

WEEELABEX

De-pollution monitoring specification



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1 Introduction

The CLC/TS 50625-3-1 - “Collection, logistics & treatment requirements for WEEE - Part 3-1: Specification for de-pollution – General” provides the general de-pollution limits and target values and describes the related procedures and methods that have to be followed in order to measure the depollution efficiency of the WEEE treatment processes. For specific audited streams, specific Technical Specifications (TS) of the EN 50625 series of standards are applicable and provide additional specific limit values, target values, procedures and methods for measuring the depollution efficiency.

In addition, the auditor shall refer to this WEEELABEX document “A10 WEEELABEX De-pollution monitoring specification” which may supplement, specify or clarify the information given in the TS.

This A10 document is applicable for the accredited WEEELABEX Certification scheme - Operators no.: **EURo B2501**.

1.1 Standards of reference

In the context of the WEEELABEX Certification scheme, WEEELABEX requirements consist of several standards including the WEEELABEX normative document on Treatment V10.0, this WEEELABEX document “A10 WEEELABEX De-pollution monitoring specification” and published relevant CENELEC standards – the currently valid list of the applicable standards is available in the B04 WEEELABEX Guidance Document.

In general, the following Technical Specifications (TS) of the EN 50625 series of standards, that provide general and specific limit values, target values, procedures and methods for measuring the depollution efficiency, are applicable for each WEEELABEX Audit:

No.	WEEE treatment process stream:	Applicable Technical Specifications (TS) of the EN 50625 series of standards
A	Large appliances *	CLC/TS 50625-3-1 and CLC/TS 50625-5
B	Mixed equipment *	CLC/TS 50625-3-1 and CLC/TS 50625-5
C	Temperature exchange equipment *	CLC/TS 50625-3-1 and CLC/TS 50625-3-4 and CLC/TS 50625-5
D	CRT display appliances *	CLC/TS 50625-3-1 and CLC/TS 50625-3-3 and CLC/TS 50625-5
E	Flat panel display equipment *	CLC/TS 50625-3-1 and CLC/TS 50625-3-3 and CLC/TS 50625-5
F	Gas discharge lamps *	CLC/TS 50625-3-1 and CLC/TS 50625-3-2 and CLC/TS 50625-5
G	Photovoltaic panels *	CLC/TS 50625-3-1 and CLC/TS 50625-3-5 and CLC/TS 50625-5
H	Others *	CLC/TS 50625-3-1 and CLC/TS 50625-5

* Definitions and descriptions of the WEEE treatment streams are defined in the document “B02TR Eligibility of Treatment and Preparation for Re-use Operators”

Table 1: List of applicable Technical Specifications (TS) of the EN 50625 series of standards to be followed

1.2 Use of this document

Each WEEELABEX Auditor shall have knowledge of and access to the applicable Technical Specifications (TS) of the EN 50625 series of standards as described in the Table 1. This A10 document does not substitute those TS, however, it does only summarize, supplement, specify or clarify the information given in the TS if needed or if appropriate.

1.3 Copyright

All extracts from the CENELEC standards (EN 50625 series of standards and related Technical Specifications) included in this document are © CENELEC copyrighted.

2 Overview of the de-pollution methodologies, limit values and target values

2.1 Applicable de-pollution performance methodologies

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

- **Target value methodology** = quantification of the outgoing stream and comparison with a target value (benchmark)
- **Mass Balance methodology** = establishment of a mass balance between incoming and outgoing streams
- **Analysis methodology** = analyses of representative samples of relevant output fractions, or analysis of emissions to ambient air, air, and water

The following table lists the WEEE treatment streams and related applicable de-pollution performance methodologies (note that the detailed de-pollution target and limit values are summarized in the Chapter 3):

WEEE treatment stream	Target value methodology	Mass Balance methodology	Analysis methodology
LARGE APPLIANCES	Applicable for: - CAPACITORS	Not applicable	Applicable for: - PCB and CADMIUM in the physically smallest non-metallic mechanical treatment fraction (applicable for mechanical treatment only)
MIXED EQUIPMENT	Applicable for: - CAPACITORS - BATTERIES	Not applicable	Applicable for: - PCB and CADMIUM in the physically smallest non-metallic mechanical treatment fraction (applicable for mechanical treatment only) - BROMINE/ RESTRICTED PBDEs in plastics fractions
TEMPERATURE EXCHANGE EQUIPMENT	Applicable for (Target value / Mass Balance methodology): - CAPACITORS - VFC and VHC recovered in the STEP 1 treatment - OIL recovered in the STEP 1 treatment - VFC and VHC recovered in the STEP 2 treatment - VFC removed and captured in STEP 2 treatment and transferred to the STEP 3 treatment - CONVERTING RATE for STEP 3 treatment		Applicable for: - VFC/VHC in oil - VFC/VHC in PU fraction - VFC in some other fractions (applicable for specific treatment of VHC appliances only) - OIL in compressors - PU in Fe, non-Fe and plastic fractions - VFC/VHC/DANGEROUS SUBSTANCES in air emissions

CRT DISPLAY APPLIANCES	Applicable for: - CAPACITORS	Not applicable	Applicable for: - SULPHUR in the cleaned panel/mixed glass, or - FLUORESCENT COATINGS on the CRT glass - LEAD OXIDE in the separated panel glass - CRT GLASS in anti-implosive metal frames and shadow masks, in crushed or shredded mixed fraction, in deflection coils, in electron canons - BROMINE/ RESTRICTED PBDEs in plastics fractions
FLAT PANEL DISPLAY EQUIPMENT	Not applicable	Applicable for: - INTACT BACKLIGHT LAMPS that are not broken during manual treatment process (applicable for manual treatment only) - AIR FILTRATION EFFICIENCY (applicable for mechanical treatment only)	Applicable for: - MERCURY in the shredded mixed fraction - MERCURY in air emissions - BROMINE/ RESTRICTED PBDEs in plastics fractions
GAS DISCHARGE LAMPS	Not applicable	Not applicable	Applicable for: - MERCURY in the glass fractions - MERCURY in the metal and mixed metal plastics fractions - MERCURY concentration in Ambient Air, Air, and Water
PHOTOVOLTAIC PANELS	Not applicable	Not applicable	Applicable for: - CADMIUM in glass fractions - SELENIUM in glass fractions - LEAD in glass fractions
For final treatment (Type 4) – the auditors shall refer to the CLC/TS 50625-5 Specification for the final treatment of WEEE fractions - Copper and precious metals			

Table 2: List of WEEE treatment streams and related applicable de-pollution performance methodologies

3 WEEELABEX de-pollution summaries, supplements, specifications and clarifications

This section provides summaries of de-pollution target values and limit values and in addition supplements, specifications and clarifications where appropriate per each WEEE treatment stream.

3.1 LARGE APPLIANCES

3.1.1 Summary of de-pollution target values and limit values

LARGE APPLIANCES				
	PARAMETER TO BE EVALUATED	TARGET VALUE / LIMIT VALUE	FREQUENCY	NOTE
Target value methodology	removed CAPACITORS	target value = calculated (calculation according to the CLC/TS 50625-3-1, clause 6.2), or: = 1,3 kg/t (generally applicable for European countries), or = 1,4 kg/t (specifically applicable for France), or = 1,0 kg/t (specifically applicable for Italy), or = 1,0 kg/t (specifically applicable for Switzerland).	At least annually (it shall be recommended a regular data collection and evaluation monitoring system, e.g. monthly)	See the WEEELABEX Official Statement 2016_006 for details.
Mass Balance methodology	Not applicable	-	-	-
Analysis methodology	PCB in the physically smallest non-metallic mechanical treatment fraction	limit value = 50 mg/kg	At least once per year	Applicable for mechanical treatment only.
	CADMIUM in the physically smallest non-metallic mechanical treatment fraction	limit value = 100 mg/kg	At least once per year	Applicable for mechanical treatment only. Applicable only if a mixture of large and small appliances is treated in the same process.
<i>For final treatment (Type 4) – the auditors shall refer to the CLC/TS 50625-5 Specification for the final treatment of WEEE fractions - Copper and precious metals</i>				

3.1.2 De-pollution supplements, specifications and clarifications

3.1.2.1 Target value methodology

Capacitors:

- Target value shall be calculated according to the CLC/TS 50625-3-1, clause 6.2 as specified in the WEEELABEX Official Statement 2016_006.
- Electrolytic capacitors containing substances of concern shall be removed if they have height > 25 mm and diameter > 25 mm or proportionately similar volume = 12,27 cm³ (Annex 1 shows couples of min. values “diameter-height” for electrolyte capacitors in scope).
- As per the WEEELABEX Official Statement 2016_007 it is not required to remove capacitors with a “plastic casing” during the treatment/depollution process.

3.1.2.2 Mass Balance methodology

- Not applicable.

3.1.2.3 Analysis methodology

In general:

- Sampling and analysis procedures shall follow the **CLC/TS 50625-3-1**.
- **WEEELABEX Official Statement 2018_001** specifies requirements related to the sampling of fractions to be analysed (either by a laboratory or via an on-site handpicking analysis), including requested sampling documentation and records.
- It is required to complete a **SAMPLING PROTOCOL** for each sample taken (**Annex 2a** shows a SAMPLING PROTOCOL example). The **Annex 2b** shows an example of a **SAMPLE LABEL**.
- Samples intended for laboratory analysis shall be analysed by **laboratories approved** by the WEEELABEX Organisation (a list of approved laboratories is provided by the WEEELABEX Organisation).
- **Annex 3** gives examples of sampling **equipment and tools**.
- **Annex 4** summarizes in detail **analytical methods** to be followed by laboratories (as extracted from the relevant Technical Specifications).

Specifically:

- **PCB** in the physically smallest non-metallic mechanical treatment fraction
 - No supplements, specifications or clarifications.
- **CADMIUM** in the physically smallest non-metallic mechanical treatment fraction
 - No supplements, specifications or clarifications.

