



Environment  
Agency



# Waste cooling equipment (WCE): appropriate measures for permitted facilities

Consultation

Date: July 2021

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We help people and wildlife adapt to climate change and reduce its impacts, including flooding, drought, sea level rise and coastal erosion.

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Published by:

Environment Agency  
Horizon House, Deanery Road,  
Bristol BS1 5AH

[www.gov.uk/environment-agency](http://www.gov.uk/environment-agency)

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# 1. Introduction

This guidance explains the extra standards (appropriate measures) that are relevant to regulated facilities with an environmental permit to treat or transfer waste cooling equipment (WCE). They are additional to the relevant standards in 'Waste electrical and electronic equipment: appropriate measures for permitted facilities'.

## 1.1 Types of WCE

WCE includes:

- fridge and freezer appliances – domestic, commercial and industrial, for example, fridges, chest freezers or chilled display cabinets
- portable air-conditioning appliances (excluding permanently installed fixtures in buildings)
- heat pump tumble-driers (including combined washer-dryers)
- de-humidifier appliances that use cooling gases
- appliances that dispense cold products (for example, water coolers, ice cream or ice cube dispensers)

WCE contains refrigerants, blowing agents and oil, which must be removed during its treatment. They may also contain mercury switches and capacitors over 25mm, which must also be removed.

Waste fractions and residues resulting from the treatment of WCE (with most likely List of Waste codes) include:

- refrigerants and blowing agents (14 06 01\* if containing fluorinated compounds or 14 06 03\* if not containing any fluorinated compounds)
- treated polyurethane insulation foam (19 10 06 or 19 02 10)
- ferrous scrap metal, for example iron and steel (19 12 02)
- non-ferrous scrap metal, for example aluminium and copper (19 12 03)
- plastic, for example polystyrene and rubber (19 12 04)
- glass (19 12 05)
- mercury switches (16 02 15\*)
- compressor oil (13 02 08\*)
- spent activated carbon (06 13 02\*)
- shedder light fraction (19 10 04 or 19 10 03\*)
- plugs and cables (16 02 16 or 16 02 15\*)
- capacitors over 25mm (16 02 16 or 16 02 15\*)
- compressors (16 02 16 or 16 02 15\* if containing hazardous substances)

These codes and descriptions are likely to be appropriate for uncontaminated, separate fractions of relevant wastes. You should consider and use alternative codes for other contaminated or mixed fractions of waste, where appropriate.

The refrigerants and blowing agents in WCE may include:

- chlorofluorocarbons (CFCs)
- hydrochlorofluorocarbons (HCFCs)
- hydrofluorocarbons (HFCs)
- volatile hydrocarbons, for example pentane, propane and butane (VHCs)
- other refrigerants, for example ammonia
- other blowing agents, for example carbon dioxide

The fluorinated substances (CFCs, HCFCs and HFCs) are referred to in this guidance as volatile fluorocarbons (VFCs).

CFCs and HCFCs are ozone depleting substances and are subject to additional controls under [The Ozone Depleting Substances Regulations 2015](#).

HFCs have a high global warming potential and are subject to additional controls under [The Fluorinated Greenhouse Gases Regulations 2015](#).

There's further guidance on managing fluorinated gases in:

- [recovering F gas when disposing of equipment and insulating foam](#)
- [HCFCs in refrigeration and air conditioning equipment](#)

VHCs are highly flammable – you must handle them safely.

The type and quantity of refrigerant and blowing agent contained in WCE varies depending upon the age, size and type of appliance.

WCE manufactured before 1995 typically contain CFC and HCFC refrigerants and blowing agents. After 1995, these began to be replaced by HFC and VHC refrigerants and blowing agents.

You should be able to identify the type of refrigerant and blowing agent contained in WCE from the rating plate on the appliance, if present and legible. This is usually found inside the refrigerator or freezer compartments. The blowing agent marking may also be found on the exterior of the back panel of the appliance or on the compressor label, if present and legible. Unless you positively identify the refrigerant and blowing agent, you should assume the appliances contain VFC gases.

Earlier guidance, such as the 2002 Environment Agency (EA) and Scottish Environment Protection Agency (SEPA) Guidance on the Recovery and Disposal of Controlled Substances Contained in Refrigerators and Freezers, focused primarily on preventing and controlling emissions of VFCs. WCE on the market now, and most WCE entering the waste stream, contain VHCs. Therefore, this guidance sets appropriate measures for preventing and controlling both VHC and VFC emissions. It also incorporates relevant requirements and emission limits from the [waste treatment BAT reference document and BAT conclusions](#) for the treatment of WEEE containing VFCs and VHCs.

