



SENS / Swico Recycling

## **Technical regulations on the recycling of electrical and electronic appliances**

### **PART I GENERAL TECHNICAL REGULATIONS**

### **PART II DIRECTIVES**

Directive 1: Recycling and recovery quotas

Directive 2: ICT and entertainment equipment

Directive 3: Lamps

Directive 4: Refrigeration appliances

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## **PART II DIRECTIVES**

**Directive 1: Recycling and recovery quotas**

**Directive 2: Information and communication technology equipment and entertainment electronics (ICT and entertainment equipment)**

**Directive 3: Lamps**

**Directive 4: Refrigeration appliances**

**Directive 5: Dental appliances**

## **PART I GENERAL TECHNICAL REGULATIONS**

## **A. General**

### **A.1 Purpose**

- A.1.1 These technical regulations shall lay down measures to protect the environment and human health by preventing or reducing the adverse effects of the recycling of waste electrical and electronic appliances.
- A.1.2 These technical regulations shall contribute towards closing material cycles, thereby reducing the consumption of natural resources.
- A.1.3 These technical regulations are an integral part of the recycling contract on environmentally-friendly treatment of waste electrical and electronic appliances concluded between SENS or Swico Recycling (hereinafter known as the system operator) and the recycling company.
- A.1.4 These technical regulations stipulate the processing requirements and special obligations of the recycling companies, and observance of these is assessed by controlling boards.

### **A.2 Scope**

- A.2.1 These technical regulations are valid for all waste electrical and electronic appliances, as well as their components, which are treated together with WEEE categories according to the WEEE Directive. These technical regulations are valid for the entire collection and treatment chain, from receipt of the appliances to manufacturing of the final fractions being recovered or disposed of. Additional requirements are defined for specific appliance categories in directives.
- A.2.2 The recycling company is responsible for ensuring that the dismantling companies working on its behalf, and fraction consumers, fulfil the requirements stated in the technical regulations for external further treatment.
- A.2.3 Waste electrical and electronic appliances are subject to the technical regulations insofar as they still contain cables, electronic components and other hazardous components. Casing made from metals, contaminant-free plastics or wood is scrap and is not subject to the technical regulations.

### **A.3 Definitions**

- A.3.1 *'Recycling'* means the collection, transport, storage and treatment of waste, as well as its recovery.
- A.3.2 *'Treatment'* means the physical, chemical or biological modification of the waste.
- A.3.3 *'Materials'* are, according to Art. 4 of the Chemicals Act and Art. 7 of the Conservation Act, considered to be natural elements or chemical elements manufactured through a production process, as well as their compounds. Equivalent to these are preparations (mixtures, compounds, solutions) and items containing such materials.
- A.3.4 *'Material flow'* means the movement and storage of materials, items and secondary products (mass, piece) per time unit, taking into account dismantling and conversion.

- A.3.5 *'Hazardous waste'* means components containing substances which can, even in comparatively low concentrations, directly or indirectly endanger humans or the environment.
- A.3.6 *'De-pollution'* is the process during which hazardous waste is removed from waste electrical and electronic appliances.
- A.3.7 The *'controlling board'* assesses the observance of the technical regulations on the recycling of electrical and electronic appliances at the recycling companies.
- A.3.8 The terms *'reuse'*, *'recycling'*, *'recovery'* and *'disposal'* are based on the definitions in the European regulations on waste<sup>1</sup>.

## **B. Legal compliance in the areas of conservation, and occupational health and safety**

### **B.1 Legal background**

- B.1.1 The relevant federal, cantonal and municipal regulations on waste, particularly the Conservation Act (USG, SR 814.01, Art. 30 Duty to recycle, decontaminate and dispose of waste), the technical ordinance on waste (TVA, SR 814.600), the ordinance on taking back and recycling of electrical and electronic appliances (VREG, SR 814.620) and the ordinance on handling waste (VeVA, SR 814.610) must be upheld. The corresponding approvals must be available, and the associated obligations observed.
- B.1.2 Apart from the requirements derived from the waste legislation and appropriate implementation rules, other relevant regulations must, depending on the type of company, size and location, be upheld in the areas of the environment and occupational health and safety. As a rule, the following apply:

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<sup>1</sup> cf. also Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE) and DIRECTIVE 2006/12/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 5 April 2006 on waste.

- Federal act on water protection (GSchG, SR 814.20)
- Water protection ordinance (GSchV, SR 814.201)
- Hazardous incident ordinance (StFV, SR 814.012)
- Ordinance on the environmental compatibility test (UVPV, SR 814.011)
- Clean air act (LRV, SR 814.318.142.1)
- Noise protection ordinance (LSV, SR 814.41)
- Ordinance on reducing risks when handling certain, particularly hazardous substances, preparations and items (ChemRRV, SR 814.81)
- Ordinance on the systems for storing and handling water-polluting liquids (Technical tank regulations TTV, SR 814.226.211)
- Ordinance on soil contamination (VBBo, SR 814.12)
- Ordinance on restoring contaminated sites (Hazardous waste site ordinance, AltIV, SR 814.680)
- Ordinance on specialist approval for handling cooling agents (VFB-K, SR 814.812.38)
- Ordinance on risk prevention officers for the carriage of dangerous goods by road, rail and water (GGBV, SR 741.622)
- European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR, SR 0.741.621)
- Basel Agreement on the controlling of cross-border waste and its disposal
- Ordinance 3 and 4 on the labour law (SR 822.11)
- Ordinance on the prevention of accidents and occupational illnesses (VUV, SR 832.30)
- as well as cantonal and municipal regulations

B.1.3 The federal act on data protection (DSG, SR 235.1) must be taken into account for non-disclosure/destruction of software and data on data carriers.

B.1.4 Companies based abroad must uphold the legal regulations applicable at the location. As a rule, the Swiss regulations apply in the event of significant discrepancies.

## **B.2 Burden of proof**

B.2.1 The recycling company must always be in a position to prove to the controlling board that all legal regulations have been met. An extensive physical check of compliance with the regulations does not form part of the audit.

B.2.2 The proof consists of a company-specific relevance assessment of all legal requirements, as well as registration of all documents, records, memos, approvals, provisions and contact between the company and the municipal, cantonal and national enforcement authorities, as well as with inspectors and auditors.

## **C. General rules on treatment**

### **C.1 Data carriers**

- C.1.1 Any software and data still existing on data carriers may not be reused or used inappropriately elsewhere.
- C.1.2 Data carriers must be treated at the recycling company in such a way that any remaining data is made unreadable through the reworking/destruction of material (e.g. shredding or burning of data carriers). Treatment processes in which the data could be read again later are not permitted.

### **C.2 Disassembling and mechanical processing**

- C.2.1 In accordance with TVA Art. 12, the preparatory processes must focus on optimum recovery of scrap and the concentration of hazardous substances.
- C.2.2 The staff at the recycling company must be trained and instructed so that they can identify and assess contaminant-containing appliances and hazardous waste, and their threat potential, at all times.
- C.2.3 Hazardous substances mentioned in Section D must be removed from the appliances according to the regulations defined there, and disposed of as per the regulations.
- C.2.4 When removing hazardous substances, suitable measures must be taken so that hazardous waste is not released or distributed over fractions. Full removal of the hazardous waste must be guaranteed at all times by co-ordinating the processes.
- C.2.5 Waste electrical and electronic appliances may not be processed mechanically with scrap metal or other waste. Exceptions are only granted by the controlling boards under special conditions and by taking into account ecological criteria, and require particular measures. Such exception rules must be stated in writing, and the particular measures must be documented.