3.2 MIXED EQUIPMENT

3.2.1 Summary of de-pollution target values and limit values

MIXED EQUIPMENT				
	PARAMETER TO BE EVALUATED	TARGET VALUE / LIMIT VALUE	FREQUENCY	NOTE
Target value methodology	removed CAPACITORS	target value = calculated (calculation according to the CLC/TS 50625-3-1, clause 10.2), or: = 0,9 kg/t (generally applicable for European countries), or = 1,0 kg/t (specifically applicable for Switzerland).	At least annually (it shall be recommended a regular data collection and evaluation monitoring system, e.g. monthly)	See the WEEELABEX Official Statement 2016_006 for details.
	removed BATTERIES	target value = calculated (calculation according to the CLC/TS 50625-3-1, clause 10.2), or: = 1,8 kg/t (generally applicable for European countries), or = 4,9 kg/t (specifically applicable for France), or = 2,3 kg/t (specifically applicable for Switzerland).	At least annually (it shall be recommended a regular data collection and evaluation monitoring system, e.g. monthly)	See the WEEELABEX Official Statement 2016_006 for details.
Mass Balance methodology	Not applicable	-	-	-
Analysis methodology	PCB in the physically smallest non-metallic mechanical treatment fraction	limit value = 50 mg/kg	At least once per year	Applicable for mechanical treatment only.
	CADMIUM in the physically smallest non-metallic mechanical treatment fraction	limit value = 100 mg/kg	At least once per year	Applicable for mechanical treatment only.
	BROMINE/ RESTRICTED PBDEs in plastics fractions in plastics fractions	limit value = based on the REGULATION (EU) 2019/1021 as specified in the WEEELABEX Official Statement 2020_003	At least once per year	See the WEEELABEX Official Statement 2020_003 for details.
For final treatment (Type 4) – the auditors shall refer to the CLC/TS 50625-5 Specification for the final treatment of WEEE fractions - Copper and precious metals				

3.2.2 De-pollution supplements, specifications and clarifications

3.2.2.1 Target value methodology

Capacitors:

- Target value shall be calculated according to the CLC/TS 50625-3-1, clause 10.2 as specified in the WEEELABEX Official Statement 2016_006.
- Electrolytic capacitors containing substances of concern shall be removed if they have height > 25 mm and diameter > 25 mm or proportionately similar volume = 12,27 cm³ (Annex 1 shows couples of min. values “diameter-height” for electrolyte capacitors in scope).
- As per the WEEELABEX Official Statement 2016_007 it is not required to remove capacitors with a “plastic casing” during the treatment/depollution process.

Batteries:

- Target value shall be calculated according to the CLC/TS 50625-3-1, clause 10.2 as specified in the WEEELABEX Official Statement 2016_006.

3.2.2.2 Mass Balance methodology

- Not applicable.

3.2.2.3 Analysis methodology

In general:

- Sampling and analysis procedures shall follow the **CLC/TS 50625-3-1**.
- **WEEELABEX Official Statement 2018_001** specifies requirements related to the sampling of fractions to be analysed (either by a laboratory or via an on-site handpicking analysis), including requested sampling documentation and records.
- It is required to complete a **SAMPLING PROTOCOL** for each sample taken (**Annex 2a** shows a SAMPLING PROTOCOL example). The **Annex 2b** shows an example of a **SAMPLE LABEL**.
- Samples intended for laboratory analysis shall be analysed by **laboratories approved** by the WEEELABEX Organisation (a list of approved laboratories is provided by the WEEELABEX Organisation).
- **Annex 3** gives examples of sampling **equipment and tools**.
- **Annex 4** summarizes in detail **analytical methods** to be followed by laboratories (as extracted from the relevant Technical Specifications).

Specifically:

- **PCB** in the physically smallest non-metallic mechanical treatment fraction
 - No supplements, specifications or clarifications.
- **CADMIUM** in the physically smallest non-metallic mechanical treatment fraction
 - No supplements, specifications or clarifications.
- **BROMINE / RESTRICTED PBDEs** in plastics fractions
 - Not applicable should be used only if the material is sent to incineration, for chemical conversion, or disposal.
 - One of the following possible scenarios shall be implemented to prove compliance with the de-pollution requirements related to brominated flame retardants in plastic fractions (see the WEEELABEX Official Statement 2020_003 for details):
 - **SCENARIO 1) two laboratory analysis of a plastic sample (PREFERABLE SOLUTION):**
 - one analysis for the TOTAL BROMINE concentration (limit value = 2000 ppm as per the CLC/TS 50625-3-1);
 - the second analysis for the RESTRICTED PBDEs (limit value = 1000 mg/kg as per the REGULATION (EU) 2019/1021).

- SCENARIO 2) one laboratory analysis only for the RESTRICTED PBDEs:
 - if the result for RESTRICTED PBDEs is below 1000 mg/kg (compliant with the REGULATION (EU) 2019/1021) then such result can be assumed to be compliant with the CLC/TS 50625-3-1 as well (as the CLC/TS 50625-3-1 is aiming to remove the restricted PBDEs where the total Bromine is an indicator).
- SCENARIO 3) one laboratory analysis only for the TOTAL BROMINE:
 - the WEEELABEX organisation does not defined any new limit value, however, as there is only limited evidence that the 2000 ppm total Bromine limit value is still suitable to confirm compliance with the up-dated REGULATION (EU) 2019/1021, the following scenario shall be applied:
 - if the result for total Bromine is below 1000 ppm then such result can be assumed to be compliant with the REGULATION (EU) 2019/1021 as it can be assumed that the concentration of restricted PBDEs is below 1000 mg/kg as well; however, data confirming this statement shall be continuously collected;
 - if the result for total Bromine is higher than 1000 ppm then an additional analysis of the restricted PBDEs shall be carried out to confirm (or not) compliance with the REGULATION (EU) 2019/1021.
 - NOTE: if there is a proven evidence in a country or region (based on sufficient analysis results) that a different value for the total Bromine can be used as a more suitable indicator confirming compliance with the REGULATION (EU) 2019/1021 then such value may be used instead of the mentioned 1000 ppm.

3.3 TEMPERATURE EXCHANGE EQUIPMENT

3.3.1 Summary of de-pollution target values and limit values for performance tests and for day-to-day business

TEMPERATURE EXCHANGE EQUIPMENT				
	PARAMETER TO BE EVALUATED	TARGET VALUE / LIMIT VALUE	FREQUENCY	NOTE
Target value methodology	removed CAPACITORS	target value = calculated (calculation according to the CLC/TS 50625-3-1, clause 7.2), or: = 0,08 kg/t (generally applicable for European countries).	At least annually (it shall be recommended a regular data collection and evaluation monitoring system, e.g. monthly)	see the WEEELABEX Official Statement 2016_006 for details
Target value / Mass Balance methodology	VFC recovered in the STEP 1 treatment in performance tests	target value = 90% of expected value for VFC [in kg]	Once a year (during a validated STEP 1 performance test)	-
	VFC and VHC recovered in the STEP 1 treatment in day-to-day business	target value = 90% of expected value for VFC and VHC [in kg]	Daily monitoring (data collection); weekly evaluation of results	-
	OIL recovered in the STEP 1 treatment in day-to-day business	target value = 90% of expected value for OIL [in kg]	Daily monitoring (data collection); weekly evaluation of results	-
	VFC and VHC recovered in the STEP 2 treatment in performance tests	target value = 90% of expected value for VFC/VHC [in kg]	Once a year (during a validated STEP 2 test)	Water content in recovered blowing agents shall be determined regularly and deducted from the mass of blowing agents.
	VFC and VHC recovered in the STEP 2 treatment in day-to-day business	target value = 90% of expected value for VFC/VHC [in kg]	Daily monitoring (data collection); weekly evaluation of results	Water content in recovered blowing agents shall be determined regularly and deducted from the mass of blowing agents.

	VFC removed and captured in STEP 2 treatment and transferred to the STEP 3 treatment in performance tests	target value = 90% of expected value [in kg]	Once a year (during a validated STEP 3 test)	-
	VFC removed and captured in STEP 2 treatment and transferred to the STEP 3 treatment in day-to-day business	target value = 90% of expected value [in kg]	Daily monitoring (data collection); weekly evaluation of results	-
	CONVERTING RATE for STEP 3 treatment	target value = 99,99%	Conversion efficiency of the step 3 treatment plant shall be proven annually	Input data for raw gas mass flow shall be measured continuously and recorded accordingly.
Analysis methodology	VFC and VHC in oil	limit value = 0,2%	Quarterly laboratory analysis	Residual sum of refrigerants (VFC/VHC) in oil.
	VFC in oil	limit value = 0,01%	One analysis for each vessel containing oil disposed	Applicable in case that the operator treats only VHC appliances in the STEP 1 process.
	VFC in output VHC refrigerants	limit value = 0,01%	One analysis for each vessel containing refrigerants disposed	Applicable in case that the operator treats only VHC appliances in the STEP 1 process.
	PHASED OUT VFCs in non-phased out VFCs refrigerants	limit value = 0,01%	One analysis for each vessel containing refrigerants disposed	Applicable in case that the operator sorts out phased-out VFCs from other VFCs in the STEP 1 process.
	OIL in compressors directly after the suction process	limit value = 15 g	Monthly on-site analysis	-

	OIL in compressors leaving the treatment plant for further treatment	limit value = “non-dripping”	Monthly on-site analysis	-
	VFC and VHC in polyurethane	limit value = 0,2%	Quarterly laboratory analysis	Residual sum of VFC and VHC in PU fraction.
	VFC in output polyurethane from VHC appliances	limit value = 0,01%	Quarterly laboratory analysis	Applicable in case that the operator treats only VHC appliances.
	VFC in output VHC blowing agents	limit value = 0,01%	One analysis for each vessel containing blowing agents disposed	Applicable in case that the operator treats only VHC appliances
	PU in ferrous fractions	limit value = 0,3%	Monthly on-site analysis	-
	PU in non-ferrous fractions	limit value = 0,3%	Monthly on-site analysis	-
	PU in plastics fractions	limit value = 0,5%	Monthly on-site analysis	-
	Chemical composition of the recovered refrigerants (VFC/VHC) from STEP 1	No limit value is defined	One analysis for each vessel containing refrigerants disposed	The information is to be used for VFC/VHC recovery calculations and plausibility checks.
	Chemical composition of the recovered blowing agents (VFC/VHC) from STEP 2	No limit value is defined	One analysis for each vessel containing blowing agent disposed	The information is to be used for VFC/VHC recovery calculations and plausibility checks.
	VFC and VHC concentration and mass flow in exhausted air (from STEP 2 process)	general limit values = 20 mg VFC/m³ = 0,01 kg VFC/h = 50 mg VHC/m³ = 0,05 kg VHC/h	VFC – continual monitoring VHC – at least quarterly monitoring	Generally applicable for concentration and mass flow in the exhausted air from the STEP 2 treatment.

	VFC concentration and mass flow in exhausted air (from STEP 2 process)	specific limit values (applicable for VHC treatment plants) = 4 mg VFC/m³ = 0,002 kgVFC/h	VFC – continual monitoring	Specifically applicable only for VHC treatment plants
	VFC and VHC concentration and mass flow in exhausted air (from STEP 3 process)	general limit values for the VFC and VHC (in total) = 4 mg/m³ = 0,002 kg/h	VFC – continual monitoring VHC – at least quarterly monitoring	Generally applicable for concentration and mass flow in the exhausted air from the STEP 3 treatment .
	VFC concentration and mass flow in exhausted air (from STEP 3 process)	specific limit values for the VFC (applicable VHC converting plants) = 4 mg VFC/m³ = 0,002 kg VFC/h	VFC – continual monitoring	Specifically applicable only for STEP 3 VHC converting plants
	Dangerous substances concentration in exhaust gas flow (from STEP 3 process)	general limit values defined in Directive 2010/75/EU (Industrial Emissions Directive), or limit values per a valid permit shall be applied	At least once a year	Applicable for concentration and mass flow in the exhausted air from the STEP 3 treatment. As a minimum, the substances of Annex VI of the Directive 2010/75/EU (Industrial Emissions Directive) should be determined.
For final treatment (Type 4) – the auditors shall refer to the CLC/TS 50625-5 Specification for the final treatment of WEEE fractions - Copper and precious metals				

3.3.2 De-pollution supplements, specifications and clarifications

3.3.2.1 Target value methodology

Capacitors:

- Target value shall be calculated according to the CLC/TS 50625-3-1, clause 7.2 as specified in the WEEELABEX Official Statement 2016_006.
- Electrolytic capacitors containing substances of concern shall be removed if they have height > 25 mm and diameter > 25 mm or proportionately similar volume = 12,27 cm³ (Annex 1 shows couples of min. values “diameter-height” for electrolyte capacitors in scope).

