.

By 13 August 2005:

- private householders will be able to return their WEEE to collection facilities free of charge; and
- producers (manufacturers, sellers, distributors) will be responsible for financing the collection, treatment, recovery and disposal of WEEE from private households deposited at these collection facilities.
- Producers will be responsible for financing the collection, treatment, recovery and disposal of WEEE from users other than private householders from products placed on the market after 13 August 2005.
- Producers will also be responsible for financing the management of WEEE from products placed on the market before 13 August 2005. However, it may be possible for all or part of these costs to be recovered from users other than private householders.

By 31 December 2006:

- producers will be required to achieve a series of demanding recycling and recovery targets for different categories of appliance; and
- the UK must have reached an average WEEE collection rate of four kilograms for each private householder annually.

Timescale

The Directive is due to be brought into force in the UK by 13 August 2004.

More information of WEEE

[Source: http://www.getrid.uk.com/pages/weee.html]

1. The primary target is domestic waste and is categorized as follows:

1. Large household appliances
2. Small household appliances
3. IT and Telecoms equipment
4. Consumer equipment
5. Lighting equipment
6. Electrical Electronic tools
7. Toys, leisure and sports equipment
8. Medical services
9. Monitoring & control equipment
10. Automatic dispensers

Each of these is further broken down to qualify the type of equipment included and excluded. Only equipment with a voltage rating not exceeding 1000v AC and 1500v DC is included.

2. Take Back Requirement

[Source : http://www.weeenetwork.com/Retailers.htm]

The WEEE Directive requires that, from the 13th August 2005 you will need to:

- Accept the take back of WEEE from householders or businesses free of charge when a like item is sold. This can be achieved in a variety of ways at according to your method of delivery, for example: -
    - The consumer can bring back the old item to your point of sale if you do not offer a delivery service
    - The consumer can expect you to arrange the take back the old item from their premises if you deliver the new item
    - You can arrange an alternative method of take back, through a third party agreement, but this method must not make it harder for the consumer to return the product. For example, the consumer can post (at your expense) the old item to a third party because you have given them

a stamped addressed envelope (this is suitable for small items such a mobile phone).

- Let consumers know about the take-back services you offer, or alternative schemes
- Ensure that all separately collected WEEE enters a logistical chain whereby the end result is reuse or recycling. Separately collected WEEE cannot be disposed of in a landfill site or incinerated.

3. Recovery target

Minimum end-of-life reuse, recycling and recovery targets set by the WEEE Directive		
Product category*	Component, material and substance reuse/recycling by average appliance weight (%)	Rate of recovery** by average appliance weight (%)
Large household appliances (eg. Fridges, washing machines, electric ovens etc)	75	80
Small household appliances (eg. Vacuum cleaners, toasters, etc)	50	70
IT and telecommunication equipment (eg. Computer, photocopiers, etc)	65	75
Consumer equipment (eg. Televisions, video recorders, etc)	65	75
Lighting equipment (eg. Fluorescent lamps, discharge lamps etc)	80	N/A
Electrical and electronic tools (eg. Drills, sewing machines etc)	50	70
Toys, leisure and sports equipment (eg. Video games, train set etc)	50	70
Medical equipment system (eg. Radiotherapy equipment etc)	No target has been set	No target has been set
Monitoring and control equipment (eg. Thermostats, control panel etc)	50	70
Automatic dispensers (eg. Drinks machines etc)	75	80

*See the WEEE Directive at wwww.dti.gov.uk/sustainability for further details
**Includes energy recovery in a power plant, in addition to reuse and recycling

The Restriction of Hazardous Substances in Electrical and Electronic Equipment (ROHS) Directive (2002/95/EC)

[Source : http://www.environment-agency.gov.uk/netregs/legislation/380525/477158/?version=1&lang=_e]

Who does it affect?

Manufacturers, sellers, distributors and recylers of electrical and electronic equipment containing lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls or polybrominated diphenyl ethers.

Purpose

The Directive aims to:

- protect human health and the environment by restricting the use of certain hazardous substances in new equipment;
- complement the WEEE Directive.