### **C.3 Mixing ban**

- C.3.1 Hazardous waste may not be distributed over the fractions through the preparatory processes if this primarily serves to reduce the hazardous waste content of the waste fractions through dilution so as to uphold the regulations on release, recovery or storage (mixing ban as per TVA Art. 10).
- C.3.2 Separated components must be prepared in such a way that the hazardous recovery is isolated for the purposes of destruction, recovery or final storage, and are separated from recyclable parts not containing hazardous waste. The same also applies to contaminant-containing residue from filter systems, air classifiers and other preparatory systems.

C.3.3 Equipment not completely rid of hazardous waste may not be mixed with other waste for further treatment, or be released to external companies which are not recycling partners of SENS or Swico.

#### **C.4 Disposal of unusable fractions**

C.4.1 All combustible fractions which cannot be recovered are subject to the incineration duty as per TVA Art. 11, and must be burned in suitable plants. This also applies to substances and appliances exported to countries which are not aware of this legally stipulated incineration duty.

C.4.2 All non-recyclable and non-combustible fractions (and any combustible fractions which cannot be burned for technical reasons) must be prepared so that they meet the storage requirements as per TVA, Appendix I.

### **D. De-pollution**

#### **D.1 Batteries and accumulators**

D.1.1 Batteries and accumulators must be removed from the appliances or other components and disposed of in accordance with the standard of technology.

D.1.2 The regulations on the carriage of dangerous goods must be observed for the mixed collection and transport of batteries and accumulators.

#### **D.2 Capacitors**

D.2.1 All capacitors containing hazardous substances must be removed from waste electrical and electronic appliances before these are damaged or destroyed by any further treatment, which in turn releases hazardous substances.

D.2.2 Capacitors are considered to contain hazardous substances if at least one of the two following conditions is met:

- Electrolyte capacitors which may contain substances hazardous to health or the environment (height > 25 mm; diameter > 25 mm or similar volumes)
- PCB-containing capacitors (PCB: polychlorinated biphenyles) as per the European legislation

D.2.3 Capacitors are only considered to be free of PCBs if one of the following conditions is met:

- if they were produced after 1986 or come from appliances manufactured after 1987.
- if they have been declared as PCB-free.
- if they have been declared as PCB-free based on documentation from the manufacturing firm.

D.2.4 Capacitors which have not been clearly identified as being PCB-free are considered to be 'PCB-containing / likely to contain PCB'. Such capacitors are considered as special waste as per the VeVA Code 16 02 09<sup>2</sup>, and must be disposed of in a high-temperature incineration plant. They are subject to the relevant transport and export regulations. The obligation of proof of material flow with regard to the controlling boards as per G.4 applies.

D.2.5 All other contaminant-containing capacitors as per these regulations are considered to be 'components removed from used appliances', as per the VeVA Code 16 02 15, and must be disposed of in an incineration plant with further flue gas cleaning. They are subject to the relevant transport and export regulations. The obligation of proof of material flow with regard to the controlling boards applies.

### **D.3 Plastics**

D.3.1 Separated plastics from waste electrical and electronic appliances must be used in material recycling or energy recovery.

D.3.2 Energy recovery in a designated system is stipulated if the separated plastics contain hazardous substances and must be classified as special waste as per the legal regulations.

D.3.3 If a company can prove, through appropriate analyses, that the separated plastics cannot be classified as special waste according to the legal regulations, material recycling is permitted.

D.3.4 Plastic compounds containing plastics, which must be classified as special waste according to the legal regulations, as well as those which are not considered special waste, can be treated and recycled in suitable plants if the recycling company is demonstrably able to separate the plastics.

### **D.4 Asbestos**

D.4.1 Asbestos-containing electrical appliances must be separated from other equipment, and asbestos emissions from such appliances must be prevented appropriately. The appliances must be disposed of separately by adhering to the relevant safety measures.

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<sup>2</sup> UVEK ordinance on lists for handling waste, dated 18 October 2005

## **D.5 Radioactive components**

- D.5.1 The recycling companies must have measuring devices to determine radioactive or radioactively contaminated appliances or components.
- D.5.2 The contracted dismantling companies must be informed of any risks by the recycling companies, and suitable precautionary measures must be taken.

## **D.6 Mercury-containing components**

- D.6.1 Mercury-containing components must, as a rule, be disposed of, and mercury emissions must be prevented appropriately. The components must be disposed of separately, adhering to the relevant safety provisions.
- D.6.2 Separate regulations (see Directives 2 and 3) apply to LCD background lighting and lamps.

## **E. Recovery**

- E.1.1 In accordance with the WEEE Directive, the recycling company is obliged to reach recycling and recovery quotas. These are stated in Directive 1 'Recycling and recovery quotas'.
- E.1.2 Proof of compliance with the minimum recycling and recovery quotas is provided by means of a batch trial validated by the controlling board. The controlling body must be given the opportunity to attend the batch trial without having to request this.
- E.1.3 Changes in the internal processes or with regard to external processing companies which could modify the recycling or recovery quotas must be reported to the controlling boards within one month.
- E.1.4 In special cases, annual material flow balances can, in consultation with the controlling boards, be used to prove the recycling and recovery quotas.

## **F. Storage, handling and transport**

### **F.1 Storage**

- F.1.1 Complete appliances, component parts, and contaminant-containing fractions must be stored in such a way that unauthorised persons do not have access, particularly outside operating hours.
- F.1.2 The legal obligations apply to the maximum stock of all appliances, but no more than 20% of the average annual turnover.

- F.1.3 Temporarily higher stock must be reported to the controlling boards.
- F.1.4 Contaminant-free appliances and pure scrap fractions made from metal, plastic, glass or wood which do not contain hazardous substances may be stored outdoors without weatherproofing, insofar as the storage site drainage leads into a sewer system as per the regulations.
- F.1.5 Complete appliances, components, as well as metal-plastic fractions from mechanical processing (e.g. RESH), for which hazardous substances can be released into the environment through atmospheric influences, must, as a rule, be stored with weatherproofing. Where this is only technically and economically possible at disproportionately high expense, exceptions are permitted insofar as the recycling company can prove that no unauthorised emissions are released into the soil or water. The relevant requirements are:
- The storage site must be sealed.
  - The flood water at the storage site must be channelled into a sewage system as per the regulations.
  - A sampling and analysis plan must be presented to the controlling boards for approval, before the stock is set up outdoors.
- F.1.6 If the sewage channelling limit values in the water protection ordinance are exceeded, the material must be immediately weatherproofed, and the relevant decontamination measures must be initiated.
- F.1.7 Lamps and other contaminant-containing fractions such as batteries, capacitors, cathode ray tubes and their components, flat screens (LCD) and their components, printed circuit boards, photoconductor drums, asbestos-containing components, toner cartridges, phosphor powder from lamps and mercury-containing fractions may not be stored outdoors.
- F.1.8 Lamps must be stored in a shatter-proof manner.
- F.1.9 Glass breakage from lamps must be locked up when stored to minimise the release of mercury.

## **F.2 Handling**

- F.2.1 Containers with mixed goods (small electrical appliances, as well as entertainment and information technology equipment) must be handled in such a way that no screens are damaged.
- F.2.2 Refrigeration, freezing, air-conditioning and other compressor appliances, old washing machines, cooking stoves, heating appliances, sun beds and lamps must be handled particularly cautiously and with suitable equipment.

F.2.3 The recycling company must take all measures to ensure the contaminant-containing lamps are delivered to it undamaged. Lamps must be collected separately from lights, packaging material and protective casing.

### **F.3 Transport**

F.3.1 The handling of special wastage is particularly regulated. The relevant regulations of the VeVA and ADR / SDR apply.

F.3.2 Lamps must be transported in such a way that they cannot be damaged by abrasion and mechanical influences. Rod-shaped lamps and other forms must be stored separately. The lamp recyclers determine the suitable containers in consultation with the controlling board.

## **G. Documentation and recording duties**

### **G.1 Company organisation and responsibility**

G.1.1 The recycling company must have an organisation chart which clearly shows the responsibilities and names of the responsible persons in the areas of safety and the environment.