- As per the WEEELABEX Official Statement 2016_007 it is not required to remove capacitors with a “plastic casing” during the treatment/depollution process.

3.3.2.2 Target value / Mass Balance methodology

- For details, see a separate **WEEELABEX Temperature exchange equipment Auditor manual** defining detailed procedures for the performance and validation of **TEE** performance tests.

3.3.2.3 Analysis methodology

In general:

- Sampling and analysis procedures shall follow the **CLC/TS 50625-3-4**.
- **WEEELABEX Official Statement 2018_001** specifies requirements related to the sampling of fractions to be analysed (either by a laboratory or via an on-site handpicking analysis), including requested sampling documentation and records.
- It is required to complete a **SAMPLING PROTOCOL** for each sample taken (**Annex 2a** shows a SAMPLING PROTOCOL example). The **Annex 2b** shows an example of a **SAMPLE LABEL**.
- Samples intended for laboratory analysis shall be analysed by **laboratories approved** by the WEEELABEX Organisation (a list of approved laboratories is provided by the WEEELABEX Organisation).
- **Annex 3** gives examples of sampling **equipment and tools**.
- **Annex 4** summarizes in detail **analytical methods** to be followed by laboratories (as extracted from the relevant Technical Specifications).

Specifically:

- **VFC/VHC in oil**
 - CLC/TS 50625-3-4 defines the limit value for residual “VFC/VHC in oil”. This limit value shall be understood as follows:
 - The limit value is defined for the sum of VFC and VHC in oil
- **VFC in oil**
 - applicable in case that the operator treats only VHC appliances in the STEP 1 process
 - no supplements, specifications or clarifications
- **VFC in output VHC refrigerants**
 - applicable in case that the operator treats only VHC appliances in the STEP 1 process
- **PHASED OUT VFCs in non-phased out VFCs refrigerants**
 - applicable in case that the operator sorts out phased-out VFCs from other VFCs in the STEP 1 process
 - no supplements, specifications or clarifications
- **OIL in compressors directly after the suction process**
 - no supplements, specifications or clarifications
- **OIL in compressors leaving the treatment plant for further treatment**
 - CLC/TS 50625-3-4 defines the limit value as “non-dripping”. As per the WEEELABEX requirements, the procedure to evaluate if the compressors comply with the limit value is as follows:
 - 10 compressors shall be randomly selected for sampling
 - 10°C is the minimum temperature at the sampling area
 - 10 mm hole shall be drilled to each compressor either from the top or from the back side
 - 10 seconds is the minimum duration that each compressor shall be left dripping
 - the limit value is fulfilled when at least 9 of the 10 compressors are non-dripping
- **VFC/VHC in polyurethane**
 - CLC/TS 50625-3-4 defines the limit value for residual “VFC/VHC in polyurethane”. This limit value shall be understood as follows:
 - The limit value is defined for the sum of VFC and VHC

- The limit value is related to the PU fraction (including the foreign matters)
- **VFC in output polyurethane from VHC appliances**
 - applicable in case that the operator treats only VHC appliances
 - no supplements, specifications or clarifications
- **VFC in output VHC blowing agents**
 - applicable in case that the operator treats only VHC appliances
 - no supplements, specifications or clarifications
- **PU in ferrous fractions**
 - no supplements, specifications or clarifications
- **PU in non-ferrous fractions**
 - no supplements, specifications or clarifications
- **PU in plastics fractions**
 - no supplements, specifications or clarifications
- **VFC and VHC concentration and mass flow in exhausted air**
 - generally applicable for concentration and mass flow in the exhausted air from the STEP 2 treatment
 - no supplements, specifications or clarifications
- **DANGEROUS SUBSTANCES in exhaust gas flow**
 - no supplements, specifications or clarifications
- **Water content in the PU fraction**
 - CLC/TS 50625-3-4 does not define any analysis of the PU to determine water content. However, as per the **WEEELABEX Official Statement 2017_001**, the Auditor shall let determine the water content in PU fraction by an accredited laboratory and shall take into consideration the result for the calculation and evaluation of the **TEE** performance test results – the water content shall be deducted from the original weight of the PU fraction.

3.4 CRT DISPLAY APPLIANCES

3.4.1 Summary of de-pollution target values and limit values

CRT DISPLAY APPLIANCES				
	PARAMETER TO BE EVALUATED	TARGET VALUE / LIMIT VALUE	FREQUENCY	NOTE
Target value methodology	removed CAPACITORS	target value = calculated (calculation according to the CLC/TS 50625-3-1, clause 8.2), or: = 1,0 kg/t (generally applicable for European countries).	At least annually (it shall be recommended a regular data collection and evaluation monitoring system, e.g. monthly)	See the WEEELABEX Official Statement 2016_006 for details.
Mass Balance methodology	Not applicable	-	-	-
Analysis methodology	CRT GLASS in anti-implosive metal frames and shadow masks	limit value = 2%	Monthly on-site analysis	Concerns processes of splitting of CRTs and crushing/shredding of CRTs.
	CRT GLASS in ferrous metal fraction	limit value = 2%	Monthly on-site analysis	Concerns process of crushing/shredding of CRT display appliances.
	CRT GLASS in crushed or shredded mixed fraction after CRT glass separation	limit value = 2%	Monthly on-site analysis	Concerns process of crushing/shredding of CRT display appliances. Mix fraction = fraction after crushing/shredding and glass separation composed of metal parts, plastics, wood, deflection coils ...

	CRT GLASS in deflection coils fraction	limit value = 4%	Monthly on-site analysis	-							
	CRT GLASS in electron canons fraction	limit value = 8%	Monthly on-site analysis	For electron canons, the transparent glass embedded in the base of the electron canon (usually inside a plastic cap) shall not be considered for analysis.							
	SULPHUR in cleaned panel/mixed glass fraction	limit value = 5 mg/kg (dry matter) (all five samples randomly collected and analysed shall meet the limit value)	The number of samples for analysis per year depends on the mass of CRT glass treated per year as follows: <table border="1"><tr><td>Mass of CRT glass treated per year</td><td>Number of chemical analysis</td></tr><tr><td>< 7 500 tonnes</td><td>1</td></tr><tr><td>7 500 to 15 000 tonnes</td><td>2</td></tr><tr><td>> 15 000 tonnes</td><td>4</td></tr></table>	Mass of CRT glass treated per year	Number of chemical analysis	< 7 500 tonnes	1	7 500 to 15 000 tonnes	2	> 15 000 tonnes	4
Mass of CRT glass treated per year	Number of chemical analysis										
< 7 500 tonnes	1										
7 500 to 15 000 tonnes	2										
> 15 000 tonnes	4										

FLUORESCENT COATINGS on panel glass	limit value = “no” fluorescent coating remains on the CRT glass fraction (based on visual inspection)	The number of samples for visual inspection protocol per year depends on the mass of CRT glass treated per year as follows: <table><tr><th>Mass of CRT glass treated per year</th><th>Number of visual inspection protocols</th></tr><tr><td>< 7 500 tonnes</td><td>4</td></tr><tr><td>7 500 to 15 000 tonnes</td><td>8</td></tr><tr><td>> 15 000 tonnes</td><td>16</td></tr></table>	Mass of CRT glass treated per year	Number of visual inspection protocols	< 7 500 tonnes	4	7 500 to 15 000 tonnes	8	> 15 000 tonnes	16	Applicable in case of visual inspection protocol, i.e. only in case of manual splitting (incl. cutting and hot band) of CRT followed by manual removal of fluorescent coatings (the visual inspection protocol shall not be accepted by a WEEELABEX Auditor during a validated batch test).
Mass of CRT glass treated per year	Number of visual inspection protocols										
< 7 500 tonnes	4										
7 500 to 15 000 tonnes	8										
> 15 000 tonnes	16										
LEAD OXIDE in separated panel glass	limit value = 0,5wt% (by weight)	The number of samples for analysis per year depends on the mass of CRT glass treated per year as follows: <table><tr><th>Mass of CRT glass treated per year</th><th>Number of chemical analysis</th></tr><tr><td>< 7 500 tonnes</td><td>1</td></tr><tr><td>7 500 to 15 000 tonnes</td><td>2</td></tr><tr><td>> 15 000 tonnes</td><td>4</td></tr></table>	Mass of CRT glass treated per year	Number of chemical analysis	< 7 500 tonnes	1	7 500 to 15 000 tonnes	2	> 15 000 tonnes	4	The “XRF” measurement to determine the remaining PbO in the separated panel glass shall not be accepted by a WEEELABEX Auditor during a validated batch test.
Mass of CRT glass treated per year	Number of chemical analysis										
< 7 500 tonnes	1										
7 500 to 15 000 tonnes	2										
> 15 000 tonnes	4										
BROMINE/ RESTRICTED PBDEs in plastics fractions in plastics fractions	limit value = based on the REGULATION (EU) 2019/1021 as specified in the WEEELABEX Official Statement 2020_003	At least once per year	See the WEEELABEX Official Statement 2020_003 for details.								

For final treatment (Type 4) – the auditors shall refer to the CLC/TS 50625-5 Specification for the final treatment of WEEE fractions - Copper and precious metals

3.4.2 De-pollution supplements, specifications and clarifications

3.4.2.1 Target value methodology

Capacitors:

- Target value shall be calculated according to the CLC/TS 50625-3-1, clause 8.2 as specified in the WEEELABEX Official Statement 2016_006.
- Electrolytic capacitors containing substances of concern shall be removed if they have height > 25 mm and diameter > 25 mm or proportionately similar volume = 12,27 cm³ (Annex 1 shows couples of min. values “diameter-height” for electrolyte capacitors in scope).
- As per the WEEELABEX Official Statement 2016_007 it is not required to remove capacitors with a “plastic casing” during the treatment/depollution process.

3.4.2.2 Mass Balance methodology

- Not applicable.

