Normative document

WEEELABEX

Treatment

7 May 2013

With the financial support of the LIFE programme of the European Community

Table of contents

Table of contents ii
Foreword v
Introduction vi
Part I, General requirements 1
1 Scope 1
2 Normative references 2
3 Terms & definitions 3
4 Administrative and organisational requirements 7
4.1 Legal compliance 7
4.2 Management principles 7
4.3 Technical and infrastructural preconditions 7
4.4 Training 8
4.5 Downstream monitoring 8
4.6 Preparing for re-use 8
4.7 Shipments 8
5 Technical requirements 10
5.1 Handling 10
5.2 Storage 10
5.3 De-pollution 11
5.4 De-pollution monitoring 11
5.5 Further treatment 12
5.6 Storage of fractions and components 12
5.7 Recycling and recovery 12
5.8 Disposal of fractions 13
5.9 Documentation 13
Bibliography 15
Annex A (normative) De-pollution guidelines 16
A.1 Introduction 16
A.2 Capacitors 16
A.3 Components containing mercury 17
A.4 Batteries and accumulators 18
A.5 Printed circuit boards 18
A.6 Plastics containing certain types of brominated flame retardants 19
A.7 Volatile fluorocarbons and volatile hydrocarbons 19
A.8 Asbestos 20
A.9 Components containing radioactive substances 20
A.10 Other components 20
Annex B (normative) De-pollution monitoring 22
B.1 Introduction 22
B.2 Capacitors, batteries and printed circuit boards 22
B.3 Shredder light fraction 23
B.4 Plastics with certain types of brominated flame retardants 23
Annex C (normative) Requirements concerning batches 24
C.1 Introduction 24

C.2 Input material 24
C.3 Processing 25
C.4 Output fractions 25
C.5 Documentation and validation 26
Annex D (normative) Determination of recycling and recovery rates 27
D.1 Scope and definitions 27
D.2 Principles 27
D.3 Calculation 28
D.4 Documentation 29
D.5 Classification model 30
Part II, Specific requirements 32
Specific requirements for the treatment of CRT display appliances 32
1 Scope 32
2 Normative references 32
3 Terms & definitions 33
4 Administrative and organisational requirements 35
4.1 General 35
4.2 Environmental, health and safety requirements 35
5 Technical requirements 37
5.1 Separation process 37
5.2 Cleaning process 37
5.3 Recycling and recovery process 38
Specific requirements for the treatment of Flat Panel Displays 39
1 Scope 39
2 Normative references 39
3 Terms & definitions 40
4 Administrative and organisational requirements 41
4.1 Technical and infrastructure conditions 41
4.2 Transport 41
4.3 Information materials 41
5 Technical requirements 42
5.1 Preparation for treatment 42
5.2 General de-pollution 42
5.3 Mercury 42
5.4 Indium tin oxide (ITO) 42
5.5 Fluorescent coatings 42
5.6 Monitoring 43
Specific requirements for the treatment of Lamps 44
Introduction 44
1 Scope 45
2 Normative references 46
3 Terms & definitions 47
4 Administrative and organisational requirements 48
4.1 General management structure 48
4.2 Treatment facility infrastructure 48

4.3 Occupational health and safety, and industrial hygiene requirements 48
4.4 Documentation of accidents & incidents 48
5 Technical specifications 50
5.1 General requirements 50
5.2 Reception 50
5.3 Handling and storage 50
5.4 Separation process 51
5.5 Recovery and disposal 51
5.6 Monitoring and control 51
5.7 Documentation 52
Bibliography 53
Annex A (normative) Treatment process and related measurement points 54
Annex B (informative) Treatment options for Lamps fractions 55
Annex C (normative) Frequency table of residual mercury concentration checks 56
Specific requirements for the treatment of Temperature Exchange Equipment 57
Requirements for the Collection, Transportation, Storage, Handling and Treatment of Household Cooling and Freezing Appliances containing CFC, HCFC or HFC 58
1 Objective 58
1.1 General Requirements 58
1.2 Collection, storage, transportation and handling 59
1.3 Requirements concerning treatment and output quality 60
1.4 Requirements concerning Quality Assurance 61
1.5 Requirements for the annual data reporting (monitoring and records) 61
1.6 Inspection and Control 62
1.7 Revision of the requirements 62
2 Performance test recycling Step 1 63
3 Performance test recycling Step 2 64
Requirements for the Collection, Transportation, Storage and Treatment of Cooling and Freezing Appliances containing Hydrocarbons (HC) 67
1 Introduction 67
2 Objective 68
3 General requirements 68
4 Collection, storage, transport and handling 68
5 Treatment 69
6 Quality assurance 70
7 Inspection and control 70

Foreword

Since the start of the WEEELABEX project in 2009, the WEEE Forum, jointly with stakeholders from the community of WEEE processors and producers of electrical and electronic equipment, has focused on the normative requirements that operators, i.e. collection facilities, logistics operators and treatment sites, are expected to comply with. For the first time, all requirements are presented as one integrated package in a coherent structure.

Previous versions have been subject of intensive discussions in different working groups. This version 9.0 arises from unanimous approval by the General Assembly of the WEEE Forum on 1 April 2011 in Amsterdam.

In 2011 and 2012, the WEEELABEX project will focus on conformity verification. Among the deliverables, it is envisaged to produce an audit reporting template, input measurement protocols, sampling and analysis protocols, audit manuals, a conformity declaration form, definitions of target and concentration values, the definition of the audit dossier, and possibly additional guidelines. To assist the WEEELABEX project management perform these tasks, a 'watch list' was created to list all items (previously highlighted as signposts in the form of notes and comments in the normative documents) which require further research, are purely related to conformity verification or need to be subject of further considerations.

It is also envisaged to set up a *sui generis* WEEELABEX organisation – in this document referred to as '[WEEELABEX]' – the governance structure and business model of which will be subject of discussions. Auditors will be trained to perform audits in the light of WEEELABEX conformity verification – the auditors' profile will pertain to, amongst other things, confidentiality and impartiality requirements.

Furthermore, the use of WF_RepTool, a web-based tool developed by the WEEE Forum that allows operators to report recycling and recovery rates on the basis of uniform definitions, shall be actively encouraged.

The member organisations of the WEEE Forum, as well as more generally other organisations that possibly join the WEEELABEX organisation (hereinafter 'WEEE systems'), shall be required to integrate all provisions laid down in this normative document into their contracts with operators. WEEE systems shall only contract with operators that comply with the requirements in this normative document or can demonstrate that they meet equivalent specifications.

At their meeting on 1 April 2011 in Amsterdam, the WEEE systems decided that they will require the operators with whom they have a contractual relationship to comply with the WEEELABEX requirements by 31 December 2013 (old member states) and 31 December 2014 (new member states). A 'vanguard of early birds' will start gaining experience through implementation in 2011-12 and will feed back experience into the WEEELABEX project management.

Until 1 October 2012, i.e. in the 18 months following the adoption of the standards on 1 April 2011, this version 9.0 will not undergo modifications. Formal discussions and approval of the WEEELABEX requirements within CENELEC (or equivalent standardisation organisations) shall not commence earlier than the adoption of the recast Directive 2002/96/EC.

Introduction

The WEEELABEX normative requirements lay down measures related to the protection of the environment and human health and safety through the prevention and mitigation of the adverse impacts of treatment of waste electrical and electronic equipment (WEEE). It defines both technical and management requirements for operators, which can be integrated into other management requirements and assist organisations achieving demands with respect to treatment operations.

Compliance with the WEEELABEX set of normative requirements cannot infer immunity from legal obligations. This standard is not intended to create trade barriers nor to increase or decrease an organisation's legal obligations. It is intended to apply to all types and sizes of organisations and accommodate diverse geographical, cultural and social conditions.

Part I (General Requirements), addresses all operators involved in treatment of WEEE. The structure of the standard is in accordance to the general rules for the structure and drafting of normative documents. Clauses 1, 2, and 3 introduce and format the document. Clause 4 refers to the administrative and organisational principles. Clause 5 covers the technical requirements of the activities at the treatment sites. Detailed requirements, descriptions of working processes, and tools are provided in the Annexes of this standard.

Part II encompasses specific requirements concerning CRT display appliances, flat panel displays, cooling and freezing equipment (temperature exchange equipment), and lamps which demand special requirements. Those specific requirements prevail over the (General Requirements) of Part I. Requirements related to treatment of WEEE from private households containing volatile fluorinated hydrocarbons or volatile hydrocarbons are presently being developed as CENELEC EN standards based on voluntary specifications developed by WEEE Forum, CECED and EERA with respect to the collection, transport, storage and treatment of end-of-life household temperature exchange equipment containing HC, CFC, HCFC and HFC. The EN standard will replace those voluntary specifications as soon as they are formally adopted.

This normative document contains language concerning preparation for re-use activities. However, the preparation for re-use requirements concerning what needs to be in place in order to market equipment which has been prepared for re-use falls outside the scope of this document and is therefore not dealt with here. It is generally agreed that any standard related to the marketing of equipment prepared for re-use should require that the party bringing the equipment prepared for re-use back on the market shall place its name on the equipment, shall safeguard the original manufacturer from any claim related to the equipment and shall deliver legal guarantees for it. Producers or parties contracted to act on their behalf shall deliver a list of authorised preparation for re-use operators, with whom they have contracts with, to the authorities.

In those cases where normative requirements in this document differ from national or sub-national legal or regulatory provisions, the stricter requirements will be applicable.

Until 1 October 2012, i.e. in the 18 months following the adoption of the standards on 1 April 2011, this version 9.0 will not undergo modifications. However, a 'watch list' of issues which will be made subject of further consideration or more research in response to new developments in legislation or evolving technologies and work practises, will allow the WEEELABEX project management to prepare the next review.

Part I, General requirements

1 Scope

1.1 This normative document is applicable to all WEEE and all components and fractions thereof until the end-of-waste status is fulfilled, or until WEEE or components thereof are fit for re-use, or fractions are recovered or disposed of.

1.2 This normative document addresses all treatment operations, including preparing for re-use, handling, sorting, storage and treatment of WEEE (including the full treatment of hazardous fractions).

1.3 This normative document addresses all operators that perform operations in accordance with clause 1.2, regardless of size, main focus of activities, geographic location, structure of the WEEE business, or legal status of the operator's business.

1.4 This normative document is applicable to the territory of the member states of the European Union and EFTA.

1.5 This normative document aims to:

- achieve effective and efficient treatment and disposal of WEEE in order to prevent pollution and minimise emissions,
- promote increased quantity and high quality recovery of secondary products,
- prevent inappropriate disposal of WEEE and fractions thereof,
- assure protection of human health and safety, and the environment,
- prevent undocumented cross boundary shipments of WEEE to operators whose operations fail to comply with this normative document or an equivalent set of requirements
- create fair competition for all operators in the WEEE chain.

This will be achieved through:

- the harmonisation of monitoring, measuring and reporting measures in order to promote environmentally sound de-pollution, recycling, recovery and disposal of WEEE (demonstration of legal compliance), and
- specification of existing legal rules, principles and best practices.

1.6 This normative document is based on the objectives of the Community's environment policy which are aimed at preserving, protecting and improving the quality of the environment, protecting human health and utilising natural resources prudently and rationally. That policy is based on the precautionary principle and principles that preventive action should be taken, that environmental damage should as a priority be rectified at source, and that the polluter should pay. This normative document is also based on the presumption that operators adhere to the principle of due diligence with all activities. Due diligence includes understanding of all obligations to which the company is subject and transparency with business partners.

2 Normative references

EN 14899: Characterization of waste – Sampling of waste materials – Framework for the preparation and application of a sampling plan. 2005.PAS 141:2011, Reuse of used and waste electrical and electronic equipment (UEEE and WEEE) – Process management – Specification

3 Terms & definitions

For the purposes of this document, the following terms and definitions apply:

3.1
backlight
part of the flat panel module found in some flat panel displays technologies that illuminates the panel to make the image visible

3.2
batch
manual or mechanical processing of a definite and well-defined amount of WEEE or fractions thereof to determine the yields and compositions of the resulting output fractions and de-pollution performance

3.3
collection
gathering of WEEE, including the preliminary sorting and preliminary storage of WEEE for the purposes of transport to a WEEE treatment facility

NOTE 1 The term “collection” is derived from Directive 2008/98/EC.

NOTE 2 Gathering includes taking back from final users or other collection facilities.

3.4
collection facility
location designated for the gathering of WEEE from private households to facilitate separate collection

NOTE 1 The term “WEEE from private households” is defined in Directive 2002/96/EC and the terms “collection” and “separate collection” are defined in Directive 2008/98/EC.

NOTE 2 Collection facilities are typically registered, listed, or otherwise approved or designated in accordance with the national legislation implementing Directive 2002/96/EC.

3.5
component
element of an appliance with a distinct proper function as part of a device as a larger unit

NOTE Typical components of WEEE are batteries, capacitors, printed circuit boards, CRT and hard disks.

3.6
CRT (Cathode Ray Tube)
vacuum tube containing an electron gun and a fluorescent screen used to create images in the form of light emitted from the fluorescent screen

NOTE The CRT vacuum tube consists of a screen, cone, frit glass, shadow mask (only for colour CRTs), anti-implosive metal frame, and an electron gun.

3.7
CRT display appliance
complete TV set or whole computer monitor containing a cathode ray tube (CRT) or CRT with related deflection coil

NOTE CRT display appliances include business to business appliances like hospital monitors, bank cash machines, oscilloscopes etc.

3.8
de-pollution
selective treatment during which hazardous wastes and other components are removed from WEEE

NOTE The term “de-pollution” describes the selective treatment for materials and components of WEEE as per Annex II of Directive 2002/96/EC.

3.9
disposal
any operation which is not recovery even where the operation has as a secondary consequence the reclamation of substances or energy

NOTE The term “disposal” is defined in Directive 2008/98/EC; Annex I of the Directive 2008/98/EC sets out a non-exhaustive list of disposal operations.

3.10
end-of-waste
fractions may cease to become waste and be regarded as a secondary product following a recovery or recycling operation in compliance with specific criteria according to Article 6 of Directive 2008/98/EC

NOTE The term “end-of-waste status” is described in Directive 2008/98/EC.

3.11
energy recovery
use principally as a fuel or other means to generate energy; including reprocessing into materials that are to be used as fuels,

NOTE Energy recovery is defined in accordance with Annex II (Selective treatment of materials and components of WEEE) of Directive 2008/98/EC.

3.12
flat panel display
thin screen equipment, larger than 100 square centimetres (cm^2), using technologies that produce and display an image without the use of cathode ray tubes

NOTE Examples of flat panel displays include LCD TV, Plasma TV, LCD screens and monitors, and notebooks

3.13
fraction
separate material stream generated by treatment of WEEE, including de-pollution, dismantling or any other treatment process

3.14
hazardous waste
waste which displays one or more hazardous properties

NOTE The properties of hazardous waste are described in Annex III of Directive 2008/98/EC

3.15
lamps
gas discharge lamps and retrofit LED lamps within the scope of Directive 2002/96/EC

NOTE Retrofit LED lamps are LED lamps used in exchange for CFL or GLS lamps and fit in sockets for these applications

3.16
logistics
process of planning, implementing, and controlling the efficient and effective flow of WEEE in order to achieve appropriate treatment. Logistics involves sorting, handling, storage, and preparation for transport with the intention to deliver to treatment facilities

3.17
logistics facility
location for receiving WEEE in order to sort, store, and for prepare for transport, with the intention to deliver to treatment facilities

3.18
material recovery
any recovery operation excluding energy recovery and reprocessing into materials which are to be used as fuel

3.19
flat panel module
part of the flat panel display containing the components that produces images, including the lighting and the diffusive elements and excluding the casings, printed circuit boards and speakers

3.20
operator
entity performing operations with WEEE in accordance with this normative document

NOTE Operations with WEEE may include collection, handling, shipping, sorting, storage, transport, trading, treatment, or preparing for re-use.

3.21
flat panel
part of the flat panel module of the flat panel display in which the image is produced

3.22
preparing for re-use
checking, cleaning or repairing operations, by which products or components of products that have become waste are prepared so that they can be re-used without any other pre-processing

NOTE Preparing for re-use includes, but is not limited to, the selection, visual inspection, safety and functionality testing, documentation, records and labelling in accordance with the provisions of Directive 2002/96/EC with the result that the electrical and electronic equipment is fit for use.

3.23
recovery
any operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy

NOTE In accordance with Directive 2008/98/EC; Annex II of Directive 2008/98/EC sets out a non-exhaustive list of recovery operations.

3.24
recycling
any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations

NOTE The term “recycling” is defined in Directive 2008/98/EC.

3.25
removal
manual, mechanical or metallurgic handling with the result that hazardous substances, preparations and components are contained as an identifiable (part of a) stream at the end of the treatment process.

NOTE A substance, preparation or component is identifiable if it can be monitored to prove environmentally safe treatment, in accordance with Directive 2002/96/EC.

3.26
re-use
any operation by which products or components that are not waste are used again for the same purpose for which they were conceived

NOTE The term “re-use” is defined in Directive 2008/98/EC.

3.27
treatment
recovery or disposal operations, including any preparation prior to recovery or disposal

NOTE The term “treatment” is defined in Directive 2008/98/EC.

3.28
treatment facility
location where WEEE undergoes treatment

3.29
UEEE (Used Electrical and Electronic Equipment)
UEEE is electrical and electronic equipment that has been put into service and used but has subsequently been taken out of service and not yet discarded as waste

NOTE UEEE includes, for example, second hand and pre-owned equipment, excess and obsolete equipment, service and warranty returns and display stock.