G.1.2 The recycling company must ensure and document the internal and external further training of staff.

G.1.3 The recycling company must document the internal controls, measures for improving the disposal standards, as well as particular operational incidents such as occupational accidents, leakages, fires and damage from natural phenomena.

### **G.2 Work instructions and flow charts**

G.2.1 Written instructions stating the significance and appearance of the relevant contaminants and other particular threats (e.g. risk of injury) must be available for all work stages. The instructions for manual disassembling and pre-treatment according to equipment types, as well as the flow charts for the mechanical preparation processes, must particularly be documented.

G.2.2 The internal administrative processes concerning the disposal of the E+E equipment must be documented and provided to the controlling boards on request.

### **G.3 Materials accounting**

G.3.1 The recycling company commits to keeping account of materials using the recording and analysis software provided. This consists of recording all material flows, and regular (generally once a year) compilation, taking into account the stock-keeping.

G.3.2 All incoming and outgoing deliveries of appliances and fractions must be recorded and documented using weight certificates, delivery certificates, data sheets or acceptance lists.

G.3.3 The materials accounting is used by the controlling boards to prepare factory checks, assess the recycling system as a whole, balance the material flows through all plants, and assess the key figures for individual plants. The materials accounting details are governed in the 'Materials accounting' guidelines.

#### **G.4 Proof of material flows**

G.4.1 The recycling company is responsible for the entire treatment chain, from receipt of the equipment to the final disposal process/start of the recovery process.

G.4.2 The recycling company commits to requiring proof of material flow from the recipient for fractions produced through external processing. Proof of material flow for a forwarded fraction contains the name and address of the recipient, the type of further treatment, and information on the fractions produced and the forwarding of these.

G.4.3 Proof of material flow can be sent directly to the controlling boards by the recipient insofar as no information on the type of further treatment or produced fractions is to be sent to the recycling company for operational reasons.

#### **G.5 Monitoring and checking of the quality of de-pollution**

G.5.1 The quality of de-pollution is monitored and checked through key figures from the materials accounting, internally calculated key figures, and, in the event of mechanical processing, through chemical analyses of light-weight fractions (dust, shredder light-weight fractions, etc.).

G.5.2 The quality of de-pollution of waste electrical and electronic appliances must be monitored and documented internally.

G.5.3 The quality of de-pollution in mechanical processing must be checked at least once a year (in addition to the analyses during the batch trial) with the help of chemical analyses of the light-weight fractions. A representative collected mixed sample must be taken. The sampling plan must be approved by the controlling board. The analysis process must comply with the standard of technology, and be performed by accredited laboratories.

G.5.4 To assess the quality of de-pollution through chemical analyses, the following reference values are used:

- Copper Cu 10,000 mg/kg (1.0%)
- Cadmium Cd 1,000 mg/kg (0.1%)
- PCB 50 mg/kg<sup>3</sup>

G.5.5 If one or more reference values are exceeded in a representative examination, suitable measures must be taken immediately to reach the reference values.

G.5.6 If the copper content in the light-weight fraction totals more than 4%, the copper must be recovered in a suitable process. For a copper percentage of between 1% and 4%, the controlling board will decide on any measures depending on ecological and economic criteria.

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<sup>3</sup> The 6 reference PCB congeners according to DIN 51 527 Part 1 are defined, and weighed according to LAGA (Working Group of the Federal States on Waste).

## **PART II DIRECTIVES**

## **DIRECTIVE 1: RECYCLING AND RECOVERY QUOTAS**

### **1 Scope and definitions**

- 1.1 The standardised calculation of the recycling and recovery quota at recycling companies aims to ensure the comparability of the results. The directive applies both to calculation of the recycling and recovery quota as part of batch trials, and to the recycling and recovery quota of annual quantities.
- 1.2 The definition of the recycling and recovery quota, as well as the associated terms such as 'thermal recovery' and 'disposal', are generally governed according to the WEEE Directive<sup>1</sup>. The resolutions of the WEEE Forum<sup>2</sup> are taken into account for any interpretations.
- 1.3 The recycling quota is the percentage of materials generated from processing appliances that are used for material recycling. The recovery quota is defined as the total of the recycling quota and the percentage of materials used for energy recovery. The percentages are based on the total quantities of appliances processed (100%) without deducting the losses. The recognised types of material recycling and energy recovery are listed in point 6, in accordance with the European classification (WEEE Forum).
- 1.4 Consumers are all external establishments which accept fractions and separate them into further fractions through treatment. They are also called secondary recovery facilities.

### **2 Principles**

- 2.1 The recycling and recovery quotas are calculated using the data processing program CH\_RepTool. Data is entered either by the recycling company itself or by the controlling board, as per the CH\_RepTool instructions.
- 2.2 The stated recycling and recovery quotas must be comprehensibly documented, and their calculations transparent. The recycling company must document the calculation and provide the necessary proof (point 4).
- 2.3 The recycling company must, if required, grant the controlling board access to the necessary data, calculations and proof. The system operator has access to the result through the CH\_RepTool.

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<sup>1</sup> Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE)

<sup>2</sup> WEEE Forum, [www.weee-forum.org](http://www.weee-forum.org)

2.4 Batch trials must be conducted according to the specific flow chart (point 7). The equipment volume for the trials must be collected in a relevant time frame according to the incoming goods, so that this is as representative as possible for the stipulated batch.

### **3 Recycling and recovery quotas for all appliance categories**

3.1 The recycling company must achieve the following recycling and usage quotas for every category of appliance processed:

<b>WEEE Directive category</b>	<b>Appliance category</b>	<b>Recycling quota</b>	<b>Recovery quota</b>
1	Large household appliances incl. refrigeration appliances	75%	80%
2	Small household appliances	50%	70%
3	IT and telecommunication equipment	65%	75%
4	Entertainment electronics	65%	75%
5a	Luminaires, light fittings	50%	70%
5b	Lamps, gas discharge lamps	80%	80%
6	Electrical tools, building, garden and hobby appliances	50%	70%
7	Toys, as well as sporting and recreational appliances	50%	70%
8	Medical equipment	No information	No information
9	Monitoring and controlling instruments	50%	70%
10	Automatic output appliances	75%	80%

### **4 Proof**

4.1 For fractions supplied to external consumers for further separation, proof of the composition and recycling and recovery quotas must be provided. The following documents are accepted as proof:

- Laboratory analyses of the composition (e.g. annealing residue)
- Estimations of the composition based on manual sortings of representative samples by the recycling company

These two forms of proof can be provided by the recycling company independently from the fraction consumer.

- Written confirmations and documents from the consumer stating the relevant information

Should the consumer, for confidentiality reasons (business secret, operational know-how), not be prepared to provide this proof to the recycling company, the consumer can supply this information directly to the controlling board (proof of material flow form) or enter the necessary data in the CH\_RepTool through the so-called 'black box function'. With this 'black box function', the recycling company has no access to the information of the downstream consumers and handlers.

- 4.2 Estimations based on manual sortings are only permitted for fractions which jointly make up no more than 5% of the used quantity. The proof must be comprehensible and documented (photo). Estimations without manual sorting of samples are not permitted.
- 4.3 The recycling quota of metal fractions can be used 100% if the impurities with non-metallic components total no more than 2 mass % and are supplied to a recycling factory (smelter) without further separation. In cases of doubt, proof must be provided that the maximum non-metal percentage is not exceeded.