3.4.2.3 Analysis methodology

In general:

- Sampling and analysis procedures shall follow the **CLC/TS 50625-3-3**.
- **WEEELABEX Official Statement 2018_001** specifies requirements related to the sampling of fractions to be analysed (either by a laboratory or via an on-site handpicking analysis), including requested sampling documentation and records.
- It is required to complete a **SAMPLING PROTOCOL** for each sample taken (**Annex 2a** shows a SAMPLING PROTOCOL example). The **Annex 2b** shows an example of a **SAMPLE LABEL**.
- Samples intended for laboratory analysis shall be analysed by **laboratories approved** by the WEEELABEX Organisation (a list of approved laboratories is provided by the WEEELABEX Organisation).
- **Annex 3** gives examples of sampling **equipment and tools**.
- **Annex 4** summarizes in detail **analytical methods** to be followed by laboratories (as extracted from the relevant Technical Specifications).

Specifically:

- **CRT GLASS in anti-implosive metal frames and shadow masks**
 - no supplements, specifications or clarifications
- **CRT GLASS in crushed or shredded mixed fraction after CRT glass separation**
 - no supplements, specifications or clarifications
- **CRT GLASS in deflection coils**
 - no supplements, specifications or clarifications
- **CRT GLASS in electron canons**
 - no supplements, specifications or clarifications
- **SULPHUR in cleaned panel/mixed glass**
 - no supplements, specifications or clarifications
- **FLUORESCENT COATINGS on CRT glass**
 - The “**Visual inspection protocol**” to determine the remaining fluorescent coatings on the CRT glass shall not be used by the WEEELABEX auditor during the validated Batch test. The auditor shall take samples and send them for the defined laboratory analysis at least every two years following the CENELEC TS50625-3-3 Annex CC.3 ‘Chemical analysis protocol’.
- **LEAD OXIDE in separated panel glass**
 - The “**XRF**” **measurement** to determine the remaining PbO in the separated panel glass shall not be used by the WEEELABEX auditor during the validated Batch test. The auditor shall

take samples and send them for the defined laboratory analysis at least every two years following the CENELEC TS50625-3-3 Annex CC.3 'Chemical analysis protocol'.

- **BROMINE / RESTRICTED PBDEs** in plastics fractions
 - Not applicable should be used only if the material is sent to incineration, for chemical conversion, or disposal.
 - One of the following possible scenarios shall be implemented to prove compliance with the de-pollution requirements related to brominated flame retardants in plastic fractions (see the WEEELABEX Official Statement 2020_003 for details):
 - SCENARIO 1) two laboratory analysis of a plastic sample (PREFERABLE SOLUTION):
 - one analysis for the TOTAL BROMINE concentration (limit value = 2000 ppm as per the CLC/TS 50625-3-1);
 - the second analysis for the RESTRICTED PBDEs (limit value = 1000 mg/kg as per the REGULATION (EU) 2019/1021).
 - SCENARIO 2) one laboratory analysis only for the RESTRICTED PBDEs:
 - if the result for RESTRICTED PBDEs is below 1000 mg/kg (compliant with the REGULATION (EU) 2019/1021) then such result can be assumed to be compliant with the CLC/TS 50625-3-1 as well (as the CLC/TS 50625-3-1 is aiming to remove the restricted PBDEs where the total Bromine is an indicator).
 - SCENARIO 3) one laboratory analysis only for the TOTAL BROMINE:
 - the WEEELABEX organisation does not defined any new limit value, however, as there is only limited evidence that the 2000 ppm total Bromine limit value is still suitable to confirm compliance with the up-dated REGULATION (EU) 2019/1021, the following scenario shall be applied:
 - if the result for total Bromine is below 1000 ppm then such result can be assumed to be compliant with the REGULATION (EU) 2019/1021 as it can be assumed that the concentration of restricted PBDEs is below 1000 mg/kg as well; however, data confirming this statement shall be continuously collected;
 - if the result for total Bromine is higher than 1000 ppm then an additional analysis of the restricted PBDEs shall be carried out to confirm (or not) compliance with the REGULATION (EU) 2019/1021.
 - NOTE: if there is a proven evidence in a country or region (based on sufficient analysis results) that a different value for the total Bromine can be used as a more suitable indicator confirming compliance with the REGULATION (EU) 2019/1021 then such value may be used instead of the mentioned 1000 ppm.

3.5 FLAT PANEL DISPLAY EQUIPMENT

3.5.1 Summary of de-pollution target values and limit values

FLAT PANEL DISPLAY EQUIPMENT				
	PARAMETER TO BE EVALUATED	TARGET VALUE / LIMIT VALUE	FREQUENCY	NOTE
Target value methodology	Not applicable	-	-	-
Mass Balance methodology	INTACT BACKLIGHT LAMPS that are not broken during manual treatment process	target value = 95wt% (minimum percentage of intact backlight lamps that are not broken - by weight)	At least once per year	Applicable for manual treatment only.
	AIR FILTRATION EFFICIENCY	target value = 95% (minimum percentage of the process air filtration efficiency)	The air filtration efficiency shall be monitored on a regular basis (at least once per year)	Applicable for mechanical treatment only. Concerns mass flow of mercury in process air before and after the filtration system.
Analysis methodology	MERCURY in de-polluted physically smallest shredded mixed fraction	limit value = 0,5 mg/kg (dry matter)	At least once per year	Applicable for mechanical treatment only. If mechanical treatment process of FPDs includes a step of screening to maximum 5 mm size, only the fine part shall be sampled and analysed (otherwise the fraction collected shall be sieved to a maximum of 5 mm at the time of the sampling procedure before being sent to the laboratory).
	MERCURY in air emissions	limit values = as defined by applicable laws	As defined by local legislation and permitting conditions of the treatment operator	Applicable for manual and mechanical treatment processes.

			(continuous monitoring of mercury emissions from the air filtration system is preferred)	
	MERCURY in ambient air	limit values = as defined by applicable laws	As defined by local legislation and permitting conditions of the treatment operator (ambient air shall be monitored on a continuous basis)	Applicable for manual and mechanical treatment processes.
	BROMINE/ RESTRICTED PBDEs in plastics fractions in plastics fractions	limit value = based on the REGULATION (EU) 2019/1021 as specified in the WEEELABEX Official Statement 2020_003	At least once per year	See the WEEELABEX Official Statement 2020_003 for details.
<i>For final treatment (Type 4) – the auditors shall refer to the CLC/TS 50625-5 Specification for the final treatment of WEEE fractions - Copper and precious metals</i>				

3.5.2 De-pollution supplements, specifications and clarifications

3.5.2.1 Target value methodology

- Not applicable.

3.5.2.2 Mass Balance methodology

INTACT BACKLIGHT LAMPS that are not broken during manual treatment process:

- As per the CLC/TS 50625-3-3, the target value is defined as a **minimum percentage of intact backlight lamps that are not broken** during manual treatment process = 95%.
- The target value is defined for “**pure**” **backlight lamps**, i.e. without any plastic/metal parts that are usually attached to the backlight lamps especially in the PC monitors (see the **Picture 3.5.2.2**)
- The Auditor shall consider the fact that it can be extremely **difficult to separate and weigh pure backlight lamps** without plastic/metal parts as the lamps may be broken during the separation process. If the pure backlight lamps **cannot be separated without any risk of damage or breakage**, the Auditor **shall not separate** them, however, shall weigh the lamps including the plastic/metal parts. However, in such situation, the Auditor shall take the weight of the **plastic/metal parts into consideration** and thus shall **deduct the estimated weight** from the “Total mass of intact lamps” (parameter “I”) and from the “Total mass of lamps broken by the treatment operator” (parameter “B”) as per the best available estimation.

Picture 3.5.2.2: Backlight lamps including plastic/metal parts and covers:



AIR FILTRATION EFFICIENCY:

- no supplements, specifications or clarifications

3.5.2.3 Analysis methodology

In general:

- Sampling and analysis procedures shall follow the **CLC/TS 50625-3-3**.
- **WEEELABEX Official Statement 2018_001** specifies requirements related to the sampling of fractions to be analysed (either by a laboratory or via an on-site handpicking analysis), including requested sampling documentation and records.
- It is required to complete a **SAMPLING PROTOCOL** for each sample taken (**Annex 2a** shows a SAMPLING PROTOCOL example). The **Annex 2b** shows an example of a **SAMPLE LABEL**.
- Samples intended for laboratory analysis shall be analysed by **laboratories approved** by the WEEELABEX Organisation (a list of approved laboratories is provided by the WEEELABEX Organisation).
- **Annex 3** gives examples of sampling **equipment and tools**.
- **Annex 4** summarizes in detail **analytical methods** to be followed by laboratories (as extracted from the relevant Technical Specifications).

Specifically:

- **MERCURY in physically smallest shredded mixed fraction**
 - applicable for mechanical treatment only
 - no supplements, specifications or clarifications
- **MERCURY in air emissions**
 - applicable for manual and mechanical treatment processes
 - no supplements, specifications or clarifications
- **BROMINE / RESTRICTED PBDEs** in plastics fractions
 - Not applicable should be used only if the material is sent to incineration, for chemical conversion, or disposal.
 - One of the following possible scenarios shall be implemented to prove compliance with the de-pollution requirements related to brominated flame retardants in plastic fractions (see the WEEELABEX Official Statement 2020_003 for details):
 - SCENARIO 1) two laboratory analysis of a plastic sample (PREFERABLE SOLUTION):

- one analysis for the TOTAL BROMINE concentration (limit value = 2000 ppm as per the CLC/TS 50625-3-1);
- the second analysis for the RESTRICTED PBDEs (limit value = 1000 mg/kg as per the REGULATION (EU) 2019/1021).
- SCENARIO 2) one laboratory analysis only for the RESTRICTED PBDEs:
 - if the result for RESTRICTED PBDEs is below 1000 mg/kg (compliant with the REGULATION (EU) 2019/1021) then such result can be assumed to be compliant with the CLC/TS 50625-3-1 as well (as the CLC/TS 50625-3-1 is aiming to remove the restricted PBDEs where the total Bromine is an indicator).
- SCENARIO 3) one laboratory analysis only for the TOTAL BROMINE:
 - the WEEELABEX organisation does not defined any new limit value, however, as there is only limited evidence that the 2000 ppm total Bromine limit value is still suitable to confirm compliance with the up-dated REGULATION (EU) 2019/1021, the following scenario shall be applied:
 - if the result for total Bromine is below 1000 ppm then such result can be assumed to be compliant with the REGULATION (EU) 2019/1021 as it can be assumed that the concentration of restricted PBDEs is below 1000 mg/kg as well; however, data confirming this statement shall be continuously collected;
 - if the result for total Bromine is higher than 1000 ppm then an additional analysis of the restricted PBDEs shall be carried out to confirm (or not) compliance with the REGULATION (EU) 2019/1021.
 - NOTE: if there is a proven evidence in a country or region (based on sufficient analysis results) that a different value for the total Bromine can be used as a more suitable indicator confirming compliance with the REGULATION (EU) 2019/1021 then such value may be used instead of the mentioned 1000 ppm.