Key elements

- From 1 July 2006 new electrical and electronic equipment will not contain lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls or polybrominated diphenyl ethers.
- Certain applications are exempt from the requirements of the Directive including mercury in certain types of fluorescent lamps, lead in the glass of cathode ray tubes, electronic components and fluorescent tubes, lead in electronic ceramic parts and hexavalent chromium as an anti-corrosion of the carbon steel cooling system in absorption refrigerators. The exemptions will be reviewed every four years.
- Before 13 February 2005 the European Commission will review the terms of the Directive to take into account any new scientific evidence.

Timescale

The Directive is to be brought into force in the UK by 13 August 2004.

Proposal for a Directive of the European Parliament and of the Council On establishing a framework for the setting of Eco-design requirements for Energy-Using Products (EuP Directive)

[Source : http://www.weeenetwork.com/EuP.htm]

The EuP (Energy using Products) Directive is a draft European document, that combines the previous draft EEE and EER Directives (impact on the Environment of Electrical and Electronic equipment and Energy Efficiency Requirements respectively).

The latest full text of the Directive can be found with the link to the right. It is expected to become law in member states by 31st of December 2005, and manufacturers will be obligated to comply from the 1st of July 2006.

Objective

The aim of this initiative is to provide eco-design requirements for energy using products.

- Ensure the free movement of energy-using products within the EU
- Improve the overall environmental performance of these products and thereby protect the environment
- Contribute to the security of energy supply and enhance the competitiveness of the EU economy
- Reserve the interests of both industry and consumers

Scope

Whilst the EuP Directive can in principle be applied to any product that uses energy to perform its task, it is likely to only cover those that use electricity, solid, liquid and gaseous fuels.

An important difference from the WEEE regulations is that components part manufacturers, and not just the whole product manufacturers, will be affected. Components that are both sold to an end user and that can be assessed independently for environmental performance will fall under the obligation.

‘For example, although a part may be sold directly to a customer e.g. an individual resistor or capacitor, major environmental aspects may depend upon the way that this part is used in the final product. In this case an independent analysis of its environmental performance is neither possible nor meaningful…’

However, component manufacturers will be obliged to provide basic information concerning materials and energy consumption.

All products that fall under the WEEE Directive will also be subject to the future EuP Directive, and as with WEEE, vehicles are exempt.

Requirements

Manufacturers will have to look at the entire life cycle of their product, as well as making an ecological assessment. This includes an analysis taking into consideration:

1. Raw materials used
2. Acquisition
3. Manufacturing
4. Packaging, transport and distribution
5. Installation and maintenance
6. Use
7. End of Life

The assessment will include consumption of materials and energy, emissions to the environment, expected waste and ways of recycling and reuse. There are existing schemes such as the 'Eco label' that will meet many of the requirements and the same information can be used to show compliance.

Compliance

There are two routes to compliance, either through ‘internal design control’ where information through testing is gathered and formed into profiles, or through the implementation of an ‘environmental management system’ where a control loop of planning procedures are documented.

Future

The exact requirements on certain products, timing (there are expected to be some implementation stages) and scope are still very much under discussion, yet this new law will hopefully be shaped up rapidly as it seems that the EU and the UK are keen to learn from complaints made about the introduction of WEEE and RoHS.

Annex II

[Source; http://europa.eu.int/comm/enterprise/eco_design/]

Environmentally-friendly design of energy-using products:

Proposal for a framework Directive for setting eco-design requirements for energy-using products

The European Commission proposes a Directive on the eco-design of energy-using products, such as electrical and electronic devices or heating equipment. Coherent EU-wide rules for eco-design will ensure that disparities among national regulations do not become obstacles to intra-EU trade. The proposal does not introduce directly binding requirements for specific products, but does define conditions and criteria for setting, through subsequent implementing measures, requirements regarding environmentally relevant product characteristics (such as energy consumption) and allows them to be improved quickly and efficiently. Products that fulfill the requirements will benefit both businesses and consumers, by facilitating free movement of goods across the EU and by enhancing product quality and environmental protection. The proposal constitutes a breakthrough in EU product policy and introduces many innovative elements together with concrete application of the principles of the "better regulation" package.