## 5 Standard recycling and recovery quotas for certain fractions

- 5.1 For the fractions listed in the table below, the relevant recycling and recovery quota standard can be used without any further obligation to provide proof:

Input fraction	Technology	Recycling quota	Recovery quota	Source, comment
Oil fraction	Incineration, Switzerland	0%	38.6%	EcoInvent 2008
Cable mixture of E&E appliances	Cable shredder	30%	30%	Estimate
Battery mixture of E&E appliances	Batrec, smelting	50%	50%	Batrec key environmental figures
Wood	Incineration, Switzerland	0%	38.6%	EcoInvent 2008
Capacitors	Incineration	0%	0%	Composition
Plastics	Incineration, Switzerland	0%	38.6%	EcoInvent 2008
Printed circuit boards	Copper smelting plant or similar	30%	65%	Estimate
Paper/cardboard	Incineration, Switzerland	0%	38.6%	EcoInvent 2008
Toner cartridges	Incineration, Switzerland	0%	38.6%	EcoInvent 2008

- 5.2 If recycling and recovery quotas which differ from the standards are used by the recycling company for these fractions, the necessary proof as per point 4 must be provided.

## 6 Accepted recycling and recovery technologies

- 6.1 In general, the requirements for the defined maximum quantities of hazardous substances and/or impurities must be met in all recovery and disposal options or technologies.

6.2 The recycling technologies listed in the table below are taken into account in the recycling and recovery quota calculation as per the relevant 'SENS and Swico' classification:

<b>Fraction</b>	<b>Final process/technology</b>	<b>WEEE Forum<sup>3</sup></b> (WF_RepTool)	<b>SENS and Swico</b> (CH_RepTool)
Iron/stainless steel	Melting down in the steelworks	MR	MR
	Reducing agent in the copper smelting furnace	MR	MR
Copper	Copper smelting furnace	MR	MR
	Alloying components for aluminium alloys in the smelting plant	MR	MR
Aluminium	Aluminium smelting plant	MR	MR
	Reducing agent in the copper smelting plant	MR	MR
	Reducing agent in the steel works	MR	MR
Mercury	Distillation and recycling	MR	MR
	Immobilisation and dumping	LD	LD
Other metals	Alloying elements e.g. in copper smelting furnaces	MR	MR
	Slag formers with subsequent material usage of the slag	MR	MR
	Slag formers and subsequent dumping of the slag	TD	TD
Plastics/ organic fractions	Preparation and regranulation	MR	MR
	Synthesis gas production through depolymerisation	MR (1)	MR (1)
	Pyrolysis to manufacture fuel substitute	ER (1)	ER (1)
	Reducing agent in the copper smelting plant or steelworks	MR (1)	MR (1)
	Fuel substitute in the cement furnace or other industrial energy production plants	ER	ER
	Refuse and hazardous waste incineration plant with energy recovery	TD	ER (3)
PURE foam from refrigeration appliance recycling	Oil binders	MR	MR
	Fuel in cement furnaces or other industrial energy production plants	ER	ER
Wood and wood materials	Particle board and MDF production	MR	MR
	Fuel in cement furnaces or other industrial energy production plants, matured timber incineration plants	ER	ER
	Refuse and hazardous waste incineration plant with energy recovery	TD	ER (3)
Paper/	Paper or cardboard manufacturing	MR	MR

<sup>3</sup> WEEE Forum WG Reporting System, Model Classification (9.6.2006)

Fraction	Final process/technology	WEEE Forum <sup>3</sup>	SENS and Swico
		(WF_RepTool)	(CH_RepTool)
cardboard	Fuel substitute in the cement furnace or other industrial energy production plants	ER	ER
	Refuse and hazardous waste incineration plant with energy recovery	TD	ER (3)
Oil fraction	De-pollution and refining into new technical oil	MR	MR
	Fuel substitute in the cement furnace or other industrial energy production plants	ER	ER
	Refuse and hazardous waste incineration plant with energy recovery	TD	ER (3)
(H)(C)FC	Chemical separation for using chemical raw materials	MR	MR
	Fuel substitute in the cement furnace or other industrial energy production plants	ER	ER
	Hazardous waste incineration plant with energy recovery	TD	ER (3)
Cathode ray tube glass (mixed or separated)	Cathode ray tube glass production	MR	MR
	Slag formation material in copper or lead works	MR	MR (2)
	Raw material in the ceramics industry	MR	MR
	Raw material in the cement industry		MR
	Mine packing material (filling of underground caverns)	LD	LD
Cathode ray tube faceplate	Raw material for glass wool, foam glass and other forms of glass production	MR	MR
	Raw material for coatings and fillers in civil engineering	MR	MR
Flat glass	Raw material for glass wool, foam glass and other forms of glass production	MR	MR
Glass from gas discharge lamps	Raw material for gas discharge lamps	MR	MR
	Slag formation material in copper or lead works	MR	MR (2)
	Raw material in the ceramics industry	MR	MR
	Raw material in the cement industry		MR
	Mine packing material (filling of underground caverns)	LD	LD
	Raw material for glass wool, foam glass and other forms of glass production	MR	MR
	Raw material for coatings and fillers in civil engineering	MR	MR
Toner cartridges	Cleaning, repairing and refilling	RU	(4)
	Material recycling	MR	MR
	Refuse and hazardous waste incineration plant with energy recovery	TD	ER (3)

*Abbreviations for classifying the recycling technologies:*

**MR:** Material Recycling

**ER:** Energy Recovery

**TD:** Thermal Disposal; this classification also applies to all non-combustible materials which arrive at an incineration plant.

**LD:** Landfill Disposal

**RU:** Re-use, without destruction of the original function

*The numbers (1), (2), (3) and (4) after the abbreviations mean the following:*

- (1) Interim classification
- (2) Only applies if the slag is used for material recycling, otherwise LD
- (3) For a refuse or waste incineration plant to be acknowledged as energy recovery, the criteria of the recognised European models for proving the recovery status of thermal systems must be met.<sup>4</sup> The necessary documents must be provided to the controlling board by the recycling company.
- (4) Not permitted.

*'WEEE-Forum' (WF\_RepTool) column:*

To facilitate comparability with the European harmonisation efforts, the terminology and classification applied as part of the WEEE Forum is used.

*'SENS und Swico' (CH\_RepTool) column:*

The classification of the recycling technologies in this column takes into account national, Swiss operating systems or other special factors or specifications for the recycling companies.

## **7 Flow charts for batch trials**

- 7.1 The flow charts are to be considered as checklists for planning the batch trials. They can be adjusted to the plant-related factors.
- 7.2 The trial should be able to be conducted in one working day in plants with mechanical processing, and in one week in the case of manual dismantling (preparation of plants, realisation and weighing of fractions).

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<sup>4</sup> These are set by the Confederation of European Waste-to-Energy Plants (CEWEP). The Verband der Betreiber Schweizerischer Abfallverwertungsanlagen (VBSA) is a member of the CEWEP.

7.3 The recycling company allows the controlling board to monitor the batch on site.

7.4 Flow chart for mechanical processing

<b>Planning</b>	<b>Information</b>
<ul style="list-style-type: none"> <li>- Define and plan the category, quantity, process and method of collection (origin)</li> <li>- Discuss the plan with the controlling board</li> </ul>	<ul style="list-style-type: none"> <li>- Min. 2 weight % of the annual quantity or max. 500 pieces for large equipment / 30 t for small equipment, except if the production quantity of one day is exceeded.</li> <li>- If possible, only self-de-polluting material (incl. dismantling companies)</li> <li>- if not own material, systematically check system for eliminating harmful substances</li> <li>- Incorporate findings with earlier batch trials</li> </ul>