3.6 GAS DISCHARGE LAMPS

3.6.1 Summary of de-pollution target values and limit values

GAS DISCHARGE LAMPS				
	PARAMETER TO BE EVALUATED	TARGET VALUE / LIMIT VALUE	FREQUENCY	NOTE
Target value methodology	Not applicable	-	-	-
Mass Balance methodology	Not applicable	-	-	-
Analysis methodology	MERCURY in glass fractions	limit value = 10 mg/kg (dry matter)	The number of samples for analysis depends on the amount of lamps treated per year as follows: = 1 sample per year for < 500 t of lamps treated per year; = 1 sample every 6 months for > 500 t lamps treated per year	-
	MERCURY in metal and mixed metal plastics fractions	limit value = 100 mg/kg		-
	MERCURY concentration in Ambient Air	limit values = as defined by applicable laws	Weekly (by a calibrated measurement device); For offices (non-plant area) according to the risk assessment, but at least annually	-
	MERCURY concentration in Air and Water	limit values = as defined by applicable laws	According to the risk assessment, but at least annually	-
For final treatment (Type 4) – the auditors shall refer to the CLC/TS 50625-5 Specification for the final treatment of WEEE fractions - Copper and precious metals				

3.6.2 De-pollution supplements, specifications and clarifications

3.6.2.1 Target value methodology

- Not applicable.

3.6.2.2 Mass Balance methodology

- Not applicable.

3.6.2.3 Analysis methodology

In general:

- Sampling and analysis procedures shall follow the **CLC/TS 50625-3-2**.
- **WEEELABEX Official Statement 2018_001** specifies requirements related to the sampling of fractions to be analysed (either by a laboratory or via an on-site handpicking analysis), including requested sampling documentation and records.
- It is required to complete a **SAMPLING PROTOCOL** for each sample taken (**Annex 2a** shows a SAMPLING PROTOCOL example). The **Annex 2b** shows an example of a **SAMPLE LABEL**.
- Samples intended for laboratory analysis shall be analysed by **laboratories approved** by the WEEELABEX Organisation (a list of approved laboratories is provided by the WEEELABEX Organisation).
- **Annex 3** gives examples of sampling **equipment and tools**.
- **Annex 4** summarizes in detail **analytical methods** to be followed by laboratories (as extracted from the relevant Technical Specifications).

Specifically:

- **MERCURY in physically smallest shredded mixed fraction**
 - applicable for mechanical treatment only
 - no supplements, specifications or clarifications
- **MERCURY in air emissions**
 - applicable for manual and mechanical treatment processes
 - no supplements, specifications or clarifications
- **BROMINE / RESTRICTED PBDEs** in plastics fractions
 - Not applicable should be used only if the material is sent to incineration, for chemical conversion, or disposal.
 - One of the following possible scenarios shall be implemented to prove compliance with the de-pollution requirements related to brominated flame retardants in plastic fractions (see the WEEELABEX Official Statement 2020_003 for details):
 - SCENARIO 1) two laboratory analysis of a plastic sample (PREFERABLE SOLUTION):
 - one analysis for the TOTAL BROMINE concentration (limit value = 2000 ppm as per the CLC/TS 50625-3-1);
 - the second analysis for the RESTRICTED PBDEs (limit value = 1000 mg/kg as per the REGULATION (EU) 2019/1021).
 - SCENARIO 2) one laboratory analysis only for the RESTRICTED PBDEs:
 - if the result for RESTRICTED PBDEs is below 1000 mg/kg (compliant with the REGULATION (EU) 2019/1021) then such result can be assumed to be compliant with the CLC/TS 50625-3-1 as well (as the CLC/TS 50625-3-1 is aiming to remove the restricted PBDEs where the total Bromine is an indicator).
 - SCENARIO 3) one laboratory analysis only for the TOTAL BROMINE:
 - the WEEELABEX organisation does not defined any new limit value, however, as there is only limited evidence that the 2000 ppm total Bromine limit value is still suitable to confirm compliance with the up-dated REGULATION (EU) 2019/1021, the following scenario shall be applied:

- if the result for total Bromine is below 1000 ppm then such result can be assumed to be compliant with the REGULATION (EU) 2019/1021 as it can be assumed that the concentration of restricted PBDEs is below 1000 mg/kg as well; however, data confirming this statement shall be continuously collected;
- if the result for total Bromine is higher than 1000 ppm then an additional analysis of the restricted PBDEs shall be carried out to confirm (or not) compliance with the REGULATION (EU) 2019/1021.
- NOTE: if there is a proven evidence in a country or region (based on sufficient analysis results) that a different value for the total Bromine can be used as a more suitable indicator confirming compliance with the REGULATION (EU) 2019/1021 then such value may be used instead of the mentioned 1000 ppm.

3.7 PHOTOVOLTAIC PANELS

3.7.1 Summary of de-pollution target values and limit values

PHOTOVOLTAIC PANELS				
	PARAMETER TO BE EVALUATED	TARGET VALUE / LIMIT VALUE	FREQUENCY	NOTE
Target value methodology	Not applicable	-	-	-
Mass Balance methodology	Not applicable	-	-	-
Analysis methodology	LEAD in glass fractions from treatment of silicon based photovoltaic panels	limit value = 100 mg/kg (dry matter)	The number of samples for analysis depends on the amount of photovoltaic panels treated per year as follows: = 1 sample per year for < 1 000 t of photovoltaic panels treated per year; = 1 sample every 6 months for 1 000 - 10 000 t of photovoltaic panels treated per year; = 1 sample quarterly for > 10 000 t of photovoltaic panels treated per year.	Applicable for the treatment of <u>silicon</u> based photovoltaic panels.
	CADMIUM in glass fractions from treatment of silicon based photovoltaic panels	limit value = 1 mg/kg (dry matter)		Applicable for the treatment of <u>silicon</u> based photovoltaic panels.
	SELENIUM in glass fractions from treatment of silicon based photovoltaic panels	limit value = 1 mg/kg (dry matter)		Applicable for the treatment of <u>silicon</u> based photovoltaic panels.
	LEAD in glass fractions from treatment of non-silicon based photovoltaic panels	limit value = 100 mg/kg (dry matter)		Applicable for the treatment of <u>non-silicon</u> based photovoltaic panels.
	CADMIUM in glass fractions from treatment of non-silicon based photovoltaic panels	limit value = 10 mg/kg (dry matter)		Applicable for the treatment of <u>non-silicon</u> based photovoltaic panels.
	SELENIUM in glass fractions from treatment of non-silicon based photovoltaic panels	limit value = 10 mg/kg (dry matter)		Applicable for the treatment of <u>non-silicon</u> based photovoltaic panels.
For final treatment (Type 4) – the auditors shall refer to the CLC/TS 50625-5 Specification for the final treatment of WEEE fractions - Copper and precious metals				

3.7.2 De-pollution supplements, specifications and clarifications

3.7.2.1 Target value methodology

- Not applicable.

3.7.2.2 Mass Balance methodology

- Not applicable.

3.7.2.3 Analysis methodology

In general:

- Sampling and analysis procedures shall follow the **CLC/TS 50625-3-5**.
- **WEEELABEX Official Statement 2018_001** specifies requirements related to the sampling of fractions to be analysed (either by a laboratory or via an on-site handpicking analysis), including requested sampling documentation and records.
- It is required to complete a **SAMPLING PROTOCOL** for each sample taken (**Annex 2a** shows a SAMPLING PROTOCOL example). The **Annex 2b** shows an example of a **SAMPLE LABEL**.
- Samples intended for laboratory analysis shall be analysed by **laboratories approved** by the WEEELABEX Organisation (a list of approved laboratories is provided by the WEEELABEX Organisation).
- **Annex 3** gives examples of sampling **equipment and tools**.
- **Annex 4** summarizes in detail **analytical methods** to be followed by laboratories (as extracted from the relevant Technical Specifications).

Specifically:

- **LEAD in glass fractions from treatment of silicon based photovoltaic panels**
 - applicable for the treatment of silicon based photovoltaic panels
 - no supplements, specifications or clarifications
- **CADMIUM in glass fractions from treatment of silicon based photovoltaic panels**
 - applicable for the treatment of silicon based photovoltaic panels
 - no supplements, specifications or clarifications
- **SELENIUM in glass fractions from treatment of silicon based photovoltaic panels**
 - applicable for the treatment of silicon based photovoltaic panels
 - no supplements, specifications or clarifications
- **LEAD in glass fractions from treatment of non-silicon based photovoltaic panels**
 - applicable for the treatment of non-silicon based photovoltaic panels
 - no supplements, specifications or clarifications
- **CADMIUM in glass fractions from treatment of non-silicon based photovoltaic panels**
 - applicable for the treatment of non-silicon based photovoltaic panels
 - no supplements, specifications or clarifications
- **SELENIUM in glass fractions from treatment of non-silicon based photovoltaic panels**
 - applicable for the treatment of non-silicon based photovoltaic panels
 - no supplements, specifications or clarifications

3.8 OTHERS

3.8.1 Summary of de-pollution target values and limit values

OTHERS - FINAL TREATMENT OF WEEE FRACTIONS - COPPER AND PRECIOUS METALS

For final treatment (Type 4) – the auditors shall refer directly to the CLC/TS 50625-5 Specification for the final treatment of WEEE fractions - Copper and precious metals

Annex 1: Couples of min. values “diameter-height” for electrolyte capacitors in scope

Diameter	Height	Volume
1,1 cm	12,9 cm	12,272 cm ³
1,2 cm	10,9 cm	12,272 cm ³
1,3 cm	9,2 cm	12,272 cm ³
1,4 cm	8,0 cm	12,272 cm ³
1,5 cm	6,9 cm	12,272 cm ³
1,6 cm	6,1 cm	12,272 cm ³
1,7 cm	5,4 cm	12,272 cm ³
1,8 cm	4,8 cm	12,272 cm ³
1,9 cm	4,3 cm	12,272 cm ³
2,0 cm	3,9 cm	12,272 cm ³
2,1 cm	3,5 cm	12,272 cm ³
2,2 cm	3,2 cm	12,272 cm ³
2,3 cm	3,0 cm	12,272 cm ³
2,4 cm	2,7 cm	12,272 cm ³
2,5 cm	2,5 cm	12,272 cm ³
2,6 cm	2,3 cm	12,272 cm ³
2,7 cm	2,1 cm	12,272 cm ³
2,8 cm	2,0 cm	12,272 cm ³
2,9 cm	1,9 cm	12,272 cm ³
3,0 cm	1,7 cm	12,272 cm ³
3,1 cm	1,6 cm	12,272 cm ³
4,1 cm	0,9 cm	12,272 cm ³
5,1 cm	0,6 cm	12,272 cm ³
6,1 cm	0,4 cm	12,272 cm ³
7,1 cm	0,3 cm	12,272 cm ³

