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Collection, logistics & Treatment requirements for WEEE -- Part 3-1: Specification for de-pollution - General

Foreword

This document has been prepared by CLC/TC 111X "Environmental aspects for electrical and electronic products and systems".

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This document has been prepared under mandate M/518.

Introduction

In order to support European standard EN 50625-1, Collection, logistics & Treatment requirements for WEEE - Part 1: General treatment requirements, covering treatment of WEEE and thereby fulfil the requirement of the European Commission's Mandate it is necessary to include normative requirements, such as target and limit values for the analysis, into a document that is able to be revised to take into account both practical experience and changes in treatment technologies.

1 Scope

This European Technical Specification is intended to be used in conjunction with the WEEE Treatment Standard, EN 50625-1 for most types of WEEE (other documents will be developed to define requirements for specific WEEE requiring more specialised treatment).

2 Normative references

EN 50625-1 Collection, logistics & Treatment requirements for WEEE - Part 1: General treatment requirements

3 Terms & definitions

For the purposes of this document the terms and definitions given in EN 50625-1 and the following apply.

3.1 Limit value

Value that shall not be exceeded in order to comply with the requirements

3.2 On-site verification

process carried out at the treatment facility to ascertain whether a sample fulfils expected conditions

3.3 Population

totality of items under consideration

[ISO 3534-1]

3.4 Sub-population

defined part of population

[ISO 3534-1]

3.5 Sample

portion of material selected from a larger quantity of material

[ISO 11074:2005]

3.6 Sampling plan (sampling protocol)

predetermined procedure for the selection, withdrawal, preservation, transportation and preparation of the portions to be removed from a population as a sample

[ISO 11074-2]

3.7 Scale

quantity (mass or volume), defined in space and/or time, of material represented by the sample and considered relevant for the assessment of the material

3.8 Target value

Value that shall be reached in order to comply with the requirements

4 De-pollution monitoring

4.1 Introduction

The following paragraphs cover de-pollution monitoring and refer to 5.6 of EN 50625-1. The target values and limit values defined in this Technical Specification apply to the three methodologies stated in 5.6 of EN 50625-1:

- ‘Target value methodology’ - compare a measurement of the mass of de-polluted fractions in the outgoing stream with the corresponding target value;
- ‘Mass balance methodology’ - establish of a mass balance between incoming and outgoing streams; and
- ‘Analysis methodology’ - analyse representative samples from relevant fractions that result from the treatment of WEEE.

NOTE In order to ensure that the target values and limit values remain ‘state of the art’ it is planned to review, and where necessary revise them, with a frequency of approximately 3 years.

When applying the methodologies to assess the de-pollution monitoring the sampling and analysis protocols given in the Annexes shall be used, as appropriate. The analysis shall be performed in laboratories that apply the protocols for the analysis.

4.2 Target value methodology

As stated in B.2 of EN 50625-1, to verify the efficiency of de-pollution during the performing of a batch process, target values shall be reached.

This methodology uses the following approach:

- establish targets: these masses per unit of input mass are defined in this Technical Specification and are based on the background of comparable studies developed in Europe;
- perform a batch process: the operator shall determine the mass of the specified components removed by performing a batch process according to the methodology of Annex D of EN 50625-1;
- evaluate the de-pollution performance: the operator shall compare the results of the batch process with the specified target values.

If the batch process results meet or exceed the target values then the performance of de-pollution fulfils the requirements.

4.3 Mass Balance methodology

This methodology uses the approach described in the specific Technical Specifications that can be summarised in the following procedure:

- establish characteristic numbers and targets;
- perform the test;
- evaluate the de-pollution performance.

As stated in 5.6 and B.1 of EN 50625-1, to verify the efficiency of de-pollution for specific type of WEEE, i.e. temperature exchange equipment and flat panel display equipment, a mass balance shall be performed.

NOTE Standards for household temperature exchange equipment are contained in EN Standard 50574:2012 and future substitute standards and those for Flat Panel Display will be developed by CENELEC.

4.4 Analysis methodology

As stated in B.3 and B.4 of EN 50625-1, the quality of de-pollution shall be measured on the basis of analysis of the amount of substances or indicators thereof (listed in Annex F of that Standard) in the output fractions (if applicable to the treatment process) by comparing the results with the corresponding limit values.

This methodology uses the following approach:

- establish the limits: these values are defined in this Technical Specification and are based on the background of comparable studies and legislation;
- sample the output fractions: the operator shall prepare a sample for the laboratory according to the sampling procedure defined in this Technical Specification;

- evaluate the analysis' results: the operator shall ensure that the concentration of substances is determined according to the analysis procedure defined in this Technical Specification.

If the analysis results are below the limit values then the performance of de-pollution fulfils the requirements.

Sampling protocols aim at obtaining representative samples for laboratory analysis from the output fractions obtained as a result of WEEE recycling operations.

NOTE All the sampling protocols are based on the EN 14 899.

Depending on the fractions and the substance to be analysed, two mains techniques can be used:

- sampling from a falling stream;
- sampling from a pile.

Analysis protocols will be implemented by laboratories. There are many types of physico-chemical analysis and this Technical Specification describes the suitable method for each type of sample.

The analysis protocols describe the three main steps conducted on a laboratory sample until obtaining the results (see Figure 1).

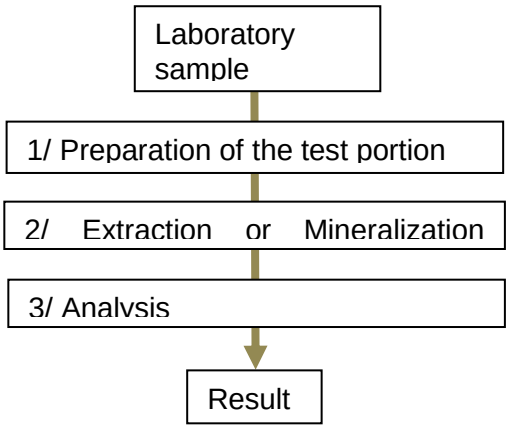


Figure 1- analysis protocol

The above three steps are commonly used in international and European analytical standards. Hence the analytical protocols used in this technical specification use these three steps and indicate which norm has to be used for each fraction and each substance.

5 Overview of the applicable methodologies

5.1 Applicable methodologies

Table 1 shows, for every of the following standard treatment flow, what are the applicable methodologies.

The following components are those identified in Annex F of EN50625-1.

