CEWASTE

Voluntary certification scheme for waste treatment

CEWASTE REQUIREMENTS FOR IMPROVING CRM RECYCLING FROM WEEE AND WASTE BATTERIES

DELIVERABLE WP2

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1 TABLE 1: VERSION HISTORY

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1.0	Aug 2019	1st draft for Consortium Partners' review	Sonia Valdivia (WRFA)
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5.0	Dec 2019	5th revised version for the European Commission for review (08.11.2019)	Sonia Valdivia (WRFA)

NOTICE

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Acronyms

BEV	Battery electric vehicle
CEWASTE	Voluntary certification scheme for waste treatment
CoC	Chain-of-Custody
CRT	Cathode ray tube
CRM	Critical Raw Materials
ELV	End-of-life vehicles
HDD	Hard Disk Drive
(P)HEV	(Plug-in) hybrid electric vehicle
P-D-C-A	Plan-do-check-act
PCB	Printed circuit board
PPE	Personal protective equipment
REE	Rare earth element
TEE	Temperature exchange equipment
WEEE	Waste Electrical and Electronic Equipment
WHO	World Health Organization

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3 PURPOSE AND STRUCTURE OF THE DELIVERABLE

This document corresponds to the deliverables of "Work Package 2 – Normative Requirements" of the CEWASTE project. In the frame of this work package, a set of normative requirements for improving recycling of Critical Raw Materials (CRM) from waste electrical and electronic equipment (WEEE) and waste batteries has been developed. These include managerial, environmental, social, traceability and technical requirements.

In the project's proposal, it was planned to address these requirements in two separate deliverables namely "D2.1-Sustainability Requirements" and "D2.2-Traceability Requirements". However, during implementation of the project and the progress made, the project's consortium decided to compile two deliverables, and report all requirements in one single document (current document) titled "CEWASTE Requirements for improving CRM recycling from WEEE and Waste Batteries". This approach was confirmed by the EC Project Officer supervising the project.

For the purpose of this deliverable, CEWASTE has taken stock of the existing principles and standards and only where they were not sufficient to meet all the project's objectives, new requirements have been developed. To do this, more than 60 existing standards and verification schemes were mapped and assessed in the first work package of the project (WP1 - Baseline and Gap Analysis). The result of the baseline analysis revealed that the European Standards on Collection, Logistics and Treatment Requirements for WEEE (EN 50625) approved by CENELEC (European Committee for Electrotechnical Standardization) on 2014-01-27, is the most comprehensive standard relevant for the purpose of the CEWASTE project.

Based on this conclusion, the EN 50625 standard series was considered as the basis for developing the CEWASTE normative requirements. Accordingly, for drafting the current deliverable, CEWASTE adopted and followed the structure of this standard series, which fits the generic structure of a standard. This structure is composed of the following sections:

- *Notes to the reader:* This section provides information about the structure of the document as well as instructions for the users of the normative requirements.

- *Introduction:* The Introduction provides specific information or commentary about the technical content of the document, and about the reasons prompting its preparation.

- *Scope:* The scope clearly defines the subject of the document and the aspects covered, thereby indicating the limits of applicability of the document or particular parts of it.

- *Normative references:* This section lists, for information, those documents which are cited in the text in such a way that some or all of their content constitutes requirements of the document.

- *Terms and definitions:* This clause provide definitions necessary for the understanding of certain terms used in the document.

- *Management requirements:* This clause contains the management requirements for operators and facilities.

- *Technical requirements*: This clause describes the aspects that apply to all WEEE including waste batteries and CRM fractions treated.

- *De-pollution Monitoring:* This section provides requirements for adequate documentation and description of the applicable methodologies for each treatment process.

- *Bibliography:* The Bibliography lists, for information, those documents which are cited informatively in the document, as well as other information resources and background material used.

- *Annexes:* Annexes are used to provide additional information to the main body of the document.

The requirements which were sufficiently addressed in the EN 50625 series or other standards and guidelines have been referenced in the current document. Due to copyright issues, only the number of clause and the name of the corresponding standard have been mentioned for referencing. When the existing requirements were not fulfilling the project's objectives new set of requirements have been developed.

NOTES TO THE READER

The document was developed on the basis of the CENELEC 50625 series (see the list in the normative references). The main principle followed while developing the CEWASTE Requirements was to assess (a) how the existing CENELEC 50625 requirements are specifically addressing CRM recycling and (b) which the gaps are to improve the CRM recovery.

Existing requirements in the CENELEC 50625 series specifically addressing CRM recycling were referred to in the text. New CEWASTE requirements developed focus on the additional requirements to the current CENELEC 50635 series standards needed to improve CRM recycling.

The first parts of the document cover general aspects to be considered by all economic operators and include the scope (clause 1), the normative references (clause 2) and definitions (clause 3). These three clauses help aligning the understanding on scope addressed by the CEWASTE requirements, references used and key definitions that appear throughout the document.

Clause 4 on 'management requirements' incorporate also the sustainability and traceability requirements.

Sustainability requirements include local communities well-being (4.10.1), emissions control (4.10.2), and society related aspects (4.10.3). In the international literature, employees' concerns are sometime considered a sustainability issue. However, in the CEWASTE requirements, you will find some sustainability aspects related to employees such as 'training (4.9.1)', 'occupational health (4.9.2)' and 'contractual aspects (4.9.3)' under personnel management (Clause 4.9) together with other general employee-related topics. This was done to facilitate the reading from the 'employee' perspective.

Traceability requirements are placed in clause 4.6 and apply to lead-acid waste batteries and printed circuit boards.

Aiming at developing and continuously improving the management system of operating facilities, collection and logistics facilities, treatment and final treatment operators shall comply with clause 4 on 'management requirements' and the clauses 5.1 on 'general requirements' and 5.4 on 'receiving' under 'technical requirements'.

Collection points are exempted of several management requirements as explained in clause 4.

Requirements on traceability (4.6), on local communities well-being (4.10.1) and on contribution to society (4.10.3) have the status of recommendations.

Technical requirements clauses 5.2, 5.3 and 5.5 through 5.11 address specific operations (collection, sorting, handling, shipping, de-pollution, etc.) and will be applied depending on the tasks conducted by the concerned operator to be defined case-by-case.

For economic operators running final treatment operations, specific guidance is provided for the following components in clauses 5.12: fluorescent powders, waste batteries, magnets and printed circuit boards.

Regarding the Annexes, the first one presents the list of critical raw materials (CRM) to be addressed as well as the CRM components and equipment covered. The second Annex presents an example of a monitoring and assessment plan including performance indicators. Annexes III, IV and V introduce the processes recommended for the fluorescent powders, waste batteries and magnets identified as gaps.

The term ‘treatment’ was used to refer to ‘pre-treatment’ and ‘final treatment’.

The following definitions apply in understanding how to implement this deliverable.

- *"shall"* indicates a requirement
- *"should"* indicates a recommendation
- *"may"* is used to indicate that something is permitted
- *"can"* is used to indicate that something is possible, for example, that an organization or individual is able to do something

A requirement is defined as an "expression in the content of a document conveying objectively verifiable criteria to be fulfilled and from which no deviation is permitted if compliance with the document is to be claimed."

A recommendation is defined as an "expression in the content of a document conveying a suggested possible choice or course of action deemed to be particularly suitable without necessarily mentioning or excluding others."

In the document, equivalent expressions of the term 'shall' are: is to, is required to, it is required that, has to, only … is permitted. The opposite 'shall not' can be also expressed through: is not allowed [permitted] [acceptable] [permissible], is required to be not, is required that … be not, is not to be, do not.

In the document, equivalent expressions of the term 'should' are: it is recommended that, ought to. The opposite 'should not' used to discourage certain practice can be also expressed through: it is not recommended that, ought not to.

'Notes' found in this document include examples, recommendations – if so, then expressed as 'should' - and additional details that can be useful to the user of this document.

Structure of this document is following the generic structure of a standard and is composed of the following sections:

Introduction

The Introduction provides specific information or commentary about the technical content of the document, and about the reasons prompting its preparation.

1. Scope

The scope clearly defines the subject of the document and the aspects covered, thereby indicating the limits of applicability of the document or particular parts of it. The scope indicates subjects that might be reasonably inferred to be covered but actually excluded from the document. The scope shall be succinct so that it can be used as a summary for bibliographic purposes, for example, as an abstract. If further details and background information are necessary, these shall be included in either the Introduction or in an annex.

The Scope does not contain requirements, permissions or recommendations.

2. Normative references

This clause lists, for information, those documents which are cited in the text in such a way that some or all of their content constitutes requirements of the document.

Informative element; for dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

3. Terms and definitions

This clause provides definitions necessary for the understanding of certain terms used in the document. If necessary, terminological entries can be supplemented by information (including requirements) given in the notes to entry.

4. Management requirements

This clause contains the management requirements for operators and facilities. The implementation of these requirements should be adequate to the size and type of operation and the respective requirements (e.g. legal, technical).

5. Technical requirements

This clause describes the aspects that apply to all WEEE including waste batteries and CRM fractions treated.

6. De-pollution Monitoring

De-pollution monitoring during collection, logistics and the overall treatment requires an adequate documentation and description of the applicable methodologies for each treatment process.

7. Bibliography

The Bibliography lists, for information, those documents which are cited informatively in the document, as well as other information resources and background material used.

Annexes

Annexes are used to provide additional information to the main body of the document and are developed for several reasons, for example:

- when the information or table is very long and including it in the main body of the document would distract the user;
- to set apart special types of information (e.g. tables, lists, data);
- to present information regarding a particular application of the document.

INTRODUCTION

The overall objective of the CEWASTE standard is to improve the recycling of valuable and critical raw materials (CRM) from waste electrical and electronic equipment (WEEE) and waste batteries, through traceable and sustainable treatment processes in the entire supply chain of secondary raw materials.

As such, CEWASTE addresses the specific challenge to secure the sustainable access to CRM for the EU economy and objectives set by the EU action plan for the Circular Economy. It also supports the development of environmentally and socially sound recycling systems globally.

The CEWASTE standard has taken stock of the normative requirements defined in existing relevant guidelines and standards in the field of electrical and electronic waste treatment and responsible sourcing of raw materials. Among others, development of the CEWASTE normative requirements is based on the European Standards on Collection, Logistics and Treatment Requirements for WEEE (EN 50625) approved by CENELEC (European Committee for Electrotechnical Standardization) on 2014-01-27.

By identifying and assessing the gaps, CEWASTE has expanded the current guidelines and standards through proposed new requirements that have a focus on recovery of valuable and critical raw materials. This includes a set of normative managerial, environmental, social, traceability and technical requirements for waste collection, transport, pre-treatment and final treatment facilities. Traceability requirements apply to operators handling and treating lead-acid batteries and printed circuit boards.

By following the CEWASTE standard, operators implement the necessary measures to achieve maximum CRM recovery. Firstly, key CRM products are separated, during the collection and pre-treatment phase, thus achieving larger amounts of streams with higher concentrations of CRM. Secondly, the standard formulates the necessary requirements that final treatment processes have to meet in order to recover CRM in an effective and sustainable way, from both environmental and health & safety perspective.

Treatment facilities of printed circuit boards and lead-acid acid batteries are required to ensure a credible traceability of their operations and compliance with the sustainability requirements, hence, they need to have a validation and verification system in place. In

addition, other operators such as producers and take-back systems, as well as collection, transport and treatment facilities that wish to ensure a credible traceability of their operations and compliance with the sustainability requirements, will also need to have a validation and verification system in place. The traceability requirements described in this CEWASTE requirements document are based on a Chain of Custody (CoC) approach and experiences of its application in a number of materials, products or sectors (e.g. coffee, palm oil, bio-based products/biofuels, aluminium, gold, platinum products and conflict minerals). Traceability requirements include the definition of:

- Management systems and responsibilities,
- CoC policy and procedures in line with the most commonly used material accounting model of mass balance,
- product documentation and records incl. confirming eligible input (traceable origin of waste materials),
- compliant claims (on-product or off-product claims) and communication aspects.

1. SCOPE

The CEWASTE requirements are applicable to the recycling of Critical Raw Materials (CRM) from WEEE and waste batteries.

This document define:

- the sustainability requirements regarding the environmental, social and governance performance, and technical requirements for collection, transport, pre-treatment and final treatment for the development of a voluntary certification scheme.
- the traceability requirements to ensure the accuracy and verifiability of various aspects throughout the value chain of (secondary) raw materials, such as records of material inputs and outputs at facilities, product documentation and management, and product claims.

The CEWASTE sustainability requirements are relevant to all operators and facilities involved in the collection, pre-treatment and final treatment including related logistics, handling, sorting, and storage of WEEE and waste batteries.

Traceability requirements apply to operators handling and treating lead-acid batteries and printed circuit boards.

This document supports the essential requirements of Directive 2012/19/EU (WEEE).

1.1 PRODUCTS AND MATERIALS WITHIN THE SCOPE

This document focuses on WEEE containing CRM and valuable materials (like precious metals, PMs) as well as waste batteries from WEEE and ELV. Specifically, the following types of waste equipment have been selected because of the potential to recover CRM (materials of interest contained in each item are indicated in brackets) (see Annex I with a more elaborated overview):

- Cathode ray tube (CRT) monitors and televisions (Bi, Co)
- (Compact) fluorescent lamps (Eu, Tb, Y, Ce, La)
- Household appliances such as washing machines (Dy, Nd)

- Temperature exchange equipment (TEE) such as refrigerators and air-conditioning equipment (Nd)
- Mobile phones excl. batteries (Sm, Pr, Au, Ag, Bi, In, Pd, Sb)
- Laptops excl. batteries (Dy, Nd, Pr, Au, Ag, Bi, Pd, Sb, In)
- Tablets excl. batteries (Ag, Au, Bi, Pd, Sb, In)
- Desktop computers & professional IT equipment (Sm, Dy, Tb, Pr, Nd, Au, Ag, Bi, Pd, Sb)
- Lead-acid waste batteries (Sb)
- Lithium-ion waste batteries from electric vehicles include those from e-bikes (Co)
- Battery electric vehicle BEV, (plug-in) hybrid electric vehicle (P)HEV (Co)

CRM are concentrated in the following components: magnets, fluorescent powder, printed circuit boards and batteries.

In the case of lead-acid batteries minimum criteria are provided to tackle the worst unsound recycling practices. This document does not provide requirements addressing the more efficient recycling of Sb from lead-acid batteries.

1.2 VALUE CHAIN IN THE SCOPE: END-OF-LIFE

- Collection: gathering of WEEE after disposal by either consumers or companies, including the preliminary sorting and storage of WEEE (before transport to either a logistics facility or a pre-treatment facility));
- Logistics: planning, implementing and controlling of transportation, handling, preliminary storage and/or sorting of waste from the point of origin to point of delivery ;
- Pre-treatment: may include preparation for reuse, manual or mechanical pre-sorting, de-pollution, shredding and sorting of output fractions;
- Final treatment: refining of secondary materials from the output fractions of pre-treatment, through (pyro/hydro)metallurgical or chemical processes
- Recycling: any material recovery operation by which waste materials are reprocessed into products, materials or substances.

Please note that a combination of the activities listed above may take place at the same facility. For example, a facility may hold collection, logistics and treatment activities.

2. NORMATIVE REFERENCES

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies. In case of contradictions, legislation and its amendments in force shall always prevail.

- CLS/TS 50625-3-2 Collection, logistics & Treatment requirements for WEEE - Part 3-2: Technical specification for de-pollution – Lamps
- CLS/TS 50625-3-3 Collection, logistics & treatment requirements for WEEE - Part 3-3: Specification for de-pollution - WEEE containing CRTs and flat panel displays
- CLC/TS 50625-4, Collection, logistics & treatment requirements for WEEE - Part 4: Specification for the collection and logistics associated with WEEE
- CLC/TS 50625-5, Collection, logistics & Treatment requirements for WEEE - Part 5: Specification for the final treatment of WEEE fractions
- EN1 50625-1, Collection, logistics & Treatment requirements for WEEE - Part 1: General treatment requirements
- EN 50625-2-1, Collection, logistics and treatment requirements for WEEE - Part 2-1: Treatment requirements for lamps
- EN 50625-2-2, Collection, logistics & Treatment requirements for WEEE - Part 2-2: Treatment requirements for WEEE containing CRTs and flat panel displays
- EN 50625-2-3, Collection, logistics & treatment requirements for WEEE - Part 2-3: Treatment requirements for temperature exchange equipment and other WEEE containing VFC and/or VHC
- European Directive on Industrial Emissions (Directive 2010/75/EU) and the Best Available Techniques Reference Documents as well as national regulations
- UNEP (2003). Technical Guidelines for the Environmentally Sound Management of Waste Lead-acid Batteries (Basel Convention series/SBC No 2003/9)

[1] European Standards can only be obtained from the national standardization body which is member of the European Standardization Association CEN as a national edition (national title page), the content of the European standard being unchanged.

References listed above shall not be considered a complete list because other documents may have been omitted during the preparation of this document, or new applicable requirements may be released after the publication of this document.

3. DEFINITIONS (NEW & PARTIALLY REVISED)

For the purposes of this document, the terms and definitions given in the glossary and the following definition apply:

3.1

Critical Raw Materials (CRM)

materials which, based on a defined classification methodology, are economically important, and have a high-risk associated with their supply. For the purpose of the CEWASTE requirements, CRM are the ones listed in annex 1 of {COM(2017) 490 final} [2]. Future updates to this list will apply and replace former versions of this list.

Source: adapted from EN 45558:2019, 3.1.1

3.2

Chain-of-custody

chain of responsibility for or control of materials as they pass from one operator to another through each step of the process under assessment

Source: adapted from ISO 13065:2015, 3.7

3.3

Claim

statement used for communication purposes about compliance with the CEWASTE requirements, and about the main characteristics of the lead-acid waste batteries and fractions thereof

Note 1 to entry: Claims are of two types: — On-product claims are attached to a specific batch of lead-acid waste batteries or fractions thereof, along with product documentation, following the successful completion of a chain-of-custody assessment based on a third-party verification process. They guarantee that a given batch of physical batteries or fractions thereof is compliant. — Off-product claims indicate that a company or a facility was verified following a second-party verification process and deemed compliant. On-product claims are primarily used in general communications to the public (e.g. annual reports and marketing documents). Off-product claims are used for communications with workers, suppliers and shareholders.

330 Source: ISO IWA 19:2017, 3.5, modified.

331 3.3

332 **CRM equipment**

333 equipment containing significant amounts of CRM.

