



# Storage and treatment of cathode ray tubes (CRTs) and display equipment containing CRTs

Quick guide 874\_11

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## What's this document about?

This document covers the main storage and treatment requirements for CRTs under 'best available treatment recovery and recycling techniques' (BATRRRT). This is required by the WEEE Directive, and is also an extension of the principles of 'best available techniques' (BAT) required under the Integrated Pollution Prevention and Control Directive.



Document details

## Who does this apply to?

This document has been produced to help Environment and PPC officers with compliance of CRT storage and treatment activities. It does not specifically cover repair/reuse activities.

Whilst this is an internal guide it may be shared externally where appropriate to help deliver a consistent regulatory approach.



Related documents

## Main issues covered by this guide

This document covers:

- CRT types, composition and hazardous waste coding;
- permitting requirements;
- storage and handling standards;
- treatment requirements;
- use of CRT glass/end of waste;
- health and safety considerations during site visits.



Feedback

## Contact for queries

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## CRT types, composition and hazardous waste coding

CRTs are commonly used in TVs and computer monitors but can also be found in bank cash machines, arcade game units and hospital equipment e.g. oscilloscopes etc.

A typical colour CRT screen is illustrated below. The neck section contains around 40% lead oxide, the funnel section contains around 20% lead oxide. The glass 'frit' or solder glass which joins the panel and funnel sections together contains around 75 to 90% lead oxide. The screen typically contains very little lead but instead contains barium, strontium, and zirconium oxides. The inside of the screen is first covered with a graphite coating and then the fluorescent coatings (that give the blue, green and red colours). These coatings are often referred to as 'phosphors' and can be composed of zinc, cadmium and yttrium sulphides and copper or silver chloride, and may even contain arsenic but do not contain phosphorous. They can have H4, H5, H6, H12, H14 and H15 hazards.

**Note:** A small amount of black and white CRTs may also be present in the waste stream. These are still hazardous and should be dealt with in the same manor as colour CRTs, but if the glass is being cleaned for reuse into new CRTs it should be kept separate as some re-processors may not want it mixed in with colour CRT glass as the constituents are different.

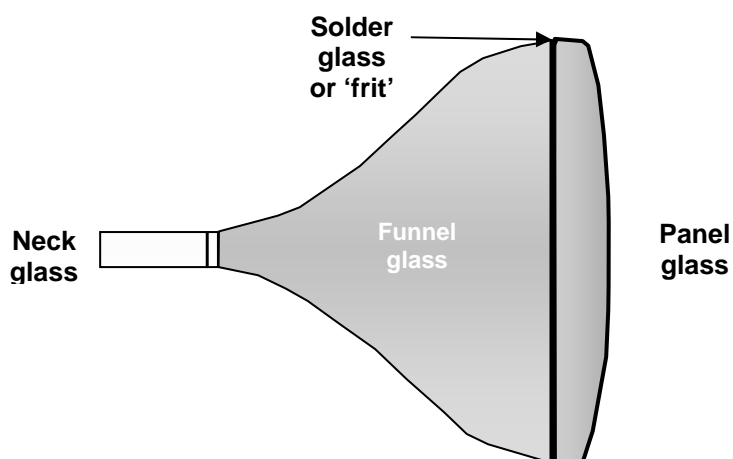


Figure 1 Main glass components of a typical CRT

### Hazardous waste coding

Whole WEEE items containing CRTs are classified under the European Waste Catalogue (EWC) as hazardous waste, either as 16 02 13\* or if arising from municipal sources as 20 01 35\*. The bare CRT is classed as hazardous waste 16 02 15\* until the fluorescent coatings are removed (see '*Classification of Electronic Display Devices*' in Related documents for more information). Further information on classification and coding of treatment outputs is in Appendix 1 at the end of this document.

**Permitting requirements**

If the site you regulate is dismantling TVs/PC monitors, processing CRTs or handles CRT glass, then please ensure that the facility holds the correct type of permit.

Most WEEE treatment sites will be 'waste operations' **but** any site that undertakes any treatment of the separated (bare) CRT, e.g. splitting or granulating (other than removing plastic and metal bits from the outside of it) in a plant with a capacity of >10 tonnes per day must have an EPR installations permit for Schedule 1, Section 5.4 A(1)(c) R5 operations. This is because casing removal (R3) and metal removal (R4) operations are not currently subject to IPPC, but R5 operations are. An example is depicted below.