Treatment process flows[c]	Categories in Directive 2012/19/EU	Target value methodology	Mass Balance methodology	Analysis methodology
Large appliances[d]	Annex I: cat. 1. Annex III: cat. 4.	Applicable to capacitors[e].	Not applicable.	Applicable for the PCB in the physically smallest non-metallic mechanical treatment fraction.
Cooling and freezing appliances[d f]	Annex I: cat. 1. Annex III: cat. 1.	Applicable to capacitors[e].	EN 50574:2012 and future TS[a].	EN 50574:2012 and future TS[a]
CRT/FPD Display appliances[d]	Annex I: cat. 3 & 4. Annex III: cat. 2.	Applicable to capacitors[e].	Specific for FPD: specific TS for CRT/FPD	Applicable for BFRs in plastics fractions. Specific for CRT/ FPD: specific TS for CRT/FPD
Gas discharge lamps[d]	Annex I: cat. 5. Annex III: cat. 3.	Not applicable.	Not applicable.	Specific TS for lamps.
Small appliances[d]	Annex I: cat. from 2 to 10. Annex III: cat. 5 & 6.	Applicable to capacitors[e] and batteries.	Not applicable.	Applicable for the PCB and Cadmium in the physically smallest non-metallic mechanical treatment fraction and BFRs in plastics fractions.
Other appliances[b]	Annex I: Cat 1 to 10 Annex III: cat. 1 to 6.	----	----	----

[a] currently the EN 50574:2012 is based on experience on household appliances.

[b] other appliances are, for example, Business to Business products not similar to the household appliances and medical equipments.

[c] treatment flows are defined based on the common treatment flows

[d] In case of different composition of the flow treated, adjustment shall be made to manage this different cases.

[e] see Annex A.2 of EN 50625-1.

[f] while Directive 2012/19/EU refers to the term 'Temperature Exchange Equipment' this term includes radiators containing oil and other temperature exchange equipment using fluids other than water and such WEEE is not within the scope of EN 50574:2012. Those equipment are covered by other treatment flows.

Table 1 - Applicable methodologies

6 Large appliances

6.1 Introduction

The de-pollution monitoring of Large appliances (LA) shall use both the target value methodology and the analysis methodology.

6.2 Target value methodology

The target value $C_{tot\ LA}$ (kg of capacitors per tonne of Large appliances treated), given in this technical specification, shall be reached.

The requirements for capacitors given in this technical specification are for the capacitors listed in Annex F of EN 50625-1 which have been removed, either as a distinct fraction or an identifiable (part of) a stream, and sent to the correct treatment process, see 11.2.

The targets are obtained by multiplying the pollution assessment results (fixed per type of appliance or category) and the composition rate (composition of appliances/categories in each treatment flow).

NOTE 1 An example of the pollution assessment results and of the composition rate is given in Annex F.

For each type of appliance (*i=1…n*) the mass of the capacitors per tonne (Ci) contained in it shall be fixed.

For each type of appliance (*i=1…n*) the composition rates (r_i) shall be fixed for the LA flow.

The target value shall be calculated by the following formula:

$$C_{tot\ LA} = \left(\sum_i C_i \times r_i\right) \times 90\% = target\ amount \text{ of capacitors per tonne of LA treated}$$

NOTE 2 90% is added in the formula to consider the variation and the limit of the technologies.

If an operator is able to provide evidences for the parameter r_i (related to different input categories treated in this flow or distinct mixtures of them) this figures shall be used when calculating the target values.

NOTE 3 The sampling results can be different, for example, from the western countries to the eastern countries and can differ from operator to operator because it is related to the type of product treated.

In case that the operator is not able to provide data for r_i, then the appropriate target values defined in Annex E shall apply.

6.3 Analysis methodology

For large appliances the operator shall perform an analysis on the physically smallest non-metallic mechanical treatment fraction. The substance to be investigated is the Polychlorinated Biphenyls (PCB), the limit value is 50 mg/kg.

In the Annexes A and B are indicated the protocols for sampling and analysis of this fraction.

7 Cooling and freezing appliances

7.1 Introduction

The de-pollution monitoring of Cooling and Freezing appliances (C&F) shall use all three methodologies: target value, mass balance and analysis.

7.2 Target values methodology

The following target value shall be reached: $C_{tot\ C\&F}$ (kg of capacitors per tonne of C&F treated).

The requirements for capacitors given in this technical specification are for the capacitors listed in Annex F of EN 50625-1 which have been removed, either as a distinct fraction or an identifiable (part of) a stream, and sent to the correct treatment process, see 11.2.

The targets are obtained by multiplying the pollution assessment results (fixed per type of appliance or category) and the composition rate (composition of appliances/categories in each treatment flow).

NOTE 1 An example of the pollution assessment results and of the composition rate is given in Annex F.

For each type of appliance (*i=1…n*) the amount of the capacitors per tonne (Ci) contained in it shall be fixed.

For each type of appliance (*i=1…n*) the composition rates (ri) shall be fixed for the Cooling and Freezing flow.

The target value shall be calculated by the following formula:

$$C_{tot\ C\&F} = \left(\sum_i C_i \times r_i\right) \times 90\% = target\ amo\text{unt of capacitors per tonne of C\&}F\text{ treated}$$

NOTE 2 90% is added in the formula to consider the variation and the limit of the technologies.

If an operator is able to provide evidences for the parameter r_i (related to different input categories treated in this flow or distinct mixtures of them) this figures shall be used when calculating the target values.

NOTE 3 The sampling results can be different, for example, from the western countries to the eastern countries and can differs from operator to operator because it is related to the type of product treated.

In case that the operator is not able to provide data for r_i, then the appropriate target values defined in Annex E shall apply.

7.3 Mass balance methodology

For cooling and freezing appliances the target values of the EN Standard 50574:2012 shall be reached.

NOTE Target values will be contained also in future Technical Specification.

7.4 Analysis methodology

For Cooling and freezing appliances the limit values of the EN Standard 50574:2012 shall apply.

NOTE Limit values will be contained also in future Technical Specification.

8 CRT/FPD Display appliances

8.1 Introduction

The de-pollution monitoring of CRT Display appliances shall use both the target value methodology and the analysis methodology.

The de-pollution monitoring of FPD Display appliances shall use the three methodologies: target value, mass balance and analysis.

8.2 CRT display appliances - Target value methodology

The following target value shall be reached: $C_{tot\ CRT}$ = (kg of capacitors per tonne of CRT display appliances treated).