334 3.4

335 **Downstream monitoring**

336 monitoring in which each party of the value chain is required to trace and document the
337 compliance of the processing of waste and it streams by acceptors of the waste fractions it
338 processes.

339 3.5

340 **Due diligence**

341 monitoring in which each party of the value chain is required to conduct a second-based
342 verification process to trace and document compliance of the processing of waste batteries
343 and its streams with the CEWASTE requirements.

344 3.6

345 **Final treatment**

346 metallurgical and chemical processing to obtain fractions of higher CRM content or to
347 recover metals

348 Note 1 to entry: This includes hydro-, pyro- and electro-metallurgical processes that involve chemical reactions,
349 e.g. pyrolysis, smelting, chemical leaching, alloying and cementation.

350 Note 2 to entry: Generally, metallurgical processing follows the manual and/or mechanical processing of waste
351 and end-of-waste fractions or materials that contain metals.

352 3.7

353 **Final treatment facility**

354 location where WEEE and fractions thereof of WEEE containing CRM undergoes final
355 treatment

3.8

Monitoring system

system of procedures and management applied to trace the compliance with the CEWASTE requirements of waste and its processed streams by each party of the value chain.

Note 1 to entry: Processed streams of waste include: end-of-life waste; key CRM equipment, CRM fractions

3.9

Operator

individual, enterprise, association, cooperative or organization involved in the collection, manual or mechanical processing, pre-treatment, final treatment (metallurgical processing), transportation and storage, of WEEE and waste batteries that contain CRM.

Source: adapted from ISO IWA 19:2017, 3.9

3.10

Pre-treatment

manual or mechanical processing as first steps in the treatment of WEEE, waste batteries, or their fractions.

Note 1 to entry: Manual and mechanical processing refers to processes to separate and concentrate higher CRM fractions.

Note 2 to entry: Manual processes include sorting, separating, cleaning, emptying, dismantling, de-pollution and segregation.

Note 3 to entry: Mechanical processes include shredding, milling and grinding, as well as segregation by, for example, eddy current or air stream classifiers.

3.11

Pre-treatment facility

location where WEEE undergoes pre-treatment.

3.12

Pre-treatment operator

operator responsible for pre-treatment.

3.13

Requirement

normative (prescriptive) element, quality or qualification, applicable to the whole or part of a business process that shall be followed in order to comply with regulations or a certification scheme.

3.14

Shipment

means the transport of waste destined for recovery or disposal which is planned or takes place:

(a) between a country and another country; or

(b) between a country and overseas countries and territories or other areas, under that country's protection; or

(c) between a country and any land area which is not part of any country under international law; or

(d) between a country and the Antarctic; or

(e) from one country through any of the areas referred to above; or

(f) within a country through any of the areas referred to above and which originates in and ends in the same country; or (

g) from a geographic area not under the jurisdiction of any country, to a country.

Source: Regulation (EC) No 1013/2006 on shipments of waste, Article 3(34)

3.15

Sustainability requirements

405 criteria or well-defined indicators covering socio-economic, environmental, governance and
406 management aspects that ensures that the operator meets the needs of the present
407 generation without compromising the ability of future ones to meet their own needs.

408 3.16

409 **Technical Specification**

410 normative document developed in anticipation of future harmonization when there is not
411 yet sufficient agreement on a European Standard (EN), or for providing specifications in
412 experimental circumstances and/or evolving technologies.

413 Source: CEN-CENELEC Internal Regulation Part 2: Common Rules For Standardization Work,
414 Clause 2.7

415 3.17

416 **Treatment facility**

417 location where WEEE and waste batteries undergo treatment

418 3.18

419 **Waste batteries**

420 addresses end-of-life batteries, used batteries and spent batteries.

421

4. MANAGEMENT REQUIREMENTS (PARTIALLY NEW TEXT)

This clause contains the management requirements for operators and facilities involved in the collection, pre-treatment and final treatment including related handling, logistics, sorting and storage of WEEE and waste batteries. The requirements specifically focus on environmental, social and management aspects.

Facilities and operators (regardless of the scope of activities, except for collection points) shall meet the requirements established in Clause 4.1 of EN 50625-1 on management requirements. More specifically, operators and facilities involved in collection, handling, sorting, and storage shall apply the administrative and organizational requirements in 4.1 of TS 50625-4.

Collection points are only required to apply the requirements established in clause 4.2 of TS 50625-4.

Note: WEEE and waste batteries collection is the core activity of a collection facility, e.g. a municipal or non-municipal collection centre, in general, this is not the core activity of a collection point. Example of collection points are a collection bin or other collection mechanism provided at a retail, a not-for profit outlet, public building, community space. (clauses 3.2 and 3.3 of EN 50625-4)

Traceability requirements in clause 4.5.2 only apply to lead-acid batteries and printed circuit boards.

Refer to clause 4.1 of EN 50625-1

Refer to clauses 4.1 and 4.2 of TS 50625-4

Note: An organization can review the applicability of management system requirements due to the size or complexity of the organization, especially considering small operators and facilities having different needs and challenges compared to large organizations, with different ways of working and often with limited resources. Especially the extent of documented information for the management system can differ from one organization to another due to the size of organization. The result and measures following this review shall not jeopardize the credibility of CEWASTE requirements.

4.1 MANAGEMENT PRINCIPLES (NEW TEXT, 50625-1, 50625-4)

Main management principles of the management system that shall be in place include 'legal requirements and identification and review of compliance', 'risk assessment and mitigation' and 'competency development' and 'continuous improvement'. Additional specific requirements of a management system are listed in "clause 4.3 Management system".

To support continuous improvement, a documented 6 to 12-month plan shall be established including the scope of the activities which includes short-term and mid-term actions and key performance indicators and targets.

Note: An example of management plan is provided in Annex II.

Operators of collection and logistic facilities shall meet the applicable requirements of clause 4.1.1 of TS 50625-4.

Pre-treatment and final treatment operators shall meet the requirements of clause 4.1. of EN 50625.

Refer to clause 4.1 of EN 50625-1

Refer to clause 4.1.1 of TS 50625-4

4.2 COMPLIANCE WITH LEGAL REQUIREMENTS (NEW)

Operators and facilities shall comply with all applicable legislation and others that the operator decides to comply with considering their relevance for implementing CEWASTE in their facilities.

The operators shall maintain records documenting compliance with legal and regulatory obligations applying to the activities defined in the scope, and with additional applicable requirements relevant for implementing CEWASTE which the operator commits to comply with.

4.3 MANAGEMENT SYSTEM (NEW)

The management system shall cover the activities in the value chain scope (see clause 1.2) of the CEWASTE certification of the operator.

The operator shall first determine which facilities, sites, as well as associated temporary or mobile facilities are included in the scope for which it claims conformity with the CEWASTE requirements. For each of its activities relevant to the CEWASTE standard, the operator shall clearly indicate whether it includes it or excludes it from its scope of conformity.

The operator shall define and document their activities and waste streams within its facilities that are relevant for recycling of CRM and that are covered by the CEWASTE certification the operator applies for.

The operator and facilities shall specify the responsibility, authority and interrelationship of all personnel involved in the waste processing operations.

The operator shall identify management positions that have overall responsibility for the waste processing operations.

The management system shall set objectives and key performance indicators.

The management system shall also define review cycles of progress done for objectives and key performance indicators set (see example in Annex II).

Note: The management positions should have the resources needed as established in the management plan (see annex II) to implement the CEWASTE requirements.

Note: Management positions roles should be documented and communicated, for example, through an organizational plan that includes the functional levels responsible for the treatment of WEEE, waste batteries and/or fractions thereof, the transport and the handling of materials that exhibit hazardous properties.

Note: In order to assess progress done and identify improvement opportunities, the management for waste processing operations should pursue for iterative cycles following the plan-do-check-act (P-D-C-A) sequence of well-spread management systems in place.

4.4 RISK MANAGEMENT

This section concerns the management of the risks associated by the activities in the scope of the CEWASTE certification including those on health and safety issues for workers and community members, poor material quality, CRM losses and environmental damage.

4.4.1 Risk assessment procedures and activities (50625-1)

The operator shall define and document risk assessment procedures and activities.

The operator shall review and update its risk assessment reports on a regular basis and take into account changes to the operating environment, its activities and the efficiency of the measures implemented.

Risk assessments shall be planned so that the operator can maintain confidence that the activities continue to fulfil the CEWASTE requirements.

Refer to clause 4.2 of EN 50625-1

4.4.2 QUALITY RISKS (new)

Quality risk is the potential for CRM losses due to minimum target characteristics that are not met.

High-quality CRM recovery depends on state of the art collection and treatment, as well as the implementation of advanced recycling techniques, to maximize the recovery of CRM while avoiding any adverse environmental and social impacts.

Personnel handling the materials shall be trained on proper collection, sorting, processing, and shipping to reduce the risk of CRM losses. Technical requirements in this regard are described in clause 5.

4.4.3 HEALTH, SAFETY AND ENVIRONMENT (HSE) RISKS (NEW)

Operators shall take all necessary measures to prevent and mitigate risks posed to the environment and human health due to the (possible) presence of hazardous substances released during the handling and pre-treatment of WEEE and waste batteries, or formed during the final treatment processes (e.g. metallurgical processing).

Requirements for de-polluting hazardous substances are detailed in the existing CENELEC 50625 series (see clauses on de-pollution).

As a minimum, fire and explosion prevention plan and emergency plan shall be in place. This includes emergency testing and corrective actions procedures.

4.4.4 Risk mitigation (new)

The operator shall implement documented action plans (including timetable, responsibilities and activities) including risk mitigation measures that cover the activities in the scope of the CEWASTE certification.

Note: The implementation of risk mitigation measures is recommended to tackle identified risks.

4.5 Monitoring (new, 50625-1, ISO IWA 19)

Monitoring supports continuous improvement and aims to track progress against set objectives for each monitoring cycle as well as to demonstrate and report on environmental, economic and social outcomes in an efficient, transparent and accountable manner.

Operators and facilities shall maintain an adequate monitoring system by tracking compliance with the CEWASTE requirements of waste and its processed streams. This includes the tracking of:

- progress on environmental and social performance,
- critical risk factors and related responses at least for the risk points were the accidental release of hazardous solid, liquid and gaseous effluents is possible (including during transportation, treatment and disposal

The operator shall have procedures in place to evaluate and control that its activities help improve CRM recovery, based on the key performance indicators set within the management system.

Note: Please note that de-pollution monitoring aspects are presented in clause 6 and occupational health monitoring is in clause 4.9.2 under the umbrella topic on 'occupational health' (4.9).

4.5.1. Downstream monitoring (50625-1, 50625-4, NEW)

Downstream monitoring requirements are established in EN 50625-1.

Refer to clause 4.4 of EN_50625-1

Final treatment of CRM containing fraction shall take place in facilities that can ensure CRM recycling and meet the CEWASTE requirements.

Furthermore, the pre-treatment and final treatment operator shall maintain records for each waste stream (i.e. batteries, waste containing magnets, lamps containing fluorescent powders, waste containing printed circuit boards and displays containing fluorescent powders).

Records shall include the input of each waste stream containing CRM, and output fractions containing CRM and fractions thereof. Records shall include data on the mass of the input and output CRM fractions from each waste stream, rates of output divided by input, information on the first sender of the materials and the downstream acceptor(s) of the fractions, and the treatment technology(ies) applied in the next pre-treatment of final treatment step.

For the collection and logistics phase, additional monitoring requirements are established in clause 4.1.4 of TS_50625-4.

Refer to clause 4.1.4 of TS_50625-4

4.5.2 UPSTREAM MONITORING (50625-1)

As established in clause 4.4 of EN_50625-1, the treatment operator shall record the origin of each consignment of WEEE and waste batteries accepted at the treatment facility.

Refer to clause 4.4 of EN_50625-1

4.6 TRACEABILITY REQUIREMENTS (NEW)

Traceability requirements shall be complied with for lead-acid batteries and printed circuit boards waste streams and fractions thereof in order to:

a. guarantee the origin of the waste streams, and
b. demonstrate that waste lead-acid batteries and printed circuit boards as well as their CRM fractions treated or recovered along the supply chain are in compliance with the CEWASTE requirements.

In order to ensure fluent communication and cooperation along the supply chain, operators and facilities concerned shall seek to reach a documented agreement regarding the implementation of the CEWASTE requirements throughout the supply chain.

Due diligence and/or chain-of-custody processes shall be implemented for issuing a credible claim of compliance associated with the CRM fraction recovered.

This requirement is fulfilled if an equivalent traceability scheme is already in place.

4.6.1 DUE DILIGENCE (NEW)

For internal communication along the value chain, as a minimum, a second-party verification process such as the due diligence shall be implemented.

Note: Based on a second-party verification process such as due diligence, an off-product claim can be issued.

Note: Example of off-product claim: Enterprise X supports the implementation of the CEWASTE requirements and is sourcing up to X % of compliant secondary Pt as of [date].

4.6.2 CHAIN-OF-CUSTODY (CoC) (NEW)

For external communication purposes, a third party verification process such as chain-of-custody (CoC) shall be implemented. A chain-of-custody process shall include the definition of policy and procedures, responsibilities, documentation and claims.

Note: Note: Based on a third -party verification process such as CoC, an on-product claim can be issued.

Note: Example of on-product claim: A brief text such as “This batch of secondary Pt was recovered in compliance with the CEWASTE requirements.

4.6.2.1 POLICY AND PROCEDURES (NEW)

CoC policy and procedures shall be developed and published, as well as implemented throughout the CRM recycling chain to ensure the accuracy and verifiability of records of entering and leaving waste streams and materials at facilities, documentation and claims.

The mass balance model shall be used as material accounting for demonstrating that the amount of outgoing CRM does not exceed the amount of incoming CRM contained in lead-acid batteries, printed circuit boards or their fractions.

This material accounting model shall be also used when consignments of waste lead-acid batteries, printed circuit boards or their fractions with demonstrated origin and compliance with the CEWASTE requirements, are physically mixed with other consignments of lead-acid batteries, printed circuit boards or their fractions of unknown origin.

4.6.2.2 RESPONSIBILITIES (NEW)

A CoC manager responsible for the implementation of the CoC policy shall be appointed by the operator seeking compliance with the CEWASTE requirements. Workers involved in the acquisition, processing and delivery of lead-acid waste batteries, printed circuit boards or fractions thereof shall be adequately trained and monitored by the CoC manager.

4.6.2.3 COC PRODUCT DOCUMENTATION AND RECORDS (NEW)

Operator implementing a chain-of-custody for external communication purposes shall document and record important characteristics of the lead-acid waste batteries, printed circuit boards and fractions thereof including but not limited to:

a) name and address of supplier;

b) unique reference number;

c) date of receipt of the lead-acid waste batteries, printed circuit boards and fractions thereof and their date of release/shipment;

d) origin (address) of batch or consignment;

e) shipment address;

h) weight;

j) proof of compliance with the CEWASTE requirements based on third-party audits to issue on-product claims;

k) name and details of the assurance provider concerned with issuing the proof of compliance;

l) name and address of all supplier(s), contractor(s) and subcontractor(s) involved in the acquisition, processing and delivery of the batch or materials.

Recorded lead-acid batteries, printed circuit boards and fractions thereof without appropriate documentation shall be considered of unknown and uncontrolled origin and therefore not in compliance with the CEWASTE requirements.

4.7 DOCUMENTATION (50625-1, 50625-4, 50625-5)

The management system shall include the following in addition to the requirements established in clause 6 of EN 50625-1.

- Fire and explosion prevention plan, emergency plan, emergency testing procedures, records of tests performed and any corrective actions or amendments to the plans.
- Documents in which the environment, health and safety procedures are included .
- EHS reports including environmental performance and incidents (Lost Time Injury frequencies, near misses) concerning the workers and sub-contractors, and data on measured occupational health. If limit values have been exceeded there shall be a report on improvement actions and data shall be reported that also indicate any effects that such corrective measures will have.

The only documentation required from and maintained at collection points are records concerning compliance, health, training, as well as an annual report on collection quantity.

Specific documentation requirements for treatment facilities, as well as for fluorescent powders are described in the next clauses.

4.7.1 DOCUMENTATION: COLLECTION AND LOGISTICS FACILITIES (50625-1, 50625-4)

In addition to the required document in CENELEC 50625-4, collection and logistics operators shall have annual reports on collection quantity shall be maintained by collection points according to clause 6 EN 50625-4.

Refer to clause 6 of EN 50625-4

4.7.2 DOCUMENTATION: PRE-TREATMENT AND FINAL TREATMENT FACILITIES (50625-1, NEW)

Pre-treatment and final treatment facilities shall have the following:

- documents that record downstream the processing of components and fractions identified as containing CRM and records describing the determination of recycling and recovery rates prepared in accordance with Annex C of EN 50625-1.

- reports from sub-contractors and sub-processors indicating the processors receiving the waste batteries, printed circuit boards, CRM or fractions
- documentation on special work procedures of processes performed for waste batteries, printed circuit boards, CRM containing components or fractions.
- an up-to-date organisational chart with all management and production personnel levels, including those positions regarding acceptance and treatment of WEEE and/or fractions thereof, waste management, the transport and the handling of materials that exhibit hazardous properties;
- Document in which the actual insurance coverage is stated.

Pre-treatment and final treatment facilities shall keep records on annual basis of:

- Mass input for each waste stream (i.e. batteries, WEEE containing magnets, WEEE containing printed circuit boards, lamps containing fluorescent powders, displays containing fluorescent powders etc.).

  Note: Example for magnets processed: number and weight of magnets removed per ton of WEEE received, etc.

- CRM components and outputs containing CRM removed from the input waste, e.g., number and weight of magnets removed, fluorescent powders removed etc.

If relevant changes occur from one period to the next, the operator shall identify the causes. If these related to non-compliance with the CEWASTE requirements, CENELEC standards applicable or legal requirements, corrective actions shall be introduced and induced changes verified in the next auditing period.

Refer to Annex C of EN 50625-1

4.7.3 DOCUMENTATION: FLUORESCENT POWDERS (NEW)

If there is mercury present in lamps- fluorescent powders and of lead and cadmium in CRT-fluorescent powders, these fractions shall be labelled following the European Waste Catalogue - Commission Decision 2000/532/EC. The above-mentioned fluorescent powders as classified with the code 19.12.11*.

Fluorescent powders that have been treated in a hydrometallurgical process for the recovery of CRM create various streams, some which are hazardous waste and a product stream containing the CRM. The recoverable CRM in the product stream are Yttrium and Europium. This product stream should be indicated as a health hazard in the records produced when it is forwarded to further downstream treatment.