<b>Preparation</b>	<b>Information</b>
<ul style="list-style-type: none"> <li>- Organisation</li> </ul>	<ul style="list-style-type: none"> <li>- Instruct staff</li> <li>- Advise deadline</li> </ul>
<ul style="list-style-type: none"> <li>- Collect equipment</li> </ul>	<ul style="list-style-type: none"> <li>- Plan enough time</li> <li>- Wet and unemptied equipment can cause balance differences</li> </ul>
<ul style="list-style-type: none"> <li>- Record equipment</li> </ul>	<ul style="list-style-type: none"> <li>- Weigh</li> <li>- Describe condition (wet/dry), photographic documentation</li> <li>- Possibly use hand counters to count large appliances</li> </ul>
<ul style="list-style-type: none"> <li>- Organise de-pollution (can take place prior to and during the batch trial)</li> <li>- Monitor trial preparation</li> </ul>	<ul style="list-style-type: none"> <li>- Weigh harmful substance fractions</li> <li>- Weigh capacitors from large appliances</li> <li>- Provide empty fraction containers for replacement</li> <li>- Calculate and record the tare weight of the fraction containers</li> <li>- Organise the recording of weight data</li> </ul>

<b>Realisation</b>	<b>Information</b>
<ul style="list-style-type: none"> <li>- Empty shredder and shred supply</li> </ul>	<ul style="list-style-type: none"> <li>- 10% of the trial quantity</li> </ul>

**SENS / Swico Recycling****Technical regulations on the recycling of electrical and electronic appliances**

- Place empty fraction containers at output - Start batch trial	
- Constantly change fraction containers and calculate tare weight - Constantly check the fraction containers for capacitors in the large equipment batch	- Possibly also keep checklists for each fraction - Remove and weigh capacitors, and give to capacitor fraction
- Take samples of the finest fractions for analyses of PCB, Cu, Hg, Pb, Zn, Cd - Run the shredder until empty	- Take samples according to the angle of repose method
- Weigh all fraction containers - Compile data sheets	- Create samples for data sheet entry

<b>Analysis</b>	<b>Information</b>
- Collate data, enter into CH_RepTool, and analyse - Have the samples analysed	- State the weight and recycling and recovery quota per fraction - Observe CH_RepTool specifications
- Documentation (CH_RepTool report)	- Send to the controlling board by no later than one month after the end of the trial - Have the quota calculation confirmed by the controlling board

## 7.5 Flow charts for the manual dismantling of fractions

<b>Planning</b>	<b>Information</b>
- Define the quantity, duration, appliance category, fractions and method of collection - Discuss the plan with control experts	- Min. 2 weight % of the annual quantity or 1 week, if all dismantling work stations are involved - Extent of dismantling and fractions must be maintained just as they routinely take place

<b>Preparation</b>	<b>Information</b>
- Organisation	- Instruct staff etc. - Advise deadline

- Collect equipment	- Plan enough time - Wet and unemptied equipment can cause balance differences
- Record equipment	- Weigh - Describe condition (wet/dry), photographic documentation - Possibly use hand counters to count large equipment
- Weigh fractions	- Define the weight recording process for container change - The reliability of the weight recording for container changes must be ensured - Document fractions with photos

<b>Realisation</b>	<b>Information</b>
- Start batch trial	- Set precise time of the batch, if possible at the start of the week - Check that all containers and pallets at batch work stations are empty
- Checks	- Carry out regular checks for reliable weight recording by the party responsible, particularly at the start, as well as plausibility assessments of the measured weights
- Final checks	- Have all containers yet to be filled with fractions been weighed?
- Compile and analyse data sheets	

<b>Analysis</b>	<b>Information</b>
<ul style="list-style-type: none"><li>- Compile and analyse data on the fraction groups</li><li>- Compile data and enter it into CH_RepTool</li></ul>	<ul style="list-style-type: none"><li>- Calculate recycling and recovery quotas</li><li>- Obtain proof from external processors</li><li>- Determine composition</li><li>- Observe CH_RepTool specifications</li></ul>
<ul style="list-style-type: none"><li>- Documentation (CH_RepTool report)</li></ul>	<ul style="list-style-type: none"><li>- Send to the controlling board by no later than one month after the end of the trial</li><li>- Have the quota calculations confirmed by the controlling board</li></ul>

## **DIRECTIVE 2: ICT AND ENTERTAINMENT EQUIPMENT**

### **1 LCDs**

- 1.1 Cold cathode fluorescent lamps in LCDs greater than 100 cm<sup>2</sup> must be removed and recycled or disposed of appropriately.
- 1.2 It is possible to process LCDs without prior removal of the cold cathode fluorescent lamps, after discussion with the controlling boards, insofar as it is ensured that no hazardous substances contained in the cold cathode fluorescent lamps, particularly mercury, have been distributed over the fractions produced in the process, and that the hazardous substances have been recycled or disposed of appropriately.
- 1.3 When de-polluting and processing LCDs, the emissions of hazardous substances – particularly mercury – must be kept low enough to ensure that the environment and the health of the staff are not adversely affected.

### **2 Cathode ray tubes**

- 2.1 Cathode ray tubes must be ventilated prior to manual or mechanical processing (implosion risk).
- 2.2 The luminescent coating, as well as the getters, must be removed in accordance with the applicable occupational safety regulations and then recycled or disposed of appropriately.
- 2.3 Screen glass must, where possible, be recycled in cathode ray tube manufacturing.
- 2.4 If it is proven that no material recycling is possible in the cathode ray tube manufacturing process, recycling of screen, cone or mixed glass in the ceramics industry, smelting works or other suitable recycling processes (e.g. special glass manufacturing) is permitted. In doing so, harmful substances (e.g. lead) must not be used in applications where they are not technically necessary. The controlling boards must be informed of the disposal route.

### **3 Printers and copiers**

- 3.1 Photoconductor drums with selenium arsenide or cadmium sulphide coating, as well as toner cartridges, must be removed in accordance with the applicable occupational safety regulations and be recycled or disposed of appropriately.
- 3.2 When handling toner cartridges, attention must be paid to the risk of dust explosions.

## **DIRECTIVE 3: LAMPS**

### **1 Scope and definitions**

- 1.1 These regulations specify, in accordance with the WEEE Directive<sup>1</sup>, the minimum requirements for recycling quotas, as well as the contaminant recovery details for lamps.
- 1.2 The regulations apply for all gas discharge lamps classified as hazardous waste according to VeVA. The following types are distinguished:

<b>Straight lamps</b>	FL: Tubular fluorescent lamps
<b>Curved lamps</b>	CFL-nl: Energy-saving lamps without integrated ballast
	CFL-l: Energy-saving lamps with integrated ballast
	HID: High intensity/pressure discharge lamps (mercury, halogen metal and sodium vapour discharge lamps), as well as low-pressure sodium vapour discharge lamps
	LED lamps (light-emitting diodes)

Recycling companies which dispose of lamps have the technical and organisational qualifications to treat lamps so that the contaminant-containing luminescent coating can be recovered as completely as possible, and the lamp components can be used as much as possible.

### **2 De-pollution and recycling**

- 2.1 Working steps and plants for the treatment of lamps must be organised in such a way that the emissions of mercury in the form of gas or dust or other hazardous substances from the coating material are kept as low as possible.
- 2.2 Plants must be equipped with suitable backup systems and operated in such a way that functional efficiency can be constantly verified.

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<sup>1</sup> Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE)

- 2.3 Recycling companies must have industrial vacuum cleaners with functional activated carbon filters, as well as lockable containers for mercury-containing fractions and lamp breakages.
- 2.4 Glass and metal fractions for material recycling, as well as all fractions not stored at a special waste disposal site, must not contain more than 5 mg mercury per kg of dry substance (DS).

### **3 Recycling and recovery quotas**

- 3.1 The recycling company must bindingly achieve and uphold the recycling and recovery quotas stipulated in the 'Recycling and recovery quotas' directive.
- 3.2 The calculation is, as a rule, based on one year's material flow. When assessing the quota achieved, the composition of the input must be taken into account in relation to the lamps stated under point 1.2. The quota must be achieved if the percentage of straight lamps is  $\geq 80\%$ .