**Please ensure that any CRT processing facility you inspect is correctly permitted by carefully auditing the CRT throughput figures.**

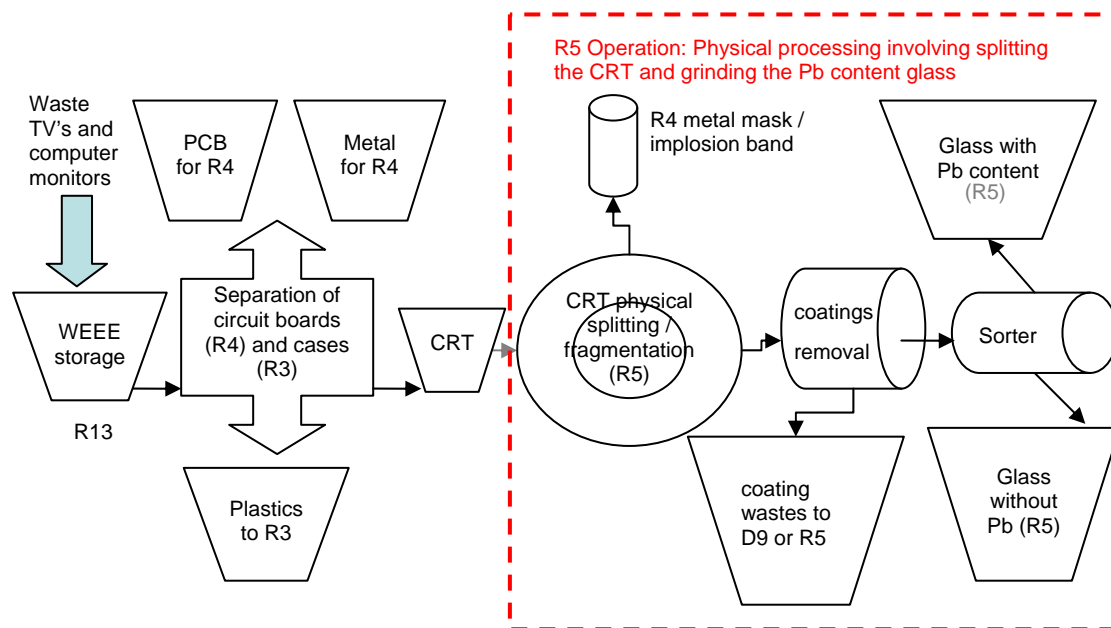


Figure 2: Typical process steps for CRT treatment

## Storage and handling standards

### Key requirements

- Waste equipment must be stored on an impermeable surface with sealed drainage. It must also be stored under cover 'where appropriate' – i.e. if going for repair/re-use or if damaged with potential for contaminated runoff.
- Display equipment containing CRTs and bare CRTs must be stored/ handled to prevent breakage i.e. not dropped or stacked in an unstable manner. To prevent breakage cages, pallets or bulk bags should be used accordingly.
- Any broken CRTs must be handled in an enclosed environment with appropriate systems to ensure that any fluorescent coatings/ leaded glass dust released are contained, collected and subsequently managed properly.
  - If dropping whole or broken CRTs into skips, the skips should be in a building (or covered) and operating under Local Exhaust Ventilation with abatement to capture all dust.
  - If bulk tipping of broken CRTs or mixed CRT glass, tipping must be done in an area operating under extraction and negative pressure to collect all dust. Appropriate noise controls may also be required for any unloading at sensitive sites.
- Unloading and transport of glass and its subsequent reception/handling at a receiving facility must also be undertaken in accordance with BATRRRT e.g. sending a bulk tipper of loose or funnel or mixed glass to a facility without an enclosed tipping environment would not be acceptable and breach the operators Duty of Care to prevent waste escaping.

The inevitable consequence of smashing CRTs, is that some fluorescent coatings/ leaded glass dust will be released at both the dismantling site and the receiving site if there is not adequate containment or abatement of this activity. Such a release is preventable and so is not acceptable as BATRRRT or BAT.