The hazardous waste streams of the hydrometallurgical treatment are corrosive and need to be classified according to the European Waste Catalogue. The applicable codes are 19.02.04* and/or 19.02.05*.

Labels Legend:

 Corrosive  Health Hazard

4.8 COMMUNICATION AND AWARENESS RAISING (NEW, ISO IWA 19)

For communication purposes, collection, pre-treatment and final treatment facilities shall identify key stakeholders including suppliers, general public and business sourcing with WEEE and waste batteries, and other stakeholders (see examples of possible stakeholders in clause 4.8.1).

To ensure fluent communication with identified stakeholders, prevent, anticipate and resolve conflicts or grievances, grievance mechanisms shall be implemented (see clause 4.8.2).

4.8.1 STAKEHOLDERS COMMUNICATION (NEW)

In order to raise awareness of key stakeholders the following topics shall be addressed in the communication means of the operators concerned (collection, pre-treatment and final treatment facilities):

Table 1: Topics to be communicated to stakeholders

Stakeholders	**Topics…**
Supply Chain	…that shall be communicated

Stakeholders	Topics…
	• Grievance mechanisms • Criteria for sorting key CRM equipment (as per Annex I) • Challenges or pollution issues that can be caused by a lack of capacity during previous treatment steps
	…that may be communicated
	• Data erasure practices • Advantages of CEWASTE and international trends • Advantages and business case of the CEWASTE requirement, including mitigating environmental and social risks • Improving resource supply security, management and efficiencies through the continuous supply of raw materials to manufacturers without further exploration of natural resources • The importance of documentation
Workers	…that shall be communicated
	• Grievance mechanisms, if not covered by the national regulations concerned • Challenges or pollution issues that can be caused from a lack of capacity during the processing steps. • Practical approaches on how to implement CEWASTE • Possible difficulties when switching to CEWASTE
	…that may be communicated
	• Advantages for CEWASTE and how to reduce health risks • Environmental and health risks associated with unsafe recycling techniques of WEEE and waste batteries
Local Communities	…that shall be communicated
	• Grievance mechanisms • Environmental and health risks associated with the processing activities at the facility
	…that may be communicated

Stakeholders	Topics…
	• Advantages of applying the CEWASTE requirements including the well-being of local communities, avoidance of environmental risks
Authorities	…that may be communicated
	• Reporting on legal compliance
General public and anybody who is handing over WEEE -containing data- and waste batteries at collection facilities and collection points	…that may be communicated
	• data erasure measures followed • visual materials to raise awareness of the relevance of collecting WEEE containing CRM, and waste batteries.

712

713 Note: Examples of additional topics that may be relevant in their communication to stakeholders are presented
714 in the Table 1: Topics to be communicated to stakeholders

715 Note: Visual materials may be developed as communication means.

716 4.8.2 GRIEVANCE MECHANISMS (NEW)

717 A grievance mechanism shall be made easily accessible and shall explain how to file a
718 grievance, how it is being handled, length of time to receive a response, how the results are
719 communicated and how to file an appeal.

720 Note: Examples of grievance mechanisms include help desks, complaint boxes and hotlines located inside and
721 outside of the company vicinity.

722 4.8.3 DATA ERASURE PRACTICES (NEW)

723 Operators of facilities involved in the collection or treatment of WEEE containing CRM and
724 data, are encouraged to develop implement data erasure processes.

725 A plan to verify the efficacy of the data erasure methods used may be put in place.

4.9 PERSONNEL MANAGEMENT (NEW, 50625-1, 50625-4,50625-5, 50625-2-1, 50625-2-2, ISO IWA 19)

4.9.1 COMPETENCES (NEW, 50625-1, 50625-4)

Training needs shall be identified and, as necessary, training programmes shall be provided to enhance the skills and capabilities on WEEE and waste batteries collection, handling, pre-treatment and final treatment processes to prevent CRM losses.

Training shall be also provided on CEWASTE requirements, legal requirement identification and other relevant requirements.

If a CoC is pursued for lead-acid waste batteries recycling, training shall also cover how to implement and assure a CoC in the value chain concerned.

The operator shall determine the criteria for the competence of personnel for each function in the waste handling process in scope of the CEWASTE requirements.

More specific requirements are in clause 4.3 of EN_50625-1 and 4.1.3 of TS_50625-4.

Refer to clause 4.3 of EN_50625-1 *for pre-treatment operators*

Refer to clause 4.1.3 of TS_50625-4 *for collection and logistics facilities*

Refer to clause 4.2 of TS_50625-4 *for collection points*

4.9.1.1 CRM RELATED TRAINING (NEW)

Personnel conducting any activity in collection, pre-treatment and final treatment chains shall have received adequate training covering the following aspects :

- key types of WEEE containing CRM;
- importance of collecting separately key WEEE containing CRM (see Annex I);
- sorting criteria for key WEEE and components containing CRM;
- data erasure procedures that the facility follows to remove personal data from all WEEE containing such data;
- technical requirements for the pre-treatment and final treatment of key WEEE and waste batteries containing CRM.

Training materials shall include information on the types of WEEE containing CRM as per the list included in Annex I of this document and on the sorting criteria. Training materials shall include information on the subsequent data erasure measures for ensuring data destruction of data containing devices, and on the processes and technical requirements that improve or hinder the CRM recovery.

4.9.2 OCCUPATIONAL HEALTH AND SAFETY (50625-5, ISO IWA 19)

To ensure safe working environments for workers, the operator and facilities shall meet the requirements of a management system (4.3), compliance with the law (4.2), risk management (4.4), occupational health monitoring (4.9.2.1, 4.9.2.2 and 4.9.2.3), documentation (4.7), communication (4.8), well-established competences development programs (4.9.1), as well as proper technical facilities (5.2).

Personal protection equipment (PPE), first aid equipment and sanitary and eating spaces infrastructure shall be made available at no cost to workers potentially exposed to deleterious substances.

Specific measures shall be in place to address issues in relation to women's health (e.g. pregnancy, maternity).

Note: Examples of PPE include e.g. masks, goggles, gloves, safety helmets, safety equipment and clothing to protect workers from e.g. accidents, hazards and toxic emissions.

Note: Additional specific examples of PPE for use during the pre-treatment and final treatment of lead-acid batteries include masks with a vent which does not require to be removed when speaking;

Collection, logistics, pre-treatment and treatment facilities shall have clearly marked emergency exits, escape routes, firefighting equipment and fire alarms for every indoor workplace, according to industry standards. Fire exits and escape routes shall be kept clear of obstacles, allowing for swift and safe exit. Emergency exits shall be made known to all workers.

Specific technical guidance on facilities infrastructure required are presented in Clause 5.2.

Specific requirements related to health and safety are established for the final treatment of end-of-life mobile phones, desktop computers (PC), laptops and tablets are established in clause 4.3 of TS 50625-5.

Refer to clause 4.3 of EN_50625-5

4.9.2.1 OCCUPATIONAL HEALTH MONITORING (50625-2-1, NEW)

Regular (once a year) health monitoring shall be undertaken in treatment facilities handling WEEE such as lamps and fluorescent powders and waste batteries (lead-acid and lithium-ion).

Exposure of employees to any toxic substance or heavy metal shall be monitored and tested regularly. Remediation measures shall be implemented, and its efficacy assessed when workers exposure places them at health risk. Medical checks should occur at least once per year.

Where a country requires more frequent medical checks, the frequency established in the applicable country legislation shall apply to the country concerned.

Note: As a best practice target, the permissible exposure limit (PEL) or occupational exposure limit (OEL) value at the treatment facility cannot exceed an 8-hour Threshold Limit Values (TLV).

Where a country imposes PELs lower than 8-hour, these lower values shall be respected for that country.

In order to protect workers of pre-treatment and final treatment facilities, the following requirements shall be fulfilled:

- Occupational exposure of workers to toxics (such as lead released from lead-acid batteries, hydrogen fluoride and VOC from lithium-ion batteries and mercury from fluorescent powders recycling) is assessed and risk assessments are completed to ensure exposures respect the PEL (or OEL) values.
- If the case of lead-acid batteries and fluorescent powders pre-treatment and final treatment, based on the hierarchy of hazard controls, effective engineering controls and use of adequate equipment and materials are in place before routine use of personal protective equipment.

Note: The hierarchy of hazard controls is as follows: 1. Elimination of hazardous substances; 2. Substitution by a substance less hazardous; 3. Design of appropriate work processes and engineering controls and use of adequate equipment and materials, so as to avoid or minimise the release of hazardous chemical agents which may present a risk to workers' safety and health at the place of work; 4. Application of collective protection measures at the source of the risk, such as adequate ventilation

and appropriate organisational measures; 5. Where exposure cannot be prevented by other means, the application of individual protection measures including personal protective equipment (PPE).

- In the case of fluorescent powders pre-treatment and final treatment, a segregated eating area must be provided, which is air conditioned (HEPA filtered and slightly over-pressured2) to avoid lead- or mercury- contaminated dust ingress. Eating areas must be regularly cleaned and tested to ensure they are lead-free.
- Proper work wear is provided by the employer.
- Shower and hand cleaning facilities must be provided.
- Regular information and training on health risks must be provided to workers.
- Suitable personal protection equipment must be provided by the company and used by concerned workers.

In the absence of more specific requirements or stricter ones, all sections of the European Framework Directive on Safety and Health at Work (Directive 89/391 EEC) shall be complied with.

Lamps and CRT equipment (NEW)

Medical checks of employees and contractors of lamps and CRT equipment treatment facilities shall be in accordance with annex AA (of EN_50625-2-1). See references in clauses 5.11 of EN 50625-2-1 and .11 of EN 50625-2-2.

Refer to clause 5.11 of EN_50625-2-1

Refer to clause 5.11 of EN 50625-2-2

Fluorescent powders (NEW)

Employees and contractors from fluorescent powders treatment facilities who are at potential risk of exposure to deleterious elements and/or compounds beyond the exposure limits, shall undergo at least annual health and hygiene-related checks. Records of each check shall be made.

[2] HEPA - High Efficiency Particulate Air filter to remove any traces of Lead dust. Therefore, the room should be under positive pressure to ensure that outside unfiltered air does not enter the eating area.

The specific health test includes urine samples and the specific markers are cadmium, ALA-d (an indirect bio-marker for lead) and beta-2 macroglobulin (an indirect bio-marker for mercury).

Note: EU Member States have implemented national occupational exposure limit (OEL, eight hour average) values for "mercury and its inorganic divalent compounds (as Hg)" ranging from 0.03 mg/m^3 in Lithuania, Sweden, Slovakia to 0.1 mg/m^3 in Germany [EU OSHA 2007, GESTIS 2009, TRGS 900].

Note: On the European level no corresponding indicative value is available but (SCOEL 2007)3 recommended an 8-hour TWA of 0.02 mg mercury/m^3 for "elemental mercury and inorganic divalent mercury compounds". A biological limit value (BLV) of 10 µg Hg/l blood and 30 µg Hg/g creatinine in urine is also recommended by (SCOEL 2007).

Employees and contractors who are exposed to the hydrometallurgical treatment of the CRM containing fluorescent powders shall use special PPE consisting of:

- Splash guard visor
- Anti-acid overalls
- Chemical and mechanical resistant gloves
- Specific solvent and powder filters protection mask
- Anti-acid boots

Lead-acid waste batteries (NEW)

Lead exposure and blood lead levels of employees working in lead-acid batteries pre-treatment and final treatment facilities shall be monitored and tested regularly. Depending on the exposure risk, following test intervals shall be applied (minimum frequency) as established in Table 2: Intervals for blood level tests

Table 2: Intervals for blood level tests

Job Position	Blood lead level test interval
E.g. workers at furnace and off-gas treatment systems, in battery breaking area or other high exposure positions	3 months or more often if the trend is towards the restriction level

[3] SCOEL, Recommendation from the Scientific Committee on Occupational Exposure Limits for elemental mercury and inorganic divalent mercury compounds", SCOEL/SUM/84, May 2007, http://ec.europa.eu/social/BlobServlet?docId=3852&langId=en

Job Position	Blood lead level test interval
E.g. workers operating in a pre-treatment facility	6 months
Office job	12 months

Source: World Health Organization (WHO), 2017

Where no available national legislation or guidelines, all employers shall commit to reduce employee lead exposure to levels as low as reasonably practicable. Facilities' policies shall ensure that women are adequately protected.

Lithium-ion waste batteries (NEW)

The indoor air quality (particularly levels of hydrogen fluoride (HF) and volatile organic compounds VOC) shall be regularly (every three months) monitored.

Note: As based on the US Occupational Safety and Health Administration (OSHA) the Permissible Exposure Limit (PEL) are:

- Fluoride: 2.5 mg/m^3;
- Nickel: metal 0.5 mg/m^3, insoluble 0.1 mg/m^3
- Cobalt: metal 0.02 mg/m^3
- Manganese: metal 0.2 mg/m^3

The PEL is reduced for shifts longer than 8 hours by the equation PEL = 400/hours worked.

Note: Detailed requirements are elaborated in the (document reference) as published by OSHA.

Workers handling lithium-ion batteries during treatment shall use protective work wear and gear such as goggles and HF-proof (HF = hydrogen fluoride) gloves.

Magnets (NEW)

Measurements at the final treatment facilities include those of Nd and Nd oxide concentrations in the air.

Medical checks of workers before and after the treatment include the presence of irritated eyes mucous membranes.

Note: Magnet scrap powders generated after the cutting processes contain a large amount of fine powders (1mm or less), which can ignite violently, or explode in an air-dried condition posing risks to workers. In addition, Nd dust and salts highly irritate the eyes and mucous membranes and moderately the skin. Nd oxide (Nd_2O_3) was reported as mutagen.

Note: Frequency of measurements and medical checks as well as further details will be elaborated in a next revision.

4.9.3 CONTRACTUAL ASPECTS (ISO IWA 19)

In the context of contractual agreements required, the parties concerned include operators in the recycling chain and their workers.

4.9.3.1 ENTITIES RESPONSIBLE FOR THE COLLECTION (NEW)

In order to motivate citizens to dispose of appliances containing CRM (as listed in Annex I) and to ensure that key CRM equipment is collected separately, collection facilities and collection points are encouraged to set agreements with the entities responsible for delivering collected equipment. Examples of entities responsible for the collection are:

- extended producer responsibility organisations
- waste competent authorities
- other companies such as retailers
- Producers of EEE and batteries including distance selling producers

4.9.3.2 EMPLOYEES (NEW)

If gaps in labour-related legislations of the countries where the collection, logistics, pre-treatment and final treatment facilities operate, requirements established in Principle 1, Objective 1.2 of the ISO IWA 19 on employment contracts, working hours and overtime, remuneration and holidays shall be complied with.

Refer to ISO IWA 19:2017(E), Sustainability requirements, Section 6.2-Principle 1, Objective 1.2 – Establish working terms and conditions that are decent and equitable

4.10 SUSTAINABILITY REQUIREMENTS (ISO IWA 19, NEW)

Sustainability areas in CEWASTE requirements focus on 'local communities well-being', 'environmental protection' and contribution to 'society'.

4.10.1 LOCAL COMMUNITIES WELL-BEING (ISO IWA 19)

The operator and facilities should contribute to the well-being of the local communities and regional development. Social management systems and outreach programs help to address environmental and social risks and improve the contribution to sustainable development.

This is supported with the communications required for this stakeholder group (see clause 4.8).

Note: In support of waste collection activities in the local community, facilities may join outreach programs e.g. led by the municipality to facilitate the collection of WEEE and waste batteries as input materials for the facilities implementing CEWASTE.

Note: Pre-treatment and final treatment operators and collection facilities are encouraged to support social management systems in the local community already in place as part of the corporate social responsibility.

4.10.2 ENVIRONMENTAL PROTECTION (NEW)

The operators and facilities shall demonstrate an understanding of the potential environmental impacts of their activities and of how to limit the adverse impacts.

Operators shall therefore have an environmental management plan in place with performance indicators and monitored regularly (see example in Annex II). Particular attention shall be given to any potential dispersion of pollutants to the environment (for example, chemical contamination of surface- or groundwater and soil as well as air quality).

Environmental monitoring shall be carried out on a regular basis regarding process effluents and wastewater characteristics (COD, POPs, high salt content, heavy metals, F, P), emissions to air (secondary pollutants, such as volatile organic compounds but also greenhouse gases) and soil quality near treatment facilities. If limit values have been exceeded, mitigation measures shall be implemented to remediate the effects as soon as possible.

Measures shall prevent and mitigate all forms of pollution and aim to reduce greenhouse gas emissions through, e.g., low-carbon technologies and/or energy efficiency measures.

Assessment of the efficacy of the measures shall be carried out.

Specific emissions monitoring and control requirements for fluorescent powders, waste batteries, printed circuit boards and magnets treatment are described in the following sections.

4.10.2.1 EMISSIONS MONITORING AND CONTROL - FLUORESCENTS POWDERS TREATMENT (NEW)

For hazardous waste and non-hazardous waste related to the hydrometallurgical treatment operator that is generated on-site the following measures shall be in place:

- A procedure for handling of waste packaging material;
- A procedure for safe handling and disposal of all waste that cannot be recycled or recovered;
- If the waste is sent to a third party, such facilities shall have the required permits from the relevant authorities as needed and the treatment operator shall demonstrate compliance if such facility is located in a non-OECD country;
- The final treatment operator shall document the conformity of the third parties accepting its waste making available the required permits from the relevant authorities;
- The provision of weight notes for each consignment of output wastes dispatched and an electronic or written registration system to record the destination and weight(s) of each output waste consignment.

Environmental monitoring shall be carried out on a regular basis covering process effluents. If limit values have been exceeded there shall be a report on improvement actions and data shall be reported that also indicate any effects of such corrective measures will have.

Limits in final water effluent stream discharge to environment. The values of permitted limits in final water effluent streams discharged to the environment (from process and surface water drainage when applicable) are:

Element/parameter	**Concentration in final effluent discharge**
Pb	≤0,5 mg/l
Cd	≤0,1 mg/l
Zn	≤ 1,0 mg/l

Hg	≤0,02 mg/l
pH	6,5 - 10

Note: Limits are expressed as yearly averages based on 24 h qualified random or weekly samples.

If stricter limits are set by the applicable legislation, these shall prevail over the ones indicated in the list above.

Note: These limit values apply without prejudice to the BAT-AELs provided in the BAT conclusions of the non-ferrous metals BREF in accordance with the European Directive 2010/75/EU.