By encouraging manufacturers to design products with the environmental impacts in mind throughout their entire life cycle, the Commission implements an integrated product policy and accelerates the move towards improving the environmental performance of energy-using products.

After adoption of the Directive by the Council and the European Parliament, the Commission, assisted by a Committee, will be able to enact implementing measures on specific products and environmental aspects (such as energy consumption, waste generation, water consumption, extension of lifetime) after impact assessment and broad consultation of interested parties.

There will not be obligations for all energy-using products, but only for those meeting criteria such as important environmental impact and volume of trade in the internal market and clear potential for improvement, for example where market forces fail to make progress in the absence of a legal requirement.

This policy initiative is expected to increase the effectiveness and synergies of other EU legislative acts and initiatives concerning environmental aspects of products. Examples of related measures are the Directives regulating the management of waste from electrical and electronic equipment (WEEE) and the use of certain hazardous substances used in this equipment (RoHS) as well as Directives related to the energy efficiency of appliances such as the Energy labelling Directive. Existing Directives on minimum energy efficiency requirements shall be considered as implementing this Directive for the products that they cover with regard to energy efficiency during use.
Products which have been awarded the Eco-label will be considered as compliant with the implementing measures in so far as the Ecolabel meets the requirements of the implementing measure. Although the EMAS registration on its own does not grant presumption of compliance to the products manufactured by the enterprise, enterprises which have an EMAS registration, which includes product design, may use directly their environmental management system for demonstrating that their product complies with the applicable implementing measure.

What is eco-design?

The environmental impacts of energy-using products take various forms, such as energy consumption and related negative contribution to climate change, consumption of materials and natural resources, waste generation and release of hazardous

substances.

Eco-design, which means the integration of environmental considerations at the design phase, is arguably the best way to improve the environmental performance of products.

The creation of a coherent framework for environmental product policy will avoid the adoption of uncoordinated measures that could lead to an overall negative result; for example eliminating a toxic substance from a product, such as mercury from lamps, might lead to increased energy consumption, which on balance would have a negative impact on the environment.

A Community framework will also ensure that no divergent national or regional measures that could hinder the free movement of products and reduce the competitiveness of businesses are taken.

Businesses and consumers will benefit greatly not only from better products and an improved environment, but also economically, because of a more rational use of resources. Easier access to an enlarged EU single market will help enhance competitiveness in the global market place, where environmental concerns are becoming increasingly important. The environment will also gain from this Commission initiative, which tackles all environmental considerations holistically.

The proposal shows the determination of the Commission to integrate environmental aspects in enterprise policies. Its structure (clear framework given by Council and Parliament, technical measures adopted by the Commission) and scope (environmental aspects of products with a view to safeguarding the internal market) present many new elements. Mechanisms for rapid, efficient and participatory decision-making are proposed, which at the same time leave sufficient room for innovation and initiative to product manufacturers. Widespread application of environmentally-friendly processes and products is among the goals of both the 6th Community Environment Action Programme and of the Commission Communication on Industrial Policy in an Enlarged Europe.
The introduction of eco-design measures that include requirements for improved energy efficiency of products is also an important and long-lasting contribution to combating climate change securing energy supply and achieving sustainable development.

Annex III

Legislation

Electrical and electronic equipment has the authorities' attention, primarily because of the rising amounts of waste and the connected disposal problems.

This is the reason why since the beginning of the nineties there has been an ongoing work on legislation in this field, starting in Germany, Denmark, The Netherlands, Sweden and Norway, as well as on the EU-scale.

The regulations are primarily concerned with:

- establishing collection systems and securing correct handling of waste, which means recycling and regaining of resources
- safe separation and disposal of environmental hazardous parts
- certain hazardous substances, which will either be banned or restricted in use

The regulations also introduces a producer responsibility for the disposal, and demands information from the producer to the recycler about e.g. the content of environmentally hazardous parts and possibilities for recycling.