The requirements for capacitors given in this technical specification are for the capacitors listed in Annex F of EN 50625-1 which have been removed, either as a distinct fraction or an identifiable (part of) a stream, and sent to the correct treatment process, see 11.2.

The targets are obtained by multiplying the pollution assessment results (fixed per type of appliance or category) and the composition rate (composition of appliances/categories in each treatment flow).

NOTE 1 An example of the pollution assessment results and of the composition rate is given in Annex F.

For each type of appliance (*i=1…n*) the amount of the capacitors per tonne (Ci) contained in it shall be fixed.

For each type of appliance (*i=1…n*) the composition rates (r_i) shall be fixed for the CRT display appliances flow.

The target value shall be calculated by the following formula:

$$C_{tot\ CRT} = \left(\sum_i C_i \times r_i\right) \times 90\%$$

$$= target\ amount \text{ of capacitors per tonne of CRT display appliances treated}$$

NOTE 2 90% is added in the formula to consider the variation and the limit of the technologies.

If an operator is able to provide evidences for the parameter r_i (related to different input categories treated in this flow or distinct mixtures of them) this figures shall be used when calculating the target values.

NOTE 3 The sampling results can be different, for example, from the western countries to the eastern countries and can differs from operator to operator because it is related to the type of product treated.

NOTE 4 The amount of Batteries in display appliances is considered negligible.

In case that the operator is not able to provide data for r_i, then the appropriate target values defined in Annex E shall apply.

8.3 CRT display appliances – Analysis methodology

For the plastics fractions the substances to be investigated and the limits are one of the following depending on the treatment process performed on plastics:

- plastics fractions declared as without BFR: 2000 ppm of Bromine (Annexes C and D);
- plastic fractions declared as without restricted BFRs: 1000 ppm of each restricted BFRs (Annexes C and D);

In the related Annexes are indicated the protocols for sampling and analysis of these fractions.

NOTE For the specific limit values related to CRT display appliances: the limit values indicated in the specific Standard and Technical Specification shall be reached.

8.4 FPD display appliances - Target value methodology

The following target value shall be reached: $C_{tot\ FPD}$ = (kg of capacitors per tonne of FPD display appliances treated).

The requirements for capacitors given in this technical specification are for the capacitors listed in Annex F of EN 50625-1 which have been removed, either as a distinct fraction or an identifiable (part of) a stream, and sent to the correct treatment process, see 11.2.

The targets are obtained by multiplying the pollution assessment results (fixed per type of appliance or category) and the composition rate (composition of appliances/categories in each treatment flow).

NOTE 1 An example of the pollution assessment results and of the composition rate is given in Annex F.

For each type of appliance (*i=1…n*) the amount of the capacitors per tonne (Ci) contained in it shall be fixed.

For each type of appliance (*i=1…n*) the composition rates (r_i) shall be fixed for the FPD display appliances flow.

The target value shall be calculated by the following formula:

$$C_{tot\ FPD} = \left(\sum_i C_i \times r_i\right) \times 90\%$$

$$= target\ amount \text{ of capacitors per tonne FPD display appliances treated}$$

NOTE 2 90% is added in the formula to consider the variation and the limit of the technologies.

If an operator is able to provide evidences for the parameter r_i (related to different input categories treated in this flow or distinct mixtures of them) this figures shall be used when calculating the target values.

In case that the operator is not able to provide data for r_i, then the appropriate target values defined in Annex E shall apply.

NOTE 3 The sampling results can be different, for example, from the western countries to the eastern countries and can differs from operator to operator because it is related to the type of product treated.

8.5 FPD display appliances – Mass balance methodology

For FPD display appliances the Mass balance methodology is applicable.

NOTE For FPD display appliances the specific targets of the Technical Specification for FPD shall apply.

8.6 FPD display appliances - Analysis methodology

For the plastics fractions the substances to be investigated and the limits are one of the following according to the treatments performed on plastics:

- plastics fractions declared as without BFR: 2000 ppm of Bromine (Annexes C and D);
- plastic fractions declared as without restricted BFRs: 1000 ppm of each restricted BFRs (Annexes C and D);

NOTE For the specific limit values related to FPD display appliances: the limit values indicated in the future specific Standard and Technical Specification shall be reached.

9 Lamps

9.1 Introduction

The de-pollution monitoring of Lamps shall use the analysis methodology.

9.2 Analysis methodology

For Lamps the analysis methodology is applicable.

NOTE The limit values that shall apply are indicated in the future specific TS for lamps.

10 Small appliances

10.1 Introduction

The de-pollution monitoring of Small appliances (SM) shall use both the target value methodology and the analysis methodology.

10.2 Target value methodology

The following target values shall be reached:

- capacitors: $C_{tot\ SM}$ (kg of capacitors per tonne of Small appliances treated);
- batteries: $B_{tot\ SM}$ (kg of batteries per tonne of Small appliances treated).

The requirements for capacitors and batteries given in this technical specification are for the capacitors and batteries listed in Annex F of EN 50625-1 which have been removed, either as a distinct fraction or an identifiable (part of) a stream, and sent to the correct treatment process, see 11.2 and 11.3.

The targets are obtained by multiplying the pollution assessment results (fixed per type of appliance or category) and the composition rate (composition of appliances/categories in each treatment flow).

NOTE 1 An example of the pollution assessment results and of the composition rate is given in Annex F.

For each type of appliance (*i=1…n*) the amount of the capacitors per tonne (Ci) and batteries per tonne (Bi) contained in it shall be fixed.

For each type of appliance (*i=1…n*) the composition rates (r_i) shall be fixed for the Small appliances flow.

The target values shall be calculated by the following formulas:

$$C_{tot\,SM} = \left(\sum_i C_i \times r_i\right) \times 90\% = target\ amount \text{ of capacitors per tonne of } SM \text{ treated}$$

$$B_{tot\,SM} = \left(\sum_i B_i \times r_i\right) \times 90\% = target\ amount \text{ of batteries per tonne of } SM \text{ treated}$$

NOTE 2 90% is added in the formula to consider the variation and the limit of the technologies.

If an operator is able to provide evidences for the parameter r_i (related to different input categories treated in this flow or distinct mixtures of them) this figures shall be used when calculating the target values.

In case that the operator is not able to provide data for r_i, then the appropriate target values defined in Annex E shall apply.

NOTE 3 The sampling results can be different, for example, from the western countries to the eastern countries and can differs from operator to operator because it is related to the type of product treated.

10.3 Analysis methodology

For small appliances the limit values that shall apply are the following.