4.10.2.2 EMISSIONS MONITORING AND CONTROL – WASTE BATTERIES TREATMENT (NEW)

In lead smelters for lead-acid waste batteries (new)

Effective measures shall be in place to keep all working environments and the surrounding areas free from acid and acid mist and lead containing fume and dust.

Emissions to air and discharges to soil and water shall be measured, restricted, monitored and controlled. Respective national or regional emission standards shall be applied. If no suitable or applicable national standards are available, then appropriate international and EU standards contained in the International Lead and Zinc Study Group (ILZSG)4 Study on Environmental and Health Controls on Lead listed in Table V.1 of Annex V shall apply.

In lithium-ion waste batteries treatment (New)

Releases of harmful gases shall be prevented by installing a ventilation system and filters.

In case of the treatment and recycling of lithium ion batteries, if no national regulations are available, then the following limit values for airborne emission shall be applied:

- Dust < 5mg/Nm³
- TOC < 18 mg/Nm³
- Dioxins< 0,1 ng TEQ/Nm³
- SO2 < 200 mg/Nm³
- NOx < 260 mg/Nm³

[4] http://www.ilzsg.org/static/introduction.aspx?from=1

- CO < 100 mg/Nm³

Monitoring shall be based on daily averages. The frequency of the emission measurements is determined by the competent licensing authority for the plant.

4.10.2.3 EMISSIONS CONTROL - MAGNETS TREATMENT (NEW)

Emissions controls a in addition to the ones established based on the health and safety risk assessment are not required during the pre-treatment of waste magnets.

Releases of ozone-depleting substances during the removal of NdFeB-magnets from compressors of temperature exchange equipment (e.g. refrigerators) shall be prevented.

During the final treatment controls are needed (TB further elaborated in a next revision)

4.10.3 SOCIETY (NEW)

Pre-treatment and final treatment operators and facilities are encouraged to show openness to contribute with local and national authorities in the development and demonstration of educational technological programs that support the CEWASTE ultimate goal of improving the CRM recovery. This can contribute e.g. to expanding the availability of skilled labour force that is required for the implementation of sound WEEE and waste batteries treatment according to the CEWASTE requirements. Other parties such as entities responsible for collection may initiate similar initiatives.

5. TECHNICAL REQUIREMENTS

This clause describes the requirements that different flows of WEEE, key CRM equipment and key CRM component shall follow. A graphic description is in Fig. 1 which also highlights the CEWASTE scope, the flows that are not part of it and where they should be delivered to.

Concerning the handling through treatment processes of lead-acid waste batteries and li-ion batteries, they follow a simplified option (see Fig. 2).

5.1 GENERAL TECHNICAL REQUIREMENTS (50625-1)

General technical requirements focus on the separation, pre-treatment and treatment of WEEE and waste batteries containing CRM (see clause 5.1 of EN 50625-1).

This It excludes WEEE suitable for (preparation for) re-use which shall be separated from WEEE destined for recycling as early in the end of life supply chain as possible. Overall general guidance based on the waste hierarchy principles are in clause 5.10 of EN 50625-1.

Refer to clause 5.1 of EN 50625-1

5.1.1 COLLECTION OPERATORS AND LOGISTICS OPERATORS (50625-4)

For the collection and logistics facilities, additional technical requirements are established in clause 5.1.1 of TS 50625-4.

Refer to clause 5.1.1 (principles) of TS 50625-4

5.1.1.1 WEEE COLLECTED IN CRM RELATED STREAMS (NEW)

The following types of WEEE received at collection points, collection facilities and logistics facilities shall be sorted into streams (see list of key CRM equipment in Annex I):

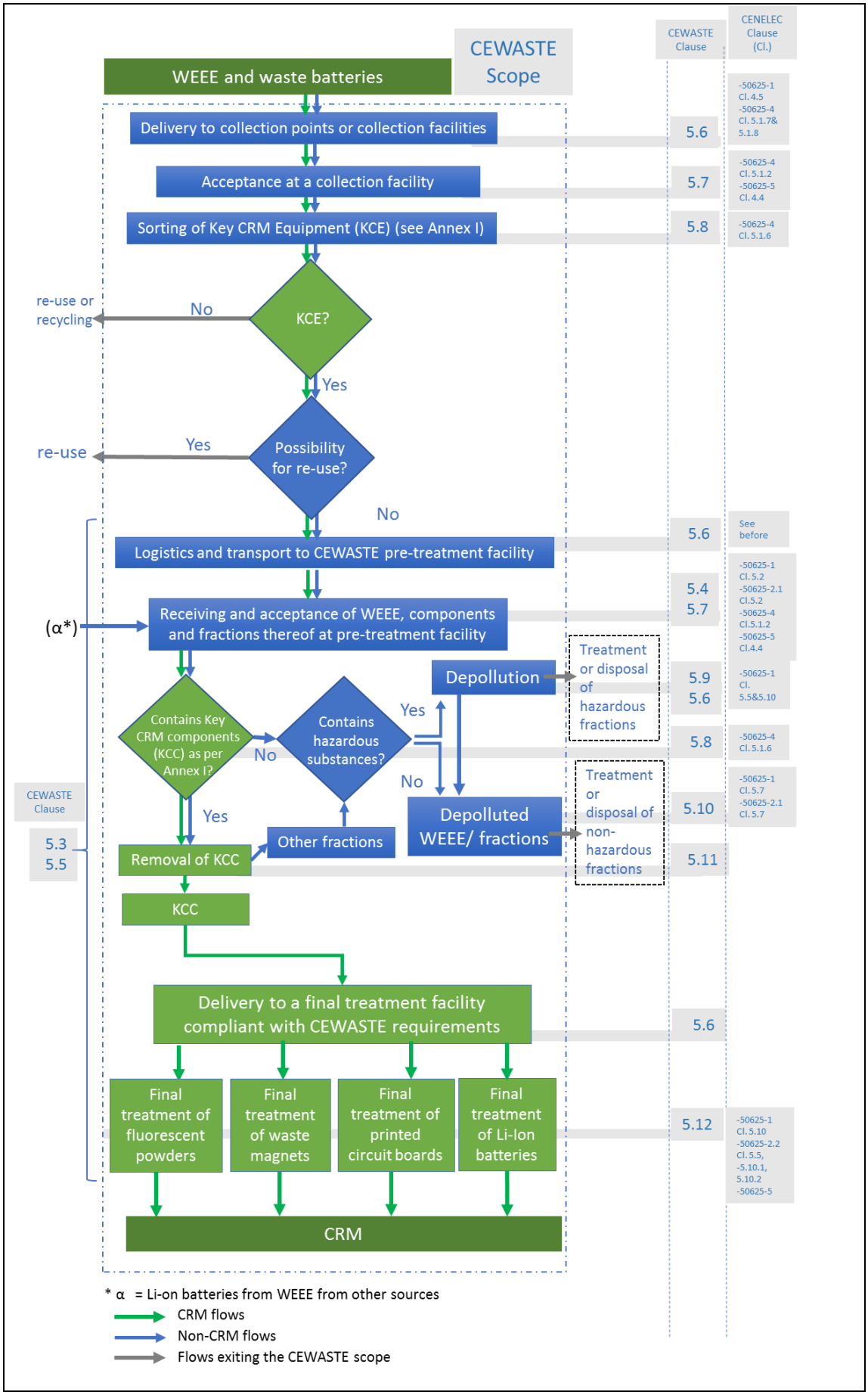

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Figure 1. Flow of CRM equipment, components and materials and requirements

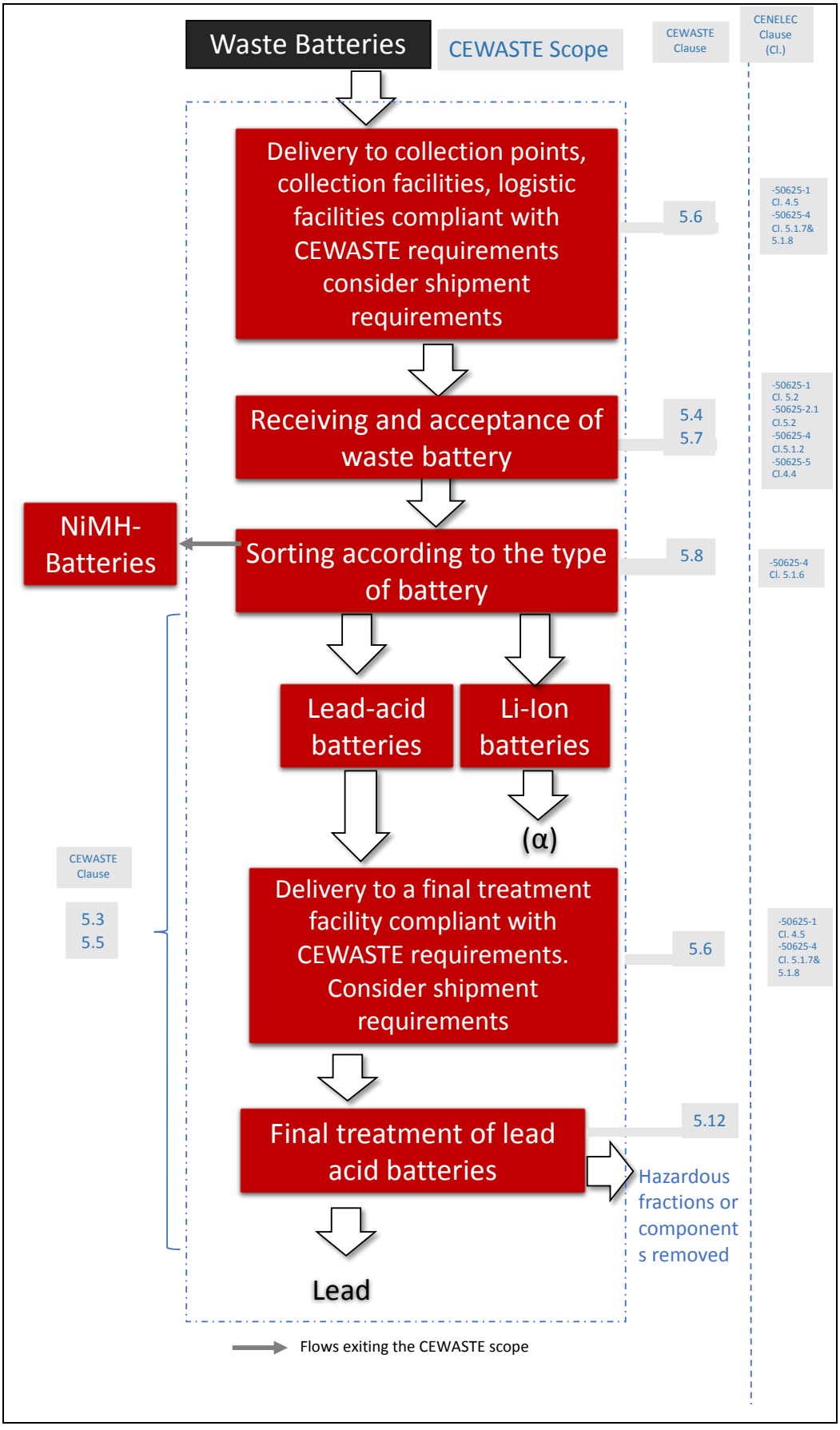

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Figure 2. Flow of waste batteries, components and materials as well as requirements

- Lamps containing fluorescent powders
- CRT displays containing fluorescent powders
- Desktops, laptops, mobile phones, tablets, devices containing external CDD and ODD and similar equipment containing printed circuit boards
- Lead-acid waste batteries
- Lithium-ion waste batteries and NiMH waste batteries
- Household appliances other than TEE (motors/drives) and Temperature exchange equipment (TEE) (engine, compressor)

5.1.1.2 COLLECTION POINTS (50625-4)

The technical requirements in clause 5.2 (of TS 50625-4) applies to collection points. Clause 5.1 of TS 50625-4 does not apply to collection points.

Refer to clause 5.2 (principles) of TS 50625-4

In addition to the requirement in clause 5.2 (principles) of TS 50625-4, consider the following for collection points:

- Received batteries from notebooks, mobile phones and tablets shall be kept separate for further pre-treatment and final treatment.
- Collection point operators shall not carry out any form of pre-treatment or preparing for re-use, unless the site has the relevant permit or is permitted to undertake the activity according to local legislations. If the latter is the case, these operators shall work as treatment operators according to or towards the preparing for re-use standard, the EN 50625-series and/or EN 50574-1.

  NOTE Such treatment activities include any form of dismantling.

The entity responsible for the collection shall ensure that WEEE not intended for re-use containing CRM as per the Annex I of this document are sorted before treatment.

5.1.2.3 COLLECTION OF WASTE BATTERIES (NEW)

There are typically five collection routes for batteries collection:

a. *Collection points for portable batteries.* These are collected separately and often mixed without differentiating the battery chemistry. Collection points for portable batteries are located for instance at supermarkets or other public places easily accessible by consumers.

   Portable batteries shall be put in containers and transported, according to the requirements in section 5.6.3, to sorting facilities.

b. *Collections points and facilities for WEEE*. Most (lithium-ion) batteries are collected together with the WEEE in which they are embedded (e.g. notebooks, tablets, mobile phones, power tools). These may be collected at public collection points, collection facilities, retailers or repair shops.

   WEEE (including the batteries) shall be taken in suitable transport containers to electronic waste treatment operators (ADR 2019 ECE/TRANS/275, 2019).

c. *Collection of batteries from end-of-life vehicles.* These contain lead-acid or lithium-ion battery packs which follow a different waste regime and collection route than WEEE.

- Lithium-ion batteries shall be removed from end-of-life electric vehicles (BEV, HEV, PHEV5) by trained personnel and transported to dismantling plants as dangerous goods.
- While removing lithium-ion batteries from WEEE, operators shall prevent damage to the batteries.

d. *Take-back schemes for industrial batteries*. This particularly concerns lithium-ion batteries are e-bikes and e-scooters.

e. *Collection of (semi)industrial waste batteries.* Waste batteries from industrial sites such as forklift trucks, but also energy storage systems shall be collected separately at company sites and brought to collection facilities.

5.1.3 LAMPS TREATMENT OPERATORS (50625-2-1)

Refer to clause 5.1 of EN 50625-2-1

5.1.4 CRT DISPLAYS TREATMENT OPERATORS (50625-2-2)

Refer to clause 5.1.1 of EN 50625-2-2e

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5 BEV = battery electric vehicle, HEV = hybrid electric vehicle, PHEV = plug-in electric vehicle

5.2 TECHNICAL AND INFRASTRUCTURAL PRE-CONDITIONS (50625-1, 50625-2-1)

Facilities shall be equipped and managed in such a way to prevent and mitigate emission to air (e.g. through an advanced ventilation system and filters), discharge of contaminated wastewater and leakage of chemicals to surface- and/or groundwater and soil.

Refer to clause 4.2 of EN 50625-1 for pre-treatment and treatment facilities

Refer to clause 4.1.2 of TS 50625-4 for collection and logistics facilities

Refer to clause 4.2 of EN 50625-2-1 for lamps

5.2.1 COLLECTION OPERATORS AND LOGISTICS OPERATORS (50625-4)

For the collection and logistics phase, the infrastructural pre-conditions are established in clause 4.1.2 of TS 50625-4.

Refer to clause 4.1.2 of TS 50625-4:

5.2.2 LAMPS TREATMENT OPERATORS (50625-1)

In case of lamps the following applies instead of the clause 4.2 of EN 50625-1 on 'technical and infrastructural pre-conditions'.

Refer to clause 4.2 of EN 50625-2-1

5.2.3 FLUORESCENT POWDERS TREATMENT OPERATORS (NEW)

Facilities applying hydrometallurgical processing for the treatment of fluorescent powders (see Annex III) shall apply the following:

- Store sulphuric acid in appropriate containers and appropriately labeled. Sulfuric acid shall be stored in a cool, dry area away from direct sunlight and heat sources. Sulfuric acid should not be stored indoors in large quantities, to prevent the possible accumulation of vapours. Product containers shall be regularly examined for signs of damage or leaks.
- Facilities shall have a centralized aspiration consisting of cartridge filters for fluorescent powders and a scrubber unit for acid vapours.

- Facilities shall count with an automatic remote blocking system (to stop the process in case of an emergency).

5.2.4 WASTE BATTERIES TREATMENT OPERATORS (NEW)

Waste lead-acid and lithium-ion battery recycling plants should be situated in designated industrial zones and not adjacent to residential areas or rural populations.

Battery removal shall take place in a separate space equipped with fire protection devices, ventilation and alarm system.

Sites for treatment of lithium-ion and lead-acid batteries shall be equipped with Impermeable surfaces and waterproof covering for appropriate areas with the provision of spillage collection facilities and, where appropriate, decanters.

More specifically, sites for treatment of lithium-ion batteries shall be equipped with:

- Appropriate collection containers such as mesh boxes for disassembled and separated spare parts (casings, cables, electronics, etc.) of industrial lithium-ion batteries;
- Equipment for the treatment of water in compliance with health and environmental regulations determined by the competent licensing authority for the plant
- Balances to measure the weight of the treated waste.

In addition, the battery storage facilities shall be designed in a way that potential discharges of acid cannot contaminate soil, ground or surface water sources.

5.2.5 NDFEB-MAGNETS TREATMENT OPERATORS (NEW)

Pre-treatment operators separating magnets from WEEE shall have non-magnetizable receptacles available for their storage to ensure the magnets can be easily cleared from the receptacles for further pre- or end-treatment steps.

5.3 HANDLING (50625-2-1)

General requirements on handling of WEEE and waste batteries, including the loading, unloading and transport is in clause 5.3 of EN 50625-1.

These shall be applied to all WEEE (incl. magnets), waste batteries and fractions containing CRM. Handling shall be carried out using appropriate tools, containers and fixings to avoid damage where there is the potential for preparation or re-use, or when there is the risk of hazardous substances being emitted.

Refer to clause 5.3 of EN 50625-1

5.3.1 HANDLING AT COLLECTION FACILITIES (50625-4)

In addition to the requirement in clause 5.1.4 of TS 50625-4, consider the following:

- When batteries can be removed without tools, they shall be removed

Refer to clause 5.1.4 of TS 50625-4

5.3.2 HANDLING OF FLUORESCENT LAMPS DURING TREATMENT (50625-2-1)

Refer to clause 5.3 of EN 50625-2-1

5.3.3 HANDLING OF CRT DISPLAYS EQUIPMENT DURING TREATMENT (50625-2-2)

Refer to clause 5.3.1 of EN 50625-2-2

5.4 RECEIVING OF WEEE AND WASTE BATTERIES AT TREATMENT FACILITIES (50625-1)

For receiving WEEE and waste batteries, the clause 5.2 of EN 50625-1 applies.