Annex 2a: SAMPLING PROTOCOL example

BATCH / PERFORMANCE TEST IDENTIFICATION:		
Name of audited company:	OPERATOR A (hereinafter as „Operator“)	
Audit location:	Street, Town, Country	
Audit scope and WEEE stream related	Temperature exchange equipment stream: – WEEELABEX TEE performance test – STEP 2	
Audit date and time:	5 – 7 December 2018	The start: 5 December 2018; 8.00
		The end: 7 December 2018; 17.00
SAMPLE IDENTIFICATION:		
Output fraction name:		
SAMPLE INFORMATION:		
Sample identification number:	- TEE/PU/OPERATOR A/03; TEE/PU/OPERATOR A/03_spare; - TEE/PUIMP/OPERATOR A/04; TEE/PUIMP/OPERATOR A/04_spare; - TEE/PUWATER/OPERATOR A/05; TEE/PUWATER/OPERATOR A/05_spare	
Sampling date and time:	7 August 2025	10.30
Sampling place:	Outside the treatment hall no. 2 (under a weatherproof shelter).	
Conditions during the sampling:	Dry, temperature around 15°C.	
Sample description:	The PU fraction is the cleaned PU from the temperature exchange equipment after STEP 2 process including plastic and metallic impurities and including water content.	
Sample size and packaging:	500 ml (each sample) / plastic bags sealed with aluminium tape	
Sampling procedure:	Sampling procedure compliant with the CLC/TS 50625-3-4	
Notes:	No notes.	
SAMPLING PARTICIPANT(S):		
Name of sampler(s):	Sampler A	Signature:
	Sampler B	Signature:
Laboratory:		
Laboratory name:	Laboratory A, Country (TEE/PU/OPERATOR A/03; TEE/PUIMP/OPERATOR A/04) Laboratory B, Country (TEE/PUWATER/OPERATOR A/05)	
Date of sending of the sample to the laboratory:	8 December 2018	
Required analysis:	VFC and VHC in the PU fraction (according to the CLC/TS 50625-3-4) Determination of plastic and metallic impurities in the PU fraction (according to the CLC/TS 50625-3-4) Determination of water content in the PU fraction (gravimetric method according ISO 11465 or EN 14346)	

Annex 3b: SAMPLE LABELING example

Sample ID: TEE/PU/OPR_A/03 Sample description: POLYURETHANE FRACTION Operator: ... Sampler: ... Date/Time: ... Analysis: VFC and VHC in the PU fraction (according CLC/TS 50625-3-4)	Sample ID: TEE/PU/OPR_A/03_SPARE Sample description: POLYURETHANE FRACTION Operator: ... Sampler: ... Date/Time: ... Analysis: VFC and VHC in the PU fraction (according CLC/TS 50625-3-4)
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Annex 4: Examples of sampling equipment and tools

Portable and folding quartering cross to be used for homogenization and reduction of a sample:



Portable sieve for sieving physically smallest non-metallic mechanical treatment fraction produced by the process in case of particles size over 5mm:



Aluminium tape (or another gas tight tape) to prevent gas leakage from a sample in a plastic bag (applicable e.g. for PU fractions):



Paraffine tape to prevent gas leakage from a sample in a glass (applicable e.g. for Oil and VFC)



Annex 5: Analytical methods to be used by accredited laboratories for the analysis of samples

WEEE Stream	Type of analysis	Description of the Analysis	Comments
Large appliances / Mixed equipment	PCB in physically smallest non-metallic mechanical treatment fraction	Method description as per the standard CLC/TS 50625-3-1 (Clause 4.4): The preparation of the test portion of the sample to be analysed shall be carried out according to EN 15002 and then: • for PCB, the digestion (e.g. homogenization) of the sample and the subsequent analysis shall be carried out in accordance with EN 15308 or US EPA 8082A/2007, quantification of PCBs as congeners.	Sample volume = ca 1 litre
Large appliances / Mixed equipment	Cadmium in physically smallest non-metallic mechanical treatment fraction	Method description as per the standard CLC/TS 50625-3-1 (Clause 4.4): The preparation of the test portion of the sample to be analysed shall be carried out according to EN 15002 and then: • for cadmium, the digestion of the sample and the subsequent analysis shall be carried out by ICP-OES or ICP-MS according to IEC 62321-5. As an alternative the digestion shall be carried out according to EN 13656 and the subsequent analysis performed according to EN ISO 11885 or the EN ISO 17294 series. NOTE 4 ICP-OES is an abbreviation for Inductively Coupled Plasma/Optical Emission Spectrometry and ICP-MS is an abbreviation for Inductively Coupled Plasma Mass Spectrometry, which are the two methods of chemical analysis to be used when analysing cadmium.	Sample volume = ca 1 litre
Mixed equipment / Flat panel displays / Flat panel displays	Bromine in plastic fraction	Method description as per the standard CLC/TS 50625-3-1 (Clause 4.4): The preparation of the test portion of the sample to be analyzed shall be carried out according to EN 15002 and then: • for bromine, the digestion of the sample and the subsequent analysis shall be carried out in accordance with EN 14582.	Sample volume = ca 12 litres or less

WEEE Stream	Type of analysis	Description of the Analysis	Comments
Temperature exchange equipment	Residual refrigerant in oil	Method description as per the standard CLC/TS 50625-3-4 (Annex CC.3): Determination of residual refrigerant in oil – METHOD 2 Analysis: Before the laboratory analysis, the oil samples need an ice/water cooling bath for 1 h. A sample of oil is weighted (1-2 g) in a gastight 40ml vessel and VFCs and VHCs are extracted/solved in 10 ml of Diacetone Alcohol (4-hydroxy-4-methyl-pentan-2-one, CAS. 123-42-2) for a night at room temperature, without stirring. After the extraction/solubilization, 1 ml of Diacetone alcohol is diluted in 9 ml of water in a 20 ml headspace vial. A sample of the gas in the headspace is injected into a GC-MS instrument. The GC-MS analysis of the head-space sample is suitable for the determination of the compounds at low concentration, such as Freon-11 and traces of other CFCs. Gas-chromatography (GC) equipped with a flame ionization detector (FID) and double column is preferred for compounds at high concentrations (Freon-12). Analysis Repetition: The analyses are repeated twice for each sample and the analysis report shall show the two sets of non-duplicate values, avoiding the average. As a minimum R12, R22, R134a and R600a will be detected. Chromatographic Settings: The chromatographic analyses are recorded under the follow instructions: - chromatographic column: capillary column specific for the determination of volatile organic pollutants, particularly for chlorofluorinated pollutants; - advised thermal profile: plateau at 35 °C for 3 min followed by a 7 °C/min thermal ramp until 110 °C (at the end of the analysis, a cleaning process at a high temperature depending on the column model is needed); - Gas-transport flux and pressure: gas-transport flux and pressure shall guarantee good resolution and separation of the chromatographic peaks; gas-transport flux and pressure shall avoid the overlap chromatographic peaks on other peaks. The chromatograms should be available for two years after the analysis. In chromatograms, the peaks of all components, as listed above, and internal standard (eventually unknown) should be clearly identified.	Sample volume = ca 100 ml

WEEE Stream	Type of analysis	Description of the Analysis	Comments
Temperature exchange equipment	Chemical composition of the output refrigerants (VFCs/VHCs) from the step 1 treatment	Method description as per the standard CLC/TS 50625-3-4 (Annex DD.3): Determination of chemical composition of the output refrigerants (VFCs/VHCs) from the step 1 treatment: Direct determination of R12, R22, R134a, R600a, R290 and oil using the following method: The relative amount of VFCs and VHCs in the liquid refrigerant phase shall be determined using gas chromatography or infrared spectroscopy. The types of VFCs and VHCs identified and their respective percentage mass fractions shall be documented.	Sample volume = ca 10 - 20 ml
Temperature exchange equipment	Chemical composition of the output blowing agents (VFCs/VHCs) from the step 2 treatment	Method description as per the standard CLC/TS 50625-3-4 (Annex DD.4): Determination of chemical composition of the output blowing agents (VFCs/VHCs) from the step 2 treatment: Direct determination of R11, R12, R141b and Cyclo-Pentane, N-Pentane as well as Iso-Pentane using the following method: The relative amount of VFCs and VHCs in the liquid blowing agent phase (exclusive water content) shall be determined using gas chromatography or infrared spectroscopy. The types of VFCs and VHCs identified and their respective percentage mass fractions shall be documented.	Sample volume = ca 10 - 20 ml

WEEE Stream	Type of analysis	Description of the Analysis	Comments
Temperature exchange equipment	Residual VFC and VHC in polyurethane fraction	Method description as per the standard CLC/TS 50625-3-4 (Annex EE.2): Determination of residual VFC and VHC in polyurethane fraction - METHOD 1 <u>Preparation for Analysis in the Laboratory:</u> Phase separation: not necessary Drying: not necessary and not applicable for the analyse but the water content should be determined on a distinct subsample Homogenization and sub sampling: mechanical homogenization using cryogenic grinding in order to obtain a test portion of 3 to 6 g as a subsample. NOTE 1 Drying would cause VFC losses. NOTE 2 Homogenization without using nitrogen would cause VFC losses. <u>Analysis:</u> At the analysis laboratory, a sample of the polyurethane matrix is weighted (3 g to 6 g). In an gastight 60 ml vessel, VFCs and VHCs are extracted from Polyurethane matrix in 50 ml of ultrapure Methanol for a night at 20 °C room temperature without stirring. After the extraction, 1 ml of methanol is diluted in 9 ml of water in a 20 ml headspace vial. A sample of the gas in the headspace is injected into a GC-MS instrument. Gas-chromatography (GC) equipped with a flame ionization detector (FID) and double column is preferred for compounds at high concentrations (Freon-11). <u>Analysis Repetition:</u> The analysis repetition on several specimens from the same plant is needed in order to obtain a precise evaluation of the residual VFC and VHC content in the Polyurethane matrix. Particularly, 3 specimens are needed for briquette plants and sampling during the laboratory analysis shall be done from the centre of the briquette; 3 specimens are needed also for pellet plant and for powder plants sampling is obtained by quartering. As a minimum R11, R141b, cyclopentane and isopentane are analysed. <u>Chromatographic Settings:</u> The chromatographic analyses are recorded under the follow instructions: - Chromatographic column: capillary column specific for the determination of volatile organic pollutants, particularly for chlorofluorinated pollutants; - Advised thermal profile: plateau at 35 °C for 3 min followed by a 7 °C/min thermal ramp until 110 °C (at the end of the analysis, a cleaning process at a high temperature depending on the column model is needed). - Gas-transport flux and pressure: gas-transport flux and pressure shall guarantee good resolution and separation (at least 0,8 min) of the chromatographic peaks corresponding to all components, as listed above, gas-transport flux and pressure shall avoid the overlap of their chromatographic peaks on other peaks. - The calibration is obtained by the internal standard method, i.e. a response factor is determined by a calibration curve determined with three known-concentration samples of each of the above mentioned components and the internal standard (the internal standard should be a chemical compound similar to Freon-11 and Freon-12, its chromatographic peak should not overlap the Freon-11 and Freon-12 chromatographic peaks or those of other compounds of interest in the mixture. The chromatograms shall be available for two years after the analysis. In chromatograms, the peaks of the above mentioned components and internal standard (eventually unknown) should be clearly identified.	Sample volume = ca 100 – 750 ml