### **4 Monitoring and controls**

- 4.1 The air emissions from production sites and plants must be constantly monitored so that increased emissions from malfunctions or technical defects can be identified at all times.
- 4.2 Emissions at critical work stations must be regularly checked according to the results and orders of the occupational enforcement authority. In addition, staff at exposed work stations must undergo a medical examination for mercury ingestion and exposure at least once a year.
- 4.3 Calibration of the measurement equipment and maintenance of the emission appliances must be performed according to the recommendations of the system suppliers.
- 4.4 The residual mercury content (total Hg) of fractions which may constitute a diffuse emission source through recycling or incineration (cf. point 2.4) must undergo a chemical analysis at least once a year on the basis of a representative collective mixed sample.

## DIRECTIVE 4: REFRIGERATION APPLIANCES

### 1 Scope and definitions

1.1 These requirements apply to recycling companies which process appliances with substances which are harmful to the ozone layer and climate, such as refrigeration, freezing, air-conditioning and other compressor appliances.

#### 1.2 Appliance groups

Group A: Appliances with substances which are harmful to the ozone layer and climate, such as CFCs, PFCs, HFCs and HCFCs (e.g. R11, R12, R22, R502, R134a)  
(hereinafter simplified to **CFC appliances**)

Group B: **Absorbing appliances** (NH<sub>3</sub>)

Group C: Equipment with hydrocarbons (e.g. isobutane, cyclopentane)  
(hereinafter simplified to **HC appliances**)

#### 1.3 Equipment categories

**Cat. 1 to 5** up to the dimensions: Height+Width+Depth ≤ 420 cm

Cat. 1: Simple appliances (up to 180 l),

Cat. 2: Combined refrigeration and freezing appliances (180 to 350 l)

Cat. 3: Deep-freeze appliances

Cat. 4: Commercial refrigeration appliances (solid construction) weight 80 to 140 kg

Cat. 5: Commercial refrigeration appliances (solid construction) weight 140 to 200 kg and chrome steel refrigeration appliances up to 200 kg

#### **Cat. 6 and 7:**

Cat. 6: Industrial and commercial appliances (Height+Width+Depth ≥ 420 cm) and air-conditioning appliances

Cat. 7: Boilers

### 2 Principles

#### 2.1 Objective

The aim of these requirements is:

- to separate the appliances into fractions for material recycling and energy recovery, as well as to retain substances which are harmful to the ozone layer and climate to ensure these are destroyed.
- to destroy substances which are harmful to the ozone layer and climate, in accordance with Regulation (EC) No 2037/2000 of the European Parliament

#### 2.2 Duty of care

- 2.2.1 The recycling company must ensure that refrigeration, freezing, air-conditioning and other compressor appliances which contain substances harmful to the ozone layer and climate are supplied to it undamaged.
- 2.2.2 It must then inform its suppliers that sorting of different appliance types is not permitted at the collection points.
- 2.2.3 All plants that handle appliances must be protected against explosions, and the company must follow the instructions for fire and explosion safety.
- 2.2.4 Prior to performing the processing in step 2, mercury switches and PCB-containing capacitors must be dismantled.
- 2.3 Treatment stages
  - 2.3.1 The specialised recycling companies record the number of appliances in point 1.3 according to the size categories 1 to 7.
  - 2.3.2 The treatment and destruction of substances which are harmful to the ozone layer and climate are divided into 'coolants' in stage 1 and 'insulating materials' in stage 2.

### **3 Requirements for the treatment and quality of end fractions**

- 3.1 Group A: CFC equipment

#### **Stage 1: 'Coolants'**

- 3.1.1 All liquids must be removed.
- 3.1.2 CFCs must be separated from the oil.
- 3.1.3 The quantity of removed CFCs must be greater than or equal to 90% of the expected quantity. The necessary plant tests must be conducted according to this directive.
- 3.1.4 All removed substances which are stable in air must be demonstrably destroyed through a thermal or chemical process. Delivery certificates, invoices, etc. from the relevant plant operators are considered proof.
- 3.1.5 Compressor oil with less than 0.2% halogen content can be used for material recycling or for energy recovery in conventional combustion plants (unless otherwise directed by the authorities).
- 3.1.6 Compressor oil with more than 0.2% halogen content must be combusted in suitable plants with safe destruction of the CFCs.
- 3.1.7 Compressors must not be recycled.

#### **Stage 2: 'Insulating material'**

- 3.1.8 The quantity of recovered CFCs must be greater than or equal to 90% of the expected quantity. The necessary plant tests must be conducted according to this directive.
- 3.1.9 All recovered substances which are stable in air must be demonstrably destroyed through a thermal or chemical process. Delivery certificates, invoices, etc. from the relevant plant operators are considered proof.
- 3.1.10 Polyurethane (PU) fractions from plants must not contain more than 0.2% CFCs in the PU percentage.
- 3.1.11 It must be ensured that the residual polyurethane percentage in the metal and plastic fractions pending recovery is completely minimised to prevent CFC losses. Maximum residual percentages of 0.3% weight % polyurethane in the metal fractions and 0.5% polyurethane in the plastic fractions must be upheld as limit values after performing all treatment steps.
- 3.2 Group B: Absorbing appliances

**Stage 1 'Coolants'**

- 3.2.1 No degree of recovery for ammonia is specified for absorbing appliances.
- 3.2.2 The refrigeration cycle has not been purged of chromate, the iron sections of the refrigeration cycle must be sent directly to the smelting plant without prior treatment due to their residual chromate content.
- 3.2.3 Disposal of any other fraction (water, NH<sub>3</sub>) must take into account the chromate content.

**Stage 2 'Insulating material'**

- 3.2.4 Absorbing appliance insulating materials which are harmful to the ozone layer and climate must be removed according to the requirements in point 3.1.8 et seq.

- 3.3 Group C: HC appliances

**Stage 1 'Coolants'**

- 3.3.1 The coolant mixture (HC and oil) must be removed.
- 3.3.2 HC must be separated from the oil.
- 3.3.3 The HC emissions must not exceed the limit values stated in the Clean Air Act (LRV).
- 3.3.4 Plant safety must be confirmed by the relevant specialist departments.

**Stage 2 'Insulating material'**

- 3.3.5 The HC emissions must not exceed the limit values stated in the Clean Air Act (LRV). Observance of the legal regulations must be proven.
- 3.3.6 Simultaneous loading of plants with HCs and CFCs must not lead to a reduction in the recovery or destruction of the CFCs.
- 3.3.7 Plant safety must be ensured by the relevant specialist departments.

#### 3.4 Treatment of CFC-containing boilers

- 3.4.1 To recover and destroy substances which are harmful to the ozone layer and climate resulting from the boilers' PU insulation foam, the plants employed to treat the appliances (Cat. 1 to 7) must be used, and the relevant requirements met.

### 4 Duties of documentation and record-keeping

- 4.1 In addition to the conventional documentation, the recycling partners must keep separate monthly records of all incoming air-conditioning and compressor appliances, and refrigeration appliances based on types and categories according to stages 1 and 2.
- 4.2 The following key figures must be re-collected each year and recorded:
- Residual CFC content in the PU fraction
  - Residual content of organically bound halogens in the oil fraction
  - Residual content of PU proportions in metal and plastic fractions

### 5 Monitoring and controls

- 5.1 The controlling board will assess the following aspects in an on-site check:
- Annual material flow dossier
  - Conditions for meeting the requirements
  - Environmental law conformity for each sample (approvals, storage plants, etc.)
- 5.2 Performance test and acceptance of the plants by the controlling board
- 5.2.1 The controlling board will conduct separate performance tests for the acceptance of plants for final treatment of refrigeration appliances with CFC-containing household refrigeration appliances according to stage 1 and stage 2.
- 5.2.2 The performance test for initial acceptance must take place within three months:
- after the recycling company has signed the disposal contract
  - after installation and start-up of a new, relocated or significantly modified plant.
- 5.2.3 The initial acceptance must again be renewed within three months by means of a performance test after one year. All other certifications must each be renewed after two more years.
- 5.2.4 If certification cannot be successfully completed, no more CFC-containing appliances can be processed, except for trial purposes.