Refer to clause 5.2 of EN 50625-1

5.4.1 RECEIVING OF FLUORESCENT LAMPS (50625-2-1)

Refer to clause 5.2 of EN 50625-2-1:

5.4.2 RECEIVING OF LITHIUM-ION WASTE BATTERIES (NEW)

The state of lithium-ion waste batteries typically received by treatment facilities fall in three types:

1. Whole batteries are complete and undamaged;
2. The cases are complete while inner short-cut may occur during transportation;

3. The cases or the batteries themselves are damaged possibly with leakage of electrolyte.

The 2nd and 3rd types are critical as these pose possible danger during transport and shall be distinguished from type 1 (non-critical).

Type 3 shall be separated from batteries with complete cases.

Damaged batteries (type 3) shall be separated from batteries with complete cases. Appropriate safety measures shall be taken, such as storing them in Pyro-Bubbles in an appropriate container.

Portable type 1 lithium-ion batteries also from electric vehicles shall be kept separate and labelled based on their chemistry composition.

Note: Typical lithium-ion composition is as follows

- The cathode composition of lithium-ion waste batteries from electric vehicles typically include LiFePO4 type battery, LiMnO2 type battery, Li(Ni,Co,Mn)O2 type battery, Li(Ni, Co, Al)O2 type battery, LiCoO2;
- NCM type lithium-ion waste batteries have different compositions e.g. NCM111, 523, 622, 811 etc.; there are also mixed lithium-ion waste batteries e.g. LiMnO2 mixed with NCM, LFP mixed with LMO;
- Concerning the anode compositions most typical ones are graphite based; Li4Ti5O12 based; Silicon-C combined and Si-O based.

5.5 Storage at collection and treatment facilities

(NEW, 50625-1, 50625-1, 50625-4, 50625-2-1, 50625-2-2, 50625-1 AND 50625-2-1)

Treatment logistics, and collection facilities operators shall take all necessary measures to ensure the proper and safe storage methods of WEEE, waste batteries, and CRM and fractions, particularly the separate storage of hazardous and non-depolluted fractions. General guidance can be also found in clauses 5.4 of EN 50625-1 and 5.1.5 of TS 50625-4.

Additional requirements are also provided for waste batteries storage in 5.5.3.

Refer to clause 5.4 and 5.8 of EN 50625-1 for treatment facilities

Refer to clause 5.1.5 of TS 50625-4 for collection and logistics facilities

Refer to clause 5.4 of EN 50625-2-2 for displays treatment facilities

Refer to clause 5.4 and 5.8 of EN 50625-2-1 for lamps treatment facilities

5.5.1 SOUND STORAGE OF LEAD-ACID WASTE BATTERIES (NEW)

Uncontrolled draining and leakage of sulfuric acid from lead-acid waste batteries at storage places and in the recycling plant shall be avoided.

Leaking batteries shall be stored in acid-proof containers to avoid environmental contamination (UN Approved Plastic Leak Proof Container)[6]

Lead-acid waste batteries shall be separately stored.

5.5.2 SOUND STORAGE LITHIUM-ION WASTE BATTERIES (NEW)

Lithium-ion batteries shall be protected to prevent exposure to excessive heat, water, or any crushing or physical damage during handling, sorting, and storage.

Lithium-ion waste batteries with different compositions shall be separately stored.

NiMH can be sorted together with the lithium-ion batteries

5.6 SHIPPING (NEW, 50625-1)

Requirement is established in clause 4.5 of EN 50625-1. More specific requirements are provided for transport in general in clause 5.1.7 of TS 50625-4, and for transfers between operators in clause 5.1.8 of TS 50625-4.

Refer to clause 4.5 of EN 50625-1e (a mentioning to batteries was added)

Refer to clause 5.1.7 and 5.1.8. of TS 50625-4 for collection and logistics facilities

Note: Where shipment for further processing of WEEE and/or waste batteries, or fractions thereof, is to be undertaken, treatment operators shall ensure that receiving facilities comply with:

- the WEEE treatment requirements of European Directive 2012/19/EU or equivalent treatment requirements;
- the Regulation (EC) No 1013/2006 on shipments of waste;
- the Regulation (EC) No 1418/2007 on the export for recovery of certain waste listed in Annex III or IIIA to Regulation (EC) No 1013/2006;

[6] http://www.enviroquip.co.uk/hazardous-waste-containers/pallet-box/

- the Directive (EURATOM)2006/117 on the supervision and control of shipments of radioactive waste; and
- national authorization procedures of the country where the facility is established.
- EERA, Technical Guidance Document, Safe Collection and Transport of Electronic Equipment with Lithium Batteries, 2019
- CEWASTE requirements

For the safe inland and international transport by road, rail or inland waterways of dangerous fractions (such as lithium batteries, fluorescent powders, among others) there shall be ensured compliance with the European agreement and regulations.

- Directive 2008/68/EC of the European Parliament and of the Council of 24 September 2008 on the inland transport of dangerous goods
- European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways – ADN (2017)
- European Agreement concerning the International Carriage of Dangerous Goods by Road – ADR (2019)

5.6.1 TRANSPORT (*50625-4*)

Refer to clause 5.1.7 of TS 50625-4

5.6.2 TRANSFER BETWEEN OPERATORS (50625-4)

Refer to clause 5.1.8 of TS 50625-4

Furthermore, for final treatment CRM components or fractions thereof transfer shall be done to operators compliant with the CEWASTE requirements.

5.6.3 SHIPPING OF WASTE BATTERIES AND FRACTIONS (NEW)

5.6.3.1 LEAD-ACID WASTE BATTERIES (NEW)

Lead-acid batteries shall be collected and transported complete with acid.

For bulk transports of waste lead-acid batteries the requirements listed in the standards in Table V-2 shall be fulfilled.

The transport of Waste Lead-Acid Batteries is subject to ADR (European Agreement concerning the International Carriage of Dangerous Goods by Road – 2019). The criteria set out in ADR 7.3.3 VC1, VC2 and AP8 apply. Respectively for Transport on Inland Water, the newest version of AND (European Agreement concerning the International Carriage of

Dangerous Goods by Inland Waterways) applies. For transport, WLABS have to be in compliance with the following principles:

- packed and secured so they cannot slip, fall or be damaged;
- provided with carrying devices, unless stacked on pallets;
- free of any dangerous traces of acid on the outside;
- protected against short circuits.

Further detail is given in Annex V, Table V-2.

5.6.3.2 LITHIUM-ION WASTE BATTERIES (NEW)

For transports of lithium-ion waste batteries the requirements according to the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) as listed in Table V-3 of Annex V shall apply.

5.7 ACCEPTANCE BY COLLECTION AND LOGISTICS OPERATORS– GENERAL (50625-2-4)

Requirements for acceptance by collection and logistics facilities established in clause 5.1.2 of TS 50625-4 apply to all WEEE (incl. magnets), waste batteries and components containing CRM.

Additionally, for ensuring smooth reception and acceptance of key CRM equipment, collection and logistics facilities shall provide clear instructions to public accessing the facilities for leaving the equipment. Instructions shall include visuals and descriptions that help identifying the types of WEEE containing CRM and the locations for disposing them of.

Refer to clause 5.1.2 of TS 50625-4 for collection and logistics facilities

5.7.1 AGREEMENT FOR ACCEPTANCE OF PRINTED CIRCUIT BOARDS AND FRACTIONS CONTAINING CU AND PRECIOUS METALS (50625-5)

Refer to clause 4.4 of TS 50625-5 for final treatment operators

5.7.2 AGREEMENT FOR ACCEPTANCE OF FLUORESCENT POWDERS, WASTE BATTERIES, PRINTED CIRCUIT BOARDS AND WASTE MAGNETS (NEW)

Deliveries of fluorescent lamps, waste batteries, printed circuit boards and magnets to a further treatment facility shall only occur once a written agreement is issued between the concerned operators (the supplier and the receptor). The minimum elements of the contract shall include:

- Description of material i.e. type of the waste, physical characteristics, and condition of the WEEE or component – functional or not;
- The delivery mode e.g. transport by road, ship or rail;
- Specification of authorized transport and logistics related requirements
- Duration of the agreement;
- Agreed quantities.
- Mutually agreed specification of materials.
- Specification of authorized transport and logistics related requirements;

  NOTE 3 Compliance with Waste Shipment Regulation - (EC) No 1013/2006 and European List of Waste - 2000/532/EC if required and compliance with the ADR (European Agreement concerning the International Carriage of Dangerous Goods by Road) provisions if applicable.
- Packaging requirements;
- Arrangements for handling of 'off-spec material';
- In the case of printed circuit boards, arrangements for sampling as set out in 5.3 of TS 50625-5;
- In case of waste batteries, list with container to collect uncontrolled draining and leakage of sulfuric acid or other types of liquid electrolyte from waste batteries;
- Minimum specification on possible contaminants such as:
  - Acceptance levels of mercury (Hg);
  - Acceptance levels of fluoride (F);
  - Declaration of check of volatile materials (LiPF6, DMC, EC.);
  - Agreed acceptance levels of beryllium (Be);

  NOTE 1
  - Typical Hg acceptance level < 10 ppm.
  - In case of detection of any radioactivity, in which there should be generally a low tolerance level, while the evaluation of radioactivity and maximum content's threshold should be in accordance

with 2003/122/Euratom or those of the equivalent competent authority whichever is the most stringent.

- Typical Beryllium acceptance level < 200 ppm.

A procedure shall be in place to allow verification and compliance with the agreement for acceptance of materials. The procedure shall include the following:

- Inspection at reception;
- Each delivery shall be inspected to verify quality and respect of environmental requirements and compliance with the agreement for acceptance;
- Proof of inspection of transport documents and record of the origin;
- The results of the verification shall be documented.

5.8 SORTING (50625-4, NEW)

As required in clause 5.1.6 of TS 50625-4, WEEE containing CRM that may be suitable for re-use shall be identified and separated at collection facilities.

Refer to clause 5.1.6 of TS 50625-4

WEEE and waste batteries including their components containing CRM, shall be collected and sorted with the aim to:

a. Avoid CRM mixing or dilution in the mass flow;

b. Improve the concentration of CRM in the output flows;

c. Meet that requirements for further treatment or recycling.

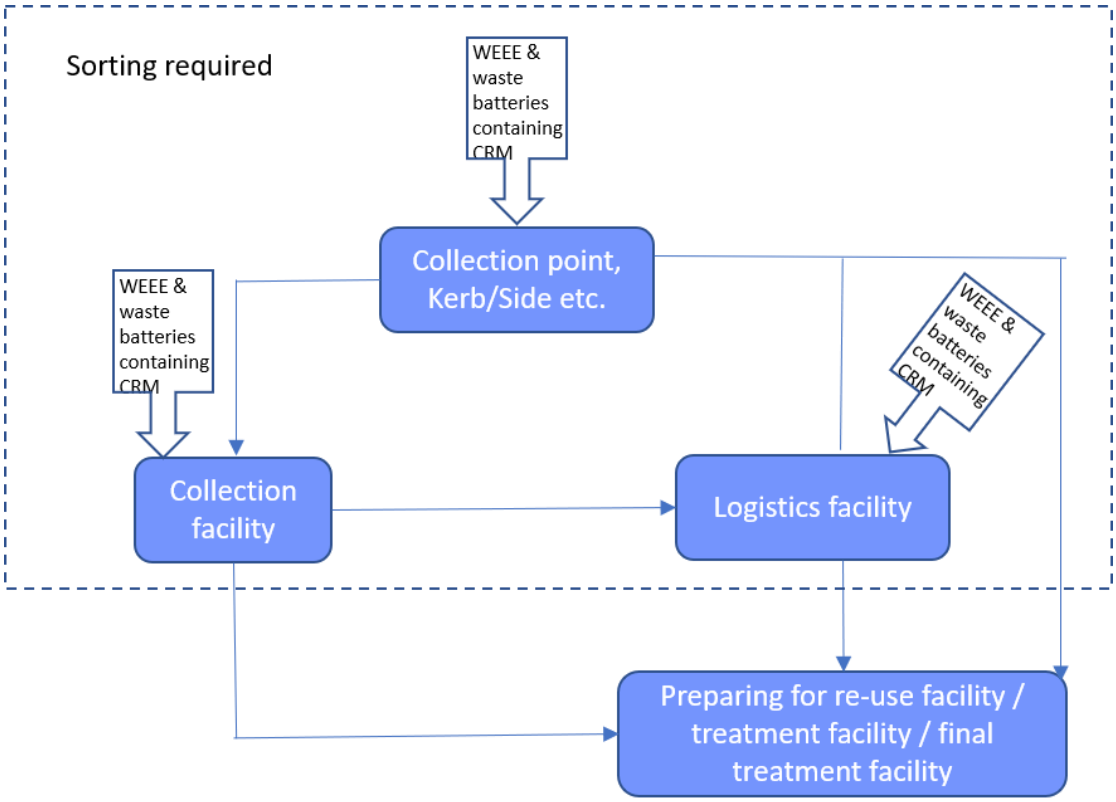
When WEEE and waste batteries are not intended for preparing for re-use, the following types of key CRM equipment (KCE) (as in Annex I) shall be sorted separately at collection points, and collection and logistics facilities before delivering them to recycling facilities:

- Fluorescent lamps
- CRT monitors and TVs
- Temperature exchange equipment (TEE) (engine, compressor)
- Household appliances other than TEE (motors/drives)

- Laptops (hard disk drive - HDD), desktop Computers (HDD), mobile phones, tablets and similar devices containing printed circuit boards
- Electro engines from electric vehicle (BEV) and (plug-in) hybrid electric vehicle (P)HEV
- Batteries from electric vehicle (BEV) and (plug-in) hybrid electric vehicle (P)HEV
- External CDDs, ODDs, devices with internal CDDs/ODDs
- Li-ion batteries
- Lead-acid batteries

Personnel conducting the sorting of KCE from the rest shall have received proper training and know the sorting criteria

If KCE are not sorted at the collection points or collection facilities, the treatment facility shall complete this operation.



5.8.1 SORTING OF WASTE BATTERIES (NEW)

More specifically spent lead-acid batteries must be sorted separately from spent lithium-ion and NiMH batteries, and other types of waste batteries.

Note: Further technical details and recommendations for sorting of waste batteries are listed in the document in the Technical Guidelines for the Environmentally Sound Management of Waste Lead-acid Batteries (2003) (Chapter 3.4 on sorting).

5.8.2 SORTING OF WASTE MAGNETS (NEW)

Removed NdFeB-magnets from household appliances, compressors of temperature exchange equipment (TEE), HDD in laptops desktop computers, large loud-speakers, and from electric engines of end-of-life vehicles shall be sorted from others than NdFeB-magnets.

Non NdFeB-magnets shall be removed from the treatment process and final processing unless it is ensured that the final treatment of the magnets tolerate non-NdFeB-magnets fractions without loss of recycling performance.

Figure 3: Sorting at collection points and facilities (adapted from Fig.1 of TS 50625-4)

Note: Further technical details and recommendations for sorting of lead-acid waste batteries are listed in the document in the UNEP Technical Guidelines for the Environmentally Sound Management of Waste Lead-acid Batteries (Basel Convention series/SBC No. 2003/9) (Chapter 3.4 on sorting).

5.9 DE-POLLUTION AT TREATMENT FACILITIES (50625-1)

General requirements for de-pollution are in clause 5.5 of EN 50625-1.

Any pre-treatment process of waste lead- acid batteries shall be considered as de-pollution and, hence, clause 5.10 of EN 50625-1 shall apply.

Gas discharge lamps and components containing mercury shall be removed before the final treatment process that can cause damage to the item, or shall be treated in such a way that the mercury can be removed and monitored to prove environmentally safe treatment.

Specific de-pollution requirements are in clause 5.5 of EN 50625-2-1 for lamps, and in clause 5.5.1 of EN 50625-2-2 for CRT displays.

Refer to clause 5.5 and 5.10 of EN 50625-1

5.10 TREATMENT OF NON-DEPOLLUTED WEEE AND FRACTIONS (50625-1, 50625-2-1, 50625-2-4)

This clause covers requirements for the treatment of hazardous fractions resulting from the pre-treatment.

General requirements are provided in clause 5.7 of EN 50625-1, which are not applicable to fluorescent lamps. For fluorescent lamps refer to clause 5.7 of EN 50625-2-1.

Removal practices should not damage components in a way that this will hinder subsequent CRM recovery.

Fractions containing both hazardous components and CRM shall be treated in a manner to ensure effective de-pollution as well as high recycling efficiency. For example, components should not be damaged as this may hinder subsequent CRM recovery.

Refer to clause 5.7 of EN 50625-1

Refer to clause 5.7 of EN 50625-2-1

5.11 REMOVAL OF CRM-CONTAINING COMPONENTS (NEW)

Components containing CRM shall be removed from key CRM equipment as listed in Annex I.

Removal practices shall comply with health and safety requirements.

Removal of CRM-containing components shall be conducted by trained personnel by using the appropriate tools. If no trained personnel available or no appropriate tools in place, key CRM equipment shall be transported to dismantling plants.

In the case of waste batteries and lamps, they shall be transported as dangerous wastes[7].

Removal practices shall not deliver hazardous substances or CRM materials into the environment.

[7] In the case of damaged lithium-ion batteries, stricter regulations apply to their transport.

Removal practices shall ensure subsequent treatment of CRM containing components is not hindered.

Key CRM components removed from WEEE shall be transferred for further treatment.

The operator shall record:

- the weight and/or number of incoming KCE and of component removed.
- the weight and/or number components removed handed over for further treatment.
- The identification of the treatment facility receiving removed KCE
- In the case of NdFeB-magnets handed over for further treatment, their mass shall be also recorded.

Note: Considering that NdFeB-magnets recycling options are not yet commercially available, pre-treatment operators should explore the market at least every two years for identifying final treatment operators of NfFeB-magnets with a better CRM recycling performance. If a better CRM recycling performance facility is identified, and NfFeB-magnets removed are still being transferred to a less-performance facility, pre-treatment operators should explain why.

5.11.1 REMOVAL OF PRINTED CIRCUIT BOARDS (NEW)

For recovering valuable (Au, Ag, Pd) and other CRM in addition to Pd from printed circuit boards of computers, tablets, mobile phones and alike, PCBs shall be manually or mechanically separated.