Figure 3 - open storage of broken CRTs is unacceptable

## Treatment requirements

The relevant treatment requirements of the WEEE Directive are contained in Defra's BATRRRT guidance in Table 1. Waste CRTs must only be treated at sites that meet these requirements.

### Key requirements

- Initial treatments involve removing casings and circuitry to leave the 'bare CRT' for further processing off-site. Where this is done removal of the copper yoke must be undertaken carefully to minimise breakage of the neck which can lead to fragmentation of the CRT. When breakage does occur all broken glass should be collected and not mixed with other fractions.
- The treatment process must remove the fluorescent coatings as a separate fraction. This is typically done either by splitting the CRT and vacuuming from inside the screen or whole shredding and recovery via a washing process (see Appendix 1). Although not an absolute requirement, it is expected that the treatment process will separate the high lead content funnel glass from the low lead content screen glass. The screen glass must contain minimal to no frit glass.



Figure 4. Poor handling leading to breakage and loss of fluorescent coatings during the dismantling process.

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## Use of CRT glass/end of waste

The main uses for the CRT glass are:

- Closed loop recycling into new CRTs
- Aggregate
- Other niche uses – decorative pebbles, tiles and marbles (typically smaller volumes)

The waste hierarchy would prioritise the reuse of the cleaned CRT glass in remanufacture of new CRTs (closed loop recycling) or the recovery of the lead from the glass.

It is believed that some CRT glass (only) is currently being used under the aggregates quality protocol (QP). Whilst some cleaned low lead content screen glass may be within acceptable leaching limits, **the use of funnel glass is not acceptable for this purpose.** CRT glass is not envisaged as an input material under this QP, and the revised aggregates QP will specifically exclude CRT glass in future. The Waste Protocols Project was unable to develop a QP for CRT glass due to insufficient information on the environmental risks from the use of CRT glass.

As with other wastes, if an operator would like to submit an application for their material to cease being a waste, details about how to do this are available on our website

(<http://www.environment-agency.gov.uk/business/sectors/124299.aspx>)

Our current position regarding use of processed CRT glass is set out in our regulatory position statement 'The regulation of materials being considered by the Waste Protocols Project' on our website

(<http://www.environment-agency.gov.uk/business/regulation/99685.aspx>)

CRT glass will be removed from this statement in January 2012 and a separate position statement, confirming the waste controls around the use of processed CRT glass, will be published.

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## Health and safety considerations during site visits

The HSE are principally concerned over the release of lead during processing of CRTs under the Control of Lead at Work Regulations 2002 (CLAW). This requires operators to adequately assess the risks and put in place suitable control measures to prevent or control exposure. More information is available on their website (<http://www.hse.gov.uk/foi/internalops/sectors/manuf/03-11-01/index.htm>)

Please ensure you have all necessary PPE when undertaking compliance visits, including face fit masks where appropriate and follow good hygiene practices to minimise any lead exposure via inhalation or ingestion.

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**Table 1: Extract from Defra's 'Guidance on Best Available Treatment Recovery and Recycling Techniques (BATRR) and treatment of Waste Electrical and Electronic Equipment (WEEE)' November 2006**

**Cathode ray tubes**

81. The WEEE Directive requires:

***“first, that the CRT has to be removed from separately collected WEEE, and second, that the fluorescent coating in the CRT has to be removed.”***

82. Cathode ray tubes (CRTs) are mainly used in either computer monitors or televisions. Handling of CRTs can present a danger of implosion. As a consequence, safe systems of work will need to be used to control the risk to operators. This would typically include enclosure of the process to prevent flying glass entering the working area..

83. The objective of the removal of the fluorescent coating is to ensure that it does not cause pollution or harm. Two main types of approach could be used to separate the fluorescent coating:

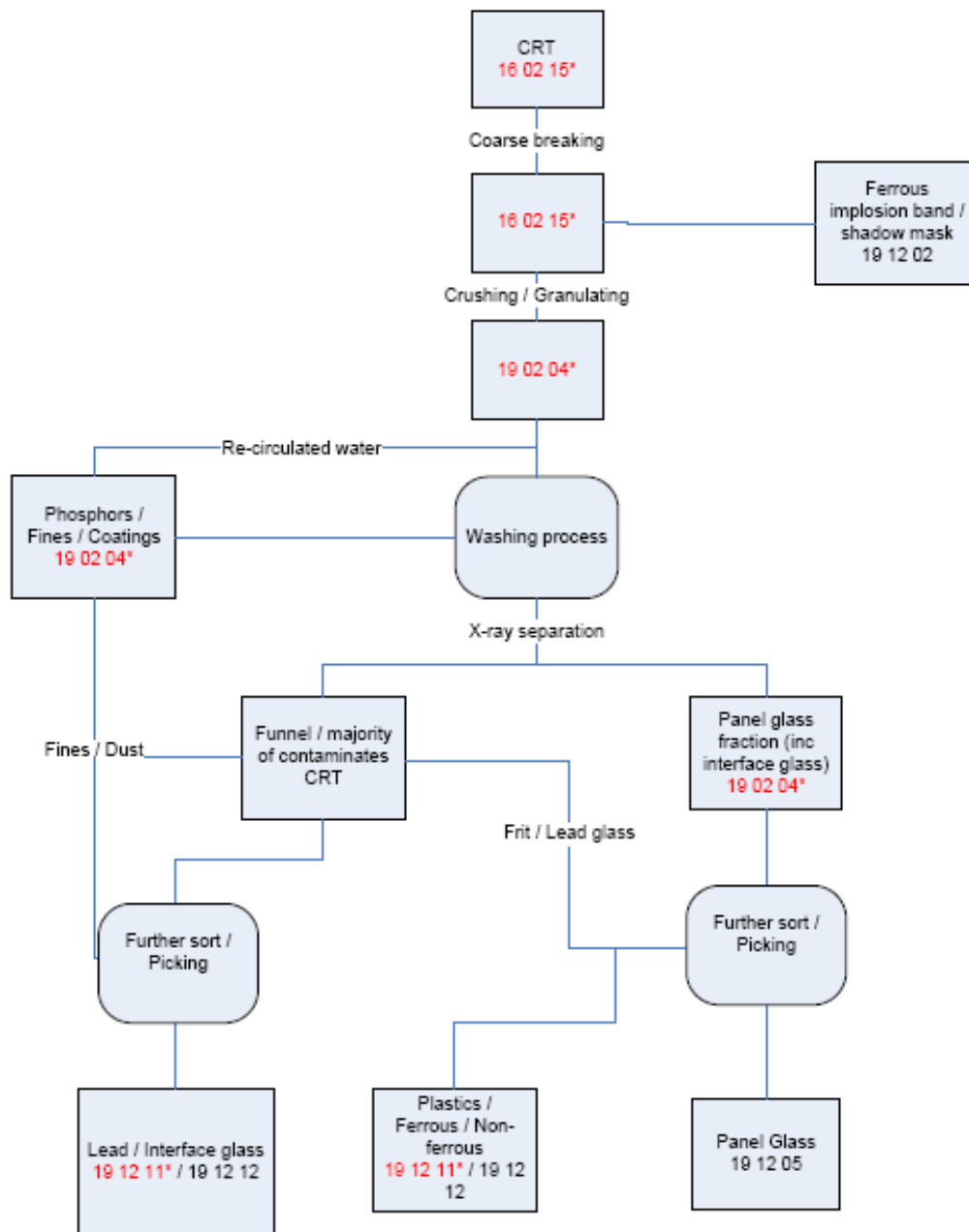
(i) The main approach is to separate the lead-containing cone glass from the front glass using a hot wire, laser or cutting disc, followed by removal of the fluorescent coatings.

(ii) An alternative approach is to shred either the CRT or TV/monitor whole and then mechanically recover the various fractions.