3 EU-directives within this field are being prepared:

Directive	Main Content	Status	
Directive on Waste Electrical and Electronic Equipment (WEEE directive) Amendment	• Specifies collection requirements and targets in the member states • Specifies recycling targets • Introduces producer responsibility for the disposal costs • EE-equipment shall be marked, telling the consumer not to dispose it with normal waste stream • Producer must provide information to recyclers	• Final Directive to be implemented in national legislation by August 2004.	Error! 
Directive on the Restriction o f the use of certain Hazardous Substances in electrical and electronic equipment (RoHS directive)	• Introduces ban on the use of Lead, Mercury, Cadmium, hexavalent Chromium, Beryllium • Introduces ban on certain brominated flame retardants (PBB & PBDE)	• Final Directive to be implemented in national legislation by August 2004.	

Proposal for a framework Directive for setting eco-design requirements for energy-using products (EuP directive)	• The proposal does not introduce directly binding requirements for specific products, but does define conditions and criteria for setting, through subsequent implementing measures, requirements regarding environmentally relevant product characteristics (such as energy consumption) and allows them to be improved quickly and efficiently. • After adoption of the Directive by the Council and the European Parliament, the Commission, assisted by a Committee, will be able to enact implementing measures on specific products and environmental aspects (such as energy consumption, waste generation, water consumption, extension of lifetime) after impact assessment and broad consultation of interested parties.	• Proposal from the EU Commission • Follow the development from the EU Commisions web page	

The present Danish legislation about WEEE (which will be severely rewritten due to the implementation of the WEEE directive) can be seen here: Bekendtgørelse om håndtering af affald af elektriske og elektroniske produkter (BEK nr 1067 af 22/12/1998)
Search all information about Danish legislation from http://www.retsinfo.dk.

ANNEX IV

Proposed draft testing method for ROHS banned substances

IEC ACEA ad hoc Working Group

Mission of the ad hoc Working Group:
Develop a normative document that will define test procedures that will allow the electrotechnical industry to determine the concentration of the regulated substances Pb, Hg, Cd, Cr VI, PBB, PBDE (EU RoHS, China, US, Japan, etc.) in electrotechnical products on a consistent global basis

Goal of the ad hoc Working Group:
Develop a normative document for electrotechnical industry to be used by labs globally for OEMs, suppliers, NGOs, governments, etc. The normative document will be submitted as proposal for an IEC standard.

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1 Introduction

The widespread use of electrotechnical products has drawn increased attention to their impact on the environment. In many countries all over the world this has resulted in the adaptation of regulations affecting wastes, substances and energy use of electrotechnical products.

The use of certain substance like Pb, Hg, Cd, Cr VI, and some types of brominated flame retardants in electrotechnical products is regulated in current and proposed legislation e.g in:

- European Union (EU) directive on the "Reduction of certain Hazardous Substances in electrical and electronic equipment" (RoHS) [1]
- Chinese draft legislation on "Management Methods on the Prevention and Control of Pollution Caused by Electronic information Products" [2]
- US (California) Electronic Waste Recycling Act of 2003 (S.B. 20) [3] and Electronic Waste, Advanced Disposal Fees (S.B. 50) [4]
- Etc.

The EU RoHS directive prohibits lead (Pb), mercury (Hg), cadmium (Cd), hexavalent chromium (Cr VI), and two types of brominated flame retardants, polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE) from being used in electronic and electrical equipment (EEE) from 1st July 2006. The same substances are regulated in the Chinese draft legislation, adhering to the same timeline as the EU RoHS. Likewise, California restricts the same substances on the same timeline, although for a narrower set of products than the EU RoHS.

Industry is convinced of the importance of defining testing protocols for regulated substances of electrotechnical products that enter or are made available on markets, where legislation regulating the substance content of electrotechnical product is enacted. Testing may be performed for a variety of reasons including:

- As an alternative to supply chain material declarations, companies may choose to test products directly to determine compliance
- Companies may require their suppliers to perform testing as the basis of the supplier's material declaration
- Companies may perform "spot checks" of their suppliers to confirm compliance
- Government officials may test as basis to assess compliance

Certain test methods to determine regulated material content already exist, but most are not appropriate for testing electrotechnical products and are not internationally recognized. Currently no methods for compliance or enforcement of the substance restrictions have been agreed upon or mandated by countries regulating substances in electrotechnical products. Testing methods, which are being discussed by industry associations and academia to determine presence and levels of these banned substances differ from each other.