5.12 FINAL TREATMENT FOR RECOVERING CRM FRACTIONS AND DISPOSAL OF WASTE FRACTIONS (NEW, 50625-1)

The separated fractions/components containing CRM shall be treated by facilities that are designed for the recycling of CRM and compliant with the CEWASTE requirements. Recycling of CRM from WEEE components and waste batteries and fractions shall apply the requirements given in clause 5.10 of EN 50625-1.

The operator shall record the following information once the final treatment process is completed:

- for fractions that have reached end-of-waste status, data on the composition shall be recorded;

- for fractions that contain CRM, detailed data about the mass of the fraction, the composition, information on the first acceptor and the downstream acceptor(s), and the final treatment technologies;
- for fractions that are classified as hazardous, data on the mass, the composition, information on the first acceptor and the downstream acceptor(s) of the fractions, and the final treatment technologies;
- from the acceptor, name, address of treatment facility, treatment technology and permit issued by the authority.
- in the case of NdFeB-magnets recycling, the mass of CRM (rare earth elements in magnets) recycled.

Note: Considering that NdFeB-magnets recycling options are not yet commercially available, final treatment operators should assess their CRM recycling performance after every technological modification and at least every two years, and make the results about the CRM recycling performance available to any pre-treatment operator inquiring for this information.

Additional specific requirements are in clauses 5.10.1 and 5.10.2 of EN 50625-2-2 for CRT equipment and flat display panel equipment. Requirements for disposal of hazardous and non-hazardous fractions provided for the recovery of copper and precious metals from WEEE fractions including printed circuit boards, also apply for the recovery of other CRM as listed Annex I (see clause 5.5 of EN 50625-2-2).

A plan for achieving maximum recovery of secondary materials instead of disposal shall be in place.

Refer to clause 5.10 of EN 50625-1

Refer to clauses 5.5, 5.10.1 and 5.10.2 of EN 50625-2-2

5.12.1 FINAL TREATMENT OF CRT EQUIPMENT (50625-2-2)

Refer to clauses 5.10.1 and 5.10.2 of EN 50625-2-2

5.12.2 FINAL TREATMENT OF FLUORESCENT POWDERS (NEW)

The final treatment shall apply best available technologies capable to recover CRM contained in fluorescent powders from lamps while preventing any adverse effects on the environment. See recommended process Annex in Annex III.

Note: Final treatment of the CRM oxides consisting of hydrometallurgical recovery of metals requires two main steps:

- Leaching, in which the soluble fraction contained in a solid phase is removed as a solution. This step dissolves the metals of interest and, depending on conditions, other undesired constituents present in the material;
- Separation of the metals of interest from each other and/or from undesired elements present in solution using e.g. solvent extraction, ion exchange and/or precipitation.

Due to current Eu and Y prices, hydrometallurgical processes tend not to be economically.

5.12.3 FINAL TREATMENT OF WASTE BATTERIES (NEW)

5.12.3.1 LEAD-ACID WASTE BATTERIES (NEW)

Batteries shall not be broken manually, but through the use of state-of-the-art techniques such as automatic battery breaking.

Note: Respective technical options for battery breaking are in the EC JRC Best Available Techniques (BAT) - Reference Document for the Non-Ferrous Metals Industries (2017) (in Chapter 2.5.1.4) and in the Technical Guidelines for the Environmentally Sound Management of Waste Lead-acid Batteries (2003) (in chapter 4.1).

Batteries shall be drained in a designated area and the acid collected either prepared for re-use, converted to a saleable product or neutralized. The acid collection system shall be acid-resistant and sealed.

The operator shall follow the requirements in the EC JRC Reference Document for the Non-Ferrous Metals Industries (2017) includes requirements regarding the recovery of lead from lead-acid batteries (chapter 5.1.3.1). A general diagram flow of the recovery process is in Annex V.

The operator shall follow the requirements on the sound collection and disposal of battery acid formulated in the EC JRC Best Available Techniques (BAT) - Reference Document for the Non-Ferrous Metals Industries (2017) (in Chapter 2.5.1.4), in the Technical Guidelines for the Environmentally Sound Management of Waste Lead-acid Batteries (2003) (in chapter 4.1) and in the EC JRC Best Available Techniques (BAT) - Reference Document for the Non-Ferrous Metals Industries (2017) (chapter 5.1.3.1).

Refer to EC JRC Reference Document for the Non-Ferrous Metals Industries (2017)

Refer to Technical Guidelines for the Environmentally Sound Management of Waste Lead-acid Batteries (2003)

Sound recycling of battery cases (NEW)

Plastic-cases of lead-acid batteries shall undergo at least three washing cycles, one of them using an alkaline solution, before they can be recycled or sold to the market for further processing.

The operator shall follow the requirements regarding the sound recycling of lead-acid battery cases are listed in Chapter 5.2.4.2 (on 'Plastics from battery processing') of the EC JRC Best Available Techniques (BAT) - Reference Document for the Non-Ferrous Metals Industries (2017) and in Chapter 4.1.3 (on 'Battery Breaking: Potential Sources of Environmental Contamination') of the UNEP Technical Guidelines for the Environmentally Sound Management of Waste Lead-acid Batteries (Basel Convention series/SBC No. 2003/9).

Sound smelting and refining of lead (NEW)

All furnace emissions shall be ventilated to a baghouse in order to avoid lead-contaminated fume and dust entering the workplace or the atmosphere. The furnace shall be ventilated properly and emissions shall be monitored on a daily basis. The filtered dust is highly toxic and shall be captured in air tight containers and either processed on site or disposed of in an environmentally sound manner.

Management of process waste, including filter dust and slags (NEW)

All lead-containing waste process shall be recycled within the facility with a view to prevent emissions of lead-compounds into the environment and to minimize process waste for disposal.

5.12.3.2 LITHIUM-ION WASTE BATTERIES (NEW)

Dismantling and discharge

After removal, lithium-ion batteries from electric vehicles shall be discharged (for example by using a discharge device) before being disassembled to separate the battery packs and modules.

Discharge of the pack to a safe voltage below 0.5V shall be carried out

Requirements concerning further disassembly into cells vary depending on the type final treatment: pyrometallurgical, hydrometallurgical or mechanical treatment

For entering into a pyrometallurgical processing, removed battery modules do not need to be dismantled further down to the level of the individual cells. The module or cells can be treated without further discharging.

For hydrometallurgical or mechanical processes, the module shall be disassembled into cells. The cells can then be shredded or thermally treated and then shredded.

After the module/cells are dismantled, further chemical/complete discharge may be required depending on the types of recycling technologies.

Note: For cells after disassembling from pack or module, chemical discharge using salt solution with a concentration of 1~10wt.% or higher is usually applied.

During physical discharge, it is important to ensure the safety with more than 380V DC current. At this stage, it is possible for a fire, leakage of electrolyte or explosion of the pack to occur. The condition of each cell in the pack shall be automatically monitored and recorded in the cloud of the device so that when a defective cell is detected in the pack, an alarm system can be activated.

The batteries shall be dismantled by either specially trained personnel with the aid of suitable equipment (e.g. cordless screwdrivers) or a disassembly robot. During this process the housing (or casing), protection circuit module and cooling system shall be removed and the cables are disconnected.

The following materials shall be separated: aluminium (from battery housing), copper cables, steel components, electronic components (battery management system, printed circuit board), screws and plastic components. These components shall be recycled in-house or transported to dedicated recycling plants.

The disassembly and recycling of lithium-ion batteries from electric vehicles may happen in one plant at the same location. When transported to another recycling plant, the pack or cell modules shall be safely packed, with sand or vermiculite.

Pyrometallurgical or hydrometallurgical process

For the final treatment step, lithium-ion waste batteries can be recycled through either pyrometallurgical or hydrometallurgical processes.

In pyrometallurgical processing, lithium-ion waste batteries packs or cell modules are processed in a smelter or furnace to reduce the metal oxides into a metallic phase or an alloy. The metal bullion is then further refined using a hydrometallurgical technology.

Nickel or cobalt sulphate shall be recovered.

Hydrometallurgical process requires thermal treatment and separation of different components before the active materials can be obtained. The active material is a powder containing both cathode and anode materials.

Active materials powder shall be further processed in order to recover CRM such as cobalt as well as salts or precursors.

Pyrometallurgical technology can also process active materials powder.

European operators shall follow the general requirements as formulated in the implementing decision of the European Commission (EU) 2016/1032 (BAT conclusions for the non-ferrous metals industries for emission control) shall be followed by concerned operators.

A more detailed description is in Annex IV including diagram flows.

5.12.4 FINAL TREATMENT OF NDFEB-MAGNETS (NEW)

The final treatment process shall be capable to recover the most of CRM contained in the magnets, i.e. the rare earth elements neodymium, praseodymium, dysprosium, gadolinium terbium.

Note: NdFeB-magnets recycling options are not yet commercially available in Europe. Further elaboration on emerging potential final treatment technologies will be provided in a next revision.

5.12.5 FINAL TREATMENT OF PRINTED CIRCUIT BOARDS (PCB) (NEW)

Requirements applicable to the recovery of CRM from printed circuit boards are in TS 50625-5.

1562 ***Refer to TS 50625-5***

1563

6. De-pollution Monitoring

6.1 Introduction (50625-1, 50625_3_1)

Clauses 5.6 of EN 50625-1 and 4.1 of CLC_TS_50625_3_1 provide an introduction to de-pollution monitoring requirements during collection, logistics and the overall treatment of WEEE which also apply to waste batteries.

6.1.1 General considerations for lamps, CRT and temperature exchange equipment (50625-2-1, 50625_2-2)

More specifically, for lamps de-pollution monitoring requirements in clause 5.6 of EN 50625-1 are replaced with requirements in clause 5.6 of EN_50625-2-1.

In the case of CRT equipment monitoring, the requirements from clauses 5.6.1 and 5.6.2 of EN_50625-2-2 are added to the requirements in clause 5.6 of EN_50625-2-1.

For temperature exchange equipment, requirements in clause 4.101 of 50625-3-4 apply.

Refer to clause 5.6 of EN_50625-1

Refer to clause 4.1 of CLC_TS_50625_3_1_2015

Refer to clause 5.6 of EN_50625-2-1

Refer to clause 5.6.1 and 5.6.2 of EN_50625-2-2

Refer to clause 4.101 of EN_50625-3-4

6.2 Target value methodology (50625-3-1)

In order to assess the efficiency of de-pollution during batch processing of WEEE and waste batteries, target value(s) shall be established. Methodologies described in clause 4.2 of CLC_TS_50625_3_1 are applicable for WEEE and waste batteries except for lamps.

Refer to clause 4.2 of CLC_TS_50625_3_1_2015

6.3 Mass Balance methodology (50625-3-1)

The approach to establish a mass balance to estimate the share of pollutants in the inputs and outputs is described in clause 4.3 of CLC_TS_50625_3_1.

Refer to clause 4.3 of CLC_TS_50625_3_1_2015

6.4 Analysis methodology (50625-3-1)

Results on the presence of existing pollutants are assessed against criteria and values previously established. Guidance for assessing the results are presented in clause 4.4 of CLC_TS_50625_3_1.

Refer to clause 4.4 of CLC_TS_50625_3_1_2015

6.5 Overview of the applicable methodologies (50625-3-1)

For each treatment process flow (CRT, lamps, etc.) methodologies for target values, mass balances and analysis are indicated in clause 5. of CLC_TS_50625_3_1_2015.

Refer to clause 5. of CLC_TS_50625_3_1_2015

Additional specific methodological aspects are established for lamps, large appliances, cooling and freezing appliances, CRT display appliances, batteries and small appliances.

6.5.1 Lamps (50625-3-2)

Refer to clause 4.4. of CLC_TS_50625_3_2_2016 (Analysis methodology)

Refer to clause 9.2 of CLC_TS_50625_3_2_2016 (Analysis methodology)

6.5.2 CRT display (50625-3-1, 50625-3-3)

CRT display appliances- Target value methodology

Refer to clause 8.2 of CLC_TS_50625_3_1_2015 (Target value methodology)

CRT display appliances - Analysis methodology

Refer to clause 8.3 of CLC_TS_50625_3_1_2015 (Analysis methodology)

Refer to clause 4.4 of CLC_TS_50625_3_3_2017 (Analysis methodology)

CRT display and FPD appliances - Monitoring methodology

Refer to clause 4.101 of CLC_TS_50625_3_3_2017 (Monitoring methodology)

6.5.3 Temperature Exchange Equipment (TEE) or Cooling and freezing appliances (50625-3-1)

Cooling and freezing appliances - Target values methodology

General requirements for these appliances are in clause 7.2 of TS 50625-3-1. In particular, NdFeB-magnets shall be removed from motors avoiding, however, emissions of (H)CFCs into the environment. The removed magnets shall be stored in receptacles according to section 5.2.5.

Refer to clause 7.2 of CLC_TS_50625_3_1_2017 (Target values methodology)

Cooling and freezing appliances - Mass balance methodology

Refer to clause 7.3 of CLC_TS_50625_3_1_2015 (Mass balance methodology)

Cooling and freezing appliances - Analysis methodology

Refer to clause 7.4 of CLC_TS_50625_3_1_2015 (Analysis methodology)

6.5.4 Large house-hold appliances like washing machines, dish washers, dryers except TEE (50625-3-1)

Large appliances - Target value methodology

Refer to clause 6.2 of CLC_TS_50625_3_1_2015 (Target value methodology)

Large appliances - Analysis methodology

Refer to clause 6.3 of CLC_TS_50625_3_1_2015 (Analysis methodology)

6.5.5 Small appliances including waste batteries (50625-3-1)

Waste batteries- Analysis methodology and target values

Refer to clause 11.3. of CLC_TS_50625_3_1_2015 (Analysis methodology)

Refer to clause 10.2 of CLC_TS_50625_3_1_2015 (Target value methodology)

Small appliances - Analysis methodology

Refer to clause 10.3 of CLC_TS_50625_3_1_2015 (Analysis methodology)

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- COM(2017) 490 final: Communication from the Commission to the European Parliament, The Council, The European Economic and Social Committee and the Committee of the Regions on the 2017 list of Critical Raw Materials for the EU.
- Commission Regulation (EC) No 1418/2007 of 29 November 2007 concerning the export for recovery of certain waste listed in Annex III or IIIA to Regulation (EC) No 1013/2006 of the European Parliament and of the Council to certain countries to which the OECD Decision on the control of transboundary movements of wastes does not apply
- Council Directive 2006/117/Euratom of 20 November 2006 on the supervision and control of shipments of radioactive waste and spent fuel
- Decision (EU) 2016/1032, establishing best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for the non-ferrous metals industries
- Directive 2006/66/EC, European Battery Directive: Article 4, 8, 10
- Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010. Directive on industrial emissions: permit (Article 4, 5, 12, 14, 21), non-compliance (Article 8), emissions (Article 15, Annex), general obligations of the operator (Article 11, 17), BAT and exchange of information (Article 13), monitoring requirements (Article 16), environmental inspections (Article 23)
- Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE) Text with EEA relevance

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- WHO, 2017. Recycling used lead-acid batteries: health considerations.

ANNEX I – CRITICAL RAW MATERIALS (CRM), PRODUCTS AND COMPONENTS TARGETED

Table I: Critical Raw Materials

Information on the Waste				End-processing	
Source Component	**Key CRM Equipment (KCE)**	**Waste Type**	**CRM**	**Required/Viable Input for End-processing**	**Current Economic Feasibility**
Fluorescent powders	Fluorescent lamps	WEEE	Eu, Tb, Y, Ce, La	Fluorescent powder	No*
	CRT monitors and TVs		Y, Tb, Eu, Gd, La, Ce	Fluorescent powder	
Nd-magnets	Temperature exchange equipment (TEE) (engine, compressor)	WEEE	Nd (+ Dy, Gd, Pr, Tb)	Magnets	No
	Household appliances other than TEE (motors/drives)				
	Laptops (HDD)				
	Desktop Computers, prof. IT (HDD)				
	BEV, (P)HEV (electro engine)	ELV			
PCBs	Desktop computers, prof. IT	WEEE	Au, Ag, Bi, Pd, Sb	Entire devices without battery (mobile phones), PCBs (shredded, unshredded), CuPM granulate	Yes
	Laptops				
	Mobile phones				
	Tablets				
	External CDDs, ODDs, devices with internal CDDs/ODDs				
Li-ion batteries	Laptops	WEEE	Co	Batteries	Yes
	Mobile phones				
	Tablets				
	Li-ion batteries from other WEEE				
	BEV, (P)HEV	ELV			
NiMH battery	NiMH batteries in WEEE	WEEE	Co, (Ce, La, Nd, Pr)	Batteries	Yes for Co / No for REEs
	HEV	ELV			
Lead acid batteries	Lead-acid batteries	WEEE	Sb	Batteries	Yes

*Recent developments in countries outside the EU have been reported but detailed information about the economic feasibility is not yet available.

ANNEX II – MANAGEMENT, MONITORING & EVALUATION PLAN (MM&E), PERFORMANCE INDICATORS AND TARGETS - EXAMPLE

B.1 GENERAL

This annex provides an example of the structure and content of an MM&E plan. It shows some standard pieces to be included in such a plan, gives options for additional detail and presents the user with guiding questions to facilitate the process of developing an MM&E plan.

It is adapted from various sources, such as:

- The monitoring and evaluation framework for the Global Strategy and Plan of Action on Public Health, Innovation and Intellectual Property at the World Health Organization (2011)[50];
- The Project Monitoring and Evaluation Plan Module developed by the Search for Common Ground (SCG), UKAID and United States Institute of Peace (2013)[45]; and
- Assessing the Impacts of Social and Environmental Standards Systems. ISEAL Code of Good Practice. Version 2.0. ISEAL Alliance (2014)[30].
- ISO 14014: 2005 Environmental Management System

An MM&E plan bases on a goal and target audience definitions.

A monitoring system includes the following steps:

- Pre-Assessment
- Internal audit (or external)
- Management review
- Handling of non-conformity
- Complaints
- Indicators
- Process performance

An MM&E plan could follow the table of contents proposed below. Description of more specific contents is also proposed.

[List the names of the economic operators, their locations and the processes concerned. Make use of a table if this helps to create a clearer listing.]
Current countries of the economic operators are shown on the accompanying map.

[Insert the map here, with the geographical scope of the project pointing out to the areas where the economic operators are located.]

The baseline report was completed in [month/year].

The implementation is due to start (has started) in [month/year], and the activities will be terminating in [month/year].