For the physically smallest non-metallic mechanical treatment fraction the substances to be investigated and the limits are the following:

- Polychlorinated Biphenyls (PCB): 50 mg/kg (Annexes A and B);
- Cadmium (Cd): 100 mg/kg (Annexes A and B).

For the plastics fractions the substances to be investigated and the limits are one of the following according to the treatments performed on plastics:

- plastics fractions declared as without BFR: 2000 ppm of Bromine (Annexes C and D);
- plastic fractions declared as without restricted BFRs: 1000 ppm of each restricted BFRs (Annexes C and D);

11 Protocol for components removed during a batch process

11.1 General procedure

The mass of input material and components removed during the batch process shall follow the requirements described in the Annex D of EN 50625-1.

Input material may include sorting mistakes (i.e. Screens in Small equipment Flow). When it is possible, the sorting mistakes should be taken out of the input material before running the batch process, so that only products that belong to the desired treatment flow remain as input material.

Only components removed from the processed incoming equipment must be accounted (and not be added up to components removed from other treatment flows or waste). Components must be weighed separately per type (capacitors, batteries).

The weighing equipment used shall have sufficient precision (± 0,1 kg) and must be regularly calibrated. The weight of the receiving container in which the components are gathered together for weighing must be deducted from the gross weight in order to obtain the net weight of components (net weight = gross weight – tare weight).

11.2 Capacitors

In order to be able to compare the results both with the target and with the day-to-day conditions, it is necessary to follow the following procedures.

During the batch process the mass of all the capacitors streams shall be determined:

- M1.1: mass of the capacitors removed as a separate identifiable stream (capacitors only) and sent to an environmentally correct treatment process.
- M2.1: mass of capacitors removed as identifiable parts of streams and sent to an environmentally correct treatment process;

NOTE: the mass of the capacitors is the mass of all removed capacitors excluding the capacitors outside of the scope of the WEEE Directive 2012/19/EU, cables,pieces of printed circuit boards and batteries.

The sum of M1.1 + M2.1 provides the mass to be compared to the target value.

NOTE: one way of determining a capacitors is if the component is marked with “µF“ which is the capacity unit symbol.

11.3 Batteries

In order to be able to compare the results with the target, it is necessary to make sure that the mass of the batteries stream shall be determined.

NOTE: the mass of the batteries is the mass of all removed batteries excluding the cables,pieces of printed circuit boards and capacitors.

12 Annex A (Normative) – Sampling protocol for the physically smallest non-metallic shredder fraction

12.1 Introduction

This annex describes the sampling and analysis protocols which have to be used to implement the analysis methodology stated in 5.6 of EN 50625-1 for the physically smallest non-metallic shredder fraction, also called shredder light fraction (SLF).

The laboratory shall perform the analysis on the sample for the residual amount of PCB and Cd (Annex B).

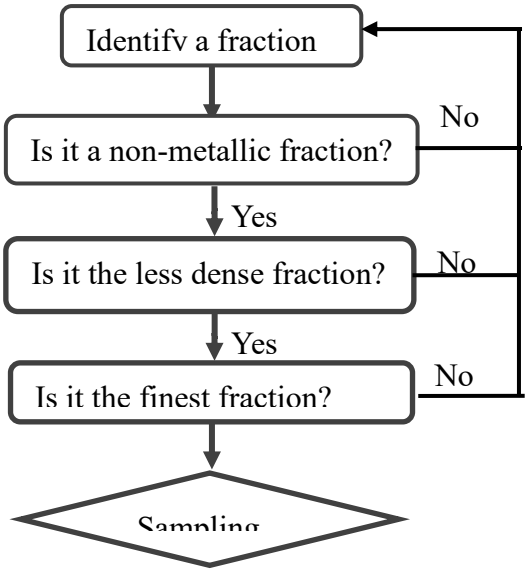
12.2 Sampling

This fraction generally contains pieces of plastics, rubber, wood, glass and very little metals.

This fraction does not have to be the dust from dust capture systems.

NOTE The choice of the Shredder Light Fraction (SLF) can be difficult if there is not any “fluff fraction” as produced by a shredder.

The following flowchart should help in choosing the appropriate fraction.



12.2.1 Population – Sub-population – Scale

The population considered shall be the annual production of Shredded light fraction from WEEE treatment.

If the operator treats separately different treatment categories of WEEE, one analysis shall be done for each subpopulation.

Sampling can be performed at any moment of the year, during a treatment campaign.

For large shredders (see D.1 EN 50625-1), the amount of SLF shall correspond to a minimum of 50 tons of input material in the recycling process.

For WEEE specific shredder, the amount of SLF shall correspond to a minimum of 10 tons of input material in the recycling process.

The treatment campaign whose SLF will be sampled need not be selected at random (for example can be carried out during a batch process).

12.2.2 Number of samples

The material shall be sampled with a minimum of 10 singles samples. The 10 single samples are mixed to form a “mixed sample”. The resulting mixed sample is reduced to the size of laboratory sample.

12.2.3 Size of samples

The sample size depends on the particles size of the sampled fraction according to the table below.

Size of the biggest particles	Min. vol. of single sample (l)	Min. vol. of mixed sample (l)	Min. vol. of reduced sample (l)	Min. vol. of lab sample after sieving (l)
< 5 mm	0,5	5	1	1 (sieving not necessary
5 to 20mm	1	10	2,5	1
20 to 50mm	5	50	12,5	1
> 50mm	30	300	75	1

If the shredder light fraction produced by the process has a particles size over 5mm, the laboratory sample shall be sieved manually on site or by the laboratory until obtain the desired quantity of SLF.

12.2.4 Sampling method from a falling stream

If it is possible, this method shall apply instead of the method “sampling from a pile”.

The tool used for sampling must have the same minimum volume as the single sample requires in order taking it in one time.

Samples are taken at the outlet of a continuous mechanical treatment process, directly from the output flow of the fraction on the whole cross section of the flow profile.

Sampling period and sampling interval: the 10 or 50 tonnes of input material, depending on the process, should be processed as a batch. The sampling period corresponds to the processing time of 10 or 50 tonnes of input material. This period varies depending on the recycling process.

To define the sampling interval, the required processing time of the input material is divided by 10. Sampling shall be carried out at regular intervals avoiding the beginning and end of the processing time.