## 1.2 Summary of common WCE treatment processes

The treatment of WCE can be split into 2 stages of treatment.

Stage 1 (degassing) typically involves:

- removing, separating and collecting refrigerant and oil from the cooling circuit of the appliance (including removing and capturing refrigerant from the oil in a contained environment)
- removing and draining compressors
- removing switches, drawers, glass, gas discharge lamps and other internal components

Stage 2 (destruction) typically involves:

- shredding the body (carcass) of the cooling equipment (including dismantled insulation panels)
- removing and capturing the blowing agent in a contained atmosphere
- separating and collecting the degassed insulation foam, metal and plastic fractions

The foam is usually processed further (for example, ground or milled) to make sure the blowing agent is removed and collected.

The collected refrigerant and blowing agent gases are stored in gas-tight vessels and sent for destruction (usually by high temperature incineration). Some facilities include on-site destruction processes (for example, thermal oxidation).

Some gases that are not VFCs (for example, from commercial and air-conditioning units), may be sent for processing and refinement at specialist gas treatment facilities, and re-sold into the refrigeration industry.

Degassed foam is sent for disposal or recovery, usually landfill or incineration (energy from waste). Some facilities compress or extrude the treated foam to produce pellets, whilst at other sites the milled foam exits the plant as a powder without additional processing.

The separated plastic, metal and degassed oil fractions are sent for recycling and recovery.

## 2. General management appropriate measures

These are the additional appropriate measures for the general management of regulated facilities with an environmental permit for the treatment or transfer of WCE.

1. You must monitor and review the performance of your WCE treatment plant on an ongoing basis (at least quarterly) as part of your management system. You must compare monitored performance with expected performance and relevant standards of operation. You must aim to maximise the collection and recovery of waste gases, residues and recyclable fractions and prevent emissions.

### 2.1 Plant commissioning requirements

1. Before commissioning new WCE treatment plant, you must provide the Environment Agency with a commissioning plan, including a timetable for completion. The commissioning plan must demonstrate how the proposed operations will meet the following requirements.

#### Monitoring of point source and fugitive emissions

2. You must complete a comprehensive monitoring exercise to demonstrate that the stage 1 and stage 2 processing of WCE does not lead to fugitive releases to air. This includes emissions of refrigerant or blowing agent gases and dust. This could be, for example, by using a combination of ambient air monitoring and gas leak detection equipment.

3. You must complete representative monitoring to:

- characterise point source emissions to air from the treatment process
- confirm you will meet relevant emission limits

Your monitoring must also determine the size distribution of particulate matter in the emissions, identifying fractions that are 10 micrometres or less in diameter (PM10) and 2.5 micrometres or less in diameter (PM2.5).

#### Quality assurance (QA) of monitoring and sampling

4. Suitably competent and trained staff must carry out monitoring and sampling, following relevant monitoring methodologies and standards. An appropriately accredited independent laboratory (for example, UKAS accredited) must carry out sample analysis.

5. An appropriately trained and experienced engineer must validate results.

6. You must calibrate and service monitoring equipment in line with the manufacturer's recommendations. You should make records available to the Environment Agency on request.

## **Making of records**

7. Records must include:

- specified details of measurements and samples to support analytical and QA requirements, including dates, times, locations and people doing the monitoring
- results of measurements and sample analyses, with error limits
- interpretation and review of results
- validation of accuracy and validity of results, by a competent person

## **Determinands monitored and sampled**

8. Records must include:

- the numbers and types of WCE treated during commissioning
- results of the testing of residual materials to meet the treatment standards specified in this guidance (including refrigerant and blowing agent recovery, and composition of other output materials, including oil, foam, plastics and metals)
- quantities of residual materials produced
- the results of the emissions monitoring done
- details of the identities, relevant experience and relevant qualifications of the people providing commissioning validation

9. After completing commissioning operations, you must provide the Environment Agency with a validation report that satisfies the requirements of the commissioning plan. You must not start destruction operations until the Environment Agency agrees the commissioning validation report in writing.

## **2.2 Other accident prevention measures**

1. Areas of the site where explosive atmospheres could occur (for example, fridge storage or treatment areas) must be assessed and, where appropriate, classified into hazardous zones in line with the [Dangerous Substances and Explosive Atmospheres Regulations \(DSEAR\)](#). Plant and equipment used in these zones must be [ATEX compliant](#) and operated by appropriately trained staff.