B.2 GOALS/OBJECTIVES

The main goals/objectives of the CEWASTE requirements implementation in our value chain are:
Overall (or final goal): [Refer to the ultimate CEWASTE goal: Improved CRM recovery]
Specific (or intermediate goals):
a) [Refer to the specific objectives of the facility: All workers count on PPE]
b) _____

B.3 TARGET AUDIENCE

The target audience is composed of [Examples: second- and third-party auditors; shareholders] for [Examples: management, evaluation, investment] purposes.

B.4 PERIOD AND FREQUENCY

This MM&E plan proposes activities for the period [Indicate here starting month/year] – final [month/year. Please note that an average period of two to five years is foreseen].

The following frequency is considered [e.g. every six months].

B.5 MM&E PLANNING: PROCESS

During the preparation of the MM&E plan, the staff reached several critical decisions and identified essential strategies for MM&E in the project. The main debates and decisions

included: [Describe here relevant assumptions, findings, agreements and key issues related to objectives prioritized, key performance indicators selected, targets, actions, resources needed, feasibility, responsibilities, methodology for developing and monitoring indicators, etc.]

The participants in the planning were: [List the main participants in the planning.]

B.6 MM&E INFORMATION MATRIX

The MM&E information matrix (table) includes the objectives, indicators, actions, responsibilities, baseline, thresholds or targets and results per period.

Table II: Example of indicators and linkages with one or more objectives and considerations

Objective	Key performance Indicator	Definition	Actions / Responsibilities	Resources needed	Base-line in year 0	Threshold or target, if any, for years 1, 2, 3, 4 and 5	Results /date of measurement	Remarks (e.g. reasons for deviation; limitations of indicator)
1.1 Enable safe and healthy work-places	% of workers with PPE	For the activity of sorting and disassembling of waste lead-acid batteries, PPE includes gloves, masks, special glasses and clothes.	-Provision of training to workers concerned/ H6S department manager - Development of visuals and communication materials and dissemination in the working areas of the facility / communication officer	- PPE includes gloves, masks, special glasses and clothes. - Visual materials for training	5 %	Year 1: 50 % Year 2: 70 % Year 3: 90 % Year 5: 100 %	45% / 31 Dec year 1	
2.1 Increasing CRM recovery	% of the total	Portion of streams with CRM content monitored in accordance to the CEWASTE requirements	-Provision of training to workers concerned / H6S department manager - Provision of required measurements devices / H6S department manager	- Measurement devices - Visuals for training	30 %	Year 1: 50 % Year 2: 80 % Year 3: 100 %	60% / 31 Dec year 1	

- Type of indicators: quantitative, qualitative
- Methods of data gathering
- Responsibilities for data collection
- Frequency of reporting
- Risks and assumptions]

B.7 RESULTS

The monitoring process was [appropriate/limited] with regard to the scope. [Provide also a brief statement about the adequacy of the methodology followed, including the frequency and scope of the monitoring.]

Highlights of results and deviations from and non-compliance with the objectives as well as related challenges include: [Provide a summary of highlights.]

[Summarize the main results per objective based on the MM&E information matrix developed and challenges faced.]

B.8 CONCLUSIONS

[e.g. include an average of progress made (10 %, 50 %, etc.) since the beginning, mention best-performing areas, add new relevant and unexpected findings that imply revision of the indicators, mention one or two main obstacles to overcome to succeed as planned.]

B.9 RECOMMENDATIONS

[E.g. about improving the process and the methodology to refine the indicators, about overcoming the main obstacles, about key messages to be internally and externally communicated.]

ANNEX III – FINAL TREATMENT OF FLUORESCENT POWDERS

Fluorescent powders contain CRM such as lanthanum, cerium, yttrium, europium, and terbium. Yttrium is the most abundant CRM in both lamp types.

Note: Straight fluorescent lamps, compact fluorescent lamps, fluorescent lamps, high intensity discharge lamps - including pressure sodium lamps and metal halide lamps, and low pressure sodium lamps contain mercury.

The hydrometallurgical treatment for treating fluorescent powders includes a series of chemical-physical liquid-phase treatment techniques (leaching, solvent extraction, extraction with supercritical fluids, reverse osmosis, nanofiltration, ultrafiltration, etc.) which are efficient resulting in high-purity materials (rare earth oxides). The process is given in annex III (see generic flow diagram).

The rare earth oxides are further processed in a final treatment process to recover specific critical raw materials like Yttrium and Europium. Final treatment is not covered in the CEWASTE requirements.

The hydrometallurgical process for the recovery of CRM from fluorescent powders is a mature technology. To recover CRM from fluorescent powders may potentially also be achieved by pyro- and bio-metallurgical, however, so far these technologies have not gone beyond the proof of concept.

Facilities applying hydrometallurgical processing release solid wastes (filter cakes). Filter cakes from lamps-fluorescent powders may contain high levels of mercury and cakes from CRT-fluorescent powders Cadmium, Lead and Zinc. The pressed filter cake after the first filtration (step 3) in the generic flow diagram given in Annex III has a very low pH, due to the leaching with sulphuric acid. The cake coming from CRT-fluorescent powders is hazardous due to the high content in lead and zinc. This pressed filter cake needs to be properly transported to authorized chemical-physical treatment plants for further treatment and disposal.

The residual solution after the second filtration is a liquid waste (step 5 in the generic flow diagram). This solution can be either reused in the process or be disposed of. In case of disposal as a liquid stream it needs to be neutralized prior to disposal.

The pressed filter cake after lime treatment (step 7 in the generic flow diagram) is non-hazardous and can be disposed of in an authorized landfill.

The following is a generic flow diagram of hydrometallurgical treatment of fluorescent powders originating from lamps and CRTs.

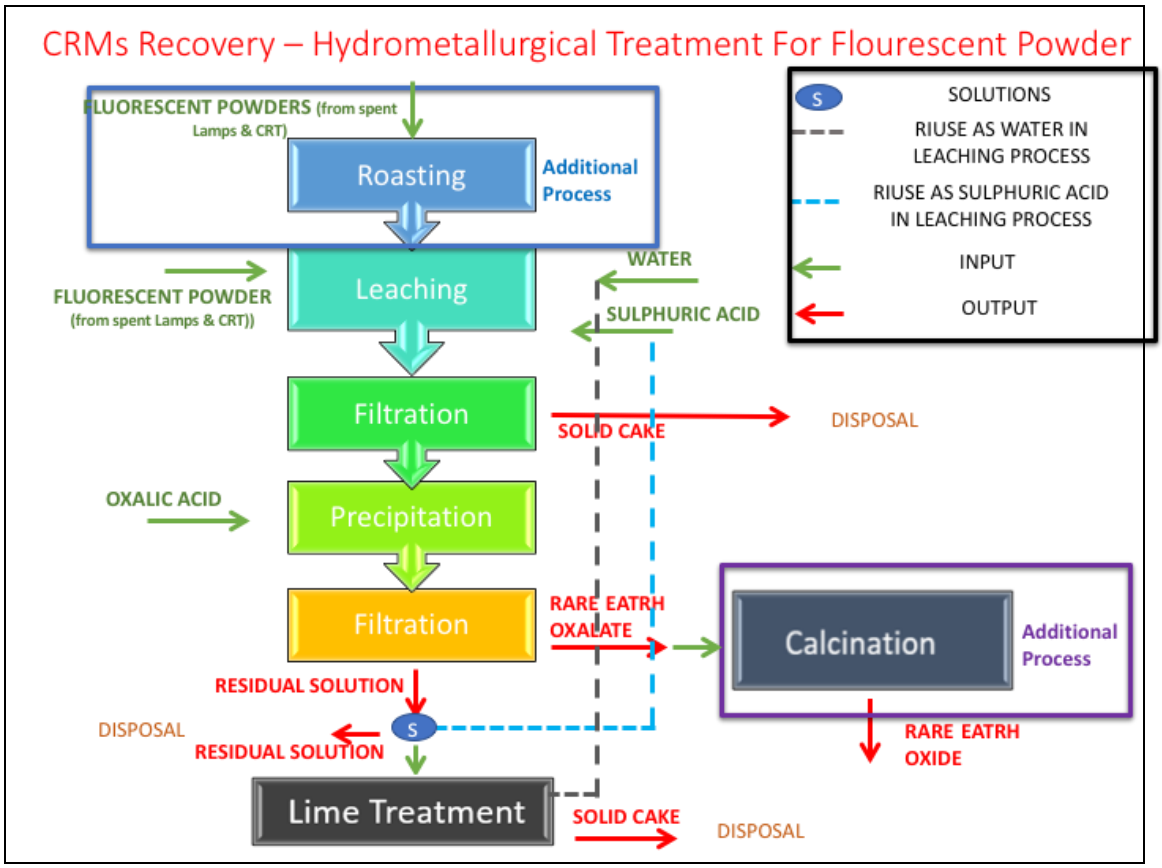

Figure III.1: Generic flow diagram of hydrometallurgical treatment of fluorescent powders

SOUND RECYCLING OF FLUORESCENT POWDERS (NEW)

With respect to CRM, Yttrium is the most abundant element in powders of lamps and CRTs. The typical CRM content in the oxide (oxalates) constitutes 85 % Yttrium and 10 % Europium.

The efficiency of the hydrometallurgical process in terms of % of rare earth elements, is closely linked to:

- the composition of the fluorescent powders mixture, which is supplied and treated, and
- the operating parameters of the process conditions (temperature, pH, reagent, etc.).

Note: Oxalates are a blend of REEs i.e. Lanthanum, Cerium, Europium, Gadolinium, Terbium and Yttrium). Typical composition of the product coming out of the Hydrometallurgical process is:

- Minimum content as REO (rare earth oxide) = 30%
- Maximum content of water = 40%
- Maximum content in oxalate: Hg = 20ppm and Fe = 50ppm

ANNEX IV – FINAL TREATMENT OF LITHIUM-ION WASTE BATTERIES

Pyrometallurgical process directly processes module or cell without further discharging. The lithium-ion waste batteries are processed in a smelter or furnace to reduce the metal oxides into metallic phase or an alloy. The metal bullion is then further refined using a hydrometallurgical technology. Nickel or cobalt sulphate can be obtained. Pyrometallurgical technology can also process active materials powder.

Hydrometallurgical process requires complete discharge, thermal treatment and separation of different components before the active materials can be obtained. The active material is a powder containing both cathode and anode materials. The mixture is further processed in order to recover critical metals as salts or precursors.

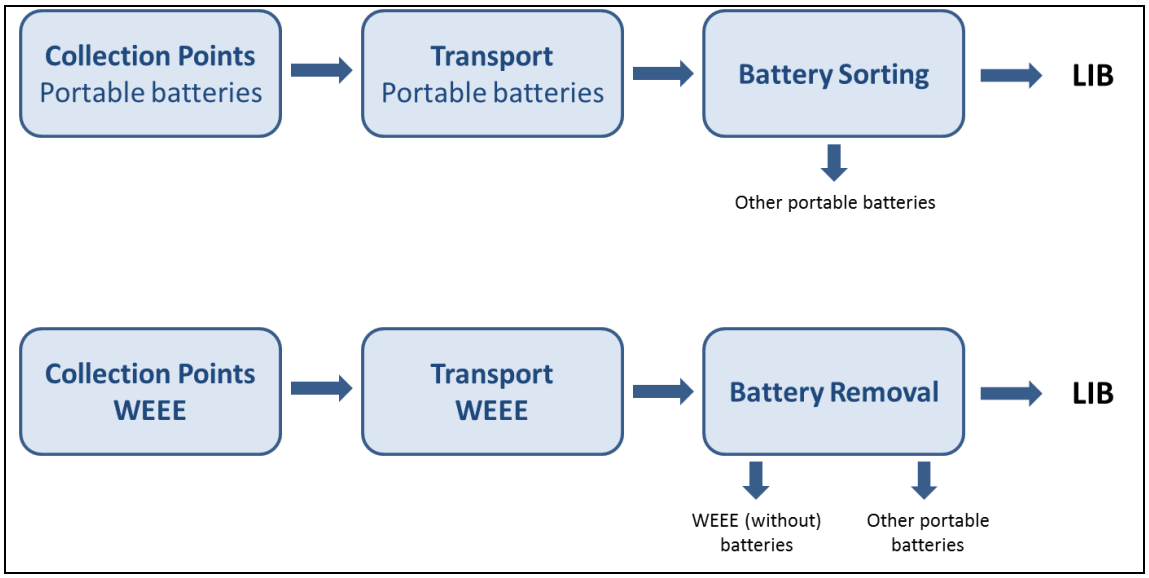

Figure IV.1. Pathways until sorting and removal of portable lithium-ion batteries based on the collection modus

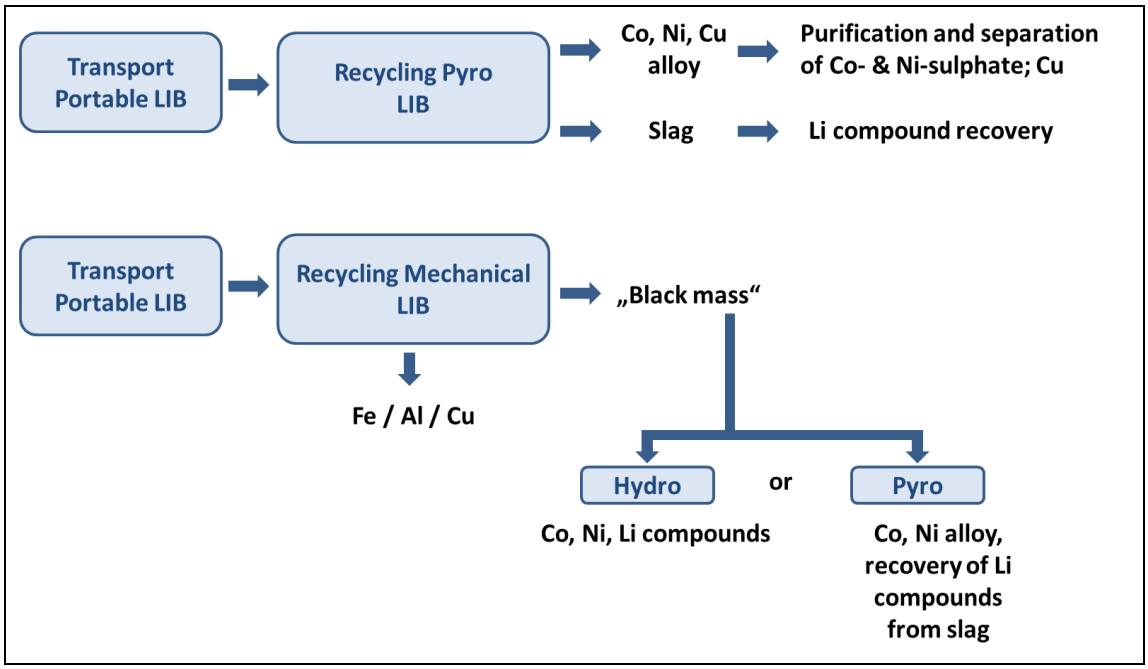

Figure IV.2. Pathways for the recycling of portable lithium-ion batteries

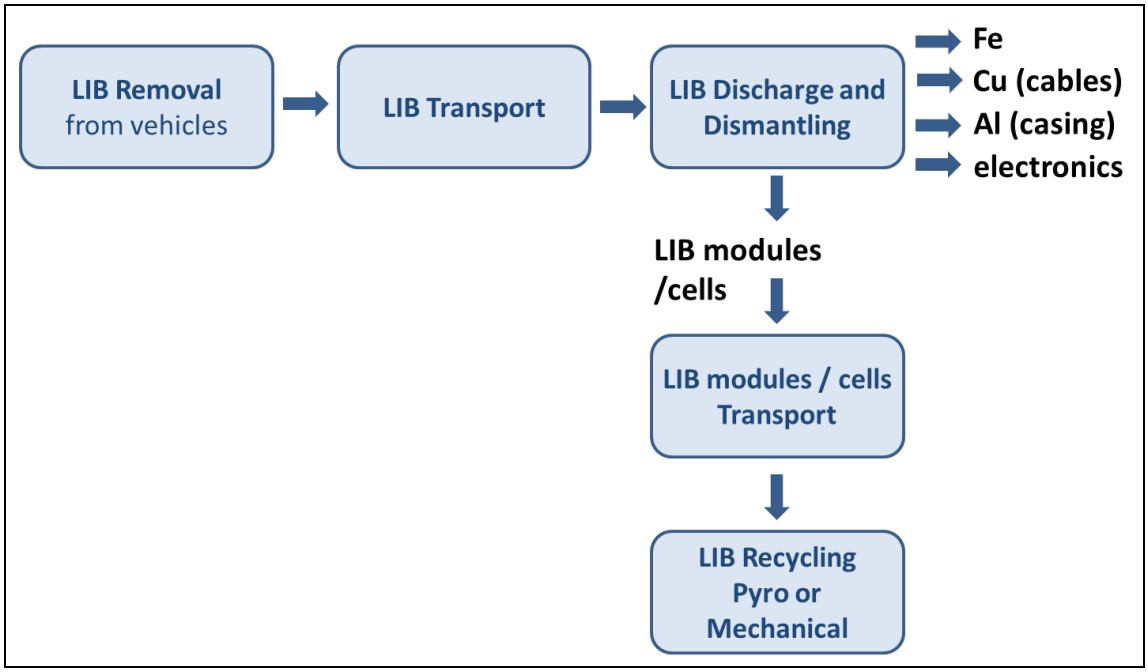

Figure IV.3. Pathway for the recycling of lithium-ion batteries from E-vehicles

Steps prior pyrometallurgical, mechanical or hydrometallurgical process

Lithium-ion waste batteries packs/modules/cells may need to be further shredded, thermally treated and separated to obtain an intermediate product, so-called black mass, depending on which technologies are used for the metal recycling.

In the mechanical/hydro-based route, the lithium-ion batteries are either shredded in a protective gas atmosphere or first thermally treated and then shredded[8].

The electrolyte together with the organic separator and other organic materials are pyrolyzed depending on the operation temperature. If the temperature is below 200 C, the electrolyte is evaporated to obtain a mixture of waste organic solvent which shall be further treated.

In this process, emission of HF, P_2O_5, SO_2, CO^2, particulates of heavy metals and dioxin shall be controlled in accordance to Directive 2010/75/EU for a combustion plant.

Discharges to the aquatic environment of waste water resulting from the cleaning of waste gases shall be limited as far as practicable and the concentrations of polluting substances shall not exceed the emission limit values set out in Part 5 of Annex VI of Directive 2010/75/EU.