3.30
waste
any substance or object that the holder discards or intends or is required to discard

NOTE The term “waste” is defined in Directive 2008/98/EC.

3.31
WEEE (Waste Electrical and Electronic Equipment)
electrical or electronic equipment which is waste, including all components, subassemblies and consumables which are part of the product at the time of discarding

NOTE The term “WEEE” is defined in Directive 2002/96/EC.

4 Administrative and organisational requirements

4.1 Legal compliance

4.1.1 The operator shall comply with European Community legislation and its corresponding transposition. The operator shall maintain a record documenting compliance with legal and regulatory obligations applying to all activities undertaken on site.

4.1.2 The operator shall establish and maintain a procedure in order to identify legal requirements that are applicable to the environmental, health and safety aspects of all activities, services and processes undertaken at the facility. A register of the operator's activities and related legal provisions shall be maintained and valid permits required by all relevant authorities shall be available.

4.2 Management principles

4.2.1 The operator shall ensure that a management system is in place for all activities in the fields of health, safety, environment and quality.

4.2.2 The operator shall demonstrate continuous improvement of their activities by a review and management process. The policy shall also be updated or revised as changes occur to the activities of the operator and evaluated in order to monitor its effectiveness.

4.3 Technical and infrastructural preconditions

4.3.1 The operator shall possess infrastructure in terms of size, technologies installed, and characteristics of the operations that are suitable for the activities performed on site. Suitability of site shall be assessed by an operational risk management process for all tasks performed on site and include the identification of hazards, the assessment of risk and, where appropriate, the elimination or reduction of the risk, and documentation of the process.

4.3.2 Employees handling lamps shall properly use required personal protective equipment (PPE) as follows from a risk assessment as required in clause 4.3.1.

4.3.3 Treatment facilities including storage areas shall be designed, organised, and maintained to provide safe access to and egress from the site, and to avoid access by unauthorised persons.

4.3.4 Treatment facilities shall be secured to prevent damage to and theft of WEEE and components thereof.

4.3.5 The treatment operator shall ensure that there is insurance coverage or other financial resources in place adequate to the nature and size of the operations. The insurances or financial resources shall accommodate legal and regulatory requirements, but as a minimum cover risks and liabilities of:

- bodily injury of employees, contractors, visitors or neighbours of the plant,
- damages to neighbouring facilities,
- damages due to accidental pollutant release to the environment where the owner of the property is liable, and
- closure of the facility assuring proper cleanup of the site and any WEEE.

4.4 Training

4.4.1 All persons at the treatment facility shall be familiar with the environmental, health and safety policy of the facility. Employees and contractors involved in operations shall be instructed and trained to perform the tasks assigned to them.

4.4.2 Training shall include emergency response planning, occupational health and safety measures, and training for the relevant operations performed on site. The effectiveness and suitability of training shall be checked regularly. Training programmes shall be delivered at a level suitable to the trainee in form, manner and language.

4.4.3 Employee training materials and information including technical guidance documents, risk assessments, safety statements, information charts, information tables, photos or examples of components of WEEE, and safety data sheets for hazardous chemical components shall be available at the work place and be easily accessible to employees at all times.

4.5 Downstream monitoring

4.5.1 The operator shall document the origin of the WEEE treated and the downstream treatment chain of WEEE and fractions thereof as long as they have not reached the end-of-waste status. Documentation shall record treatment in accordance with Clause 5 of this normative document. If downstream operators comply with this normative document, special documentation shall not be necessary.

4.5.2 Responsibility of downstream monitoring remains in cases where handing over of WEEE to dealers or brokers, or when shipped across borders.

4.6 Preparing for re-use

4.6.1 If the operator is involved in preparing for re-use activities, permits from authorities shall be obtained and the provisions in European standards for the processing of UEEE and WEEE shall be adhered to. Suitable infrastructure and trained persons shall be available for the testing of equipment and the preparation for re-use procedures and records.

NOTE PAS 141:2011 for the processing of UEEE and WEEE is an example of a publicly available specification

4.6.2 If the operator is involved in preparation for re-use of ICT equipment, personal data stored on the memory of the ICT equipment shall be destroyed.

4.6.3 Electrical and electronic equipment prepared for re-use shall conform with safety, environmental, and legislative requirements.

4.6.4 The documentation of WEEE prepared for re-use shall encompass a documentation of all tests performed on the equipment, all copies of the labels according to clause 4.6.2, all destinations and acceptors as well as a summary of amounts and types of WEEE prepared for re-use.

4.7 Shipments

4.7.1 WEEE and fractions thereof which are intended for cross-border shipments shall be subject to Regulation 1013/2006/EC on shipments of waste until the end-of-waste criteria is fulfilled in accordance with Article 6 of Directive 2008/98/EC on waste.

4.7.2 No operator shall initiate, contribute to, or otherwise allow shipments of WEEE or fractions thereof that would result in treatment that is not in compliance with the objectives of this normative document and with the legislative requirements of Directive 2002/96/EC.

4.7.3 WEEE, components, and fractions thereof which contain radioactive wastes shall not be exported outside the European Union and EFTA territory.

NOTE Council Directive 92/3/Euratom of 3 February 1992 on the supervision and control of shipments of radioactive waste between Member States and into and out of the Community

4.7.4 Components to be removed according to Annex II (Selective treatment of materials and components of WEEE) of Directive 2002/96/EC as well as WEEE containing them, unless tested and prepared for re-use in accordance with section 4.6, shall not be exported outside the European Union and EFTA territory unless the operator can demonstrate compliance with this normative document and with Directive 2002/96/EC at the destination.

4.7.5 The minimum monitoring requirements for shipments as laid down Regulation 1013/2006 on shipments of waste shall be strictly adhered to.

5 Technical requirements

5.1 Handling

5.1.1 WEEE shall be handled and stored with due care in order to avoid release of hazardous substances into air, water, or soil, as a result of damage and/or leakage.

NOTE Handling includes loading and unloading

5.1.2 During handling and storage special attention shall be given to:

- temperature exchange equipment, to avoid damage to the temperature exchange system,
- CRT display appliances to avoid implosion and/or emissions of fluorescent coatings,
- lamps and appliances containing lamps to prevent breakage resulting in the release of mercury,
- smoke detectors as they may contain radioactive components,
- appliances containing oil and other fluids within an internal circuit as part of the appliance or capacitors containing mineral or synthetic oil to avoid spillages and other emissions, and
- appliances containing asbestos or ceramic fibres to avoid release of asbestos or ceramic fibres.

NOTE 1 Appliances that contain lamps include sun beds and flat panel displays.

NOTE 2 Appliances that may contain asbestos include heaters and stoves.

NOTE 3 Temperature exchange equipment includes refrigerators, freezers, equipment which automatically delivers cold products, dehumidifying equipment, air-conditioning equipment and heat pumps.

5.1.3 All handling of WEEE including the loading, unloading and transport shall be carried out with appropriate tools, containers and fixing to avoid damage to WEEE.

5.1.4 Uncontrolled tipping of containers with CRT display appliances, flat panel displays, temperature exchange equipment, and lamps shall not be permitted.

5.1.5 WEEE shall not be handled in a way that subsequent preparation for re-use, de-pollution or recovery is adversely affected or inhibited.

5.2 Storage

5.2.1 Maximum storage amounts of WEEE shall respect legal and regulatory requirements. Where such provisions are not available, the maximum amount of WEEE stored shall not exceed the amount of WEEE that can be treated within six months

5.2.2 Sites for storage (including temporary storage) of WEEE prior to their treatment require (without prejudice to the requirements of Council Directive 1999/31/EC) according to Annex III of Directive 2002/96/EC:

- impermeable surfaces for storage areas and the provision of spillage collection facilities, and where appropriate, decanters and cleanser-degreasers, and
- weatherproof covering for appropriate areas.

NOTE Weatherproof covering includes roof, closed or covered containers.

5.2.3 For CRT display appliances, flat panel displays, temperature exchange equipment and lamps only storage areas with weatherproof covering are appropriate in the context of this normative document.

5.2.4 The quantity of WEEE stored prior to treatment without weatherproof covering shall not exceed the average quantity of WEEE supplied per month.

5.2.5 Storage areas designated for the storage of WEEE intended for preparing for re-use shall have weatherproof covering

5.2.6 When storing CRT display appliances, flat panel displays, temperature exchange equipment, and lamps they shall be placed in containers or stacked in a stable manner to prevent damage or breakage.

5.3 De-pollution

5.3.1 The treatment operator shall remove all liquids, substances, preparations, and components from WEEE according to Article 8 (2) and Annex II (Selective treatment of materials and components of WEEE) of Directive 2002/96/EC.

NOTE Annexes A (De-pollution guidelines) and B (De-pollution monitoring) provide guidelines for the de-pollution of WEEE and Part II of this normative document describes the specific requirements for the treatment of CRT display appliances, flat panel displays, lamps and temperature exchange equipment.

5.3.2 Removal practices shall not damage or destroy components in a way that hazardous substances are released to the environment or distributed to fractions, unless subsequent treatment of the hazardous substances is secured.

5.3.3 During treatment of ICT equipment, personal data stored on the memory of the ICT equipment shall be destroyed.

5.3.4 To fractions or substances classified as hazardous wastes no other types of waste or non-waste materials shall be added to make overall waste volume fall below the limit of hazardous waste classification (ban on dilution).

5.3.5 Substances, preparations and components to be removed or fractions containing these in accordance with clause 5.3.1 shall be kept separate to ensure wholesomeness (integrity) of the material stream. They shall be clearly identified, labelled and forwarded with related documentation.

5.3.6 If it is uncertain that hazardous substances are present in WEEE or components, the WEEE or components shall be treated as if they contain the substances. Especially if there is uncertainly whether

- temperature exchange equipment is free from volatile compounds such as chlorofluorocarbon (CFC), hydrochlorofluorocarbon (HCFC) and hydrofluorocarbon (HFC),
- capacitors contain polychlorinated biphenyls (PCB),
- the content of brominated flame retardants in plastic fractions is below the limit value given in Annex B (de-pollution monitoring), or
- flat panel displays are equipped with backlight lamps

5.4 De-pollution monitoring

Monitoring of de-pollution performance shall be determined by one or several of the three following methodologies:

- quantification of the outgoing stream and comparison with a target value or assessment of progress,
- establishment of a mass balance between incoming and outgoing streams, and
- analysis of representative samples of relevant fractions from treatment of de-polluted WEEE.

NOTE Benchmarks and target values relative to the first methodology may be established on the basis of collected data and statistical analyses. Mass balance assessment may be measured by means of batches or annual data comparison.

5.5 Further treatment

5.5.1 WEEE and related fractions containing hazardous wastes shall be treated separately from other wastes. Hazardous waste shall not be mixed, neither with other categories of hazardous waste nor with other types of waste, substances or materials unless:

- the mixing operation is carried out by an operator which has obtained a permit from the relevant authorities for this activity, and
- the mixing operation does not adversely affect human health, safety, or the environment

5.5.2 If non de-polluted WEEE or fractions thereof are treated by a contracted third party, the subsequent treatment operator shall be informed of the potential presence of hazardous material in accompanying documents.

5.6 Storage of fractions and components

5.6.1 All fractions containing hazardous substances shall be stored in a manner that prevents dispersal of the hazardous material to the environment.

5.6.2 Capacitors, mercury containing components, batteries, printed circuit boards, toner cartridges, asbestos waste and components which contain asbestos, cathode ray tubes, lamps, components containing refractory ceramic fibres and components containing radioactive substances shall be stored under weatherproof covering. In addition, specific conditions required by legislation shall apply.

5.7 Recycling and recovery

5.7.1 The treatment operator shall demonstrate reaching the recycling and recovery targets laid down in Directive 2002/96/EC.

5.7.2 If WEEE categories, subject to different recycling and recovery targets are treated together the calculation of recycling and recovery targets shall be according to the method provided for in Annex D (Determination of recycling and recovery rates).

5.7.3 To determine recycling and recovery rates, batch processing according to the requirements given in Annex C (Requirements concerning batches) shall be performed at least once every two years per site and per category. Following significant changes of the input quality or subsequent to significant changes of the treatment technology, an additional assessment batch shall be carried out.

NOTE If only one WEEE treatment category with continuous quality had been processed and separate documentation exists, annual data or methods equivalent to the batch may be used to determine recycling and recovery rates.

5.7.4 Batches of external separation processes on non-pure fractions shall be required from the downstream operator if this fraction represents more than 20 percent of the total input of

any WEEE treatment category according to Annex C (Requirements concerning batches) clauses C.4.2 and C.4.3.

5.7.5 The calculation of the recycling and recovery rates shall be carried out as described in Annex D (Determination of recycling and recovery rates).

5.8 Disposal of fractions

5.8.1 Within disposal options priority shall be set to avoid long-term emissions from landfills. Appropriate technologies shall be applied to destroy organic carbon, to reduce contaminated leachate and carbon containing emissions from landfills, and to reduce the volume of fractions.

NOTE In certain member states insufficient landfill capacity and legislative requirements require the landfill of organic carbon containing fractions.

5.8.2 Hazardous substances or preparations for disposal shall be destroyed or immobilised prior to disposal in authorised landfills.

5.8.3 Waste destined for landfills shall be treated to fulfil the requirements for the disposal at authorised and controlled landfill sites.

5.8.4 Materials containing mercury, halogenated compounds, and beryllium shall not be destroyed by incineration, waste to energy or be disposed of in landfill except if the law mandates these methods of disposal, or prohibits their use in electrical and electronic equipment sold after 31 December 2012.

5.9 Documentation

5.9.1 The operator shall be in a position to make available simple and understandable documents including:

- records demonstrating compliance with legal and regulatory obligations applying to all activities undertaken on site,
- internal administrative procedures and management review and improvement process, results and documents of downstream monitoring,
- documents from the preparation for reuse according to section 4.6,
- first aid measures and emergency plans including records of insurance or financial resources as required in clause 4.3.5,
- risk assessments documents and emergency records addressing incidents, accidents, illness, leakages, fires, and damages,
- records of cleaning and decontamination of containers used for storing lamps,
- training, health, safety, and environmental monitoring records,
- instructions, hints, advices for processing steps and manual dismantling,
- process diagrams with single steps and related fractions,
- records of maintenance of site and servicing of machinery,
- results of internal controls and de-pollution monitoring (Annex B and WEEELABEX specific requirements for treatment of CRT display appliances, flat panel displays, lamps and VFC/VHC appliances)
- results from batches according to Annex C (Requirements concerning batches), and
- reports according to Annex D (Determination of recycling and recovery rates).

COMMENT Without prejudice to the principle of freedom of contract between an operator, on the one hand, and a WEEE system, on the other, some of the documents that operators must be in a position to make available to [WEEELABEX] are of a confidential nature and can only be provided to external entitled parties who are subject to non-disclosure agreements.

5.9.2 The treatment operator shall keep a mass balance, which consists of the documentation of all material flows (summaries of incoming and outgoing deliveries of WEEE or WEEE fractions) in an annual overview under consideration of stored amounts.

5.9.3 All documents shall be stored securely and maintained to demonstrate compliance with the WEEELABEX normative document. All documents shall be stored for five years unless legislation or authorities stipulate a longer period.

Bibliography

[1] Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE). (Official Journal of the European Union (OJ L 37, 13.2.2003).

[2] Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives (OJ L 312, 22.11.2008).

[3] Regulation 1013/2006 of the European Parliament and of the Council of 14 June 2006 on shipments of waste (OJ, L 190/1, 12.7.2006). Regulation as last amended by Commission Regulation (EC) No 1379/2007 (OJ L 309, 27.11.2007, p. 7).

[4] Council Directive 92/3/Euratom of 3 February 1992 on the supervision and control of shipments of radioactive waste between Member States and into and out of the Community.

[5] Council Directive 1999/31/EC of 26 April 1992 on the landfill of waste (OJ L182 16.7.1999).

[6] Council Directive 96/59/EC of 16 September 1996 on the disposal of polychlorinated biphenyls and polychlorinated trephines (PCB/PCT)

[7] Council Directive 87/217/EEC of 19 March 1987 on the prevention and reduction of environmental pollution by asbestos.

[8] Council Directive 96/29/Euratom of 13 May 1996 laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionizing radiation.

[9] Guidance document on Annex II and Article 6.1 of Directive 2002/96/EC of 3 November 2005.

[10] Council Directive 89/391/EEC of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work (OJ L 183, 29.6.1989, p. 1–8).

[11] Council Directive 98/24/EC of 7 April 1998 on the protection of the health and safety of workers from the risks related to chemical agents at work (fourteenth individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC) (OJ L131 05.05.1998, p11-23).

[12] Commission Decision 95/320/EC of 12 July 1995 setting up a Scientific Committee for Occupational Exposure Limits to Chemical Agents.

[13] IEC 61619 Insulating liquids – Contamination by polychlorinated biphenyls (PCBs) – Method of determination by capillary column gas chromatography

[14] Fundación Ecolec – Proyecto de investigación, Condensadores empleados en grandes electrodomésticos no frío – July 2007

[15] EMPA – Concentrations of RoHS substances in plastics from waste electrical and electronic equipment – Final report – 17 September 2010

Annex A
(normative)

De-pollution guidelines

A.1 Introduction

A.1.1 This Annex refers to clause 5.3, de-pollution, WEEELABEX normative document on treatment – Part I (General Requirements) and gives additional information about hazardous substances and components, their removal from WEEE in accordance with Annex II (Selective treatment of materials and components of WEEE) of Directive 2002/96/EC and the Guidance document on Annex II and Article 6.1 of Directive 2002/96/EC of 3 November 2005.