## 3. Waste pre-acceptance, acceptance and tracking appropriate measures

These are the additional appropriate measures for waste pre-acceptance, acceptance and tracking at regulated facilities with an environmental permit for the treatment or transfer of WCE.

### 3.1 Waste pre-acceptance

1. You must tell your customers and waste carriers about which wastes you are permitted to store or treat, and any requirements regarding their condition and management. For example, you should tell them about the following.

#### **How to assess if WCE may be suitable for preparing for reuse**

For example, if WCE reuse is compliant with [F-gas legislation](#) – has no signs of damage, internal shelves, furniture and cable are present.

If you identify suitable units, you should:

- handle and consign them with extra care
- separate them from other WCE so that they can be unloaded correctly at the destination facility

#### **Restrictions on the types or quantities of WCE that you are permitted to accept for treatment**

For example, WCE containing ozone depleting substances or ammonia.

#### **Measures that your customer and collection site staff should take to protect appliances and prevent potential emissions during receipt, storage and handling**

For example:

- protecting the cooling circuit and exterior casing
- preventing the removal of copper bullet (component) and compressor before degassing
- checking that any organic or other contents (such as food, drink, wastes) are removed from the appliance before collection or delivery

## 3.2 Waste acceptance

1. You must check WCE on arrival for:

- damage to the casing, for example, where the foam can be seen exposed
- leaks, including whether the cooling circuit is complete and includes a compressor

2. You must move WCE to a well-ventilated area, away from any potential sources of ignition and other combustible wastes, and prioritise it for treatment (treating it within 24 hours if possible) if it:

- is damaged and the insulation foam can be seen exposed
- poses a significant risk of releasing refrigerant or oil

3. You must visually check inside WCE to check for non-compliant material or items, for example, food, drinks or other waste that may have been left in them. Empty the WCE of all foodstuffs and other items before moving them to the storage area.

## 3.3 Waste tracking

1. You must be able to track WCE whilst it is held on site and identify its location if required. For example, for:

- preparing for reuse
- storage (pre-treatment or transfer)
- degassing (stage 1)
- destruction (stage 2)

2. Through your operating procedures and records, you must be able to demonstrate how stock rotation is managed to make sure you do not exceed limits on waste storage time and quantities.

3. If your permit restricts the types of WCE that you are able to treat (for example, your stage 2 process is restricted to treating WCE that does not contain ODS), your tracking systems and procedures must be able to record and demonstrate compliance with this restriction. For example, this could be by:

- providing training to operatives in how to identify units containing ODS
- having a separate storage area in place for these units after degassing
- having records to show onward transfer or treatment at an appropriately permitted facility

## 4. Waste storage and handling appropriate measures

These are the additional appropriate measures for waste storage, segregation and handling at regulated facilities with an environmental permit for the treatment or transfer of WCE.

1. You must handle and store WCE in a way that protects and prevents damage to cooling circuits, the appliance casing and foam insulation.
2. You must not store untreated WCE for longer than 3 months before treatment on site or transfer off site. You should remove all other wastes from your site within a maximum of 6 months from receipt or production.
3. You must store WCE that has not been degassed whole. You must not store it in a way that puts weight or pressure on to the cooling circuit (for example, by storing or resting it horizontally on its back).
4. You must position any mechanical grabs, arms or similar equipment (for example, on forklifts) used to handle WCE so that they do not squeeze or damage the cooling circuit. You must control and minimise any pressure or physical contact applied to WCE to prevent causing damage to the appliance casing or insulation foam.
5. You must store WCE under weatherproof covering (for example, a roofed building) if it:
  - is damaged and the insulation foam can be seen exposed
  - poses a significant risk of releasing refrigerant or oil

You must also store any WCE that poses a significant risk of releasing refrigerant in a well-ventilated area a safe distance away from any potential sources of ignition and other combustible wastes.

6. You must store WCE and combustible waste materials resulting from the treatment of WCE (for example, plastic, foam and waste packaging) in line with an approved fire prevention plan. You must:
  - maintain adequate fire breaks between waste storage areas
  - make sure there is safe access between rows of appliances and storage containers to allow easy inspection

7. You must store WCE in a safe and stable manner on level ground. You must not stack or store appliances more than 3.5m high.