5.2.5 If the required performances are not met, the controlling board must be informed immediately.

## **6 Recycling and recovery quotas**

6.1 The recycling company must bindingly achieve and uphold the recycling and recovery quotas stipulated in the 'Recycling and recovery quotas' directive.

## Methodology for determining the effectiveness of refrigeration appliance disposal plants

### 7 Material flow dossier for refrigeration, air-conditioning and freezer appliance disposal

#### 7.1 Number, group and category of appliance in stage 1, divided according to intact and defective/empty appliances

- CFC/HCFC/HFC appliances (R12, R22)
- HFC (R134a) appliances
- HC (R600a) appliances
- NH<sub>3</sub> appliances
- Other appliances not to be treated in stage 1 (gas systems, not containing CFCs/HCFCs)
- Industrial appliances

#### 7.2 Number of appliances in stage 2

- CFC/HCFC appliances (R11/12/141b)
- HC (Cyclopentane)
- Other (glass wool, polystyrene)

#### 7.3 Fractions from stage 1

- CFC/HFC/HCFC/HC (if in the same tank, except for NH<sub>3</sub>)
- CFC/HFC/HCFC (if in the same tank, except for NH<sub>3</sub> and HC)
- CFC (R12 and other CFCs)
- HFC (R134a and other HFCs)
- HCFC (R22 and other HCFCs)
- HC (R600a)
- NH<sub>3</sub> (NH<sub>3</sub>-CrO<sub>4</sub>)
- Oil
- Other materials such as glass, wood, cables, plastic parts, compressors, capacitors, Hg switches, etc.

#### 7.4 Fractions from stage 2

- CFC/HCFC/HC (if in the same tank)
- CFC11 (if in the same tank, except for HCFC, HC)
- HC
- PU
- Ferrous metal
- Non-ferrous metal
- Plastic fraction
- Other residual material for the waste incineration plant

#### 7.5 Documents

- VREG material flow data sheet, page 4
- Proof of disposal of all harmful substances (invoices, delivery certificates)
- Analysis certificate for residual CFC content in the PU fraction

- Analysis certificate for residual halogen content in the oil
- Proof of material flow (where required)

## **8 Methodology for determining the efficiency of stage I plants**

8.1 Based on a plant input of at least 100 intact appliances from categories 1-3 (each with a compressor and refrigeration cycle and legible name plates), each refrigeration appliance is weighed, the refrigeration cycle completely emptied, and then weighed again. The containers provided to collect the CFCs and oil are empty prior to commencing work, and weighed once filled after work is complete. During the entire trial, observations must be annotated with visible CFC and oil losses, and water and parts losses which affect the mass balance. Defective appliances, i.e. appliances without CFCs, which were not separated in advance, must also be recorded.

8.2 The following recordings are available after the trial:

- Total weight of CFC (A) in kg
- Total weight of oil (B) in kg
- Total weight of the CFC quantity as per the name plate data (C)
- Decrease in total weight (D) of all extracted equipment in kg
- Number of defective appliances or appliances with losses affecting the mass balance. The comparison of the actual weight reduction of each appliance with the expected weight reduction (CFC and oil) can be used to interpret and classify defective appliances.

8.3 The following results are determined, taking into account the number of defective appliances or other observations.

### **8.3.1 Mass balance**

The ratio of **(A + B)** to **(D)** is a benchmark for the total plant performance in terms of recovery. Results greater than 0.97 are considered tolerable values.

### **8.3.2 CFC recovery**

1. The ratio of (A) to (C) is a benchmark for plant performance in terms of CFC recovery.
  2. The ratio of (A) to (D – B) is a benchmark for plant performance in terms of CFC recovery.
- Both results (1 and 2) must not exceed 0.9.

### **8.3.3 CFC quantity per appliance**

The ratio (A) to the number of intact appliances provides the quantity of CFCs per refrigeration appliance.

≥115 g CFC per appliance is a reference value.

### **8.3.4 Quantity of oil per appliance**

The ratio (B) to the number of oil-containing appliances is provided by the quantity of oil per refrigeration appliance.

≥240 g oil per appliance is a reference value.

### **8.3.5 Percentage of defective appliances**

If the percentage of defective appliances is greater than 20%, the reasons for this must be reported to the controlling board so that relevant measures can be taken.

## **9 Methodology for determining the effectiveness of stage II plants**

9.1 To determine whether the quantity of recovered CFCs is equal to or greater than 90% of the expected quantity, the following procedure is applied (basis: 1000 appliances from categories 1-3 with CFC-containing PU foam):

- These are prepared based on a plant input of 1000 appliances (weighed individually or collectively).
- The containers provided to collect the CFCs are empty prior to commencing the work, and are weighed once filled after work is completed. The weighing result in kg of CFCs (without water and any cyclopentane from unidentified CF equipment!!!) is divided by the number of CFC-containing appliances. A CFC quantity in grams per appliance is recorded as the result (value = A).

9.2 The following benchmark figures must be met when recovering CFCs, depending on equipment category:

- Equipment cat. 1: 240 g per appliance
- Equipment cat. 2: 320 g per appliance
- Equipment cat. 3: 400 g per appliance

(whereby only cat. 3 appliances with < 500 L are used for the test).

Based on the equipment mix actually available at the test, the expected CFC recovery quantity (M) is calculated according to the following formula:

$$M \text{ g/appliance} = (X\% \text{ appliance cat. 1} \times 240 \text{ g/appliance}) + (Y\% \text{ appliance cat. 2} \times 320 \text{ g/appliance}) + (Z\% \text{ appliance cat. 3} \times 400 \text{ g/appliance})$$

9.3 Furthermore, the quantity of PU fraction (P) produced is determined in kg.

- a. The percentage of foreign substances in the recovered PU fraction is determined in kg using a suitable calculation method (**a**).
- b. The analysis value for the residual CFC content (in kg) in the PU matrix is marked b.
- c. The quantity of pure PU fractions (PU fractions minus the foreign substance percentage quantity minus CFC matrix content still contained) is calculated in kg.

$$(P-a-b) = \text{result} = c \text{ kg PU.}$$

- d. The PU quantity calculated in c. corresponds to 91.5% of the original material (91.5% PU / 8.5% CFC). The quantity of original loading of CFCs in the PU produced as an output fraction is thus calculated with the formula  $((c \times 100/91.5) - c)$ .

$$\text{Result} = d \text{ kg CFC}^1$$

- e. All PU loss streams and the CFC losses accounted for by this are determined and evaluated (residual PU adhesions to Fe metals, non-ferrous metals, plastics and other output materials).