To take the sample, the following 3 special cases can be distinguished:

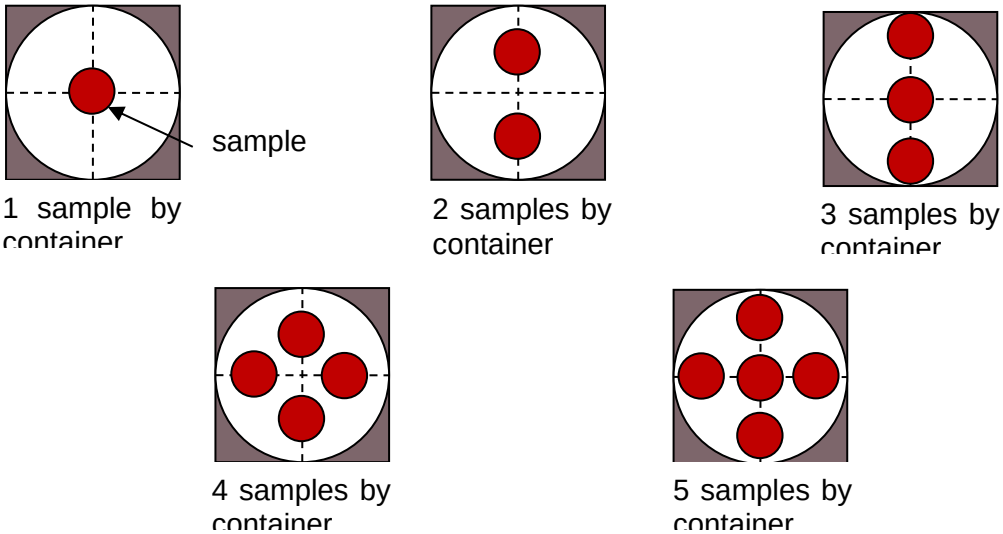
- If the width and the depth of the stream are small, put a sampling container into the stream using a single one directional action. It is recommended to place the sampling container at 90° to the falling output flow. Hold the sampling container in place for the period specified to gather the specified volume of material.
- If the width of stream is large and depth is small, insert the container at one end of the stream and, at a uniform rate designed to collect the required amount of material, move the container through the width of the stream to the opposite end.
- If width and depth of stream are large, follow the method as described above but repeat procedure at 90° to the first direction of sampling.

12.2.5 Sampling method from a pile

Case 1: If the fraction is stored in skips, it must be emptied on the ground, in a clean space. Make the pile spread out by the operator’s tractor-loader (or manually with a shovel if possible) to form a flat 50 cm high pile. The bucket of the tractor-loader or the shovel shall be cleaned immediately prior to carrying out this process. Divide visually the pile in 10 equivalent parts; take 10 single samples at various depths of the heap, without taking material in contact with the ground. The tool

used for sampling must have the same minimum volume as the single sample requires in order taking it in one time. For material with large particles sizes, a large bucket may be employed.

Case 2: If the fraction is stored in containers (as pallet box) lower than 50 cm high, take the 10 single samples directly in those containers. To determine the number of sample in each container, divide 10 by the number of containers containing the fraction from the treatment of the 50 or 10 tonnes. Take the samples as indicated below.



12.2.6 Mixed sample preparation

In a protected area, install a protective floor covering, preferably unused plastic sheeting, on the ground to avoid any contamination.

To mix the mixed sample, use the conical heap method, i.e. form a conical heap by deposing shovel by shovel (or bucket by bucket) on the peak of the new cone in such a way that the sample runs down all sides of the cone and is evenly distributed so that different particle sizes become well mixed. The size of the shovel should be of such size that this action could be repeated on at least 20 times in order to transfer the full amount of material.

Repeat the forming of a conical heap three times, to guarantee that the material is thoroughly mixed.

12.2.7 Mixed sample reduction

The mixed sample has to be reduced to comply with the laboratory sample size.

After having applied the conical heap method, flatten the cone to form a flat heap of uniform thickness and diameter.

Divide in four the flat heap along the two diagonals intersecting at right angles using a shovel inserted vertically into the material. Discard one pair of opposite quarters and shovel the remainder into a stockpile. Repeat this action until the volume of remaining subsample is equal to the desired size.

12.2.8 Sample sieving

If particles size of shredder light fraction is over 5mm, it is necessary to sieve the reduced mixed sample until obtained the required quantity of the finest non-metallic shredder fraction

If the sieving of the sample is not enough to produce the required quantity, sieve the last opposites quarters discarded, obtained at the reducing step of the mixed sample.

12.2.9 Packaging and sending of samples

3 similar samples have to be done:

- the first one for the PCB
- the second on for the Cd analysis;
- the third one is the retained sample.

Each sample must have the same volume. The three samples consist in 3 quarters drawn during the last operation of quartering.

Containers should be clearly labelled. The label must contain at least the name of the recycler (or a code), WEEE stream, name of fraction and date of sampling.

Containers must be closed airtight glass containers or any other materiel which do not interact with PCB.

13 Annex B (Informative) – Analysis protocol for the physically smallest non-metallic shredder fraction

13.1 Analysis for PCB

The laboratory should implement the standard EN 15308.

The US EPA 8082A/2007 standard can also be used, in this case, use the method “quantitation of PCBs as congeners”.

Below are described options to choose from when the standards provides a choice of techniques.

13.1.1 Test portion preparation

The test portion preparation shall follow the following steps:

- i-Phases separation:
  Not necessary.
- ii-Drying:
  Air drying at room temperature. The product must be spread out into thin layers. Be careful of the risk of contamination by dust.
  If the sample is very wet (because of an outdoor storage for example), dry in oven at 40°C maximum.
- iii-Size reduction:
  Objective: reduce from max 5mm to 1mm
  Due to heat generation by grinding, the size reduction of samples for analysis of semi-volatile organic substances must be carried out by using a cryogenic technique.
  The grinder used by the laboratory must be able to reduce small pieces of metal (cables, pieces of printed card board, electronic components…)
- iv-Homogenization and subsampling:
  Mechanical subsampling to obtain a test portion between 10 and 25g.

13.1.2 Extraction

Hexane extraction (with agitation or ultrasonic).

Because of the risk of extracting co-substances, do not use ACETONE.

Purification phases are recommended.

13.1.3 Analytical technique

Gas chromatography mass spectrometry should be used.

13.1.4 Calculation of the total amount of PCB

The EN 15308 only gives the results for 7 congeners, it is necessary to calculate the total concentration of PCBs: apply the method of calculation outlined in of EN 12766, Part 2.

For US EPA 8082A/2007, the PCB congener results may be summed and reported as total PCBs.