A.1.2 These guidelines are intended to assist treatment operators to achieve de-pollution in accordance with Annex II (Selective treatment of materials and components of WEEE) of the Directive 2002/96/EC. The examples in this text concerning the types of hazardous substances in different types of appliances are non-exhaustive.

A.1.3 In accordance with to the Guidance document on Annex II (Selective treatment of materials and components of WEEE) and Article 6.1 of Directive 2002/96/EC, substances, preparations and components may be removed manually, mechanically or chemically, metallurgically with the result that hazardous substances, preparations, and components mentioned in Annex II (Selective treatment of materials and components of WEEE) of the Directive 2002/96/EC are contained as an identifiable stream or identifiable part of a stream at the end of the treatment process. A substance, preparation or component is identifiable if it can be monitored to prove environmentally safe treatment. As a consequence of this interpretation of the phrase “have to be removed” two different categories are distinguished in this Annex:

- substances, preparations and components which “have to be removed” as a first step in the treatment process. According to Article 6.1 of Directive 2002/96/EC all fluids shall be removed.

NOTE 1 Examples of substances, preparations and components which “have to be removed” as a first step may include: external batteries (batteries readily accessible in appliance), capacitors, mercury switches, beryllium oxide components, asbestos and ceramic fibre parts.

- substances, preparations and components which "have to be removed" as an identifiable (part of a) stream during the treatment process.

NOTE 2 Examples of substances, preparations and components which “have to be removed” as an identifiable (part of a) stream in the next steps of the treatment process may include: plastics containing brominated flame retardants, printed circuit boards, and internal batteries (batteries which are internal to an appliance and not intended for replacement by the consumer).

A.1.4 The operations of handling, sorting, storage, transport and treatment of hazardous substances are not specified within this Annex. These operations shall fulfil the requirements of the WEEELABEX normative document on treatment – Part I (General Requirements).

A.1.5 The operations involved in the de-pollution of CRT display appliances, flat panel displays, lamps, and temperature exchange equipment, shall fulfil the requirements of WEEELABEX normative document on treatment – Part II, specific requirements in addition to this Annex.

A.2 Capacitors

A.2.1 Annex II (Selective treatment of materials and components of WEEE) of Directive 2002/96/EC requires that the following components shall be removed from separately collected WEEE:

- polychlorinated biphenyls (PCB) containing capacitors in accordance with Council Directive 96/59/EC of 16 September 1996 on the disposal of polychlorinated biphenyls and polychlorinated terphenyls (PCB/PCT)
- capacitors containing mineral or synthetic oil
- electrolyte capacitors containing substances of concern (either height > 25 mm, or diameter > 25 mm, or proportionately similar volume)

NOTE Capacitors containing polychlorinated biphenyls (PCB) are capacitors where the dielectric is a sheet of paper soaked with PCB oil placed between aluminium conductors. Modern capacitors use ceramic, plastics and special silicate minerals as dielectric material.

A.2.2 All capacitors which are not clearly identified as PCB free shall be considered as PCB containing or PCB suspect capacitors. Capacitors can only be considered as PCB free, if one of the following criteria is fulfilled:

- if they have been produced after 1986 or they come from appliances produced after 1987
- if they are declared and labelled as PCB free
- if they are declared as PCB free by documents of the producing company.
- if conductors are polarized and marked “+” and “-“ (electrolyte capacitors)

NOTE 1 Investigations by Fundación Ecolec have demonstrated that capacitors with plastic mantle or casings do not contain PCB.

NOTE 2 Electrolytic capacitors are special constructions of capacitors, not containing PCB, but a liquid as the anode and aluminium (or tantalum) as the cathode conductor. The dielectric layer is a metal oxide layer on the surface of the plates, build up by an electrochemical reaction between the liquid and mostly aluminium. Electrolytic capacitors are always polarized (marked “+” and ”-”). Common liquids are inorganic and organic acids and a wide range of additives are used. Electrolytic capacitors offer very high capacitance and are widely used for power-supply conditioning.

A.2.3 If an operator is not capable of separating the different types and constructions of capacitors described in clause A.2.1 and other types of capacitor, all capacitors shall be removed.

NOTE Capacitors may be found in household appliances for example: washing machines, temperature exchange equipment, dishwashers, fume extraction hoods, tumble dryers and drying hoods, microwave stoves, ballasts of lamp equipment, copying equipment, power supply units, ballast units of low voltage systems, and many other electronic components such as screens.

A.3 Components containing mercury

A.3.1 Annex II (Selective treatment of materials and components of WEEE) of Directive 2002/96/EC requires that mercury containing components, such as switches or backlight lamps shall be removed from separately collected WEEE.

A.3.2 Mercury-containing switches shall be removed as a first step in the treatment process.

NOTE 1 Mercury switches allow or interrupt the flow of electric current in an electrical circuit in a manner that is dependent on the switch's physical position and the mercury physical characteristics. This technology was used only before 1985, for example, in mercury tilt switches or in relays (air gap switches).

NOTE 2 Mercury switches are not easy to identify. In vapour pressure switches or tilt switches mercury is often visible in a glass capsule. Switches in an electronic surrounding (also called relay switches) are often encased and the metallic mercury is not visible; sometimes the switches are marked with "Mercury", "Hg", "HG" or "MC" on the casing.

NOTE 3 Mercury tilt switches or vapour pressure switches may be found in old boilers, washing machines, chest freezers, irons, coffee machines and old telephone installations. Mercury containing relay switches were used in old high quality electronic and sophisticated monitoring equipment.

A.4 Batteries and accumulators

A.4.1 Annex II (Selective treatment of materials and components of WEEE) of Directive 2002/96/EC requires that batteries shall be removed from separately collected WEEE. Batteries shall be part of an identifiable stream in accordance with clause A.1.3 of this document.

NOTE 1 When removing batteries from WEEE it is possible to remove external batteries in the first steps of treatments and internal and button type cell batteries in subsequent treatment steps. External batteries are those that are readily accessible in the appliance and internal batteries are those batteries which are internal to an appliance and not intended for replacement by the consumer.

NOTE 2 Certain primary (disposable) and rechargeable batteries (accumulators) may contain hazardous materials such as cadmium, mercury and lead. Even very small coin cell batteries can contain an important amount of mercury. These batteries should be handled in accordance with EU hazardous waste legislation.

NOTE 3 Appliances containing batteries: in general all portable consumer electronics and cordless and/or rechargeable household appliances such as vacuum cleaners, hair cutters, electronic toothbrushes, shavers, clocks, watches, scales, laptop computers, notebook computers, notepad computers, pocket and desk calculators, mobile phones, radios sets, video cameras, drills and other cordless and /or rechargeable tools, many electric toys, video game consoles and video games, portable electric sports equipment, smoke detectors, heating regulators, thermostats and other control and monitoring equipment.

NOTE 4 Appliances suspect to contain batteries: all electronic equipment with small and large printed circuit boards.

A.4.2 Special precautions and safety measures shall be in place for operations concerning used lithium batteries and for mixed batteries if any lithium battery is present in the mixture.

NOTE The share of lithium batteries in public collection bins or removed from WEEE is about 3-5 percent (2010).

A.4.3 Exposure to heat, humidity, sunlight, water, or any crushing or physical damage to lithium batteries shall be avoided during handling, sorting, storage, and transport. Lithium batteries shall be removed, without damage, during the first step of the treatment process.

NOTE Special attention should be paid to lithium-ion battery (marked Li-ion or LIB). Lithium ion batteries are a family of rechargeable battery with large capacity and often used in modern portable electronics like mobile phones. Chemistry and safety characteristics vary across lithium-ion types. Lithium batteries may rupture, ignite or explode when exposed to high temperature, prolonged sunlight, mechanical destruction of the safety device (casings), or when exposed to water or humidity. Most of the lithium ion batteries have a "Li-ion" marking on the encapsulated casings.

A.4.4 Emergency response equipment specific to the risks inherent to lithium (Class D rated fire extinguisher, and personal protective equipment) shall be available at all sites where lithium batteries are handled, stored or may be physically damaged. All involved employees shall be informed about the risk and trained to fight a lithium battery fire.

NOTE 1 It is advisable to store lithium-based batteries, in a separate area away from any other waste stream (solid or liquid).

NOTE 2 Powdered copper metal based powders are preferred for fires involving lithium and lithium alloys.

NOTE 3 Lithium batteries and cells (all types), including mixtures of batteries containing lithium types are classified as dangerous goods (UN 3090 covers primary lithium batteries and UN 3480 covers rechargeable lithium-ion batteries) for transport by road, sea and air. Packaging, labelling and other safety measures shall follow national and international provisions in accordance with the European Agreement concerning the international carriage of dangerous goods by road and rail (RID/ADR) as well as the Sea Transportation mode (IMDG). The shipment of waste lithium batteries by air is forbidden.

A.5 Printed circuit boards

Annex II (Selective treatment of materials and components of WEEE) of Directive 2002/96/EC requires that printed circuit boards shall be removed from separately collected WEEE if the surface of the printed circuit board is greater than 10 square centimetres.

NOTE 1 The fractions of lead, tin, antimony, chromium, beryllium oxide and cadmium on the printed circuit board, restricted brominated flame retardants in the plastic part of the printed circuit board, and bromine in the plastic parts should be considered for further treatment. During mechanical processing of printed circuit boards, there is a risk of diffuse emission to the environment and contamination of workplaces with dust and heavy metals.

NOTE 2 Printed circuit boards occur in a wide range of electronic appliances and also in the electronic parts of large and small household appliances, tools, toys, sport equipments, and medical devices.

A.6 Plastics containing certain types of brominated flame retardants

A.6.1 Annex II (Selective treatment of materials and components of WEEE) of Directive 2002/96/EC requires that plastic containing brominated flame retardants shall be removed from any separately collected WEEE.

NOTE Plastics shall be removed from WEEE in accordance with clause A.1.3.

A.6.2 In case of plastic recycling, plastic end-of-waste products shall be achieved. The downstream monitoring and auditing shall trace plastics fractions until the end-of-waste status is reached. The plastic recycling operator shall comply with relevant product legislation for its plastics fractions from WEEE to the end-of-waste status. Plastics that do not comply with relevant product legislation shall be treated as waste or be disposed of in accordance with legislation. As a minimum end-of-waste plastics shall comply with the criteria of clause B.4.

NOTE 1 For plastic fractions from temperature exchange equipment and non-cooling large household appliances, monitoring of compliance with relevant product legislation of the end-of-waste status is not required

NOTE 2 For all other categories, the downstream monitoring and verification in accordance with A.6.2 should be fulfilled

A.6.3 Compliance with relevant product legislation shall not be reached by mixing more than one WEEE plastic fraction unless the separation of brominated flame retardants is documented to take place after mixing, and mixing criteria for wastes as described in Directive 2008/98/EC.

A.7 Volatile fluorocarbons and volatile hydrocarbons

A.7.1 Annex II (Selective treatment of materials and components of WEEE) of Directive 2002/96/EC requires that chlorofluorocarbons (CFC), hydrochlorofluorocarbons (HCFC) or hydrofluorocarbons (HFC), hydrocarbons (HC) shall be extracted from separately collected WEEE.

NOTE This clause applies to hydrocarbon (HC) gases which have a global warming potential (GWP) above 15.

A.7.2 Appliances containing one or more of the substances mentioned in clause A.7.1 shall be sorted to a separate WEEE stream and sent to specialised treatment facilities.

NOTE 1 Appliances which commonly contain volatile fluorocarbons and volatile hydrocarbons include refrigerators, freezers, heat pump tumble dryers, de-humidifiers and portable air conditioners of the type commonly found in private households.

NOTE 2 Heat pump tumble dryers put on the market since 2005 contain fluorinated gases and oil in their heat-exchange circuit. The information is usually placed on the back of the machine or on the plating rate, declaring that the appliance contains fluorinated gases (F-gas) that are covered by the Kyoto protocol.

A.7.3 Insulation foam shall be removed from water boilers insulated with foam containing one or more of the substances mentioned in clause A.7.1 as blowing agent. The removed foam shall be disposed of in incineration plants with related permissions, or by other authorised methods destroying the dangerous substances mentioned in clause A.7.1.

NOTE Water boilers containing halogenated hydrocarbons in their insulation foam were put on the market before 1995.

A.8 Asbestos

A.8.1 Annex II (Selective treatment of materials and components of WEEE) of Directive 2002/96/EC requires that asbestos waste and components which contain asbestos shall be removed from separately collected WEEE.

A.8.2 Asbestos waste and components shall be removed as a first step in the treatment process.

NOTE Asbestos is a mineral which occurs as a white or slightly grey fibre and has been used in electronic appliances as an insulation material and as a fire-retardant because of its fibre strength and heat resistant properties. When asbestos containing appliances are damaged or disturbed by repair, treatment, or demolition activities, microscopic fibres become airborne and may be inhaled into the lungs where they may cause significant health problems.

A.8.3 Asbestos containing appliances or components shall be separated from other appliances. Handling shall avoid any emissions of asbestos fibres. WEEE that contains asbestos shall be sealed with an impermeable covering and clearly marked with the related asbestos danger label.

A.8.4 Operators shall only perform removal and disposal of asbestos with appropriate authorisations as described in Directive 87/217/EEC and its transposition.

NOTE Appliances which may contain asbestos include: stoves, electric heating systems, electric storage heaters, toaster, hairdryers, and any heat isolation system in electrical devices put on the market before 1985.

A.9 Components containing radioactive substances

A.9.1 Annex II (Selective treatment of materials and components of WEEE) of Directive 2002/96/EC requires that components containing radioactive substances, with the exception of components that are below the exemption thresholds set in Council Directive 96/29/Euratom, shall be removed from any separately collected WEEE.

NOTE Council Directive 96/29/Euratom lays down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation.

A.9.2 Components containing radioactive substances shall be removed as a first step in the treatment process.

A.9.3 Treatment facilities shall be monitored for radioactive materials in WEEE in accordance with legislation.

NOTE 1 This clause may be fulfilled using specialised monitors to detect radioactive materials or components containing radioactive substances or, as a minimum, only employees trained to identify appliances containing radioactive units shall carry out sorting and checking of the incoming WEEE stream.

NOTE 2 The units with the radioactive materials or components are generally marked with the “radioactive danger” label. Appliances that contain radioactive materials or components containing radioactive substances include smoke detectors, medical devices and laboratory equipment.

A.9.4 Components containing radioactive substances shall be separated for further treatment by companies with appropriate permissions in accordance with Council Directive 96/29/Euratom and its transposition.

A.10 Other components

A.10.1 Directive 2002/96/EC requires the removal of the following hazardous substances and components of concern as a first step in the treatment process in accordance with A.1.3:

- toner cartridges, liquid and pasty, as well as colour toner from printer equipment,
- lamps,
- components containing refractory ceramic fibres, and

- oil.

The following components may be removed as an identifiable (part of a) stream in the next steps of the treatment process in accordance with A.1.3:

- flat panel modules of a surface area greater than 100 square centimetres in any electronic appliances
- cathode ray tubes
- external electric cables

NOTE Oil from oil filled radiators is seldom contaminated by PCB. Normally radiator oils contain less than 50 ppm PCB, which is accepted as PCB free oil in accordance with the standard methodology.

A.10.2 Diffuse emissions and dust explosions of hazardous materials shall be avoided. If recycling, or recovery of materials, is not foreseen these materials shall be destroyed by incineration or be disposed of in authorised landfills licensed to receive hazardous waste.

A.10.3 Requirements to treat lamps, liquid crystal displays and cathode ray tubes are given in WEEELABEX normative requirements – Part II, specific requirements.

Annex B
(normative)

De-pollution monitoring

B.1 Introduction

B.1.1 This annex refers to clause 5.4, De-pollution monitoring, of WEEELABEX normative document on treatment – Part I (General Requirements) and lays down the rules of monitoring de-pollution performance. Although only selected hazardous substances and components shall be described in this annex, all hazardous materials as described in Annex II of Directive 2002/96/EC shall be removed from WEEE.

B.1.2 For de-pollution monitoring of temperature exchange equipment, lamps, CRT display appliances, and flat panel displays, WEEELABEX normative document on treatment – Part II specific requirements shall apply in addition to this annex.

B.1.3 Monitoring and control of the quality of de-pollution of capacitors, batteries, and printed circuit boards of all flows is based on two different methodologies. First batch results are compared with a benchmark system provided and maintained by [WEEELABEX] (clause B.2.2). Secondly a chemical analysis of shredder light fractions as defined in B.3 is required. These values are compared with the limit values laid down in B.3.

B.1.4 Requirements to run batches are described in Annex C of this document.

B.2 Capacitors, batteries and printed circuit boards

B.2.1 During the batch, performed according to clause 5.7 of WEEELABEX normative document on treatment – Part I (General Requirements) and Annex C, removed batteries, capacitors, and printed circuit boards shall be weighed separately and compared to the input volume of the batch.

B.2.2 To verify the quality of de-pollution during the batch target values of removed batteries, capacitors, and printed circuit boards shall be reached. The target values are set up by a benchmark system developed by [WEEELABEX].

NOTE The benchmark system is based on experience data from batches, special investigations or annual mass balances, with different input categories or distinct mixtures of it and in different geographical regions. It will be coordinated, approved and updated by [WEEELABEX].

B.2.3 If the treatment facility fails to reach the target values for removal of capacitors, batteries and printed circuit boards, remedial measures shall immediately be taken to improve de-pollution.

NOTE Improvement of de-pollution processes shall not be required if the operator can demonstrate that the failure to reach the target values is linked to the composition of the input material.