Until a common agreement between governments, industry and other stakeholders is reached on how regulated substances should be measured in electrotechnical products, industry has no legal certainty that products will be found compliant if tested by national enforcement authorities or by Non Governmental Organizations (NGOs) in different countries.

The purpose of this document is therefore to provide test procedures that will allow the electrotechnical industry to determine the levels of the regulated substances Pb, Hg, Cd, Cr VI, PBB, PBDE (EU RoHS, China, US, Japan, etc.) in electrotechnical products on a consistent global basis.

2 Scope

This standard provides test procedures for determining the levels of Lead (Pb), Mercury (Hg), Cadmium (Cd), hexavalent Chromium (Cr VI), and two types of brominated flame retardants, Polybrominated Biphenyls (PBB) and Polybrominated Diphenyl Ethers (PBDE) contained in electrical and electronic products covered in Annex 1.

This standard will not determine:

- Definition of a “unit” or “homogenous material” as the sample
- Disassembly procedure to get to a sample
- Assessment procedures

3 References

- “Reduction of certain Hazardous Substances in electrical and electronic equipment” (RoHS)
- Tobias Ernst, Ralf Popp, Marion Wolf, Rudi van Eldik, Anal Bioanal Chem (2003) 375 : 805–814.
- http://www.irmm.jrc.be, assessed 19. February 2004
- DIN 51701 (part 2), Ausgabe:1985-08 Prüfung fester Brennstoffe; Probenahme und Probenvorbereitung; Durchführung der Probenahme
- B. Danzer, M. Riess, H. Thoma, O. Vierle, R. van Eldik, Organohalogen Compounds 31 (1997) 108.
- Etc.

4 Terms and Definitions

The definitions of the key terms used in this document are given below

4.1 Test Procedure
4.2 Screening Test Procedure
4.3 Verification Test Procedure
4.4 Assessment procedure
4.5 Laboratory implementation
4.6 Homogenization
4.7 Etc.

5 Test Procedure

5.1 Test Procedure Scope

The content of the test procedure described can be grouped in two important steps:

- Analytical test procedures
- Laboratory implementation

Analytical test procedures have to be developed and validated to make sure they are suitable and can be used for the purpose they were designed for. Subsequently they have to be made available to the public so that interested labs around the globe can implement them.

The analytical test procedures step can itself be divided into six important points:

- Sample preparation
- Analytical technique definition
- Reference methods & materials

- Quality aspects
- Opportunity (best used for) and risk (limitations)
- Test reports (minimum information required)

The first point includes sample preparation for the samples themselves, as well as definition of the standard and reference samples. The second point is the definition of the analytical instrument to be used, which is closely linked to the sample preparation. The third important point is also how the method becomes traceable to commercial reference standards and suitable calibration samples. The forth point covers the quality aspects directly related to the chosen analytical test procedure. The fifth point highlights the opportunities for the best use of the test procedure and also the risks due to the inherent limitations of the procedure. The sixth point defines the minimal information required for the test reports.

Individual test procedure description will follow this six point outline.

The laboratory implementation will not be covered in this document, as labs should be able to implement the test procedures described using procedures and standards addressed in other sources. The implementation step includes suitable quality assurance measures and a validation protocol that documents the performance of the analytical method using the instrument in the lab. Quality assurance systems such as Good Laboratory Practice (GLP) and/or accreditation to similar (inter-) national systems (e.g. ISO) are strongly encouraged.

5.2 Test Procedure Flow

The figure below describes the flow for the test procedure to determine the levels of regulated substances in electrotechnical products.