13.2 Analysis for Cd

13.2.1 Test portion preparation

The test portion preparation shall follow the following steps:

- i-Phases separation:
  Not necessary
- ii-Drying:
  Dry in oven at 105°C
- iii-Size reduction:
  Objective: reduce from max 5mm to 250 µm
  The grinder used by the laboratory must be able to reduce small pieces of metal (cables, pieces of printed card board, electronic components…)
- iv-Homogenization and subsampling:
  Mechanical subsampling to obtain a test portion of 200 mg.

13.2.2 Mineralization

Objective: To mineralize the entire test portion

It requires drastic safety conditions.

Two methods are available, it is preferable to conduct mineralization in semi-open containers (because materials are very reactive - among others the presence of carbon)

13.2.3 Analytical technique

The laboratory should implement the standard ISO 11 885 (No particular restrictions)

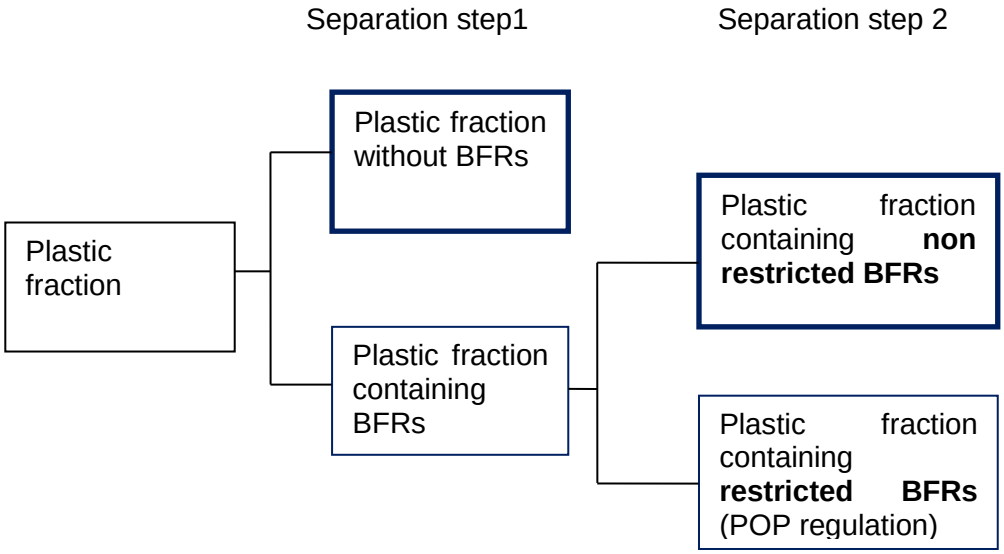
14 Annex C (Normative) – Sampling protocol for plastics

14.1 Introduction

This Annex aims to control that plastics from WEEE containing BFR are properly de-polluted. According to the EN 50625-1, depending on the available technology, two degrees of separation can be applied by operators:

- Removal of Plastic fraction containing BFRs;
- Removal of Plastic fraction containing restricted BFRs (POP regulation).

The next figure show the final fractions obtained in both cases.



NOTE The two steps can be a single process or different process.According to the Annex B "De-pollution monitoring" of the Standard EN 50625-1, an appropriate statistical sampling and analysis shall be carried out on plastic fractions not containing BFRs that have been segregated.

To control the separation level 1: the method consists in measuring the concentration of bromine of the de-polluted plastic fraction declared as free of BFRs. Those analyses shall be done by a laboratory.

To control the separation level 2: The method consists in measuring the concentration of restricted BFRs of a sample of the de-polluted plastic fraction (declared as free of restricted BFRs). Those analyses shall be done by a laboratory.

Both methods can be applied on a mix of plastic or separated resins (e.g. ABS, PS).

The laboratory shall perform the analysis on the samples for the determination of the amount of BFRs (Annex D).

14.2 Sampling

The sampling protocol is similar for plastics from separation level 1 and separation level 2.

14.2.1 Population – Sub-population – Scale

The population is defined as the annual production of plastic declared free of BFRs (or restricted BFRs).

For Level 1: Sub-populations should be considered only if the operator treats separately different treatment categories of WEEE (e.g. : Large appliances and small appliances). An analysis by sub-

population present on the treatment facility shall be performed. The analysis can be performed at any time of the year during a treatment campaign.

The amount of de-polluted plastic to be analysed shall correspond to a minimum of 10 tonnes of input material into the recycling process. The plastic to be sampled need not to be selected at random in the whole population (for example, can be carried out during a batch process).

14.2.2 Number of samples

Both input fraction and output fraction declared as free of BFRs are sampled with a minimum of 10 single samples. These 10 single samples are mixed in order to form a mixed sample, which is then reduced at the size of the sample to be analyzed.

14.2.3 Size of samples

The sample size depends on the particles size of the sampled fraction according to the table below.

Size of the biggest particles	Single sample volume (l)	Mixed sample volume (l)	Reduced sample for laboratory analysis (l)
< 20 mm	3	30	7,5
20 to 50 mm	5	50	12
> 50 mm	10	100	25

14.2.4 Method 1: sampling from a falling stream

If it is possible, this method shall apply instead of the method “sampling from a pile”.

The quantity of input material according to the recycling process should be processed as a batch.

The tool used for sampling must have the same minimum volume as the single sample requires in order taking it in one time.

For the output fraction this method has to be chosen in priority if it is possible to implement it.

Samples are taken at the outlet of a continuous mechanical treatment process, directly from the output flow of the fraction on the whole cross section of the flow profile.

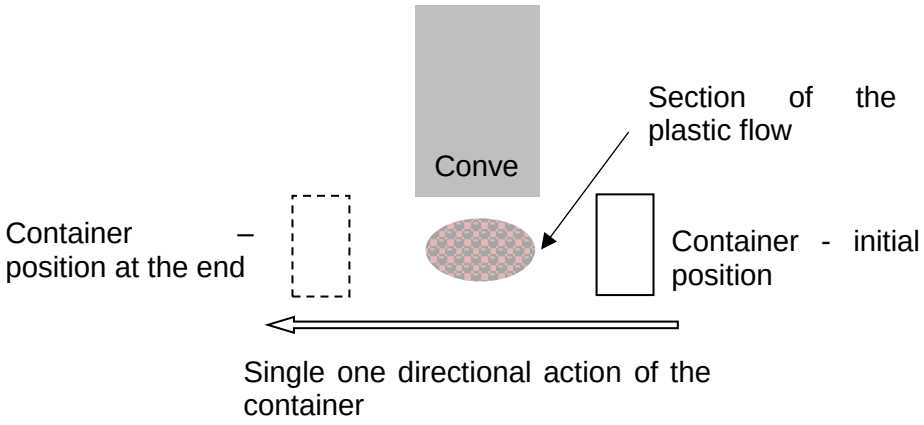
Sampling period and sampling interval: the 10 tonnes of input material, depending on the process, should be processed as a batch. The sampling period corresponds to the processing time of 10 tonnes of input material. This period varies depending on the recycling process flowrate.