B.2.4 The operator shall demonstrate through documentation of de-pollution results that the batches are comparable with day-to-day conditions. Reports shall include the volumes of:

- batteries, capacitors and printed circuit boards deliveries per year,
- batteries, capacitors and printed circuit boards stocks at the end of the year, and
- related input categories of WEEE.

In the event that printed circuit boards end up as part of one or more output fractions, the total quantities of printed circuit boards shall be assessed.

Related weighing records and supply notes shall be documented.

B.3 Shredder light fraction

B.3.1 In addition to the monitoring methodology (B.2) the quality of de-pollution shall be measured on the basis of a chemical analysis of the finest, non-metallic shredder fraction (shredder light fraction).

NOTE The shredder light fraction is the result of air separation and may consist of fibre, light plastics and dust as main parts and is sometimes differentiated into fluff light fraction and dust.

B.3.2 A representative mixed sample shall be taken and analysed at least once per year. Representativeness shall refer to the time period and the input material, and consider the sampling method of EN 14899 or an equivalent standard.

B.3.3 To verify the quality of mechanical de-pollution, the following preliminary limit values in the light shredder fraction of the first mechanical treatment operation shall apply:

- Copper (Cu) [10.000] mg/kg (see note)
- Cadmium (Cd) [100] mg/kg (see note)
- Polychlorinated Biphenyls (PCB) [50] mg/kg (see note)

Copper limit value shall not apply, if further treatment step involves copper separation.

Chemical analysis shall be carried out in accredited laboratories authorised to process and analyse waste fractions.

NOTE 1 6 PCB-congeners in accordance with DIN 51 527 Part 1 should be determined and assessed in accordance with Council Directive 96/59/EC on PCBs and PCTs and the standards and national legislation derived from this. European standard IEC 61619 and subsequent revisions shall be applied as the reference method for the determination of PCBs in insulating liquids.

NOTE 2 The limit values do not cover all the possible pollutants in the light shredder fraction; only for possible pollutants which are efficient de-pollution indicators have limit values been established.

B.3.4 Adherence to the monitoring requirements and limit values in accordance with B.3.3 is required when WEEE is treated with other waste. In those cases the operator shall demonstrate, e.g. by means of a batch, that possible pollution is not due to WEEE and that dilution of pollutants with other waste can be excluded by monitoring the light shredder fraction during the batch with WEEE.

B.3.5 If an operator fails to reach the target values for pollutants in shredder light fractions, remedial measures shall immediately be taken to improve de-pollution.

B.4 Plastics with certain types of brominated flame retardants

B.4.1 End-of-waste plastics shall not contain any Polybrominated Biphenyls (PBB) at levels of more than 50 ppm. Octa- and Penta-Polybrominated Diphenylethers (penta- and octa-BDE) shall not be present in concentrations of more than 1000 ppm each.

B.4.2 Representative product samples shall be taken and analysed at least once per quarter and recorded in the compliance documentation of the recycling operator. The analyses shall at least cover the substances mentioned under B.4.1.

NOTE 1 Investigations by the WEEE Forum have demonstrated that for plastic fractions from temperature exchange equipment and non-cooling large household appliances, monitoring of compliance with relevant product legislation of the end-of-waste status is not necessary, and that for plastic fractions from all other categories of WEEE, the downstream monitoring and verification in accordance with A.6.2 should be fulfilled.

Annex C
(normative)

Requirements concerning batches

C.1 Introduction

C.1.1 This annex refers to clause 5.7.3, recycling and recovery, of WEEELABEX normative document on treatment – Part I (General Requirements) and lays down the requirements and preconditions to plan, to prepare, to carry out and to evaluate a batch.

C.1.2 Batch results shall be representative compared with normal day-to-day conditions, especially with respect to the composition of the input material and processing operations. WEEE shall not be prepared or selected in order to change original composition. The operator shall document the manner in which the batch input material has been collected.

C.2 Input material

C.2.1 Batches shall be performed with the following treatment categories and minimum amounts of input materials

large appliances	• 2 hours of average capacity but a minimum of 50 t in large shredders (40-50 t/h capacity) • 2 hours of average capacity but minimum 10 t in a WEEE specific medium shredder • 5 t (100 units) for manual dismantling
CRT display appliances	• 2 hours of average capacity but minimum 10 t in a specific shredder for CRT display appliances • 5 t (250 units) for manual dismantling
cooling & freezing appliances	• for step one-treatment (in case of separate batch): 2 hours of average capacity but min 5 t • for step two-treatment: 2 hours of average capacity but minimum 10 t in a special shredder for cooling & freezing appliances • minimum 50 t of (H)(C)FC free cabinets in large shredders
small appliances	• 2 hours at average capacity but a minimum of 50t in large shredders (40-50 t/h capacity) • 2 hours of average capacity but minimum 10 t in a WEEE specific medium shredder • 5 t for manual dismantling
lamps	• 5 t in a lamp specific treatment plant
fractions of WEEE	• minimum 2 hours of average capacity of the fraction specific treatment process • 1 day full capacity for manual process

C.2.2 The total weight of the input material shall be determined by indelible registration methods.

C.2.3 The presence of water in the input material shall be avoided by storing the input material under weatherproof conditions. The mixture and consistency of the input material shall be checked, evaluated visually and recorded, compared with normal supplies.

C.3 Processing

C.3.1 Processing of batches shall involve the de-pollution steps as described in Annex A. Manually removed pollutants before the mechanical step of the batch shall be weighed and documented using a similar procedure as the fractions from the mechanical processes (see clause C.4).

C.3.2 Prior to commencing the mechanical processing of a batch, the treatment operator shall either process about 10 percent of the batch input volume or empty the shredder.

C.3.3 Empty containers and recipients for the output material shall be identified and weighed in order to be able to determine the net weight of each output fraction.

C.3.4 Any reasons for material input/output differences exceeding 5 percent of the total input amount during the batch process shall be checked. If there is no plausible reason, the batch shall be repeated. Breakdown or malfunctions of equipment during the batch shall be documented (see clause C.5).

C.4 Output fractions

C.4.1 The total weight of the fractions shall to be determined by indelible registration methods. The composition and water content of the fractions shall be checked and evaluated visually in order to assess the representativeness of the batch.

C.4.2 Metallic fractions with less than 2 weight percent non-metallic shares (plastics, inorganic material) shall be considered as pure fractions and shall not require further analysis regarding composition. In case of pure metal mixtures or metal compounds, the share of metals shall be estimated. The purity criteria shall also apply for non-metallic fractions, where the non-target material is considered as impurity.

C.4.3 No composition data shall be required for final fractions forwarded for disposal.

C.4.4 The composition of non-pure fractions (metals, plastics or inorganic material) dedicated to further separation steps or to final recovery operations shall be analysed in accordance with one of the following methods:

- chemical analysis of a representative sample
- records of the external operator performing the next separation step or thermal recovery
- handpicking analysis, weighing the manually separated metallic and non-metallic shares of a representative sample
- batch of the fraction, if the yield is higher than 20 percent in accordance with clause 5.7.5

NOTE If none of these analyses is possible (for example for compound fractions which cannot be sorted by handpicking analysis and the quantity of which is too small for analysis), best estimations of the composition are acceptable.

C.4.5 In order to take representative samples of the mixed fraction, the conical heap sampling method shall be applied.

NOTE The conical heap method is described by EN 14899: Characterization of waste – Sampling of waste materials – Framework for the preparation and application of a sampling plan, 2005.

C.5 Documentation and validation

C.5.1 The operator shall be in a position to make available an understandable and well structured record of the batch, comprising the following elements:

- description and pictures of the input material with special focus on composition (types and categories of appliances), separating procedures, and on representativeness,
- input/output mass balance of the batch including losses and comments,
- description of the processing technologies with output fractions, including mass flow chart and further external separations, treatment or disposal,
- description and documentation (pictures) of output fractions including weighing documents, and
- composition of mixed output fractions: assessment methodology and results.

C.5.2 Reporting of the batch and preparation of supporting documentation shall be accomplished not later than one month after the batch had been performed, and all documents shall be stored for five years.

C.5.3 The batch shall be validated by a person entitled to perform conformity verification in accordance with [WEEELABEX]. Validation shall comprise a visual check during the batch, a visual check of all input and output fractions, verification of the documentation, and assessment of compliance with this Annex.

Annex D
(normative)

Determination of recycling and recovery rates

D.1 Scope and definitions

D.1.1 This annex refers to clause 5.7.5, recycling and recovery, of WEEELABEX normative document on treatment – Part I (General Requirements) and lays down the rules of determination and calculation the recycling and recovery rates based on batch or annual results.

D.1.2 In accordance with Article 6 of Directive 2008/98/EC on waste certain specified waste shall cease to be waste within the meaning of Article 3.1 when it has undergone a recovery, including recycling, operation and complies with specific criteria:

- the substance or object is commonly used for specific purposes,
- a market or demand exists for such a substance or object,
- the substance or object fulfils the technical requirements for the specific purposes and meets the existing legislation and standards applicable to products, and
- the use of the substance or object will not lead to overall adverse environmental or human health impacts.

NOTE In the event that end-of-waste criteria are fulfilled, simplification for the determination of recycling and recovery results may be applied.

D.1.3 The classification of the use of final fractions and components in technologies shall not deviate from the model classification in the scope of these requirements. If required by legal or regulatory requirements, a different classification may be done at national level (national classification).

NOTE 1 Model classification means the categorisation of the use of the components of final fractions in final technologies as preparation for re-use, recycling, other material recovery, energy recovery, thermal or landfill disposal.

NOTE 2 This annex aims to report treatment results, following and covering the whole treatment chain and including the classification of the use of final fractions and components in technologies (model classifications).

NOTE 3 WF_RepTool is a web-based tool and has been develop by the WEEE Forum to support and promote consistent and comparable treatment results delivered by WEEE compliance schemes and operators. The WEEE Forum strongly recommends its use within the WEEELABEX normative document on Treatment.

D.2 Principles

D.2.1 The determination process of the recycling and recovery rates starts with the untreated WEEE and ends when the end-of-waste status for fractions is achieved (see clause D.1.2) or with the final recovery or disposal of fractions, produced by treatment of the appliances. Therefore the whole treatment and processing chain of WEEE shall be considered.

D.2.2 The determination of the recycling and recovery rates shall be based on the input/output analysis of every single step within the treatment chain. The input/output analysis encompasses the following elements:

- weight and description of the input material,
- description of the treatment technology,
- yield of the output fractions according to batch results or equivalent methods,
- further treatment and processing of the fractions, and

- composition data of final fractions.

D.2.3 The determination of the recycling and recovery rates shall follow all fractions until final technologies are reached.

- For fractions having reached the end-of-waste status, only composition data and the possible final technology shall be provided.
- Fractions with less than 2 weight percent impurities may be considered as pure fractions and the main component may be given as 100 percent composition. In case of non-pure fractions the shares of components shall be provided.
- For pure metallic fractions the final acceptor (see clause D.4) may be described as “world market” and the technology may be estimated with the relevant smelter.
- For final fractions being forwarded for disposal no composition data shall be required.

D.2.4 The determination of the recycling and recovery rates shall be completed for each of WEEE treatment categories, for each WEEE treatment operator, and for each treatment facility.

WEEE category	Category includes	Reuse and recycling targets	Recovery targets
Cat. 1, 10	Large household appliances, temperature exchange equipment, automatic dispensers	75 %	80 %
Cat. 3, 4	IT, telecommunication and consumer equipment	65 %	75 %
Cat. 2,5,6,7,9,	Small household appliances, lighting equipment, tools, toys leisure and sports equipment, monitoring and control instruments	50 %	70 %
Cat. 5	Lamps	80 %	-

D.2.5 The determination of recycling and recovery rates for a mixture of two WEEE categories subject to different targets shall be allowed, if the input shares of the WEEE categories are known, based on a reliable record method. The targets of the mixture shall be calculated according to the following formula:

$$T_{\text{mixed Cat.}} = T_{Cat.3,4} * S_{Cat,3,4} + T_{Cat.2,5,6,7,9} * S_{Cat.2,5,6,7,9}$$

Where T : Targets of ‘re-use and recycling’ and ‘recovery’ in percentage

S : Shares of the total of input in percentage

D.3 Calculation

D.3.1 The recycling and recovery rates shall be calculated:

- as the percentage of the total of all output fractions, classified as prepared for re-use and recycling in proportion to the total of the input amount of non treated appliances (recycling rate),
- as the percentage of the total of all output fractions, classified as prepared for re-use, recycling and other material recovery or other recovery in proportion to the total of the input amount of non treated appliances (recovery), and
- in accordance with the classification given in clause D.5.

D.3.2 Simplifying assumptions shall be allowed for the following components if no specific data are available:

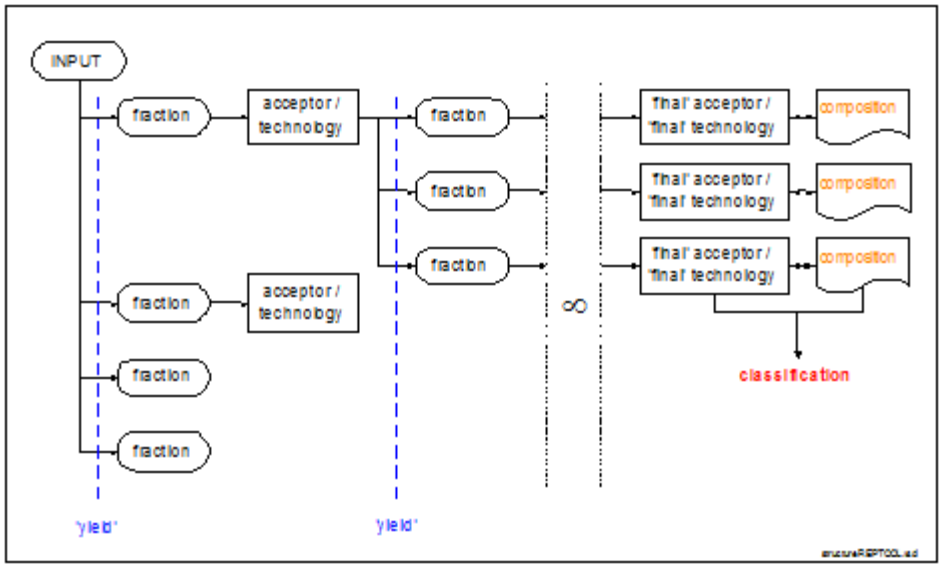
Components	Technology	Estimation yield / composition	Estimated use	Standard classification
Mixed batteries and accumulators	Battery recycling plant	50 % metals (estimate) 50 % non metals	To be completed	50 % recycling 50 % thermal disposal
Mixed cables	Specific cable shredder plant	30 % Cu 70 % plastics	Cu > Cu recovery No information – municipal waste incineration	30 % recycling 70 % thermal disposal
Capacitors	High temperature incineration	mixture	Hazardous waste incineration	100 % thermal disposal
Printed circuit boards	Copper smelter or precious metal refining	To be completed		30 % recycling 30 % energy recovery 40 % thermal disposal
Motors		To be completed		100 % recycling

D.3.3 If higher recycling and recovery rates shall apply, the equivalent verifications and supporting documents shall be available.

D.4 Documentation

D.4.1 The operator shall be in a position to make available an understandable and well structured document about the determination of the recycling and recovery rates, comprising the following elements:

- a flow chart showing the whole processing chain with names of fractions, yields and technologies, as provided for in the following example,



- a complete list of data sources, reliable and updated, and
- a detailed calculation which is traceable and based on the flow chart.

D.4.2 For fractions having reached the end-of-waste status, only composition data and the possible final technology shall be required. No composition data shall be required for final fractions forwarded for disposal.

NOTE For pure metallic fractions the final acceptor may be described as ‘world market’ and the technology may be described as ‘smelter’.

D.4.3 The determination of the recycling and recovery rates shall be completed and updated at least once every year, but also following any changes within the processing chain which may influence the recycling and recovery rates. The documents and records relating to this process shall be stored for five years.

D.5 Classification model

D.5.1 The classification model has been developed considering definitions provided for by legislation and standards, and rulings by the European Court of Justice (clause 3, terms and definitions of WEEELABEX normative document on treatment – Part I (General Requirements). Disposal processes have been further described in the categories "thermal disposal" and "landfill disposal" (i.e. the main non-thermal disposal technology, which may include other disposal technologies).

D.5.2 The options for classification are:

prep RU: prepared for re-use – includes whole appliances prepared for re-use and components prepared for re-use

R: Recycling

OMR: Other material recovery like backfilling

ER: Energy recovery

TD: Thermal disposal

LD: Landfill disposal

NOTE Fractions that cannot be allocated to one of the classifications listed in Table D.5.1 should be classified in accordance with Directive 2008/98/EC on waste.

D.5.3 In the following table the method of classification of the use of the components or fractions in final technologies is provided:

Components/ fractions	Use in final technology	Classification	Examples
….	……	…	….

D.5.4 In order to classify the use of a component or a fraction in a final technology step as “feedstock substitution”, the following requirements shall be met:

- waste fractions added during the process shall be described by type of waste fraction and share of input amounts used in daily routine under the product descriptions and/or process descriptions,
- a leachate test shall demonstrate, in accordance with European legislation and its transposition, that the test meets requirements laid down by the relevant authorities, and

- an approval that product requirements (for example the physical stability of the product without adding the waste fractions) are also met by adding the type and proportion of waste fractions given in the product or process description.

D.5.5 If the requirements from clause D.5.1 are not met, the classification term “no use” of the component / fraction shall be chosen from the “use in final technology” descriptions as described in clause D.5.1.