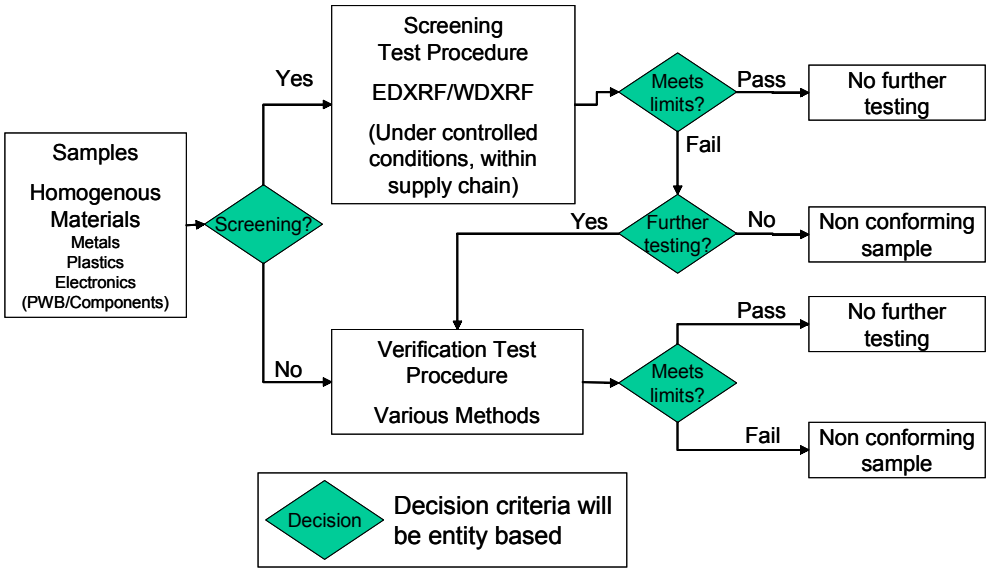

Figure 1: Test Procedure Flow

After obtaining the sample, a decision has to be taken, whether the screening test procedure or the verification test procedure using a variety of test methods should be used. The procedure to obtain the sample is not described in this document.

The screening test procedure of a sample is done using either an EDXRF (Energy Dispersive X-Ray Fluorescence) or a WDXRF (Wavelength Dispersive X-Ray Fluorescence) device, which x-rays the content of the sample. A screening of representative samples or uniform materials (such as plastics) can be done non-destructively with an EDXRF or a WDXRF device. For other

samples (like a populated printed wiring board) destructive sample preparation (homogenization) will be necessary. It must be noted that the screening test procedure needs to be run under controlled conditions, as the use of EDXRF or the WDXRF has limitations to its use and the applicability of the results obtained, although the fast and resource efficient way has its merits particularly for the demands of the electrotechnical industry.

After the screening test procedure it can be decided if the sample meets the limits based on the entity's criteria for regulated substances or if further testing is required.

The verification test procedure of a sample is done using a variety of analytical methods tailored to the regulated substances and the material of the sample, which can be either plastics, metals or electronics in form of populated PWBs or components. The use of the verification test procedures will ensure results with less error, however taking more resources to carry out.

After the verification test procedure it can be decided if the sample meets the limits based on the entity's criteria for regulated substances.

5.3 Adjustment to Material (Matrix)

Analytical methods for regulated substances that are present at relatively low levels amongst other chemical elements or compounds at relatively high concentrations or representing the major constituent of the sample are very often material or matrix dependent. Therefore the test methods have to be adjusted to the materials to be tested, either by introducing the appropriate blanks and matrix adjusted calibration samples or by a clean up step that separates the analyte from the adherent materials or the main matrix. The main material types (or matrices) in electronic equipment are plastics, mostly technical polymers with a whole series of additives that can moreover be painted; metals as well as alloys of different types; and electronics such as (populated) printed wiring boards (PWBs) and electrical and electronic components.

5.4 Screening Test Procedure Using EDXRF

The screening test procedure of a sample is done using an EDXRF (Energy Dispersive X-Ray Fluorescence) or a WDXRF (Wavelength Dispersive X-Ray Fluorescence) device, which x-rays the content of the sample. A screening of representative samples or uniform materials (such as plastics) can be done non-destructively with an EDXRF or a WDXRF device. For other samples (like a populated printed wiring board) destructive sample preparation (homogenization) will be necessary. It must be noted that the screening test procedure needs to be run under controlled conditions, as the use of EDXRF or WDXRF has limitations to its use and the applicability of the results obtained, although the fast and resource efficient way has its merits particularly for the demands of the electrotechnical industry.