To define the sampling interval, the required processing time of the input material is divided by 10. Sampling shall be carried out at regular intervals avoiding the beginning and end of the processing time.

To take the sample, the following 3 special cases can be distinguished:

- If the width and the depth of the stream are small, put a sampling container into the stream using a single one directional action. It is recommended to place the sampling container at 90° to the falling output flow. Hold the sampling container in place for the period specified to gather the specified volume of material.
- If the width of stream is large and depth is small, insert the container at one end of the stream and, at a uniform rate designed to collect the required amount of material, move the container through the width of the stream to the opposite end. (See example below)
- If width and depth of stream are large, follow the method as described above but repeat procedure at 90° to the first direction of sampling.

A more stringent sampling method than this shall be considered valid.



14.2.5 Method 2: sampling from a pile

The quantity of input material according to the recycling process should be processed as a batch.

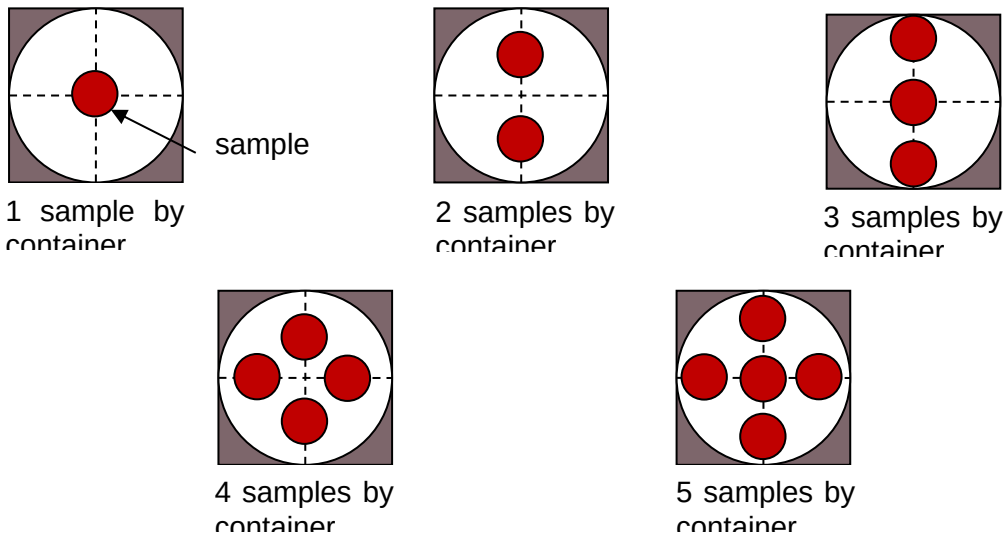
The tool used for sampling must have the same minimum volume as the single sample requires in order taking it in one time.

For the input fraction, this method is generally the only one which is applicable

Case 1: if the fraction is stored in skips or big-bags, it must be emptied on the ground, in a clean space. Make the pile spread out by the operator's tracto-loader (or manually with a shovel if possible) to form a flat 50 cm high pile. (The bucket of the tracto-loader or the shovel must be previously cleaned). Divide visually the pile in 10 equivalent parts; take 10 single samples at various depths of the heap, without taking material in contact with the ground.

The tool used for sampling must have the same minimum volume as the single sample requires in order taking it in one time. For material with large particles sizes, a large bucket may be employed.

Case 2: if the fraction is stored in containers (as pallet box) lower than 50 cm high, take the 10 single samples directly in those containers. To determine the number of sample in each container, divide 10 by the number of containers containing the fraction from the treatment of the 10 tonnes. Take the samples as indicated below.



14.2.6 Mixed sample preparation

In a protected area, install a protective floor covering, preferably unused plastic sheeting, on the ground to avoid any contamination.

To homogenize the mixed sample, use the conical heap method, i.e. form a conical heap by deposing shovel by shovel (or bucket by bucket) on the peak of the new cone in such a way that the sample runs down all sides of the cone and is evenly distributed so that different particle sizes become well mixed. The size of the shovel should be of such size that this action could be repeated on at least 20 times in order to transfer the full amount of material.

Repeat the forming of a conical heap three times, to guarantee that the material is thoroughly mixed.

14.2.7 Mixed sample reduction

The mixed sample has to be reduced to comply with the laboratory sample size.

After having applied the conical heap method, flatten the cone to form a flat heap of uniform thickness and diameter.

Divide in four the flat heap along the two diagonals intersecting at right angles using a shovel inserted vertically into the material. Discard one pair of opposite quarters and shovel the reminder into a stockpile. Repeat the process until the volume of remaining subsample is equal to the desired size.

From the same reduction operation, form 2 samples:

- The first one for the Bromine or restricted BFRs analysis in laboratory
- The second one as retained sample.

14.2.8 Packaging and sending of samples

Containers should be clearly labelled. The label must contain at least an identification code, WEEE stream, name of fraction and date of sampling.

15 Annex D (Informative) – Analysis protocol for plastics

15.1 Analysis related to the sorting of plastics fraction between plastics containing BFRs and non-containing BFRs

Analyzes should be run in triplicate. The whole mass of the laboratory sample should be reduced to prepare the test portions.

15.1.1 Test portion preparation

The laboratory should implement the standard EN 15 002 to prepare 3 test portions of 2g with a maximum size of 200µm.

To avoid plastics melt in the grinder, a cryogenic technique is strongly recommended.

15.1.2 Analytical technique

The laboratory should implement the standard EN 14582 (Characterization of waste. Halogen and sulfur content. Oxygen combustion in closed systems and determination methods).

The analysis result is the average of the three results. If one of the three values seems to be outlier, just consider the two others.

15.2 Analysis related to the sorting of plastics fraction between plastics containing restricted BFRs and non-restricted BFRs

Analyzes should be run in triplicate. The whole mass of the laboratory sample should be reduced to prepare the test portions.