D.5.6 To classify the use of a component or fraction in a final technology step as a “slag forming fraction” the amount of the necessary input amount of a slag forming raw material shall be documented.

D.5.7 If the requirement of clause D.5.6 is not fulfilled, only the input amount of a slag forming raw material shall be classified as a “slag forming component”, and for the remaining material the classification term “no use” of the component or fraction shall be chosen from the “use in final technology” descriptors.

D.5.8 All uses of components/fractions in technologies described in the examples in clause D.5.2 as technologies as ‘special’ technologies shall be approved, by an independent study approving the special use of components/fractions

NOTE An example of an independent study approving the special use of components/fractions may be for example the quantity of plastics used as reducing agent or for fuel substitution.

Part II, Specific requirements

Specific requirements for the treatment of CRT display appliances

1 Scope

1.1 This normative document describes the specific requirements pertaining to CRT display appliances in the WEEE stream as a part of the WEEELABEX normative document. This normative document is applicable to all treatment operations with CRT display appliances, including all components and all fractions thereof in waste but also in end-of-waste status, in accordance with Directive 2008/98/EC on waste. The scope of this normative document ends when waste generated from CRT display appliances is finally treated or it is utilised in a final product.

1.2 This normative document defines additional requirements to those defined in the WEEELABEX general requirements for Collection, Logistics and Treatment of WEEE and addresses the specific requirements for the treatment of CRT display appliances including all components, fractions thereof and associated coatings.

1.3 This normative document aims to:

- Achieve effective and efficient handling of CRT display appliances in order to prevent pollution, minimise emissions and maximise recovery of fractions,
- Assure that quality, environmental, and health and safety limits are complied with during CRT display appliances handling and properly documented,
- Maximise mass yield of CRT glass and achieve the highest possible rate of recovery and recycling of CRT glass. Achieve the highest possible rate of removed fluorescent coatings from CRT glass and avoid emission of fluorescent coatings to the environment,
- Avoid lead dispersion to the environment,
- Prevent illegal export of CRT display appliances and fractions thereof, and
- Identify of criteria upon which the end of life status for CRT display appliances fractions are achieved.

2 Normative references

ISO 14025:2006 Environmental labels and declarations – Type III environmental declarations -- Principles and procedures

3 Terms & definitions

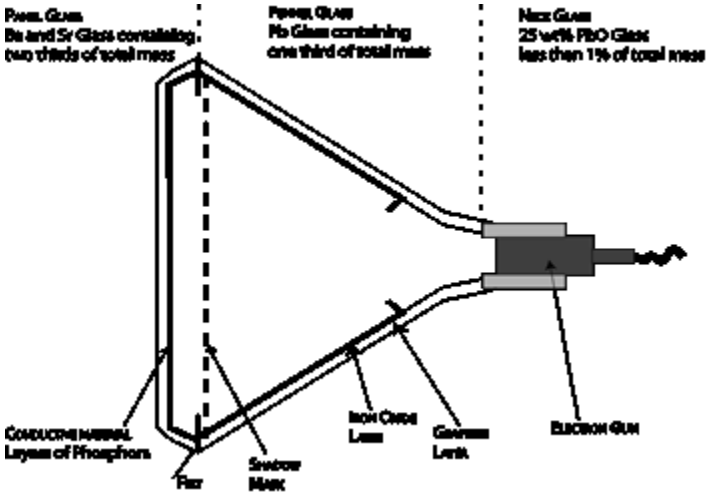
For the purpose of this document the terms and definitions given in WEEELABEX normative document on treatment – Part I (General Requirements), and the following apply.

3.1
CRT display appliance
complete TV set and whole computer monitor containing a cathode ray tube (CRT) or CRT with related deflection coil

NOTE CRT display appliances include business to business appliances like hospital monitors, bank cash machines, oscilloscopes etc.

3.2
Cathode Ray Tube (CRT)
vacuum tube containing an electron gun and a fluorescent screen used to create images in the form of light emitted from the fluorescent screen

Individual parts of CRT are shown on the following scheme:



NOTE The CRT vacuum tube consists of a screen, cone, frit glass, shadow mask (only for colour CRTs), anti-implosive metal frame, and an electron gun.

3.3
fluorescent coatings
coatings laid on the inner side of a screen which contain wide range of metals, rare-metals (e.g. europium and yttrium), and heavy metals (very often cadmium)

NOTE There is a risk that fluorescent coatings may have H6 and H13 and H14 hazardous properties in accordance with annex 3 of Directive 91/689/EEC on hazardous waste

3.4
panel glass (also sometimes called front glass)
glass from front part of CRT with high content of barium oxide and strontium oxide

NOTE Mass percentage of the lead oxide in panel glass shall not exceed 0.5 wt% as described in Clause 5.1.4.

3.5
funnel glass (also sometimes called cone glass)

glass from back part of CRT with high content of lead oxide

NOTE Panel glass and funnel glass are glued together by frit glass. Frit glass contains very high content of lead.

3.6
CRT glass
all types of glass originated from CRT either as separate fraction or mixed

3.7
cleaned CRT glass
CRT glass without fluorescent coatings

NOTE The limits concerning the content of fluorescent coatings in cleaned CRT glass are described in clause 5.2.3.

3.8
uncleaned CRT glass
CRT glass with fluorescent coatings

3.9
deflection coil
copper coil freely placed on cone that deflects electron beams emitted by electron gun

3.10
flux
additives to a smelting or refining process to assist in the forming of a slag, which is needed for the separation of slag forming elements from metals

NOTE Examples of flux used: SiO_2, CaO, FeO.

4 Administrative and organisational requirements

4.1 General

4.1.1 Dismantling, crushing or compacting of CRT display appliances prior to the treatment shall not be permitted.

4.1.2 When identification and sorting out of CRT display appliances with broken CRT can be assured at the collection facility. CRT display appliances with unbroken CRT can be stored without any special requirements to an amount that corresponds to the average monthly quantity supplied.

4.1.3 When storing CRT display appliances they shall be stacked in a stable manner to prevent damage or breakage of the appliances.

4.1.4 When a CRT display appliance is transferred to/from containers, it shall be done in a way to prevent any breakage of the CRT. Uncontrolled filling or tipping of the containers or bulk containers shall not be permitted.

4.1.5 When individual CRT display appliances (in bulk) is loaded and unloaded to/from the vehicle loading space, it shall be done in a way to prevent any breakage of the CRT. Tipping of the CRT display appliances from the vehicle loading spaces shall not be permitted.

4.1.6 Handling of containers, and loading and unloading of containers to/from a vehicle shall be performed with care to avoid any damage or breakage of the CRT.

4.1.7 CRT display appliances shall be transported in weatherproof covered containers or vehicles with covered loading space.

4.2 Environmental, health and safety requirements

4.2.1 During all treatment operations special care shall be devoted to prevent uncontrolled emissions of fluorescent and other coatings and glass dust to air to prevent health and environmental damage.

4.2.2 Fluorescent and other coatings, and glass dust shall not contaminate the breathing zone of treatment facility operators and occupational exposure limits shall be met at all times.

4.2.3 Dry crushing, shredding, splitting and cleaning of CRT or CRT display appliances shall be carried out in an environment with effective dust exhausting connected to an efficient air filtration system. The filtration class of the air filtration system shall assure that emission limits are complied with at all times.

4.2.4 If wet crushing, shredding, splitting and cleaning of CRT or CRT display appliances are carried out during treatment the water used in the technology shall be kept in a closed loop. Technological water shall not be released to sewage water system.

4.2.5 Treatment operators shall establish regular monitoring of output of the air filtration system at the treatment plant. Quantities of dust and heavy metal emissions (especially lead and cadmium) shall be determined by accredited laboratory.

4.2.6 If crushing, shredding, splitting, or cleaning of CRT or CRT display appliances is carried out by the treatment operator, a regular airborne dust monitoring of inner working environment shall be established at the treatment plant, following the periodicity and protocols

described in respective European legislation on Health and Safety and its corresponding national transposition.

4.2.7 All operator personnel shall be regularly informed about health and safety risks related to the treatment processes of CRT display appliances.

NOTE In particular the physical hazards of cutting by CRT cullet and toxic hazard of heavy metal content in phosphorous coatings should be pointed out.

5 Technical requirements

5.1 Separation process

5.1.1 During de-pollution operations CRT or CRT glass shall be separated from the rest of CRT display appliances to avoid contamination of other components and fractions of CRT display appliances.

5.1.2 CRT or uncleaned CRT glass shall be considered as a hazardous waste and handled in accordance with hazardous waste requirements set up by national legislation and treatment plant licence.

5.1.3 Other components and fractions of CRT display appliances after de-pollution operations shall not contain CRT glass. Exceptions are:

- deflection coil components where the content of CRT glass is less than 4 % by weight of CRT glass,
- waste sludge from wet method of processing,
- dust from air filtration system and the finest waste fraction from sieving process,
- removed fluorescent coatings fraction.

5.1.4 When sorting CRT glass fractions, the mass percentage of the lead oxide in panel glass fractions shall not exceed 0.5 wt% otherwise such fraction shall not be considered as panel glass fraction.

5.2 Cleaning process

5.2.1 Fluorescent coatings shall be removed from CRT glass.

NOTE Exception to this clause is possible where CRT or uncleaned CRT glass is used as a flux in smelters which have the capability to recycle or recover lead or in hazardous waste incinerators where CRT or uncleaned CRT glass is used as a slag forming material.

5.2.2 Removed fluorescent coatings shall be considered as a hazardous waste and handled in accordance with hazardous waste requirements set up by national legislation and treatment plant licence unless it is proven that fluorescent coatings do not have any hazardous properties in accordance with clause 3.3.

NOTE According to the waste treatment hierarchy, recycling or recovery of fluorescent coatings or their compounds (e.g. europium and yttrium) is preferred to disposal methods.

5.2.3 Treatment operations shall avoid contamination of components and fractions of CRT display appliances by fluorescent coatings. CRT glass fractions after de-pollution shall not contain fluorescent coatings. This shall be proven by verifying that any glass fraction does not contain more than [XX] milligrams of [yttrium/yttrium oxide] per one kilogram of dry basis or less than 0.1 milligram of yttrium per one litre of acid leach.

NOTE During mechanical treatment when whole CRT display appliances are crushed, there is a risk that also fractions other than glass can be polluted by fluorescent coatings.

5.2.4 When the CRT glass is cleaned of fluorescent coatings to the limits set in clause 5.2.3 and conditions stipulated by Article 6 of Directive 2008/98/EC (Waste Directive) are met, the end-of-waste status of CRT glass shall be considered reached. The exception is when the CRT glass is shipped to facilities under waste treatment licence, in which case the CRT glass shall remain waste.

5.3 Recycling and recovery process

5.3.1 The waste hierarchy shall be followed, therefore recycling or recovery of the CRT glass shall be preferred. Land filling of the CRT glass shall only be done in a case of last resort.

NOTE The waste hierarchy is described in Article 4 of Directive 2008/98/EC.

5.3.2 Only cleaned CRT glass shall be accepted to recycling or recovery processes.

NOTE Exception to this clause is possible where CRT or uncleaned CRT glass is recovered as a flux in smelters with a capability to recycle or recover lead or in hazardous waste incinerators where CRT or uncleaned CRT glass is used as a slag forming material.

5.3.3 Funnel glass or mixtures of CRT glass shall preferably be recovered or recycled to the products or in processes where lead content has a technical function to prevent lead dispersion to other products and the outer environment. Otherwise such glass shall be utilised in a way that lead content in the final product does not exceed limits set up by national legislation. If such glass does not reach product status then waste legislation shall still be applied.

NOTE Lead content has a technical function for example in CRT glass or X-ray glass.

5.3.4 When lead content limits in products are not set up by national legislation, then governmental approval or environmental product declaration (EDP) in accordance with ISO 14025 shall be applied.

5.3.5 When CRT or CRT glass is used in melting or smelting technology an emission filtration system that meets requirements of national legislation and treatment plant licence shall be installed.

5.3.6 The export of uncleaned CRT glass from EU and EFTA is prohibited. Export of cleaned CRT glass outside the EU and EFTA territory is only permitted for the purpose of recycling or recovery. The requirements of this normative document and corresponding EU legislation shall be achieved during recycling and recovery processes outside the EU and EFTA territory.

Specific requirements for the treatment of Flat Panel Displays

1 Scope

1.1 This normative document describes the specific requirements pertaining to flat panel displays in the WEEE stream as a part of the WEEELABEX set of normative documents. This normative document is applicable to all flat panel display WEEE and all resulting components, fractions and materials until the end-of-waste status is fulfilled in accordance with Article 6 of the Directive 2008/98/EC on waste.

1.2 This normative document defines additional requirements to those defined in the WEEELABEX general requirements for Collection, Logistics and Treatment of WEEE and addresses the specific requirements of treatment of flat panel displays as part of the WEEE stream, including all components, fractions thereof and associated powders, liquids and gasses.

NOTE Examples of products covered by this normative document include flat panel displays as part of TV screens, computer monitors, and other screens and visual display units of the type commonly found in private household appliances & IT equipment.

2 Normative references

None

3 Terms & definitions

For the purpose of this document the terms and definitions given in WEEELABEX normative document on treatment, Part I (General Requirements) and the following apply:

3.1
backlight
part of the flat panel module found in some flat panel displays technologies that illuminates the panel to make the image visible

3.2
CCFL
Cold cathode fluorescent lamps

3.3
flat panel display
thin screen equipment, larger than 100 square centimetres (cm^2), using technologies that produce and display an image without the use of cathode ray tubes

NOTE Examples of flat panel displays include LCD TV, Plasma TV, LCD screens and monitors, and notebooks

3.4
flat panel module
part of the flat panel display containing the components that produces images, including the lighting and the diffusive elements and excluding the casings, printed circuit boards and speakers

3.5
flat panel
part of the flat panel module of the flat panel display in which the image is produced

4 Administrative and organisational requirements

4.1 Technical and infrastructure conditions

4.1.1 Collection, handling and transport of flat panel displays shall be performed in a way that it does not affect the integrity of the displays. Crushing or compacting is not permitted prior to treatment.

4.1.2 Flat panel displays and their components shall be stored under weatherproof covering.

NOTE 1 Components of flat panel displays may include: backlight lamps, fluorescent coatings and/or lithium containing batteries.

NOTE 2 Examples of weatherproof covering include: roof, closed containers

4.2 Transport

4.2.1 Containers shall be loaded carefully. When stacking one container on top of another, precautions shall be in place to prevent breakage of the flat panel displays in the container underneath.

4.2.2 During transport of flat panel displays weatherproof covering shall be ensured.

4.3 Information materials

Employee training materials and information shall be available at the work place and easily accessible to workers at all times. Materials and information shall document specific risks inherent to flat panel displays.

NOTE Potential risks include physical injury, exposure to mercury, lead and/or indium tin oxide, and inhalation of dust and/or fluorescent coatings.

5 Technical requirements

5.1 Preparation for treatment

If treatment technology requires separation of different types of flat panel display, employees shall be qualified and trained in the appropriate methods to carry out the sorting tasks.

5.2 General de-pollution

5.2.1 Substances and components contained in flat panel displays shall be removed in accordance with Annex A and B (De-pollution guidelines and monitoring) of this normative document.

5.2.2 The treatment of flat panel displays shall consider the different types of displays, the fractions and components thereof, and the specific requirements for:

- mercury,
- fluorescent coatings, and
- indium tin oxide (ITO).

5.2.3 Mechanical treatment of flat panel displays shall be carried out in a dedicated treatment facility which can document that no contamination occurs with other treated streams.

5.3 Mercury

5.3.1 For treatment of flat panel displays with CCFL backlights, evidence shall be provided showing that at least (XX percent) in mass of mercury from backlight lamps is removed from the input content of the non-treated appliances.

5.3.2 This can also be demonstrated by verifying that less than [XX mg/m3 or mg/kg] of mercury is present in the fractions that are intended to be recycled and that the fractions where the mercury is concentrated are directed to appropriate disposal.

5.3.3 Broken CCFL backlights from manual dismantling shall be stored and transported in closed containers, in order to avoid mercury emissions. Such containers shall be stored in places which are not exposed to heat.

5.3.4 All CCFL backlights from manual dismantling, whether broken or not broken, shall be treated in special treatment plants for lamps or sent for appropriate disposal in accordance with national legislation.

5.4 Indium tin oxide (ITO)

5.4.1 When liquid crystal display panels or their fractions are sent to treatment facilities that intend to concentrate indium tin oxide (ITO), recovery and disposal operations shall be subject to the requirements of the WEEELABEX normative document on Treatment – Part I (General Requirements).

5.5 Fluorescent coatings

5.5.1 Flat panel displays and fractions shall be sent to treatment facilities that guarantee recovery or disposal of the fluorescent coatings and glass in accordance with clause 5.8.2 of WEEELABEX normative document on Treatment – Part I (General Requirements).

5.5.2 Fluorescent coatings and fractions containing fluorescent coatings shall be disposed of in landfill, or treated by suitable thermal processes, designed and approved for hazardous substances.

5.6 Monitoring

5.6.1 The operator shall develop protocols and procedures appropriate to his technology, to demonstrate the fulfilment of the pollutants removal target, stipulated in clause 5.2.

5.6.2 The processing of flat panel displays shall be carried out in a controlled atmosphere. Suitable ventilation equipment and filters shall ensure that occupational exposure limits (OEL) and air emission limit values on heavy metals and dust can be complied with at all times. Accumulation of heavy metals in dust shall also be measured periodically.

5.6.3 The airborne mercury content of workplaces where processing of LCD with CCFL backlights takes place and of storage areas shall be monitored, following the periodicity and protocols described in respective European legislations on Health and Safety.