WEEE Stream	Type of analysis	Description of the Analysis	Comments
Temperature exchange equipment	Residual VFC and VHC in polyurethane fraction	Method description as per the standard CLC/TS 50625-3-4 (Annex EE.3): Determination of residual VFC and VHC in polyurethane fraction - METHOD 2 <u>Preparation for Analysis in the Laboratory:</u> Phase separation: not necessary Drying: not necessary and not applicable for the analyse but the water content should be determined on a distinct subsample Homogenization and sub sampling: mechanical homogenization using cryogenic grinding in order to obtain a test portion of 3 to 6 g as a subsample. <i>NOTE 1 Drying would cause VFC losses.</i> <i>NOTE 2 Homogenization without using nitrogen would cause VFC losses.</i> <u>Analysis:</u> At the analysis laboratory, a sample of the polyurethane matrix is weighted (3 g to 6 g). In a gastight 60 ml vessel, VFCs and VHCs are extracted from polyurethane matrix in 50 ml of ultrapure Methanol for a night at room temperature without stirring. After the extraction, 1 ml of Methanol is diluted in 9 ml of water in a 20 ml headspace vial. A sample of the gas in the headspace is injected into a GC-MS instrument. The GC-MS analysis of the head-space sample is suitable for the determination of the compounds at low concentration, such as Freon-12 and traces of other CFCs. Gas-chromatography (GC) equipped with a flame ionization detector (FID) and double column is preferred for compounds at high concentrations (Freon-11). <u>Analysis Repetition:</u> The analysis repetition on several specimens from the same plant is needed in order to obtain a precise evaluation of the residual VFC and VHC content in the Polyurethane matrix. Particularly, 3 specimens are needed for briquette plants and sampling during the laboratory analysis shall be done from the centre of the briquette; 3 specimens are needed also for pellet plant and for powder plants sampling is obtained by quartering. <u>Chromatographic Settings:</u> The chromatographic analyses are recorded under the follow instructions: - chromatographic column: capillary column specific for the determination of volatile organic pollutants, particularly for chlorofluorinated pollutants; - advised thermal profile: plateau at 35 °C for 3 min followed by a 7 °C/min thermal ramp until 110 °C (at the end of the analysis, a cleaning process at a high temperature depending on the column model is needed); - gas-transport flux and pressure: gas-transport flux and pressure shall guarantee good resolution and separation (at least 0,8 min) of the chromatographic peaks corresponding to the components, as listed above; gas-transport flux and pressure shall avoid the overlap of their chromatographic peaks on other peaks; - calibration: the calibration is obtained by the internal standard method, i.e. a response factor is determined by a calibration curve determined with three known-concentration samples of each of the above mentioned components and the internal standard (the internal standard should be a chemical compound similar to Freon-11 and Freon-12, its chromatographic peak should not overlap the Freon-11 and Freon-12 chromatographic peaks or those of other compounds of interest in the mixture). The chromatograms should be available for two years after the analysis. In chromatograms, the peaks of the above-mentioned components and internal standard (eventually unknown) should be clearly identified.	Sample volume = ca 100 – 750 ml

WEEE Stream	Type of analysis	Description of the Analysis	Comments
Temperature exchange equipment	Foreign matters content in polyurethane fraction	Method description as per the standard CLC/TS 50625-3-4 (Annex EE.4): Determination of foreign matters content in polyurethane fraction by thermogravimetric analysis <u>Preparation of samples:</u> Phase separation: not necessary Drying: applicable Homogenization and sub-sampling: mechanical homogenization using cryogenic grinding to a powder in order to obtain a test portion as a subsample. <i>NOTE Homogenization of samples is absolutely necessary in order to get a representative subsample for the subsequent analysis.</i> The analysis is carried out in two steps, a semiquantitative analysis by IR spectrometry and a quantitative analysis by thermogravimetric analysis (TGA). <u>Spectroscopy IR (FT-IR):</u> The first step should aim to determine the type of impurities which could be present in the polyurethane fraction. Spectra of Solids - The KBr Disc Technique Before pressing, the polyurethane sample has to be mixed with the KBr powder at a sample concentration level of 0,1 % to 2 %. The sample has to be grounded to a fine powder in order to reduce scattering losses and absorption band distortions. Preparation of the mixture: 1/2 mm to 1 mm layer of the mixture should be transferred from the mortar to the die and the disc should be pressed. The disk should then be placed in the disk holder and the spectrum should be obtained. <u>Step 2: Thermogravimetric method (TGA):</u> TGA is a thermal analysis technique which consists of the measurement of the variation in weight of a sample as a function of temperature. The analysis has to be conducted under the following conditions of the TGA device: - The sample should be heated at 10 K/min to 1 000 °C under an atmosphere of oxygen. - Measurement in the thermal analyser.	Sample volume = ca 100 – 750 ml

WEEE Stream	Type of analysis	Description of the Analysis	Comments
Temperature exchange equipment	Foreign matters content in polyurethane fraction	Method description as per the standard CLC/TS 50625-3-4 (Annex EE.5): Determination of foreign matters content in polyurethane fraction by selective extraction method <u>Preparation of samples:</u> Phase separation: not necessary Drying: applicable Homogenization and sub-sampling: mechanical homogenization using mortar and pestle or cryogenic grinding to a powder in order to obtain a test portion of 50 g as a subsample. <i>NOTE Homogenization of samples is absolutely necessary in order to get a representative subsample for the subsequent analysis.</i> <u>Analysis:</u> The analysis is carried out in two steps, an automated solid liquid extraction of non polyurethane-polymers by pressurized liquid extraction (PLE) followed by a solid liquid extraction in a semiquantitative analysis by IR spectrometry and a quantitative analysis by thermogravimetric analysis (TGA). <u>Step 1: Pressurized liquid extraction of non polyurethane polymers:</u> The first step should aim to determine extract and weigh non polyurethane-polymers from the polyurethane fraction, which may include (PE, PP, PS, ABS, PMMA). 3 g to 8 g of the homogenized polyurethane sample (exact input weight is determined: dm(IN)) are mixed with the nine fold amount of pre extracted and dried sea-sand and filled into in 22 ml cartridges. Extractions were performed with two solvents, dichloromethane and toluene: DCM: 3 static cycles for 20 min at 80 °C Toluene: 3 static cycles for 20 min at 130 °C Extracts are combined in vessel vials and dried under a stream of Nitrogen, whereas the samples are placed in a heated alumina tray. The weight of the dry matter extracted with both, Dichloromethane and Toluene, is determined (dm(DCM) and dm(TOL)) <u>Step 2: Depolymerize and extract polyurethane from the sample:</u> The extraction residue of step 1 is filled into a 500 ml flask and depolymerized/extracted for 1 h at 230 °C in glycol using a heating mantle and a reflux condenser fixed on top of the flask. The extract is filtered with a paper filter using a suction filter aggregate. The filter residue is extracted a second time with 80 g Glycol in the same flask and again filtered. Both filter papers are washed with Ethanol and dried. The dry weight of the filter residues is determined (dm FR) <u>Calculation of polyurethane content (PU)</u> $PU (\%) = 1 - (dm(DCM) + dm(TOL) + dm(FR)) / dm(IN)$	Sample volume = ca 100 – 750 ml

WEEE Stream	Type of analysis	Description of the Analysis	Comments
Temperature exchange equipment	Water content in polyurethane fraction	Method description as per the WEEELABEX Official Statement_2017_001: Determination of water content in polyurethane (PU) fraction An accredited laboratory shall determine the water content in PU fraction by using the analytical method “Thermogravimetric analysis (drying to constant weigh) - Determination of dry matter and water content on a mass basis per ISO 11465:1993” with the following specifications: - Drying temperature = max. 105 °C (to ensure than only water is released from the sample); - Drying time = “to constant weigh”, however at least 24 hours; - Sample homogenisation and reduction under 0,3 mm; - At least three test portions shall be analysed by the laboratory (due to a possible inhomogeneity of samples); - The laboratory is requested to express the result as the average of the three sub-results; - The laboratory is requested to specify the uncertainty of the result (in %). Note: If an alternative method of sample preparation or analytical method is to be used (e.g. “EN 14346 Characterization of waste - Calculation of dry matter by determination of dry residue or water content”), the laboratory shall validate the alternative method in accordance with clause 5.4.5 of ISO/IEC 17025:2005	Sample volume = ca 100 – 750 ml

WEEE Stream	Type of analysis	Description of the Analysis	Comments
Temperature exchange equipment	Residual refrigerant in oil	Method description as per the standard CLC/TS 50625-3-4 (Annex CC.2): Determination of residual refrigerant in oil – METHOD 1 Extraction: At the analysis laboratory, a sample of the oil has to be weighed (0,5 to 2,0 g). In a gastight 60 ml vessel, VFCs and VHCs are extracted from oil in 50 ml of acetone. After the extraction, 1 ml of Acetone is diluted in 9 ml of water in a 20 ml headspace vial. Two different test portions have to be prepared with two concentrations of doped water. Analysis: The vial has to be heated at 80 °C for at least 30 min. Then, a sample of the gas in the headspace has to be injected into a GC-MS instrument. As a minimum R12, R22, R134a and R600a will be detected. Chromatography Settings: The chromatographic analyses have to be recorded under the following instructions: - Chromatographic column: capillary column specific for the determination of volatile organic pollutants, particularly for chlorofluorinated pollutants; - Advised thermal profile: plateau at 50 °C for 10 min followed by a 10 °C/min thermal ramp until 280 °C (at the end of the analysis, a cleaning process at a high temperature depending on the column model is needed); - Gas-transport flux and pressure: gas-transport flux and pressure shall guarantee good resolution and separation of the chromatographic peaks; gas-transport flux and pressure shall avoid the overlap chromatographic peaks on other peaks.	Sample volume = ca 100 ml