Table 1: Overview of the content of the screening test procedure using EDXRF or WDXRF

Steps	**Substances**	**Plastics**	**Metals**	**Electronics (PWBs/Components)**
Sample preparation		Direct measurement, Powder measurement, Thin foils	Direct measurement, Powder measurement, Pellets	Powder measurement, Pellets
Analytical technique definition (incl. typical margins of errors)	PBB/PBDE			
	Cr VI			
	Hg			
	Pb / Cd			
References (material, methods) for comparison				
Information delivered		Black/grey/white area concept		
Limitations & Controlled Condition				

5.5 Verification Test Procedure

The verification test procedure of a sample is done using a variety of analytical methods tailored to the regulated substances and the material of the sample, which can be either plastics, metals or electronics in form of populated PWBs or components. The use of the verification test procedures will ensure results with less error, however taking more resources to carry out.

Table 2: Overview of the content of the verification test procedure

Steps	**Substances**	**Plastics**	**Metals**	**Electronics (PWBs/Components)**
Sample preparation		Direct measurement, Powder measurement, Thin foils, Acid digestion Solvent extraction	Direct measurement, Grinding, Acid digestion	Acid digestion, Solvent extraction
Analytical technique definition (incl. typical margins of errors)	PBB/PBDE	**See Table 3**		
	Cr VI			
	Hg			
	Pb/Cd			
References (material, methods) for comparison		BCR-680, BCR-681 In-house references	Commercial Solid Metal Standards	None commercially available, In-house references
Limitations & Information delivered				

Table 3: Details of the of the verification test procedure

	Substance	**Plastic**	**Metals**	**Electronics (PWBs/Components)**
Analytical technique definition (incl. typical margins of errors)	PBB/PBDE	**HPLC/UV** **GC/MS** FT-IR EDXRF (total Br)	NA	**HPLC/UV** **GC/MS** FT-IR EDXRF (total Br)
	Cr VI	-	**Diphenylcarbazide-method** EDXRF (total Cr) AAS (total Cr) ICP-AES (OES) (total Cr)	-
	Hg	**EDXRF** CV AAS	**CV AAS** AFS	**CV AAS** AFS
	Pb/Cd	**ICP-AES (-OES)** **AAS** ICP-MS EDXRF	**ICP-AES (-OES)** **AAS** ICP-MS EDXRF	**ICP-AES (-OES)** **AAS** ICP-MS EDXRF

Bold: Preferred Method
Normal: Acceptable Method

6 Reference Methods and Materials

Certified Reference Material Standards (CRMS) (and standardized methods) are indispensable to obtain comparable and accurate analytical data. No CRMs are available for regulated substances in typical electrotechnical polymers like ABS, PS, ABS/PC, etc. No CRMs are available for regulated substances in printed wiring boards.

Table 4: CRMs suitable for regulated substances

Substance	CRM	Comment
PBBs / PBDEs	Not available	BAM: Round robin test (final report expected at the end of 2004) ABS, PS with OctaBDE; PUR foam, epoxy resin with PentaBDE
Total Br	BCR-680, BCR-681	Plastics packaging and packaging material; certification of mass fractions of As, Br, Cd, Cl, Cr, Hg, Pb and S in polyethylene
Cr VI	BAM-S004	Glass for cosmetics; certification of mass fractions of hexavalent chromium and of total chromium in glass
Total Cr	BCR-680, BCR-681 BAM-S004	See above (Comment, Total Br) See above (Comment, Cr VI)
Hg	BCR-680, BCR-681	See above (Comment, Total Br)
Pb	BCR-680, BCR-681 BCR-126A	See above (Comment, Total Br) Certification of a lead glass
Cd	BCR-680, BCR-681 VDA-001 to VDA-004	See above (Comment, Total Br) Association of German Automobile Manufacturers; Certification for cadmium in polyethylene

University of Erlangen (AOC) approach for a printed wiring board reference material [5]: Mixture of different RMs (Cu-Be alloy, pure ABS with brominated flame retardant, NIST glass, pure iron) to represent the main constituents of a PWB RoHS relevant elements: total Br, total Cr, Pb, Cd.

7 Annex 1: Product Groups

- Large household appliances
- Small household appliances
- IT and telecommunications equipment
- Consumer equipment
- Lighting equipment
- Electrical and electronic tools (with the exception of large-scale stationary industrial tools)
- Toys, leisure and sports equipment
- Automatic dispensers