15.2.1 Test portion preparation

The laboratory should implement the standard EN 15 002 to prepare 3 test portions of 2g with a maximum size of 500µm.

To avoid plastics melt in the grinder, a cryogenic technique is strongly recommended.

15.2.2 Analytical technique

The laboratory should implement the standard prEN 16377 (Characterization of waste - Determination of Brominated Flame Retardants (BFR) in Solid Waste)

This Standard specifies a method for the determination of selected BFRs, in waste materials using gas chromatography/mass spectrometry (GC/MS) in the electron impact (EI) ionisation mode (GC-EI-MS).

BFRs to be analyzed are 4 PBDE:

- Tetrabromo diphenyl ether,
- pentabromo diphenyl ether,
- hexabromo diphenyl ether,
- heptabromo diphenyl ether

NOTE these BFRs are commercially called C-octaBDE and C-pentaBDE

The results will be considered based on the separation level:

- In case of separation level 1: the analysis result is the average of the three results. If one of the three values seems to be outlier, just consider the two others.
  The result is compared to the limit value.
- In case of separation level 2: the sum of the concentration of the 4 molecules is considered as the concentration in total restricted BFRs.
  The analysis result is the average of the three results obtained from the 3 test portions. If one of the three values seems to be outlier, just consider the two others.
  The sum of restricted BFR is compared to the related limit value for restricted BFR.

16 Annex E (Normative) – Targets

16.1 Targets

The target values are indicated in the following tables and refers to non-de-polluted input WEEE.

NOTE These values are based on statistical analyses of measurements data from Western Europe countries. A study performed a statistical input analyses detailed by categories and/or type of appliance and investigation of the results of different batch processes and annual informations. These values are expressed in kg of components per tonne of WEEE.

Area	Large Appliances	Cooling and Freezing Appliances	CRT display appliances	FPD display appliances	Small appliances	
	$C_{tot\ LA}$	$C_{tot\ C\&F}$	$C_{tot\ CRT}$	$C_{tot\ FPD}$	$C_{tot\ SA}$	$B_{tot\ SA}$
European mean value	1,3 kg/t	0,08 kg/t	1,0 kg/t	1,0 kg/t	0,9 kg/t	1,8 kg/t

Area	Large Appliances	Cooling and Freezing Appliances	CRT display appliances	FPD display appliances	Small appliances	
	$C_{tot\ LA}$	$C_{tot\ C\&F}$	$C_{tot\ CRT}$	$C_{tot\ FPD}$	$C_{tot\ SM}$	$B_{tot\ SM}$
France	1,4 kg/t	0,08 kg/t	1,0 kg/t	1,0 kg/t	0,9 kg/t	4,9 kg/t
Italy	1,0 kg/t	0,08 kg/t	1,0 kg/t	1,0 kg/t	0,9 kg/t	1,8 kg/t
…..	-	-	-	-	-	-

As soon as data from other relevant playing field areas will be available, limit values for other playing field areas will be calculated.
In case that there is evidence of a different amount of capacitors or batteries in the appliances, a different value for Ci shall be calculated, based on the evidence of the report that utilizes statistically and scientifically accepted methods and has been issued by an independent body accepted by the relevant national competent authority, and applied.

17 Annex F (Informative)

In the following tables are presented, as a reference, the average composition of the treatment flows in specific countries.

Italy: LA flow	**Composition rate (r_i) %**	**C_i (kg of capacitors/ton of appliance)**
Washing machine	73,8%	1,3
Dishwasher	10,8%	1,0
Cooker	4,2%	-

Water heater	3,3%	-
Built-in oven	6,0%	-
Tumble-dryer	1,0%	1,0
Microwave oven	0,5%	10,9
Others appliances	0,4%	-

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France: LA flow	**Composition rate (r_i) %**	**C_i (kg of capacitors/ton of appliance)**
Washing machine	59,0%	1,7
Dishwasher	18,0%	1,5
Cooker	10,0%	-
Water heater	2,0%	-
Built-in oven	3,0%	0,4
Tumble-dryer	4,0%	2,0
Microwave oven	2,0%	11,5
Others appliances	2,0%	-

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France: CRT display appliances flow	**Composition rate (r_i) %**	**C_i (kg of capacitors/ton of appliance)**
CRT TVs	81,0%	xxxx
CRT Monitors	19,0%	yyyy

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729

France: FPD display appliances flow	**Composition rate (r_i) %**	**C_i (kg of capacitors/ton of appliance)**
FPD TVs	81,0%	xxxx
FPD Monitors	19,0%	yyyy

730
731

France: SA flow	**Composition rate (r_i) %**	**C_i (kg of capacitors/ton of appliance)**	**B_i (kg of batteries/ton of appliance)**
Xxxx (small equipment)	xx	xxxx	ccc
Yyyy (small IT and telecommunication equipment)	yy	yyyy	ccc
zzzz	zz	zzz	ccc

18 Annex G (Informative) – Void

void

Bibliography

CEN/TR 15310-1: Guidance on selection and application of criteria for sampling under various conditions

CEN/TR 15310-2: Guidance on sampling techniques

CEN/TR 15310-3: Guidance on procedures for sub-sampling in the field

CEN/TR 15310-4: Guidance on procedures for sample packaging, storage, preservation, transport and delivery

CEN/TR 15310-5: Guidance on the process of defining the sampling plan

WEEELABEX Documentation to measure depollution performances Rev01 18th September 2013

EN 14899: Characterization of waste – Sampling of waste materials – Framework for the preparation and application of a sampling plan.

EN 15308: Characterization of waste – determination of selected polychlorinated biphenyls (PCB) in solid waste by using capillary gas chromatography with electron capture or mass spectrometric detection

US EPA 8082A/2007 : Polychlorinated biphenyls (PCBs) by gas chromatography

EN 15002: Characterization of waste – preparation of test portions from the laboratory sample

EN 13656: Characterization of waste – Microwave assisted digestion with hydrofluoric (HF), nitric, (HNO3) and hydrochloric (HCl) acid mixture for subsequent determination of elements

EN 13657: Characterization of waste – Digestion for subsequent determination of aqua regia soluble portion of elements

ISO 11885: Water quality – Determination of selected elements by inductively coupled plasma optimal emission spectrometry (ICP-OES)

ISO 17852: Water quality – Determination of mercury – Method using atomic fluorescence spectrometry

EN 1483: Water quality – Determination of mercury – Method using atomic absorption spectrometry

EN 14582: Characterization of waste. Halogen and sulfur content. Oxygen combustion in closed systems and determination methods