8. Where WCE has been dismantled into panels (for example, cold room panels or large commercial refrigeration units), you must make sure you store and handle panels in way

that prevents damage to, or fragmentation or compaction of, the foam. You must make sure that any stacking of panels avoids crushing them and that stacks are stable. You must protect dismantled foam panels from the weather (wind and rain), direct sunlight and other sources of heat – for example, store them in a dedicated area of a building or under cover.

9. You must store compressors removed from equipment in secure, leak-proof containers. This is to contain any spills from the small residual quantities of oil they may contain. The containers must be:

- closed or kept under cover to prevent the accumulation and contamination of rainwater
- kept away from direct sunlight and other sources of heat

10. You must collect and store refrigerants and compressor oil that has not been degassed in gastight containers that are appropriate and sealed.

11. You must store degassed oil, recovered from compressors and cooling circuits, in above-ground storage tanks or sealed containers. These must:

- have appropriate secondary containment systems
- be located on an area of impermeable surfacing provided with sealed drainage

12. If you treat different types of WCE in separate batches or by using different plant or processes (for example, based upon refrigerant or blowing agent type), you should sort them by type before treatment and store them separately.

If you are only permitted to treat certain types of WCE (for example, you are only permitted to treat hydrocarbon WCE through your stage 2 processes, or are unable to treat ammonia WCE) then you should identify and treat these waste types separately from those that you are not permitted to treat (for example, based upon blowing agent type).

You should label the areas of a site where you store different types of WCE (using signs or markings) so it is clear what WCE is to be stored where.

13. You must store waste items removed from WCE in line with any hazardous properties they may have. You must store and manage any food waste, biodegradable waste, or waste with potential for releasing fugitive emission (including dust or odour) in a way that prevents and minimises such emissions. For example, by storing them within a building or closed container and prioritising them for treatment or transfer.

14. You must clearly mark and sign storage areas, and all clearly label containers (for example, with the relevant EWC code and any hazardous properties).

15. You must label, store and consign containers used to store hazardous waste in line with their hazardous properties.

16. You must regularly inspect storage containers, cylinders and drums and keep them sound condition.

17. You must conform to HSE standards where relevant, specifically:

- [HSG51: The storage of flammable liquids in containers](#)
- [HSG103: Safe handling of combustible dusts: Precautions against explosions](#)
- [HSG140: Safe use and handling of flammable liquids](#)
- [HSG176: The storage of flammable liquids in tanks](#)
- [L117: Rider-operated lift trucks: Operator training and safe use](#)
- [INDG139 Using electric storage batteries safely](#)

18. You must make sure that plant and equipment in which compressed gas (for example, nitrogen gas) is stored or used, are designed, operated and maintained in line with relevant industry standards and guidance. You can find further information on the [British Compressed Gases Association](#) and [HSE](#) websites.

## 5. Waste treatment appropriate measures

These are the additional appropriate measures for waste treatment at regulated facilities with an environmental permit for treating WCE.

1. Before subjecting WCE to further treatment, you should remove any:

- external electrical cables
- capacitors over 25mm
- mercury switches

Where necessary, you should also allow any excess water to drain from the WCE before treating it.

2. You must only remove the compressor from WCE after you have checked it and confirmed that the cooling circuit has been fully degassed.

3. You must fully contain and seal the treatment plant and equipment you use to carry out stage 1 and stage 2 treatment of WCE. This is to make sure you capture and hold all liquids and gases released from the equipment in sealed gastight containers.

4. The plant and equipment you use to carry out stage 1 and stage 2 treatment of WCE (including associated plant, for example, storage vessels, pipework and plant used to generate or store nitrogen gas) must be regularly:

- monitored
- inspected
- maintained
- serviced

This is to:

- make sure they continue to function efficiently and safely throughout their operational life
- prevent emissions to the environment (for example, of contaminated water, dust, VFC and VHC gases)

You must be able to demonstrate this through your written procedures and records.

5. Treatment plant and equipment must only be operated by appropriately trained and competent staff. You must be able to demonstrate this through your written training procedures and records.

6. You must support routine inspection by regularly using proprietary gas detection equipment. This is to check for any gas leaks from the treatment plant or associated infrastructure, including:

- pipework
- valves
- seals
- connections
- storage vessels

You must keep evidence of maintenance procedures and the replacement of parts for at least 2 years.

7. You must sample and analyse separately collected waste water resulting from the treatment of WCE. This is to decide appropriate treatment and whether it:

- can be reused or recovered
- must go for disposal

8. You must place tanks and containers holding the refrigerant and blowing agent collected from the stage 1 and stage 2 treatment processes on accurate electronic scales. This is so you can monitor how much gas has been recovered and identify (in advance) when a tank will need to be changed.