WEEE Stream	Type of analysis	Description of the Analysis	Comments
CRT display appliances	Sulphur in glass fraction	Method description as per the standard CLC/TS 50625-3-3 (Annex CC): General: From the methodological point of view, this analysis protocol will define the extraction of the residual content of fluorescent coatings from the surface of the CRT glass with the hydrochloric acid, and determine the content of sulphur (S) in a liquid sample. This analysis shall be performed separately on each of the five samples collected. Test portion preparation: This method applies to a laboratory sample size of 1,5 kg. The sample should be CRT glass pieces without grinding, from the fluorescent coatings removal process. NOTE In the case of grinding/milling, it is difficult to ensure the homogeneity of the sample; after grinding, the fluorescent coatings particles are in a form of freely flowing dust that separates from the CRT glass particles because of the density difference. Approximate geometry/size of cullet: about 6 x 6 cm, in order to pass the mouth of leaching vessel. Leaching step: Leaching shall be done with aqueous hydrochloric acid. The concentration of hydrochloric acid shall be as a minimum 8 % (w/w). After mixing and cooling to room temperature, the acid is ready for use. NOTE For example, 500 ml of conc. HCL is added in one portion into 2000 ml of water in a glass bottle of 2,5 L capacity in a fume board. This volume of acid is sufficient for leaching five samples. Mineral acids with oxidative effects such as HNO₃ or aqua regia should not be used for leaching tests. Oxidative dissolution in the fluorescent coatings/CRT screen system leads to formation of barium and sulphate ions in solution. Presence of barium and sulphate ions in solution will very probably lead to precipitation of insoluble barium sulphate. This would lead to possible underestimation of fluorescent coatings content in the CRT glass. Usage of hydrochloric acid can be recommended, as barium sulphate formation is avoided due to keeping sulphur in a sulphide state. Employing sulphur as a tracer element requires prompt sampling and analysis. Leaching procedure: A fume board shall be used during this procedure to avoid exposure to H₂S concentrations in ambient air. First the CRT glass sample shall be weighed with 1 g precision. Hydrochloric acid (approximately 500 ml) is added quickly in one portion on the sample (approximately 1,5 kg) in the vessel. The vessel is tightly closed with a screw cap and tightened with Parafilm. The vessel is left in an ultrasonic bath for 15 min at room temperature, occasionally taking away and swirling upside down. Then it shall be left to stand at room temperature for 15 min, with occasional swirling upside down. After final swirling, the leachate shall be taken with a syringe of 10 ml capacity, filtered through a syringe filter of 0,45 µm porosity into a plastic test tube, and tightly closed by a well-fitting stopper. The sulphur content shall be analysed not later than one hour after the sampling procedure of the leachate. Quantification technique: The sulphur content shall be quantified with an ICP OES instrument, according to ISO 11885. Sulphur standard: Calibration shall be done by the laboratory, in the leachate, the sulphur is present as volatile hydrogen sulphide non hydrate, for this reason, ordinary accessible sulphur standards (generally containing sulphur as sulphate) cannot be used for calibration. Only the standards containing sulphur as a sulphide can be used.	Sample volume = ca 1,5 kg Number of samples per each analysis = 5 single samples to be analysed separately

WEEE Stream	Type of analysis	Description of the Analysis	Comments
CRT display appliances	PbO in glass fraction	Method description as per the standard CLC/TS 50625-3-3 (Annex DD): General: Three types of analysis are applicable: — Determination of Pb content in panel glass by X-ray fluorescence (XRF), for laboratory analysis. — Determination of Pb content in panel glass by inductively coupled plasma optical emission spectrometry (ICP-OES) on a eluate after mineralisation of a the test portion. Analysis by ICP OES method: Test portion preparation: The laboratory shall implement EN 15002. 1. Phases separation: Not necessary 2. Measure the moisture content of a sub sample and use this value for a correction on the test sample. 3. Size reduction: reduce to 250 µm. 4. Mechanical subsampling to obtain a test portion of 200 mg. Mineralization: The laboratory shall implement EN 13656. Analytical technique The laboratory shall implement ISO 11885. Reporting: For the reporting of XRF or ICP OES analysis, the laboratory shall report lead or lead oxide, based on dry matter. As the limit value is on PbO, it is necessary to calculate the PbO content as follows: Description Abbreviation Lead oxide content QPbO Lead quantity in the sample – results from laboratory QPb $QPbO = QPb \times (1 + 0,07722)$ Analysis by XRF method: The laboratory shall implement the standard EN 15309 or the standard EN 63321-3-1.	Sample volume = ca 3 l the ICP OES method is the only analysis method allowed to be accepted by a WEEELABEX Auditor during a validated batch test the XRF method shall not be accepted during a validated batch test

WEEE Stream	Type of analysis	Description of the Analysis	Comments
Flat panel display equipment	Mercury in physically smallest shredded mix fraction	Method description as per the standard CLC/TS 50625-3-3 (Annex FF): Principles: This annex provides information for the analysis of mercury in the de-polluted physically smallest shredded mixed fraction of flat panel displays considering the problems arising particularly from the homogenization of heterogeneous metallic fractions. The chemical laboratory shall follow the given principles and has enough experience with digestion and test portion preparation of mercury analysis in shredded mixed fractions of flat panel displays. The method of test portion preparation shall consider that most of the mercury in the physically smallest shredded fraction is bound as amalgam on metallic parts. The total mercury content of the whole sample shall be analysed. The result should also encompass the amalgam mercury namely in the small electrode wires. The result of the analysis should represent the whole laboratory sample (normally 1 l) including all kind and size of pieces. The digestion and test portion preparation shall avoid any release of mercury as loss to the ambient air; heating of samples during the sampling preparation process shall be avoided. If a release of mercury is unavoidable, it shall be absorbed and determined quantitatively. The digestion, test portion preparation and analysis have to be repeated 3 times. The range of the three results shall not exceed 15 % of the average. The method of sample digestion and preparing the test portion has to be approved by quality assurances, internal references and other means of good laboratory practice (GLP). NOTE See OECD Series on principles of good laboratory practice and compliance monitoring, Number 1, OECD Principles on Good Laboratory Practice (as revised in 1997), ENV/MC/CHEM(98)17. Verification: The laboratory shall also verify all steps of the analysis methodology, especially so that no substantial mercury is released to the ambient air during mechanical processing, e.g.: grinding, crushing, sieving and separating. The laboratory shall also verify that the digestion with acid is completed. The results of the verification procedure shall be documented and available. Test portion preparation: The laboratory shall implement the standard EN 15002 Characterization of waste – preparation of test portions from the laboratory sample: 1. Phase separation: Not necessary. 2. Measure the moisture content of a sub sample and use this value for a correction on the test sample. 3. Size reduction: reduce from max. 5 mm to 250 µm. Due to heat generation by grinding; the size reduction of samples for analysis of mercury shall be carried out by using a cryogenic technique. The grinder used by the laboratory shall be able to reduce small pieces of metal (cables, pieces of printed circuit board, electronic components...). 4. Mechanical subsampling to obtain a test portion of 200 mg. Mineralisation: Mineralisation shall be carried out using EN 13657 'Characterization of waste – Digestion for subsequent determination of aqua regia soluble portion of elements'. Analytical technique: The laboratory shall implement one of the standards below: (no particular restrictions) EN ISO 12846, Water quality - Determination of mercury - Method using atomic absorption spectrometry (AAS) with and without enrichment ISO 16772, Soil quality - Determination of mercury in aqua regia soil extracts with cold-vapour atomic spectrometry or cold-vapour atomic fluorescence spectrometry EN ISO 17294-2, Water quality - Application of inductively coupled plasma mass spectrometry (ICPMS) - Part 2: Determination of 62 elements (ISO 17294-2:2003) ISO 17852, Water quality – Determination of mercury – Method using atomic fluorescence spectrometry	Sample volume = ca 1 l

WEEE Stream	Type of analysis	Description of the Analysis	Comments
Gas discharge lamps	Mercury in the lamp treatment fractions	Method description as per the standard CLC/TS 50625-3-2 (Annex BB and Annex CC): Principles: The method of test portion preparation shall consider that most of the mercury in the metallic fractions is bound as amalgam. The result should also encompass the amalgam mercury namely in the small electrode wires. The result of the analysis should represent the whole laboratory sample (normally 1 l) including all kind and size of pieces. The digestion and test portion preparation shall avoid any release of mercury as loss to the ambient air; heating of samples during the sampling preparation process shall be avoided. If a release of mercury is unavoidable it shall be absorbed and determined quantitatively. The digestion, test portion preparation and analysis shall be repeated 3 times. The range of the three results shall not exceed 15 %. The calculated average of these three analyses shall be used for compliance to the limit values. The method of sample digestion and preparing the test portion shall be approved by quality assurances, internal references and other means of good laboratory practice (GLP). NOTE OECD Series on principles of good laboratory practice and compliance monitoring, Number 1, OECD Principles on Good Laboratory Practice (as revised in 1997), ENV/MC/CHEM(98)17. Verification: The laboratory shall verify all steps of the analysis methodology, especially that no substantial mercury is released to the ambient air during mechanical processing, e.g. grinding, crushing, sieving and separating. It shall verify also that digestion with acid is completed. The insoluble part of the sample, filtered out after digestion shall be analysed of remaining mercury. The results of the verification procedure shall be documented and available. Remarks on the analysis of mercury in heterogeneous metal or mixed metal-plastic fractions The development of a methodology to analyse mercury in heterogeneous mixed fractions from lamp treatment is a challenge because: - there are different chemical forms of mercury in lamp fractions, including amalgam; they shall all be covered by the analysis method; - mercury is a mobile element at room temperature and above and therefore can easily be lost to the ambient air, especially during mechanical processing of the sample - digestion of metal needs a lot of strong acid (aqua regia, nitric acid), therefore homogenization by mechanical treatment of the sample is important; - the composition of mixed metal fractions from lamp treatment can be very different in terms of size, type of metal, plastics, ceramics and glass. To make sure that there is a practical and safe approach to analyse mercury in such heterogeneous fractions with reproducible results, a methodology is under development and testing with different laboratories. This methodology is based on the mineralization of sample ground to 5 mm, by nitric acid at room temperature.	Sample volume = ca 1 l

WEEE Stream	Type of analysis	Description of the Analysis	Comments
Photo-voltaic panels	Lead in glass fractions	Method description as per the standard CLC/TS 50625-3-5 (Clause 4.4): Principles: The preparation of the test portion, including homogenization of the heterogeneous samples shall be carried out according to one of the following standards: - EN ISO 15587-1, - EN ISO 15587-2, - EN 15002, - EN 13650. The chemical analysis, separation of the test portion and identification of the heavy metals shall be carried out according to one of the following standards: - EN ISO 17852, - EPA6020A - 1 Revision 1, February 2007, - EN ISO 17294-2.	Sample volume = ca 1 l
Photo-voltaic panels	Cadmium in glass fractions	Method description as per the standard CLC/TS 50625-3-5 (Clause 4.4): Principles: The preparation of the test portion, including homogenization of the heterogeneous samples shall be carried out according to one of the following standards: - EN ISO 15587-1, - EN ISO 15587-2, - EN 15002, - EN 13650. The chemical analysis, separation of the test portion and identification of the heavy metals shall be carried out according to one of the following standards: - EN ISO 17852, - EPA6020A - 1 Revision 1, February 2007, - EN ISO 17294-2.	Sample volume = ca 1 l
Photo-voltaic panels	Selenium in glass fractions	Method description as per the standard CLC/TS 50625-3-5 (Clause 4.4): Principles: The preparation of the test portion, including homogenization of the heterogeneous samples shall be carried out according to one of the following standards: - EN ISO 15587-1, - EN ISO 15587-2, - EN 15002, - EN 13650. The chemical analysis, separation of the test portion and identification of the heavy metals shall be carried out according to one of the following standards: - EN ISO 17852, - EPA6020A - 1 Revision 1, February 2007, - EN ISO 17294-2.	Sample volume = ca 1 l