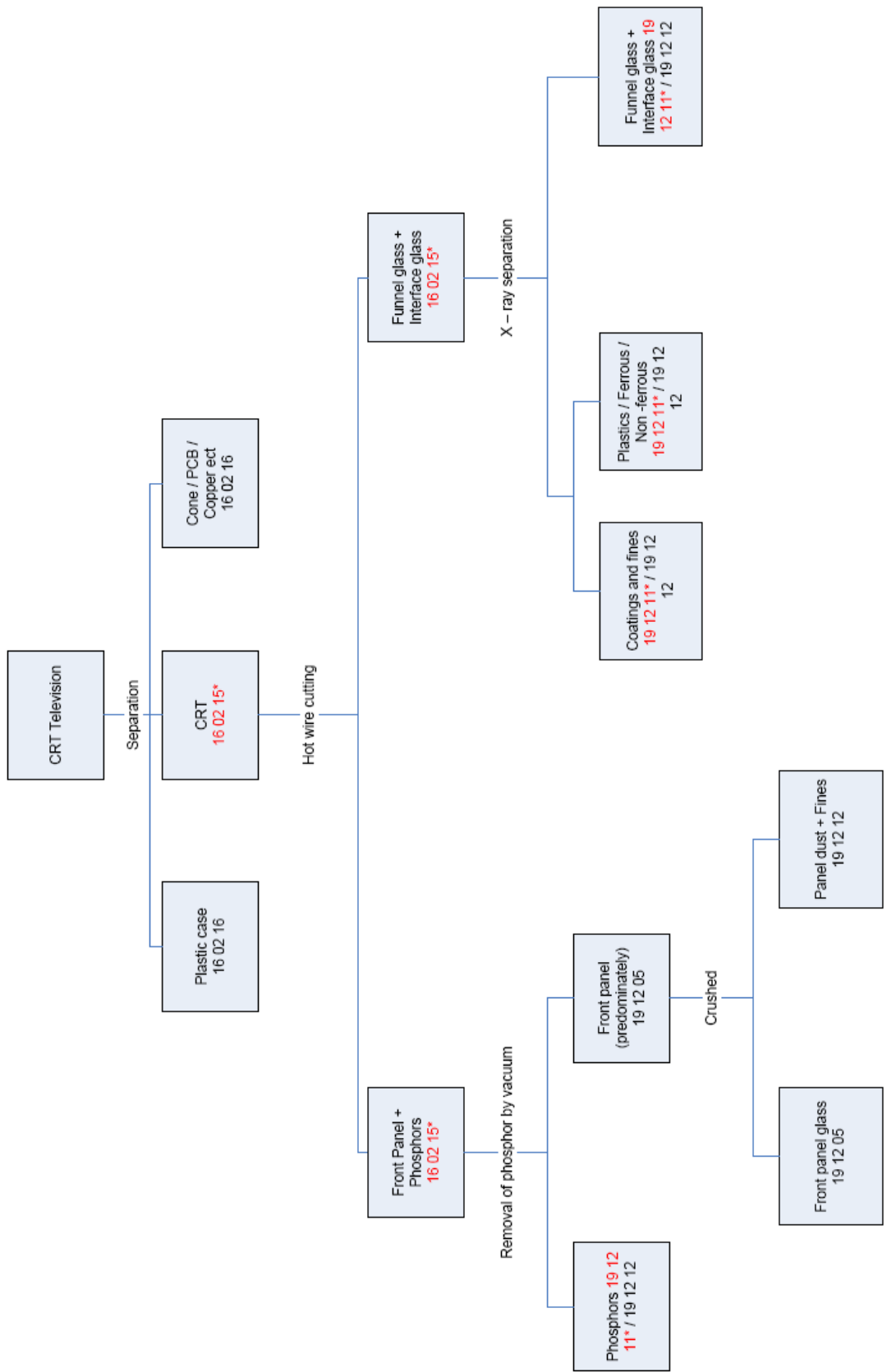
84. The second option will only meet the requirements of Annex II to the WEEE Directive if evidence is provided that demonstrates that the fluorescent coatings are removed as a separately identifiable fraction. Furthermore, it is unlikely to be regarded as BATRR if the mixing and contamination of the various fractions preclude recycling of the glass.

85. The fluorescent coatings that have been removed from the CRT should be stored in appropriate labelled containers and then disposed or recovered at an authorised treatment facility.

## Appendix 1: Waste coding for whole CRT/TV processing



# Appendix 1: Waste coding – for CRT splitting processes



## Related documents

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### Links

- [Waste Electrical and Electronic Equipment Directive](#)
  - [Guidance on Best Available Treatment Recovery and Recycling Techniques \(BATRRRT\) and treatment of Waste Electrical and Electronic Equipment \(WEEE\) November 2006](#)
  - [End of waste submissions](#)
  - [Regulatory position statements](#)
  - [Classification of electronic display devices](#)
  - [Health & Safety inspection standards for WEEE processing facilities](#)
  - [The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment \(RoHS\)](#)
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