5.6.4 Occupational health monitoring of concerned employees shall include the measurement of the intake of mercury by employees through analysis of mercury concentration in blood or urine.

Specific requirements for the treatment of Lamps

Introduction

Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on Waste Electrical and Electronic Equipment (WEEE) serves as the first and foremost European guideline in view of creating a quality standard for the treatment of lamps. The purpose of the Directive is, as a first priority, the prevention of WEEE, and in addition, the reuse, recycling and other forms of recovery of such wastes so as to reduce the disposal of WEEE. It also seeks to improve the environmental performance of all operators involved in the life cycle of electrical and electronic equipment, e.g. producers, distributors and consumers and in particular those operators directly involved in the treatment of WEEE. As lamps containing mercury have been defined as one of the priority WEEE categories of the Directive, the provisions set forth in this quality normative document for the treatment of lamps are applicable to the treatment of the lighting equipment in scope of the Directive, i.e.:

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

Directive 2002/95/EC (RoHS Directive) deals with restriction of the use of certain hazardous substances (including mercury) in electrical and electronic equipment.

Since the launch of the EU mercury strategy in 2005, the European Union has made considerable progress in further addressing the global challenges of mercury. The comprehensive strategy addresses mercury pollution both in the EU and globally. It contains 20 measures to reduce mercury emissions, cut supply and demand and protect against exposure. It resulted in:

- Directive 2007/51/EC of the European Parliament and of the Council of 25 September 2007 amending Council Directive 76/769/EEC relating to restrictions on the marketing of certain measuring devices containing mercury, and
- Regulation (EC) No 1102/2008 of the European Parliament and of the Council of 22 October 2008 on the banning of exports of metallic mercury and certain mercury compounds and mixtures (by 15 March 2011) and the safe storage of metallic mercury.

The scope of these normative requirements is limited to lamps, as in the scope of the WEEE Directive, and retrofit LED lamps. Table 0.1 describes the different lamp types falling under these categories.

Category	Type	Abbr.	Description		Line drawing
Lamps	Fluorescent Lamps	FL	Low pressure (some mbar) discharge lamps containing noble gas and either: mercury containing fluorescent powder (for visible light radiation) no fluorescent powder (for UV radiation)	Straight or different non-linear shapes	
	Compact fluorescent Lamps-integrated	CFL-i		Compact + integrated electronic ballast	
	Compact fluorescent Lamps-non-integrated	CFL-ni		Compact (without integrated electronic ballast)	
	High intensity discharge Lamps	HID	High pressure (>1 bar) atomic discharge lamps containing noble gas, mercury, sodium and salts Low pressure (some mbar) atomic discharge lamps containing noble gas and sodium		
Retrofit LED Lamps	Retrofit LED	LED	A LED consists of a central light emitting diode surrounded by a reflector cup. Once electric current is applied, it produces either: - a directed light bundle (a) - a non-directional light bundle (b)	(a) Compact (b) Various forms	

1 Scope

1.1 This normative document intends to serve as a compliance framework for treatment operators specialising in the treatment of lamps. This normative document defines quality requirements for the entire lamp treatment process, i.e. reception, handling, storage, treatment and recovery of lamps. The objective of the normative document is to ensure the

compliance with environmental, health and safety legislation and a reduction of the environmental impact of lamp treatment. These goals can be reached by means of:

- non-polluting separation of lamps in fractions, for material recycling and/or recovery,
- safe treatment of mercury in specialised treatment plants for lamp waste in compliance with all European Community legislation on health, safety and environment, and
- environmentally sound recycling, recovery, and disposal of lamp fractions in compliance with all European Community legislation on health, safety and environment.

This document incorporates the legal requirements concerning recycling and recovery targets in accordance with Directive 2002/96/EC and corresponding national regulations, as well as all European Community legislations on health, safety and environment. According to Directive 2002/96/EC the rate of component, material and substance reuse and recycling of lamps shall reach a minimum of 80% by weight of the lamps treated.

1.2 Process overview

The operations managed by a treatment operator responsible for the treatment of lamps go beyond the core recovery process. It also involves responsibilities for the steps prior to and after the treatment of lamps. Figure 1.1 represents a simplified supply chain of a general lamp treatment operator, in which all treatment steps are described in a part of this quality normative document.

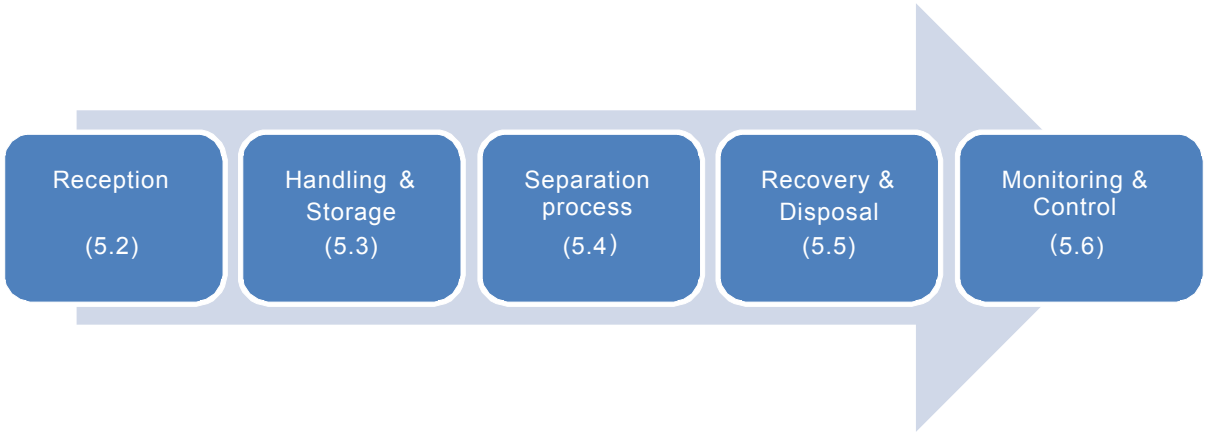


Figure 1.1: flowchart represents a simplified supply chain of a general lamp treatment operation

2 Normative references

None

3 Terms & definitions

For the purposes of this document, the terms and definitions given in the WEEELABEX normative requirements for treatment - Part I (General Requirements) and the following apply:

3.1
lamps
gas discharge lamps and retrofit LED lamps within the scope of Directive 2002/96/EC

NOTE Retrofit LED lamps are LED lamps used in exchange for CFL or GLS lamps and fit in sockets for these applications

3.2
recovery
any operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy

NOTE In accordance with Directive 2008/98/EC; Annex II of Directive 2008/98/EC sets out a non-exhaustive list of recovery operations.

3.3
recycling
any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations

NOTE In accordance with Article 3(17) of Directive 2008/98/EC.

4 Administrative and organisational requirements

4.1 General management structure

4.1.1 Treatment operators treating lamps shall comply with the WEEELABEX normative requirements for treatment, Part I (General requirements).

4.1.2 The treatment operator shall demonstrate the use of appropriate techniques to reach required targets and follow accepted environmental practices related to the treatment of lamp waste.

4.1.3 The treatment operator shall organise the treatment facility and related working procedures in such a way to prevent emission of mercury or any other pollutant.

4.1.4 Treatment operators involved in the treatment of lamps shall engage in technical and organisational conditions as to maximize removal of hazardous substances and recovery of other fractions.

4.2 Treatment facility infrastructure

4.2.1 The lamp treatment facility shall provide:

- containers for storage of output fractions designed to prevent the emission of mercury and
- an industrial vacuum cleaner with active carbon filters as well as lockable containers for mercury-containing fractions and other lamp waste.

4.2.2 The provisions for water, process water and air treatment as mentioned in the WEEELABEX normative requirements for treatment, Part I (General requirements), clause 4.3 shall consider possible diffuse emission of mercury.

4.3 Occupational health and safety, and industrial hygiene requirements

4.3.1 Employees handling lamp waste shall use required personal protective equipment (PPE) as follows from a risk assessment as required in WEEELABEX normative requirements for treatment, Part I (General requirements), clause 4.3.1.

4.3.2 The facility shall implement appropriate measures to control the employees' exposure to chemical, biological and physical agents. Such measures shall include, but are not limited to:

- personal protective equipment removed and stored in a designated area/container before leaving the work place (at the end of the day or before commencing a break) to avoid contamination
- Workers washing their hands whenever leaving the working area
- Eating in designated areas
- Smoking in designated areas

NOTE 1 A relevant chemical agent in lamps is mercury.

NOTE 2 Examples of personal protective equipment are: gloves, glasses, masks and a protective suit

4.4 Documentation of accidents & incidents

4.4.1 The lamp treatment operator shall implement a program to identify, evaluate and control incidents and accidents occurring at its facility.

4.4.2 As specified in WEEELABEX normative requirements for Treatment – Part I (General Requirements), clause 4.4.2, all employees involved in the emergency response procedures shall be trained and made aware of their tasks in the event of an accident at the treatment plant.

4.4.3 In addition to WEEELABEX normative requirements for Treatment – Part I (General Requirements), clause 5.9.1, the treatment operator shall document all necessary additional cleaning measures and decontamination activities carried out at the facility as a result of an accident or incident, as well as the date and the time taken for these activities.

4.4.4 The treatment operator shall keep records of accidents or dangerous occurrences (or other so-called RIDDORs) that occur on its premises.

NOTE The abbreviation RIDDOR refers to the 'Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995' placing a legal duty on employers, self-employed people and people in control of premises to report deaths, major injuries, over-3-day injuries – where an employee or self-employed person is away from work or unable to perform their normal work duties for more than 3 consecutive days, injuries to members of the public or people not at work where they are taken from the scene of an accident to hospital, some work-related diseases, and dangerous occurrences – where something happens that does not result in an injury, but could have done.

4.4.5 The treatment operator shall prepare and regularly update a Business Continuity Plan which includes tasks to be undertaken in case of an accident occurring at its premises, blocking the ongoing operations.

5 Technical specifications

5.1 General requirements

5.1.1 Specific treatment of lamps aims at the removal of mercury and the recovery of lamp fractions in an effective way.

5.1.2 Lamp treatment operators shall demonstrate continuous improvement of the treatment process and reliability of the treatment chain.

5.1.3 The lamp treatment operator shall ensure the separation and preparation of the fractions in a way that facilitates their recovery. This obligation holds if the treatment operator performs this activity using its own treatment facilities or using facilities of authorized contractors.

5.1.4 Each lamp, retrofit LED and components or fractions thereof shall be treated as mercury-containing including when not clearly marked as mercury-containing.

5.1.5 To enable proper treatment of end-of-life lamps, they shall be treated separately. At a minimum, lamps shall be removed from any separately collected WEEE. Removal of lamps from appliances shall be carried out in such a way that environmentally sound recycling and recovery of components or whole appliances is not hindered.

5.2 Reception

5.2.1 The amount of lamps stored shall be limited to either:

- The amount processed in less than 6 weeks, based upon lamp weight and treatment capacity, measured from the acceptance of lamp waste at the lamp treatment operator up to the isolation of extracted mercury from the different material fractions, or
- The number of lamps shall remain below 150,000 pieces.

NOTE The quantity of mercury in 150,000 lamps is found to be the equivalent of mercury stored below 500g.

5.2.2 During handling and storage special attention shall be given to the unloading of waste containers in an efficient way and in a safe manner as to avoid damage to containers, lamps and fractions thereof, and employee's health and safety.

5.2.3 During incoming inspection the lamp treatment operators shall verify whether the content of the containers is compliant with the bill of lading. In case of non-compliance, options to deal with the waste without disturbing regular deliveries shall be available.

5.2.4 The lamp treatment operators shall determine the weight (gross or net) and source of each delivery entering and register evidence supporting the traceability of lamps.

5.2.5 The lamp treatment operators shall apply the calibration procedures and standards defined by the supplier of measurement devices.

5.3 Handling and storage

5.3.1 Handling of lamps at the treatment facility in advance of the recovery process shall be performed by, and supervised by, trained employees.

5.3.2 Lamps shall be stored under conditions designed to avoid release of mercury to the environment.

5.3.3 Storage areas for lamps shall be designed and maintained to prevent and control emissions to the environment. Storage areas shall be easily accessible for authorised personnel and their equipment; however, these areas shall be frequented to a minimum extent.

5.3.4 Prior to storage of empty containers, they shall be cleaned to the point that no remaining substances are visible.

5.3.5 Where appropriate, non-reusable containers shall be treated and evidence of this activity shall be documented.

5.4 Separation process

5.4.1 The separation process is usually performed in steps. The design of these steps and possibly stages between them shall prevent a release into the direct environment of mercury in any form. The effectiveness of the measures taken shall be supported by an operational risk assessment and proven by regular measurements according to the mass balance as given in Annex A and Annex C.

5.4.2 Glass fractions intended for recycling shall have a mercury level below [5] mg/kg.

5.4.3 Other lamps fractions intended for recycling shall have a mercury level below [XX] mg/kg.

NOTE The other fractions generated from the separation process of lamps are the separated metallic fractions, separated plastics fractions and the separated phosphor powders.

5.5 Recovery and disposal

5.5.1 If a lamp treatment operator engages a third party treatment operator to recover or dispose of the fractions recycled, the following conditions shall be fulfilled:

- the lamp treatment operator shall engage potential alternate outlets with the capacity to properly recover or eliminate the separated fractions,
- the lamp treatment operator shall have the capacity to transport materials fractions in accordance with applicable regulations,
- third parties shall assure traceability and assure that recycling targets can be measured by providing certificates or records to verify the destination of each fraction and the fraction's use or application.

5.6 Monitoring and control

5.6.1 Employees dealing with hazardous substances shall undergo, at least once a year, a medical check to investigate their absorption of, and exposure to, mercury.

5.6.2 The level of mercury (mg) per cubic metre air shall not surpass the level(s) defined in national legislation and shall remain below the occupational exposure limit value determined in national legislation.

5.6.3 The air emissions at treatment facilities shall be supervised so that increased emissions caused by operational disturbances or technical defects can be identified and remedial measures shall be taken.

NOTE As per Annex C of this document.

5.6.4 The mercury concentration in the air of all working areas, including storage areas, shall be regularly monitored in accordance with Annex C of this document, and not exceed the occupational limits as set by the European legislations and their national transpositions.

NOTE As a best practice target, the occupational limit value at the treatment facility should not exceed an 8 hour TLV of 0.02 mg/m3 as described in the Commission Directive 2009/161/EU.

5.6.5 The treatment facility shall have at its disposal a system to prevent hazardous emissions into rainwater, air and soil under normal operational conditions and also in cases of emergency. The discharged wastewater, air and soil emissions shall meet the discharge limits for regulated elements.

NOTE Examples of systems to prevent hazardous emissions: a closed water sewer system or a fire water retention reservoir.

5.6.6 Minor fractions composed of fine powders containing mercury and located at the treatment facility shall be stored in a hazardous waste storage point designed to halt the diffusion of mercury to the atmosphere and dispersal of mercury within the treatment facility.

5.6.7 On a monthly basis the residual mercury in fractions at the end of the treatment process shall be quantified and documented on the basis of a representative mixed sample according to Annex A of this document.

NOTE 1 When these regular measurements show minor differences, the frequency may be gradually brought down to annual measurements.

NOTE 2 Remaining mercury in the fractions may be a diffuse source of hazardous emissions when reused or burned.

5.6.8 The treatment facilities shall comply with all Member State specific licenses regarding the containment of mercury at its site.

5.7 Documentation

5.7.1 Treatment operators and subcontractors shall keep operation journals which register the container weight, fill level, and identifier of all incoming lamps, where appropriate, according to types and categories.

5.7.2 The treatment operator shall be in a position to document the input and output streams continuously and be in a position to report quarterly mass balances data for lamps.

5.7.3 The downstream monitoring requirements of this normative document, and of WEEELABEX normative document on treatment – Part I (General Requirements), shall apply to the flow of lamp waste, components and fractions thereof, and containers.

5.7.4 Monitoring data recorded under clause 5.6 shall be documented

5.7.5 Alternate paths for the disposal of fractions shall be identified in the treatment operations risk assessment which may be used in cases of a disruption to normal operations.

Bibliography

[1] Directive 2007/51/EC of the European Parliament and of the Council of 25 September 2007 amending Council Directive 76/769/EEC relating to restrictions on the marketing of certain measuring devices containing mercury.

[2] Regulation (EC) No 1102/2008 of the European Parliament and of the Council of 22 October 2008 on the banning of exports of metallic mercury and certain mercury compounds and mixtures (by 15 March 2011) and the safe storage of metallic mercury.

[3] Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE). (Official Journal of the European Union (OJ) L 37, 13.2.2003).

[4] SI 1995/3163. Reporting of Injuries, Diseases and Dangerous Occurrences Regulations, 1995.

[5] RoHS Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS Directive).

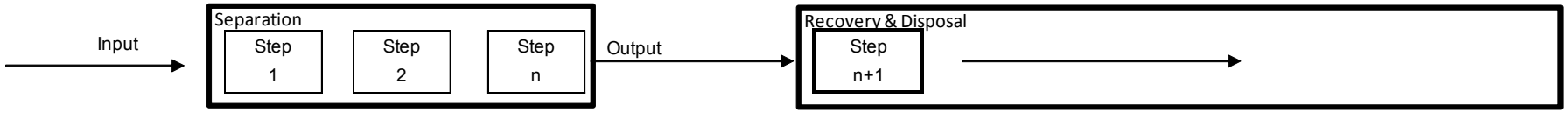
[6] Article 4 of Council Directive 75/442/EEC of 15 July 1975 on waste.