[8] See for instance the process scheme of the Accurec process: https://accurec.de/lithium

Before thermal treatment, the battery cells require complete discharging in a salt solution which will finally become waste water containing F-, PO_4^{3-}, and heavy metals of Ni, Co, Mn. This wastewater has to be treated properly to remove these hazardous substances.

During mechanical separation of different materials, emission of fine particulates of heavy metals as well as remaining organic materials shall be limited and the safe operational environment for the operators shall be ensured.

Pyrometallurgical process

Step I: smelting

The lithium-ion batteries modules or cells or active materials together flux oxides are fed into a furnace with pre-set conditions. In this step, it is important to prevent emission of particulate or dust of heavy metals as well as waste gases.

During the high temperature treatment (1100 to 1500 C), safe operation shall be ensured. The Directive 2010/75/EU on non-ferrous industry sets the minimum requirements for safety and emissions control. An important requirement being:

- Waste gases from smelting plants shall be discharged in a controlled way by means of a stack, containing one or more flues, the height of which is calculated in such a way as to safeguard human health and the environment (Directive 2010/75/EU Article 30).
- The emissions of volatile organic compounds shall be controlled under contained conditions as far as technically and economically feasible to safeguard public health and the environment and shall not exceed the relevant emission limit values defined in Annex VII of Directive 2010/75/EU.
- Emissions of other pollutants including HF, SO2, CO2, dioxin etc. shall not exceed the limit values in Annex V to VI of Directive 2010/75/EU.
- Protective clothing for workers

Step II – refining

When an alloy bullion containing CRM is obtained, it still has to be further refined using an electrochemical or hydrometallurgical process.

The alloy bullion is usually copper-based which means during electrochemical refining, pure copper is obtained on the negative electrode and nickel/cobalt is dissolved into the solution.

The solution is further treated to obtain nickel or cobalt sulphate.

The salts of critical metals can be used for further lithium-ion batteries precursor preparation.

Step III: Slag or residue treatment

All heavy-metals containing process waste shall be recycled within the system with a view to prevent environmental risks and to minimize process waste.

During the smelting/refining process smelting slag is generated: a $CaO\text{-}SiO_2\text{-}Al_2O_3$ based slag containing F, P, Li, trace Cu/Ni/Co, Mn, Mg, Fe and rare earth elements (In the event that NiMH batteries have also been introduced into the melt.). If technically and economically feasible, these elements (particularly lithium and other valuable materials) should be recovered. Landfilling should be avoided as much as possible. Heavy metals cannot be recovered shall be stabilised in the slag and not leached in nature conditions.

After stabilizing the heavy metals and F/P, the slag may be used as additive for construction materials. The heavy metal contents in the slag depends on BAT and requirements given in Annex I of Directive 2010/75/EU.

Step III: Wastewater treatment

Wastewater must undergo proper treatment. The levels of COD, heavy metal contents, NH3-N, Cl, F and PO_4^{3-}, SO_4^{2-} shall comply with national regulations and limit values in Annex VI of Directive 2010/75/EU on the discharge point of wastewater treatment plants. Recycling plant should have proper wastewater treatment facilities or divert the wastewater to specific treatment plants.

The following measurements shall be carried out at the point of waste water discharge:

(a) continuous measurements of pH, temperature and flow;

(b) spot sample daily measurements of total suspended solids or measurements of a flow proportional representative sample over a period of 24 hours;

(c) at least monthly measurements of a flow proportional representative sample of the discharge over a period of 24 hours of Hg, Cd, TI, As, Pb, Cr, Cu, Ni and Zn; additional requirement on Co and Mn shall be placed for lithium-ion waste batteries recycling;

(d) at least every 6 months measurements of dioxins and furans; however, one measurement at least every 3 months shall be carried out for the first 12 months of operation.

Continuous: Emission control and technologies

European operators shall follow the requirements in the Industrial Emissions Directive and Best Available Techniques Reference documents (BREFs) for waste treatment plants. In some Member States the occupational exposure limits may be stricter than the EU regulations.

As a minimum, non-EU operators shall follow their national or local environmental regulations. However, to safeguard environmental protection, non-EU operators are encouraged to adopt European limit values when they are stricter than national or local regulations.

In any case, occupational exposure limits[9] has to be ensured. Indicative values for hydrogen fluoride are:

- Eight hours: 1.5 mg/m3; 1.8 ppm
- Short term: 2.5 mg/m3; 3 ppm

Any potentially harmful substance in the resulting fly ashes (e.g. F-dioxines) shall be captured and treated through an exhaust gas purification system such as a regenerative thermal oxidizer unit.

Mechanical or hydrometallurgical based process

The "black mass" is treated by an acidic solution so that critical metals including nickel, cobalt are leached into the solution. The solution is further purified and solvent extraction is used to obtain a pure solution of Co sulphate and Ni sulphate or a mixture of Ni-Co-Mn sulphate. The solution is used either to prepare the corresponding salts or, directly, the precursor.

The operator may apply innovative technologies to recover the graphite.

During this process, waste water treatment is an environmental aspect of concern. Sulphate acid, chloride acid, and alkaline have to be handled carefully in order to prevent leakage to the environment and exposure to workers.

Graphite residue containing trace heavy metals and other organic or inorganic elements is the final residue after the leaching step. The residue shall be properly treated to avoid environmental damage. The operator may apply innovative technologies to recover the graphite or convert the residue into potential products.

The removal of impurities using solvent extraction generates a number of residues containing heavy metals, F, P and organic compounds. These have to be clearly labeled and classified as hazardous waste.

[9] Exposure time shall be defined for the operators in accordance to the Directive 89/391 EEC and US OSHA

The residue during the solvent extraction stage, as a result of impurities removal, contains heavy metals of Cu, Ni, Mn etc. and trace organic compounds of the solvent. Since further R&D is needed to enable recovery, operators shall ensure that these residues are disposed of in safe manner.

Requirements on wastewater treatment are the same as for the pyrometallurgical process.

The organic solvent mixtures produced during the mechanical recycling of lithium-ion batteries shall be treated as a hazardous substance. Further R&D is needed to separate these solvent mixtures and recover them as secondary materials.

Final products

After smelting in a pyrometallurgical process or solvent extraction in a hydrometallurgical process, the products can be metallic alloys, copper, Ni/Co sulphate, precursor or cathode materials.

Environmental health and safety procedures shall follow existing the requirements for the non-ferrous industry.

The final products vary per company and specific recycling technology.

For quality assurance, the operator shall follow internal or external quality requirements for either precursors and/or Ni/Co salts.

ANNEX V – FINAL TREATMENT OF LEAD-ACID BATTERIES

Collection points are the first step of end-of-life processing of waste lead-acid batteries. Here, lead-acid batteries from different sectors and applications come together, including batteries from End-of-life Vehicles (ELVs), stationary power storage and uninterrupted power supply equipment. From there, waste lead-acid batteries are transported to recycling facilities, where they are broken and drained of acid. Different technologies are available for the separation of acid and plastic from waste batteries (see chapter 4.1 in UNEP (2003): Technical Guidelines for the Environmentally Sound Management of Waste Lead-acid Batteries (Basel Convention series/SBC No. 2003/9)). In a next step, different types of furnaces can be used for smelting (see chapter 4.2 in UNEP (2003)), resulting in reduced crude lead, slag and fume. The fume is ventilated into a baghouse, and the collected (lead containing) dust put back to the furnace. To increase the lead content of produced bullions and to achieve defined purities for industrial purposes, a refining process takes place (see chapter 4.3 in UNEP (2003)). The refining process results in highly concentrated lead and dross.

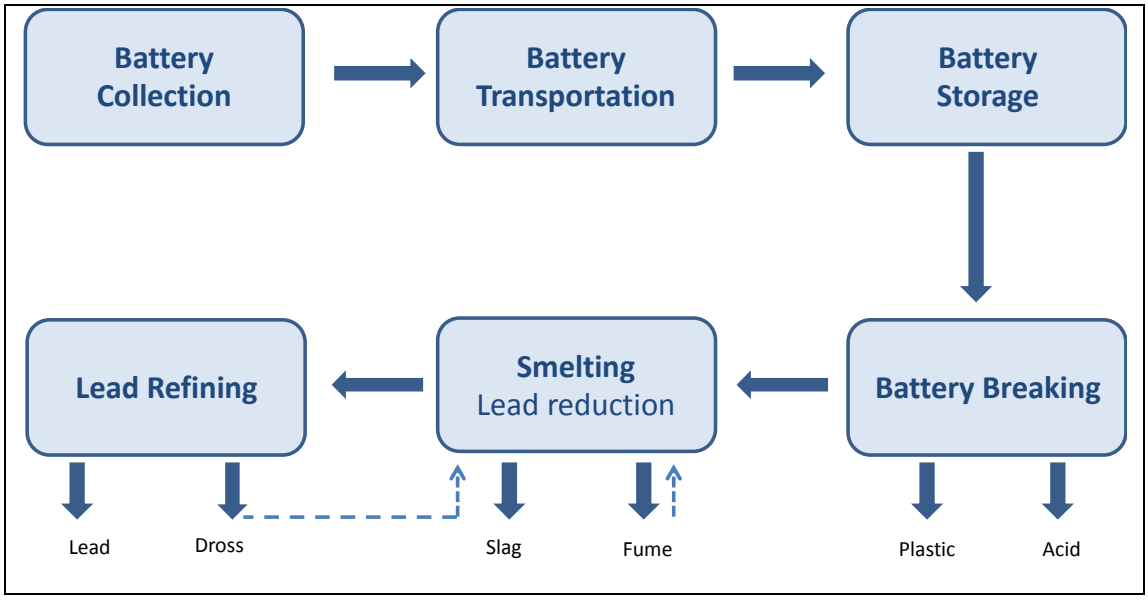

Fig.V.1: Pathways for the recycling of lead-acid batteries

Table V.1: Applicable standards for emission control in lead smelters

Standard / Directive (Version / Date)	Requirements
EU Directive 2010/75/EU on Industrial Emissions (17.12.2010)	Annex VI - Part 3 – Section 1.3: Average emission limit value for lead in air emissions: 0,5 mg /Nm^3 (sampling period 30 min – 8 h) Annex VI - Part 5: Emission limit values for discharges of wastewater from the cleaning of waste gases: 0.2 mg/l total suspended solids as defined in Annex I of the Council of the European Communities Directive 91/271/EEC of 21 May 1991 (for unfiltered samples)
EU Scientific Committee on Occupational Exposure Limits (SCOEL) for lead and its organic compounds of January 2002	Workplace air levels should be maintained below 0.1 mg/ m^3 averaged over an 8-hour period (8 hr TWA)
International Lead and Zinc Study Group (ILZSG) Study on 'Environmental and Health Controls on Lead'	Water quality: Lead in water bodies: Max. Permissible Lead Level of 0.01 mg/L
	Effluent discharge: Lead in industrial effluents: Max. Permissible Lead Level of 0.5 mg/L at pH 7-9

2025 *Table V.2: Applicable standards for the transport of waste lead-acid batteries*

Standard / Directive (Version / Date)	Requirements
European Agreement concerning the International Carriage of Dangerous Goods by Road – ADR (2019) European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways – ADN (2017)	The transport of Waste Lead-Acid Batteries is subject to the criteria set out in ADR 7.3.3 VC1, VC2 and AP8. For transport, WLABS have to be in compliance with the following principles: • packed and secured so they cannot slip, fall or be damaged; • provided with carrying devices, unless stacked on pallets; • free of any dangerous traces of acid on the outside; • protected against short circuits. Specifically, when transporting WLAB the vehicle can only carry one type of hazardous material. The WLAB can be transported in a leak proof UN approved plastic container or sealed skip. If not, the WLAB must be stacked upright on a wooden pallet with honeycomb cardboard between each layer, limited to three layers and shrink-wrapped to improve stability. A bill of lading with a description of the hazardous material is required together with the name of the company shipping the material and the name of the transport company. Some wet sealed lead-acid batteries (Valve Regulated, Absorbent Glass Mat10 and Gel Batteries) grouped under UN 2800 are exempt from Class 8. The battery manufacturer must declare how a battery is regulated on its associated Safety Data Sheet (SDS) and most AGM batteries can be shipped under the simpler UN 2800 directive. Different rules apply when shipping damaged batteries. A waste lead acid battery is considered damaged if the possibility of leakage exists due to a crack or if one or more caps are missing. Transportation companies may require draining the damaged batteries of all acid prior to transport. Place damaged batteries in an acid-resistant container and add soda ash to neutralize any acid that might spill. Damaged and intact waste batteries must be packaged separately.

[10] https://batteryuniversity.com/index.php/learn/article/absorbent_glass_mat_agm

Further technical details and recommendations are listed in the document in the UNEP Technical Guidelines for the Environmentally Sound Management of Waste Lead-acid Batteries (Basel Convention series/SBC No. 2003/9) (Chapter 3.3 on transporting).

Table V-3: Applicable standards for waste Li-ion battery transport and storage

Standard / Directive (Version / Date)	Requirements
European Agreement concerning the International Carriage of Dangerous Goods by Road – ADR (2019)	The transport of waste lithium-ion batteries is subject to the following. • Part 4 Packing • Part 5 Consignment procedures • Part 6 Requirements for the construction and testing of packagings, intermediate bulk containers, large packagings, tanks and bulk containers • Part 7 Provisions concerning the conditions of carriage, loading, unloading and handling • Part 8 Requirements for vehicle crews, equipment, operation and documentation • Part 9 Requirements concerning the construction and approval of vehicles Examples: <u>Damaged or Defective Batteries via Road</u> • Special Provision 376, Packaging Instruction P908 • Appropriate marking • Necessary transport documents • Batteries are split in “non-critical” (no possible danger during transport) and “critical” (possible danger during transport). • “non-critical” damaged or defective batteries: 1. Each damaged or defective battery or equipment containing such batteries must be packed separately in leak proof inner packaging to prevent release of electrolyte 2. UN approved packaging required for all battery types (Packing Group II), e.g. fibreboard box 3. Must be secured against movement within the package 4. Sealed packaging shall be fitted with a venting device 5. Must be packed with non-combustible and non-conductive thermal insulation material, material class A1 or A2 (non-combustible, e.g. rockwool, glass wool, foam glass, Vermiculite) 6. Absorbing material to absorb leaking electrolyte from leaking batteries 7. Batteries shall be protected against short circuit 8. “critical” damaged or defective batteries: 9. Transport is only allowed with approval from the Competent Authority (e.g. in Germany: Federal Institute for Materials Research and Testing (BAM)) with detailed requirements as stated in the approval <u>Batteries for Disposal & Recycling <=100 Wh per battery</u> • Special Provision SP 377, Packaging Instruction P909 • Weight limit: 30kg gross weight per package • Appropriate marking • Necessary transport documents • batteries >100 Wh UN-approved packaging required (Packaging Group II) • For batteries ≤ 100 Wh and for batteries contained in equipment, UN-approved packaging is not required. Strong outer packaging constructed of suitable material, and of adequate strength and design in relation to the packaging capacity and its intended use.

Standard / Directive (Version / Date)	Requirements
	• Batteries shall be packed to prevent short circuits and dangerous evolution of heat • Protection against short-circuits and dangerous evolution of heat. • This can be achieved by: individual protection of the battery terminal; inner packaging to prevent contact between batteries; batteries with recessed terminals designed to protect against short-circuits or; the use of non-conductive and non-combustible cushioning material to fill empty space between the batteries in the package • Batteries shall be secured within the outer packaging to prevent excessive movement during carriage (e.g. by using a non-conductive and non-combustible cushioning material or through the use of a tightly closed plastic bag)
Regulation (EC) No 1013/2006 of the European Parliament and of the Council of 14 June 2006 on shipments of waste	Written notification and consent; Article 3 (1); notification see article 4, contract see Article 5; financial guarantee see Article 6; transmission of the notification (Article 7); consent (Article 9); protection of the environment see Article 49
Regulations concerning the International Carriage of Dangerous Goods by Rail (RID). 2019	Packaging instructions (PI) and Special Provision (SP)
International Maritime Dangerous Goods (IMDG) Code	Packaging instructions (PI) and Special Provision (SP)
International Civil Aviation Organization (IATA): Lithium Battery Guidance Document. Technical Instruction for the Safe Transport of Dangerous Goods by Air	Packaging instructions (PI) and Special Provision (SP)

There is no consensus on what blood level is required to guarantee the employee will be free from adverse effects of lead exposure. However, some scientific advisory bodies (e.g. American Conference of Governmental Industrial Hygienists - ACGIH) have advised that male employees blood lead levels should be maintained below 20 µg/100ml to avoid subtle but long-term health consequences.

Women of childbearing age are a sensitive subpopulation as lead can adversely impact the neurodevelopment of the unborn child and breastfeeding children.

According to the UK Health & Safety Executive Publication “Control of lead at work” (Third edition as of 2002), the following actions must be triggered if the lead blood level in a male employee reaches or exceeds 50 µg/100ml, and in a female employee reaches or exceeds 25 µg/100ml:

- Warn the employer that an employee's blood-lead concentration is approaching the suspension level.
- Prompt the employer to investigate why it has been breached and to review the range and effectiveness of control measures used with the aim of reducing the employee's blood-lead below the action level.
- During the investigation the employee should be counselled by the Line Manager to prevent the employee reaching the removal or suspension level, if possible.
- removal of male workers at 60 µg/100ml and females at 30 µg/100ml from work areas where they might be exposed to lead dust and return to their place of work only when new test results are below the above stated action level.

According to the UK Health & Safety Executive Publication "Control of lead at work" (Third edition as of 2002), the following actions must be triggered if the lead blood level in a male employee reaches or exceeds 50 µg/100ml, and in a female employee reaches or exceeds 25 µg/100ml:

- Warn the employer that an employee's blood-lead concentration is approaching the suspension level.
- Prompt the employer to investigate why it has been breached and to review the range and effectiveness of control measures used with the aim of reducing the employee's blood-lead below the action level.
- During the investigation the employee should be counselled by the Line Manager to prevent the employee reaching the removal or suspension level, if possible.
- removal of male workers at 60 µg/100ml and females at 30 µg/100ml from work areas where they might be exposed to lead dust and return to their place of work only when new test results are below the above stated action level.

ANNEX VI – FINAL TREATMENT OF WASTE MAGNETS

Waste magnet recycling methods are mainly divided into three methods: extracting/recovering REEs by the smelting process, recycling as a magnetic alloy material, and the reuse of collected magnets for other uses [19].

The REEs extracting/recovering method recommended under CEWASTE is based on [hydrometallurgy using a strong acid]. [The process to be recommended is to be confirmed and further developed. A diagram flow is to be added]