$$\text{Result} = e \text{ kg CFC/HCFC}$$

- f. The degree of effectiveness based on the PU fraction produced is calculated with the following formula:

$$\text{Recovery rate} = \text{total (Ax1000)} / \text{total (d + e)}$$

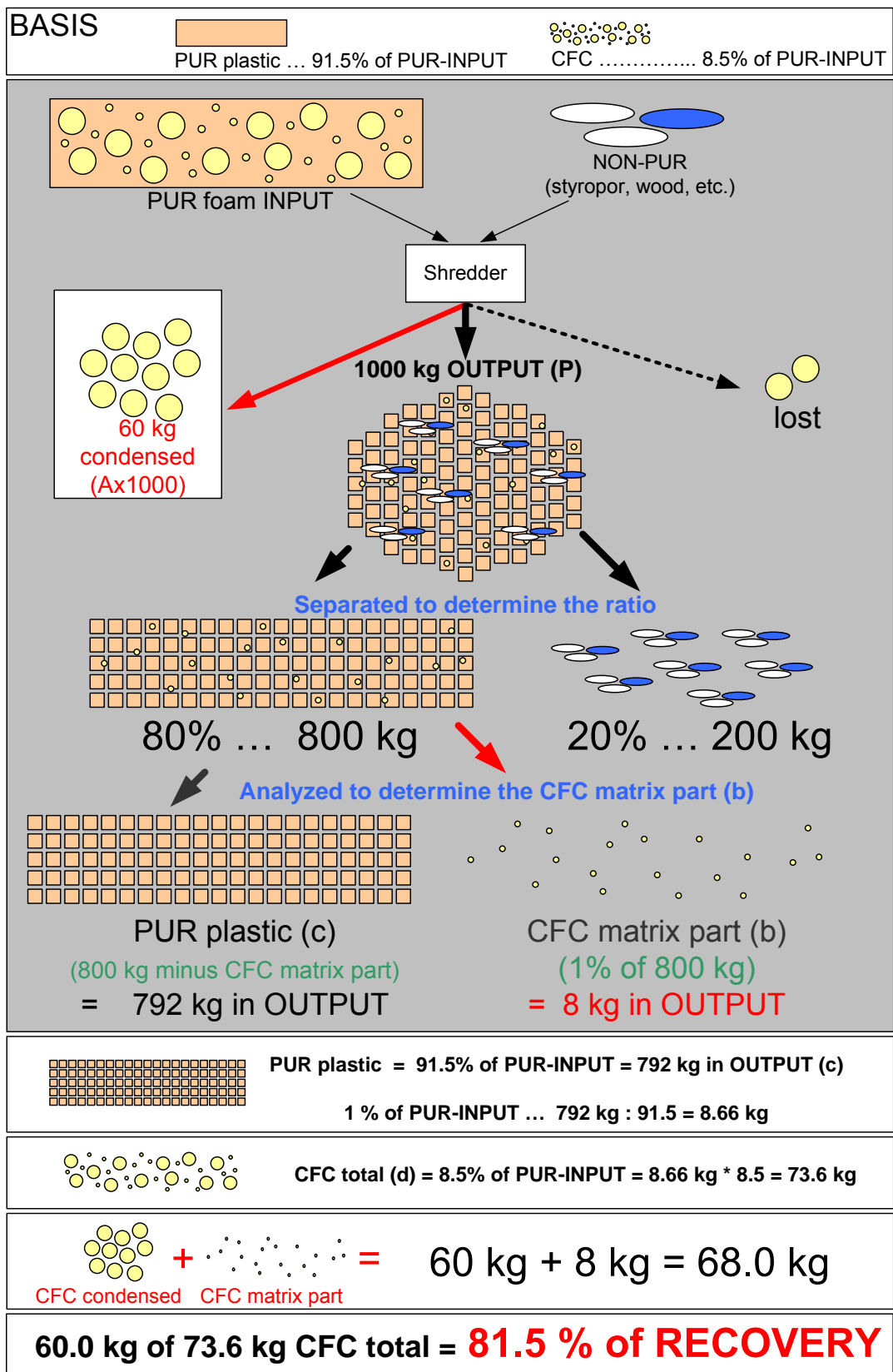
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<sup>1</sup> Results of analyses which render the expected quantity more plausible if it differs from 8.5% must be provided to the controlling board prior to publication for a final evaluation.

- g. The degree of effectiveness based on the input appliance mix introduced is calculated with the following formula:

$$\text{Recovery rate} = \text{total (Ax1000)} / \text{total (Mx1000)}$$

The following diagram serves to illustrate this analysis:



## **DIRECTIVE 5: DENTAL APPLIANCES**

### **1 General**

- 1.1 Unused dental appliances are considered hazardous waste. The waste disposal company thus requires a hazardous waste approval as per VeVA, Art. 8.

### **2 Processing regulations**

- 2.1 For disused dental appliances, the following appliance parts, in addition to the appliance parts defined in the processing, storage and transport regulations for disused electronic appliances, must be separated manually and disposed of separately: amalgam separator (storage vessel) including in-feed suction tubes, 'chemoclave' filters, liquids from 'chemoclaves', developers from X-ray image developers, special oil from X-ray heads, hydraulic oil.
- 2.2 The storage vessel in the amalgam separator, which can be contaminated with amalgam, must be classified as hazardous waste and disposed of accordingly. (NB: although such storage vessels should already have been removed, it is possible for one to be forgotten).
- 2.3 Suction tubes which have supplied the amalgam separator with water contaminated with amalgam must be incinerated in a suitable plant with extensive flue gas cleaning (e.g. waste incineration plant), and must not, under any circumstances, be used for material recycling. Any metal fittings must be removed beforehand and recycled as metal.
- 2.4 'Chemoclave' filters which may contain permanganate and other substances must be disposed of in a waste incineration plant.
- 2.5 'Chemoclaves' must then be checked to determine whether they still contain liquids (alcohol/formaldehyde). If this is the case, this must be disposed of appropriately (e.g. according to VeVA Code 18 01 06 Chemicals made from or containing hazardous substances).
- 2.6 X-ray image developers must then be checked to determine whether they still contain liquid (developer). If this is the case, this must be disposed of appropriately (e.g. as per VeVA Code 09 01 01 Water-based activator solutions and developers, or VeVA Code 09 01 03 Solvent-based developer solutions).
- 2.7 Special oil from X-ray heads, as well as hydraulic oils (e.g. from chairs), are likely to contain PCB. Until clear data on this is available, these oils must be collected separately from one another (e.g. in 200-litre containers). As soon as one container is full, the oil must be analysed for PCB, and the method of disposal discussed with the controlling board.
- 2.8 Old autoclaves, heaters and possibly also chemoclaves could be insulated with asbestos. Such appliances must be examined to determine whether they contain asbestos. Appliances which are suspected to contain asbestos must not, under any circumstances, be further processed. They

must be temporarily stored – well packaged (e.g. in a plastic bag) and clearly labelled – and must be disposed of by a company specialising in asbestos.

- 2.9 According to information from the radiation protection department of the Swiss Federal Office of Public Health, dental appliances do not contain any radioactive substances apart from, at most, medical equipment from specialist institutes. X-ray equipment from dental practices is not a source of radioactive radiation if it is switched off. Only foreign, unconventional/unknown (medical) equipment must therefore be inspected for radioactivity. If elevated radiation values are found, the radiation protection department of the Swiss Federal Office of Public Health must be informed, and the following procedures discussed.
- 2.10 Due to the fact the commonly used appliances tend to be quite old, all capacitors are considered to be 'PCB suspects' and must be disposed of accordingly.

### **3 Hygiene and safety at the workplace**

- 3.1 As the handling of dental appliances involves particular health risks, these must be dismantled separately from the usual material at specially designated work stations and with heightened safety precautions (see 2.2 – 2.4). If these work stations are also used to dismantle other electronic appliances, the heightened safety precautions (see 2.2 – 2.4) also apply for these.
- 3.2 When dismantling dental appliances, safety glasses and masks must be worn.
- 3.3 When dismantling dental appliances, acid-proof gloves must be worn and replaced regularly. After a work process is completed, the gloves (still being worn), and then the hands, must be disinfected. The disinfectant is to be provided by the Swiss Dental Trade Association (SVDH).
- 3.4 Due to the risk of Hepatitis B infection, it is urgently recommended that all persons involved with dismantling dental appliances are immunised for Hepatitis B.

### **4 Acceptance and storage**

- 4.1 When accepting dental appliances, the precautionary measures in 3.2 to 3.4 must, as for dismantling, be observed, if operation is not purely mechanical, e.g. with a fork lift truck.
- 4.2 The waste disposal company must store dental appliances separately and clearly labelled.
- 4.3 Any fractions produced must be stored in such a way that there is no risk of injury.