[7] Commission Directive 2009/161/EU of 17 December 2009 establishing a third list of indicative occupational exposure limit values in implementation of Council Directive 98/24/EC and amending Commission Directive 2000/39/E

Annex A
(normative)

Treatment process and related measurement points

A simplified mass balance for the subsequent steps in the treatment process of lamps is depicted below. The critical [Hg] concentration in the individual fractions is given by boxes in the drawing below. Please note that the 'Recovery & Disposal' options mentioned are not exhaustive.



In	C_{Hg}	Weight
FL		
CFL		
Backlight		
LED		
..		
..		
..		
..		
..		

Out	C_{Hg}	Weight
Powder		
Glass		
Electronics		
Metal		
Non-ferrous		
Plastic		
Mercury		
Gas/air		
Water		
People		

Next step	Out	C_{Hg}	Weight or Flow	Destination
Distillation	Powder			..
	Mercury			..
				Lamp Co., Other glass Co., ..
				WEEE
				Metal Co.
				Metal Co.
				Plastic Co., Incineration, Landfill
Filter				
..				

Hg in	0	Hg out	0

C_{Hg} Concentration mercury in %wt

The different Treatment steps may take place in more than one location. The exact measurement points depend on the product flow in the treatment facility (e.g. wet or dry process, pre-crushing, crushing or end-cut, vacuum).

Annex B
(informative)

Treatment options for Lamps fractions

The table below provides an overview of material fractions recovered from Lamp waste and their potential acceptors

Output fraction	Purpose	Acceptor
Glass	Glass	Glass industry
		Lamp industry
	Glazing	Ceramics Industry
	Abrasive sand for cleaning	Cleaning industry
	Fusion agent within black copper foundry	Metal industry
	Clinker	Building/cement industry
	Sand replacement	
	Under layer for asphalt road	
	Glass wool	
	Silicon substitute	Incinerators
Mercury	Cathode	Chlorine/ caustic soda industry
	Mercury	Lamp industry
	Fluorescent/phosphor powder	Controlled landfill
Powders	Waste	Controlled landfill
	New use	Rare Earth Industry
Caps & Metallic components	Metal foundries	Metal industry
Plastics	(Mix of) plastic	Plastic industry
	Plastic waste	Controlled landfill

Material fractions recovered from Lamp waste and their potential acceptors

Annex C
(normative)

Frequency table of residual mercury concentration checks

Element	Location	Frequency
Output fractions		
Glass	Point of intermediate storage	Monthly. When sequential measurement show small variation, reduced in stages to annual.
	Prior to disposal	
Metal caps	Point of intermediate storage	
	Prior to disposal	
Fluorescent/phosphor powder	Point of intermediate storage	
	Prior to disposal	
Treatment facility employees (excluding administrative staff)		
Urine (Creatinine)	N/A	annual
Emissions		
Air	Stock area	Weekly
	All entry points of recycling machine	Weekly
	Around the recycling machine	
	All exit points of recycling machine	
	Offices (non-plant area)	Annually (at increased levels, perform monthly check)
Water	Waste water output	Quarterly

Specific requirements for the treatment of Temperature Exchange Equipment

This part of the document lists the requirements for the collection, transportation, storage, handling and treatment of household cooling and freezing appliances containing CFC, HCFC or HFC as well as of household cooling and freezing appliances containing HC. Both sets of voluntary requirements were jointly developed by CECED, WEEE Forum and EERA, and made publicly available on 21 December 2007and on 18 October 2007 respectively.

The sections in this normative document are an exact copy of those requirements. Due to their adoption prior to the WEEELABEX project, some provisions in these sections may not be consistent with other sections of the WEEELABEX normative requirements (including on logistics and collection).

The draft CENELEC EN standard on end-of-life requirements for household appliances containing volatile fluorinated carbons or volatile hydrocarbons is currently subject to approval by CENELEC member organisations. Upon final adoption, the EN standard will replace the requirements in this document unless disputed by the WEEE Forum General Assembly.

Requirements for the Collection, Transportation, Storage, Handling and Treatment of Household Cooling and Freezing Appliances containing CFC, HCFC or HFC

21 December 2007

1 Objective

The objective of these requirements is to ensure:

- the non-polluting separation of household cooling and freezing appliances in fractions, for material recycling or energy recovery;
- the environmentally sound disposal of CFC, HCFC and HFC ("controlled substances") [1].This means the destruction of ozone depleting substances in accordance with Regulation (EC) No 2037/2000 on substances that deplete the ozone layer, such as CFC and HCFC, and the destruction of climate endangering compounds such as HFC and also CFC and HCFC.
- safe treatment of HC [3]. Precise requirements for treatment of HC are described in the document "Requirements for the Collection, Transportation, Storage and Treatment of Cooling and Freezing Appliances containing Hydrocarbons (HC)" [11].

This document follows the legal requirements concerning monitoring, recycling and recovery targets in accordance with Directive 2002/96/EC or corresponding national regulations, monitoring of "controlled substances" as recovered for destruction and implement a regular performance verification test procedure carried out by an independent auditor (see chapter 6, Annex 1).

Clarification: CFC, HCFC, HFC and HC are all VOC´s – Volatile Organic Compounds, however in some documents and specifications the term "VOC" is incorrectly used to refer only to HC.

1.1 General Requirements

The requirements apply to the separation of "controlled substances" from household cooling and freezing appliances for destruction. Dismantling and treatment is performed in two steps. Step 1 for taking "controlled substances" and oil out of the cooling circuits and step 2 for the extraction of "controlled substances" from the insulation foam for destruction and the separation of recyclable and recoverable material (metals, glass, plastics, cables, etc.).

Overall the document consists of a set of minimum requirements concerning:

- Collection, storage, transport and handling;

———————

[1] In this paper CFC, HFC, HCFC are summarized as "controlled substances":

CFC - Chlorofluorocarbon (e.g. R12, R11), HCFC Hydrochlorofluorocarbon (e.g. R22, R141b) and HFC - Hydrofluorocarbon (e.g. R134a)). CFC and HCFC are ozone depleting substances and have a high global warming potential (GWP) while HFC do not deplete the ozone layer but have a significant global warming potential.

- Recovery and destruction of controlled substances;
- Use of output fractions (recovery and recycling targets of 80% and 75% respectively, these targets as in accordance with Directive 2002/96/EC or future amended versions);
- Safety measures for equipment or parts of equipment [2] containing unidentified gases to secure that all equipment or parts of equipment containing any kind of HC [3]are treated adequately;
- Quality assurance (monitoring and reporting);
- Inspection and control.

Other legal requirements like dismantling of Hg-switches [4], PCB [5] containing capacitors, NH_3-water-chromate [6] mixtures or requirements derived from the explosion potential of HC [7], [8] are herewith mentioned only, but not described in-depth.

1.2 Collection, storage, transportation and handling

1) Sorting of types of cooling and freezing appliances [9] shall take place at the treatment plant.
2) Sorting of types of cooling and freezing appliances for end of life treatment in advance of the treatment process shall be performed by, and supervised by, trained personnel and in accordance with the treatment requirements of cooling and freezing appliances.
3) The signatories of this document commit to not allowing in their contracts with collection points, or with any party collecting appliances, to pre-sort types of cooling and freezing appliances for end of life treatment purposes.
4) Collection, storage, transport and handling of cooling and freezing appliances shall be done carefully to avoid damage of the appliances and leakage of controlled substances. If oil leakage is recognized, appropriate measures shall be taken to minimize environmental impacts.
5) All sites for storage and treatment shall at least be in line with the technical requirements of Annex III of Directive 2002/96/EC.
6) As for storage, transport and handling also the treatment of cooling and freezing appliances require precautionary protective measures due to the flammability of hydrocarbons. Places where hazardous explosive atmospheres may occur shall be especially designated. Furthermore, the ban on ignition sources and the ban on entering by unauthorized persons shall be indicated (Annex III of Directive 2002/96/EC). Non-observance should be punished.

———————

[2] Equipment or parts of equipment, for example loose parts such as doors, of which the presence of a gas or the gas-content cannot unambiguously be ascertained.

[3] HC - Hydrocarbons (e.g. Propane, Butane, Cyclopentane, Iso-Butane and Iso-Pentane).

[4] Hg - Mercury

[5] PCB - Polychlorinated Biphenyls

[6] NH_3 - Ammonia

[7] Directive 94/9/EC on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres

[8] Directive 1999/92/EC on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres (15th individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC)

[9] “Types” of appliances are distinguished in CFC, HCFC, HFC, HC or NH_3 containing appliances.

7) Transports optimisation is allowed as long as the initial size of the cooling and freezing appliances, including cabinets, is not reduced and good condition of the appliances is ensured.
8) All sites shall demonstrate that they are secured against unauthorised access.
9) The “controlled substances” separated shall be carefully stored, handled and transported to avoid any emissions before destruction.

1.3 Requirements concerning treatment and output quality

All cooling and freezing appliances and parts thereof which are not clearly identified as HC-type, either concerning refrigerant or foaming agent, must be treated as CFC, HCFC and HFC-type ones [10] [11]. Therefore treatment facilities for all types of appliances shall comply with explosion protection measures as stated in the Directive 1999/92/EC.

Separated “controlled substances” [1] shall be destroyed by a suitable thermal or chemical process. The destruction shall be proven by corresponding documents (e.g. bill, delivery sheet).

The treatment process of end of life cooling and freezing appliances is usually performed in two steps:

Step 1: CFC, HCFC, HFC and unidentified gases [2], Oil and compressor

1) All liquids that contribute to a contamination of separated fractions during, or after, the treatment process, shall be removed.
2) All refrigerants shall be separated from oil.
3) The amount of CFC, HCFC and HFC separated from cooling circuits shall be equal to, or higher than 90% of the expected amount (see Annex 1) of these substances.
4) The compressor oil with less than 0.2% total halogen content [12] may be used for material recycling or in normal incinerators, provided national regulation permit this procedure.
5) The compressor oil with more than 0.2% total halogen content shall be treated only in thermal processes for the safe destruction of “controlled substances” [1].
6) Compressors shall not be re-used.

Step 2: CFC, HCFC, HFC, and unidentified gases, PU [13]

1) The treatment of appliances in step 2 shall be carried out with step 1 treated appliances only (called “cabinets”).
2) The amount of CFC, HCFC, and HFC separated from the PU-foam shall be equal or higher than 90% of the expected amount (see Annex 1) of these substances.
3) After treatment PU-fractions shall contain not more than 0.2 % CFC, HCFC, and HFC.

———————

[10] For clearly identified HC cooling and freezing appliances please follow the “Requirements for the Collection, Transportation, Storage and Treatment of Cooling and Freezing Appliances containing Hydrocarbons (HC)” published in October 2006 by WEEE-Forum, CECED and EERA.

[11] Including also loose parts, delivered to the treatment plants (e.g. doors).

[12] With a refrigerant of CFC, HCFC, HFC there will be a halogen (e. g. fluor and chlor) content in the compressor oil. For example 0.2 % total halogen content in the compressor oil corresponds to 0.18 % R12.

[13] PU: abbreviation for polyurethane, used as isolation material in cooling and freezing appliances, expanded with either CFC, HFC, HCFC or HC

4) It has to be guaranteed that the PU-residues (contained in the metal and plastic fractions separated for use as secondary raw material) are minimised to avoid losses of “controlled substances” [1]. Therefore, residues of PU contained in the ferrous and the nonferrous-metal fraction are to be kept below 0.3%; residues of PU contained in the plastic fraction are to be kept below 0.5 %.

1.3.1 Recycling and Recovery aspects

Cooling and freezing appliances and components, materials and substances that are processed as described above, are expected to fulfil the requirements of the Directive 2002/96/EC, in order to achieve a rate of recovery of at least 80% and a recycling rate of at least 75% by weight per appliance [14].

1.4 Requirements concerning Quality Assurance

1) Treatment companies for cooling and freezing appliances shall use state-of-the-art technology [15] to reach the required targets and follow accepted environmental practises for the separation of controlled substances.
2) Treatment companies for cooling and freezing appliances shall have a certified ISO 9001:2000 and ISO 14001, or equivalent audited quality management system in place, which also includes treatment processes and in-house monitoring.
3) In addition to the usual controlling and documentation performed by the quality system, treatment companies are requested to keep operation journals which register all incoming cooling and freezing appliances according to types and categories [16] and all the outgoing materials and the controlled substances (see chapter 6).

1.5 Requirements for the annual data reporting (monitoring and records)

Annual reports with the following compiled information have to be prepared. These reports should include:

- Number, type and category of appliances as input to step 1 (separation of oil and refrigerants);
- A distinction between intact [17] and damaged/empty [18] appliances;
- Number, type and category of step 1 treated cabinets;
- Evidence (invoice, delivery sheet) on the amount of “controlled substances” [1] delivered for destruction out of step 1 and 2 separately considering the amounts on stock at the beginning and at the end of the year;
- Residual concentration of ”controlled substances” in PU fraction;
- Residual concentration of “controlled substances” in oil;
- Residual concentration of PU at metal and plastic fractions;

———————

[14] Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE) or corresponding national regulations

[15] “State-of-the-art technology” means, that the installation allows the recovery of “controlled substances” as well as the removal of Cyclopentane and fulfils the requirements according to chapter 4.

[16] “categories” of cooling and freezing appliances describe different sizes:

- category 1: domestic refrigerators (up to 180 l - usually one door)
- category 2: domestic combined fridge-freezers (up to 350 l - usually two doors),
- category 3: domestic freezers (chest or cabinet, less than 500 l).

[17] Intact could mean a cooling circuit still under pressure

[18] A damaged cooling circuit still contains some oil.

- Point of delivery and technologies used for 'final fractions' delivered to final treatment technologies;

1.6 Inspection and Control

The quantity of separated liquids and fractions and their forwarding destination shall be documented in compliance with monitoring requirements of the national implementations of Directive 2002/96/EC on waste electrical and electronic equipment (WEEE).

1) Compliance with the quality requirements (see chapter 5) will be decided by responsible take-back parties [19] that take back WEEE and with which treatment facilities have established contracts
2) It is recommended that an independent organisation with adequate knowledge of the treatment processes of cooling and freezing appliances will make annual inspections to control the following points:

   - Publication of annual report and all the records of treated cooling and freezing appliances and removed controlled substances and/or cabinets (see chapter 6);
   - The capability of the treatment company to comply with requirements put forward in this document;
   - Compliance with environmental legal and other requirements (permits, storage area etc.).

3) A regular performance verification test, for installations step 1 and step 2 treatment steps as described in the Annex 1 of this document should be carried out regularly by independent auditors with proven knowledge about the testing of cooling and freezing appliances treatment installations.

   3.1) A performance verification test shall be implemented not later than three months of operating under the contract with the take back party. A performance verification test shall be also done after installation and starting up of any new equipment or after relevant changes to treat step 1 and/or step 2 or the move and re-installation of old equipment at another site.

   3.2) To secure that the requirements are met continuously, performance verification tests shall be made within appropriate time frames. The frequency of verification tests shall be determined by risk assessment and specified in the contract between the take back party and the treatment facility.

   3.3) If a performance verification test demonstrates that the treatment installation does not fulfil the requirements, the take back parties shall be informed. In this case the treatment facility shall stop its operations and shall take appropriate corrective measures and a new performance test shall be performed in accordance to 7.3.1.

1.7 Revision of the requirements

The requirements presented in this paper are based on practices and best available technologies of today. It may be that new and better practices and technologies will emerge in the next 5 to 10 years. The signatories commit to reviewing the requirements document after a period of 5 years or when new developments make a revision necessary.

———————————

[19] Responsible take back parties usually are take back systems (WEEE Compliance Schemes), but could also be producers (e.g. Germany) or B2B take back.

2 Performance test recycling Step 1

The determination of the degree of recovery as a percentage of the expected amount controlled substances for destruction in recycling step 1 can be achieved in two alternatives. Tests should be carried out with appliances containing CFC only.

Following input data:

In a 100 unit test of appliances with intact cooling circuits and identification plates every single appliance is weighed before and after the treatment and the separated CFC and oil is compared with the total amounts filled in according to the identification plates. Those appliances which are recognized as defective should be sorted out. Likewise during the entire test observations with visible CFC and oil losses, water and material losses which affect the mass balance must be noted.

The following recordings are available after the test:

- total weight CFC (**A**) and oil (**B**) in kg
- total weight of the CFC amount in accordance with indications on the identification plate (**C**)
- total weight reduction (**D**) of all sucked off appliances in kg
- amount of defective appliances or appliances with losses, which affect the mass balance. Comparison of the weight reduction of each appliance with the expected amount of weight reduction (CFC and oil) can indicate defective cooling circuits. Decisions on defective circuits have to be taken in order to get plausible figures for the mass balance

The following results with consideration of the number of defective appliances or other observations are determined:

Mass balance: The relationship between (**A + B**) to (**D**) is a measure for the entire plant achievement concerning mass recovery. Results more largely than 0.97 are considered as tolerable values.

CFC recovery: 1) The relationship between (**A**) to (**C**) is a measure for the installation performance concerning CFC recovery. The result may not fall below 0.9 (=90 %). 2) The relationship between (**A**) to (**D - B**) is a measure for the installation performance concerning CFC recovery. The result may not fall below 0.9 (=90 %).

CFC per appliance: The relationship (**A**) to the number of intact appliances supplies the amount of CFC per appliance. A typical result is more largely 115 g per appliance.

Oil per appliance: The relationship (**B**) to the number of oil containing appliances supplies the amount of oil per appliance. A typical result is more largely 240 g per appliance.

Portion of defective appliances: The number of defective appliances according to experience lies between 10 and 20 %.

Following output data:

At least 1'000 appliances with intact cooling circuits [1] containing CFC are treated according to the used procedure and technology. Oil and CFC are separated. The cylinder for taking the

———————

[1] 1'000 compressors

CFC is weighed before operation begins and again when the operation is complete. The weighed amount in kilograms is divided by the number of compressors. The CFC recovered in grams per compressor is determined. The result shall not be lower than the 90% level of expected CFC [2].

3 Performance test recycling Step 2

The determination of degree of recovery as a percentage of the expected amount of controlled substances for destruction in recycling step 2 can be achieved in two alternatives. Tests should be carried out with at least 1000 appliances containing CFC only in their insulation foams.

The PU output fraction and the CFC fraction of 1'000 appliances are weighed.

The containers made available to take the CFC are weighed empty before beginning of work and with filling after ending the work. The weighing result in kg CFC (without water!!!) is divided by the number of appliances. As a result the CFC amount in gram per appliance is determined (value = **A**).

During the treatment of the appliances several samples of the PU output fraction to a total weight of approximately 1 kg have to be sampled and manually divided into its PU and non-PU part (styropor, wood etc).

The PU plastic part corresponds to 91.5% (=100%-8.5% for the amount of CFC) of the corresponding PU foam input. Part of the CFC is still remaining in the PU plastic part what is called the matrix content and part of it is recovered as condensed fluid. So the expected total amount of CFC considering also the amount analysed in the matrix can be calculated. The PU part of the fraction is sent to a laboratory to analyse the content of CFC in the matrix.

The total amount of CFC recovered (condensed and matrix part) for destruction shall be 90% of the expected and calculated amount [3].

Following input data:

The procedure when determining the CFC quantities in grams per appliance is according to the category of appliance:

category 1: domestic cooling appliances (up to 180 l),
category 2: domestic combined cooling& freezing appliances (180 l to 350 l),
category 3: domestic freezing appliances (chest or cabinet, less than 500 l).

The following benchmark values, depending on the category of appliance, are to be met when separating CFC:

Appliance category 1: 240 g CFC per appliance
Appliance category 2: 320 g CFC per appliance
Appliance category 3: 400 g CFC per appliance

The minimum amount of recovery for CFC for destruction has to be calculated according to the mix. In case of the 60/25/15% mix it should be not below 283 g/unit [4]. On the basis of

———————

[2] Each country has to determine the expected amount according to their experience of the mix of size of compressors. In most of the European countries this value is 115 g R12 per compressor. HFC containing appliances should not be part of this performance test.

[3] Each country has to determine the expected amount according to their experience of the mix of size of appliances. In most of the European countries this value is 314.5 g CFC per appliance.

[4] Based on the following assumption: 3.7 kg PU per appliance, 8.5% CFC => 314.5 g → 90% = 283 g per appliance.

the actually available mix of appliances, the expected rate of CFC recovery (**M**) according to the following formula is calculated:

M g/appliance = (X % appliances cat1 x 240 g/appliance) + (Y % appliances cat2 x 320 g/appliance) + (Z % appliances cat3 x 400 g/appliance)

Following output data:

The amount of PU fraction (**P**) in kg is determined as follows:

With a suitable method of analysis the portion of foreign material in the recovered PU fraction in kg is determined (**a**).

The by an external laboratory determined remaining amount of CFC (in kg) in the matrix of the PU structure is assigned with **b**

The amount of the pure PU fraction (PU fraction minus amount foreign material minus matrix content CFC in kg still in the foam is determined (**P-a-b**) = result = **c** kg of PU.

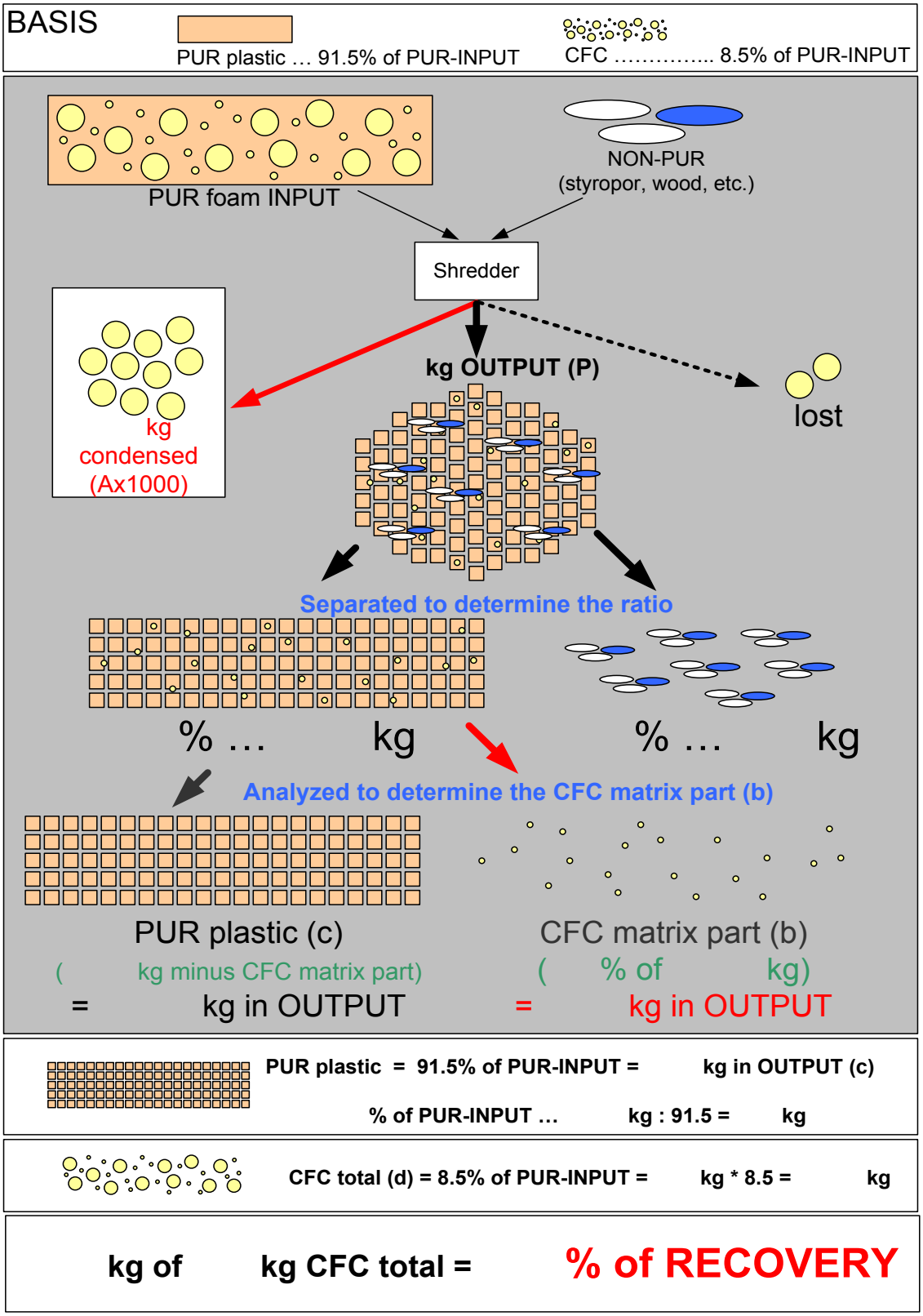
The amount of PU calculated by **c** corresponds to 91.5 % of the origin material (91.5 % PU/8.5 % CFC). Thus with the formula ((**c** x 100/91.5) - **c**)) the amount of the original loading of CFC in the PU as an output fraction can be calculated. Result = **d** kg CFC

All possible losses of PU are determined and evaluated (remaining PU adhering at Fe-metals, at NE-metals, at plastics and at other output materials). Result = **e** kg CFC

The efficiency on the basis of the yielded PU-fractions is calculated with the following formula: Recovery rate = sum(**A**x1000)/sum(**d + e**)

The efficiency on the basis of the brought in input-mix can be calculated with the following formula: Recovery rate = sum(**A**x1000)/sum(**M**x1000)

The following drawing is visualising the conditions with PU and CFC.


BASIS
PUR plastic … 91.5% of PUR-INPUT
CFC …….. 8.5% of PUR-INPUT
PUR foam INPUT
NON-PUR
(styropor, wood, etc.)
Shredder
kg OUTPUT (P)
lost
kg
condensed
(Ax1000)
Separated to determine the ratio
% … kg
% … kg
Analyzed to determine the CFC matrix part (b)
PUR plastic (c)
(kg minus CFC matrix part)
= kg in OUTPUT
CFC matrix part (b)
(% of kg)
= kg in OUTPUT
PUR plastic = 91.5% of PUR-INPUT = kg in OUTPUT (c)
% of PUR-INPUT … kg : 91.5 = kg
CFC total (d) = 8.5% of PUR-INPUT = kg * 8.5 = kg
kg of kg CFC total = % of RECOVERY

Requirements for the Collection, Transportation, Storage and Treatment of Cooling and Freezing Appliances containing Hydrocarbons (HC)

18 October 2007

1 Introduction

The use of Chlorofluorocarbons (CFCs) in the production of insulation foams and refrigerant circuits for cooling and freezing appliances was banned in the mid-1990s [20].

As a consequence the producers of cooling appliances developed a new technology based on the use of pure Hydrocarbons (HC) such as butane, propane and pentane instead of CFCs as usable refrigerants.

Cyclopentane continues to be used almost exclusively as the blowing agent of choice for the polyurethane (PUR) foam insulation.

One of the main characteristics, in comparison with CFC, H-CFC and HFC [21] is that HC has no ozone depleting potential (ODP) and only a low global warming potential (GWP) (see Figure 1).

	example	Formula	global climate change (GWP)	ozone depletion (ODP)
CFC	R11	$C Cl_3 F$	2400	1
H-CFC	R22	$CH Cl F_2$	1700	0,04 - 0,05
HFC	R134a	$C_2 H_2 F_4$	1300	0
HC	cyclopentane	$C_5 H_{10}$	11	0

Figure 1: environmental impacts of blowing agents in PUR-foam

In total the environmental impact of HC is marginal in comparison to CFC.

The new cooling and freezing appliances - so-called HC-appliances - increasingly emerge at collection facilities for WEEE and in following treatment processes. For 2006 the estimated share lies at around 10-30 % of the total amount of treated waste cooling and freezing appliances collected and treated in Europe [22].

The potential HC emissions from treatment of cooling and freezing appliances represent only a small part of the total annual VOC emissions.

———————

[20] Regulation No 2037/2000 of the European Parliament and of the Council of 29 June 2000 on substances that deplete the ozone layer.

[21] Chlorofluorocarbon (CFC), Hydrochlorofluorocarbon (HCFC) and Hydrofluorocarbon (HFC)

[22] It is expected that the estimated share of waste HC appliances in the WEEE stream will increase in the future. The requirements presented in this paper are based on practices and best available technologies of today. It may be that new and better practices and technologies will emerge in the next 5 to 10 years. The signatories commit to reviewing the requirements document after a period of 5 years or when new developments make a revision necessary.

2 Objective

The objective of the following specifications is to set up requirements for the collection, transport, storage and treatment of HC containing cooling and freezing appliances in order to ensure low environmental impact and to secure the respect of the necessary safety measures.

This can be assured by treatment in specialised treatment plants for waste cooling and freezing appliances that comply with all European Community legislation on health, safety and environment.

3 General requirements

The requirements apply to the separation of HC as liquids and/or gases from cooling and freezing appliances for recovery or disposal by means of dismantling and treatment [23].

Overall this document consists of a set of requirements concerning:

- Collection, storage, transport and handling
- Recovery or disposal of HC
- HC emissions to the surrounding
- Use of output fractions (recovery and recycling targets of 80% and 75% respectively, these targets as according to Directive 2002/96/EC or future amended versions)
- Safety measures
- Quality assurance
- Inspection and control

With these requirements also other legal aspects shall be covered:

1) Safety features at the construction of treatment plant [24].
2) Precautionary safety measures during the whole process [25].
3) Environmental sound treatment, recovery, recycling and disposal of hazardous substances [26].
4) National legal requirements concerning HC emissions.

4 Collection, storage, transport and handling

1) Sorting of types of cooling and freezing appliances [27] shall take place at the treatment plant for cooling and freezing appliances.
2) Sorting of types of cooling and freezing appliances for end of life treatment in advance of the treatment process shall be performed by and supervised by trained personnel and in accordance with the treatment requirements of cooling and freezing appliances.

———————————

[23] Step 1 for the separation of HC and oil from the cooling circuits and step 2 for the separation of HC from the foam for recovery or disposal and the separation of recyclable and recoverable materials (metals, glass, plastics, cables etc.).

[24] Directive 94/9/EC on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres

[25[Directive 1999/92/EC on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres (15th individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC)

[26]Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE) or corresponding national regulations

[8] “Types of appliances” are distinguished as CFC, H-CFC, HC or NH3 containing appliances.

3) The signatories of this document commit to not allowing in their contracts with collection points, or with any party collecting appliances, to pre-sort types of cooling and freezing appliances for end of life treatment purposes.
4) Collection, storage, transport and handling of cooling and freezing appliances shall be done carefully to avoid damage of the appliances and leakage of controlled substances. If oil leakage is recognized, appropriate measures shall be taken to minimize environmental impacts.
5) All sites for storage and treatment shall at least be in line with the technical requirements of Annex III of Directive 2002/96/EC.
6) As for storage, transport and handling also the treatment of HC appliances demand corresponding protective precautionary measures due to the flammability of hydrocarbons. Places where hazardous explosive atmospheres may occur shall be specially designated. Furthermore, the ban on ignition sources and the ban on entering by unauthorized persons shall be labelled and enforced (Annex III of Directive 2002/96/EC).
7) Transports optimisation is allowed as long as the initial size of the cooling and freezing appliances incl. cabinets is not reduced and good condition of the appliances is ensured.
8) All sites shall demonstrate that they are secured against unauthorised access.

5 Treatment

HC appliances can be treated in many different ways. The right choice of a technology is not only a question of minimising the risk of explosion, but also of getting the best separation results for the secondary raw-material market.

Even though the environmental impact of HC is low (its global warming potential is below 15) the national air limiting values have to be respected.

If there is any doubt about the type of refrigerant or foaming agent, the cooling and freezing appliances must be treated as CFC-containing ones. Therefore also treatment facilities for CFC appliances shall comply with explosion protection measures as stated in Directive 1999/92/EC.

Cooling and freezing appliances and components, materials and substances thereof have to be processed at a rate of recovery of at least 80% and a reuse and recycling rate of at least 75% by weight per appliance [see footnote 7].

The treatment process of end of life cooling and freezing appliances is usually performed in two steps:

Step 1 (removal of all liquids - Article 6.1 [see footnote 7]):
1) All liquids that may contribute to a contamination of separated fractions during or after the treatment process shall be removed.
2) All HC refrigerants [28] shall be separated from oil.
3) HC emissions shall comply with national legislation.
4) All installations shall be equipped and operated with protective measures against possible fires and explosions.

If step 1 and 2 are being carried out at 2 different physical locations, the treatment company has to ensure that HC cabinets are not been mixed up with CFC cabinets at the time of collection and storage or during transport.

———————

[28] HC refrigerants used in “Commercial refrigeration equipment” mainly contain HC-290, HC-600a, HC-1270 or blends of HC-290/HC-600a, ”Household refrigerators” mainly isobutane (HC-600a)

Step 2 (Further processing of HC cabinets):

5) It is essential for the treatment of HC cabinets that the necessary safety measures and the welfare of employees are observed.
6) The treatment of appliances in step 2 shall be carried out with step 1 treated appliances only (called “cabinets”) from which refrigerants and oil have been removed.
7) HC emissions shall comply with national legislation.
8) In case HCs from the insulation foam are not captured, they shall be released in a controlled manner respecting the health and safety regulations. Special care to precautionary safety has to be assured as stated in Directive 1999/92/EC [see footnote 6].

Explosion protection measures in accordance with Directive 1999/92/EC

Plants shall comply with Directive 1999/92/EC on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres.

In practice, explosions inside the shredder can be avoided by controlling conditions. Examples of measures to control those conditions:

- Rarefaction of the HC atmosphere by blowing air into the process or
- Reduction of the oxygen content by substituting air with inert gases [29].
- Use of alternative explosion proof processing-technologies.

6 Quality assurance

1) Treatment companies for HC containing cooling and freezing appliances shall have a certified ISO 9001:2000 and ISO 14001, or equivalent audited quality management systems in place, also covering treatment processes and in-house monitoring.
2) In addition to the usual documentation and controlling exercised by the quality system, treatment companies are requested to keep operation journals which register all incoming cooling and freezing appliances according to types and categories and all the outgoing materials.

7 Inspection and control

The quantity of separated liquids and fractions and the location to which they will be shipped shall be documented in a retrievable way to be compliant with monitoring requirements of the national implementations of Directive 2002/96/E9C on waste electrical and electronic equipment (WEEE).

3) Compliance with the quality requirements will be decided by the relevant environmental authorities, responsible take-back system (individual or collective) or other bodies being responsible in the respective countries.
4) It is recommended that an independent organisation with adequate knowledge of the treatment processes of cooling and freezing appliances will make annual inspections on behalf of the respective body to control the following points:
   - Publication of annual report of treated HC appliances and removed liquids and/or HC cabinets
   - The capability of the treatment company to comply with requirements put forward in this document
   - Compliance with environmental legal and other requirements (permits, storage area etc.)

———————

[29] There is a choice between different types of inert gases. Normally nitrogen is used (this is the usual way for treatment of HC appliances in treatment plants for CFC appliances).