9. For any oil, refrigerant or blowing agent removed from site, you must have procedures in place to make sure you record its:

- quantity
- nature
- origin and destination
- date of collection
- mode of transport
- treatment method (for example, incineration)

## **5.1 Stage 1 treatment (degassing)**

1. Your stage 1 treatment process must use specifically designed equipment (such as a specially designed drill head or piercing pliers) that pierces the cooling circuit of the WCE

in a way that maximises recovery of both oil and refrigerant. For example, at the lowest point of the compressor.

2. You must extract oil and refrigerant from the cooling circuit in the same step, using a vacuum suction system, to achieve the best recovery rate.

3. You must:

- minimise the amount of oil remaining in the compressor after treatment
- check that any remaining oil residues will not drip out from the compressor, unless the compressor is stored in (or over) a suitable covered container designed to drain and capture residual oil

You must not mix oil from WCE with oil from other sources in the facility.

4. Your operating procedures must make sure that compressors are routinely checked and tested to confirm they contain no (or minimal) residual oil before storage. For example, this could be by choosing a number of compressors at random each day and leaving them inverted, to drip, for an appropriate period. If you find any compressors drip oil, you must take appropriate action to improve the treatment process or operating procedures to prevent this happening.

5. Oil removed from WCE, including residual oil that has been drained and collected from compressors, will contain significant quantities of dissolved refrigerant. You must store the oil within a gastight sealed system or container until it has been fully degassed. This is to prevent the loss of refrigerants to the atmosphere.

6. You must pump the extracted oil into a condensing and separation unit, or equivalent contained system, for degassing (separation of refrigerant from oil).

7. You must transfer the recovered refrigerants to pressurised containers for storage through a fully contained gastight system, before on-site treatment or off-site transfer.

8. You must carry out the degassing treatment process:

- on an impermeable surface with sealed drainage
- in a building or under cover

9. If you accept WCE containing ammonia refrigerant for treatment, you must either:

- make sure that the ammonia refrigerant is removed from the cooling circuit before destruction
- demonstrate that the stage 2 fridge destruction plant is capable of safely treating fridges that contain an ammonia refrigerant



The treatment plant must be designed and operated to capture and contain the ammonia released upon destruction and prevent emissions to the environment.

10. Your stage 1 treatment plant must be capable of removing all (more than 99%) of the refrigerants and oils from the cooling circuit and compressor of WCE, to prevent emissions to the environment.

11. Your treatment process must achieve and demonstrate a refrigerant removal and recovery rate of at least 90% (see appropriate measures for [refrigerant recovery](#)).

12. Your degassing process must be designed and operated to make sure that the residual refrigerant content (VFC and VHC) in recovered compressor oil is less than 0.9% weight per weight (w/w), unless the oil is both:

- transferred immediately to a suitable sealed container to prevent fugitive emissions
- sent for further refrigerant recovery or destruction

Your sampling and testing must demonstrate that you've met the standard. You must be able to demonstrate this through your written sampling and testing procedures and records.

## 5.2 Stage 2 treatment (destruction)

1. You must use appropriate measures to minimise waste handling at your facility, for example using:

- hydraulic lifting
- belt conveyor
- other mechanical means

2. There must be no prior size reduction of WCE, other than minimal cutting of disassembled foam panels (for example, from large commercial refrigerators) where this is necessary for them to fit inside the plant.

Before stage 2 treatment, you must only cut panels to the extent required to fit in the treatment plant. Once cut, these panels must be prioritised for treatment to minimise storage time (treating them within 24 hours if possible).

If you cut panels, you must do this:

- using appropriate, intrinsically safe equipment
- with measures in place to prevent and minimise (collect and abate) emissions of dust and blowing agent gases

3. Your stage 2 treatment process must be designed and operated to make sure you:

- sort and separate foam, plastic and metal (ferrous and non-ferrous) fractions to achieve high standards of recovery
- treat the foam fraction to release and capture the blowing agent gas and contain polyurethane (PU) dust or powder – you must verify it has been treated to the required specification (for example, particle size)

4. The destruction process must:

- take place in an enclosed treatment chamber
- be provided with effective extraction and abatement systems that capture blowing agent gases and particulates (dust) and prevent emissions

5. You must prevent and control emissions of dust from your stage 2 treatment process using an appropriate air extraction and abatement system. Your abatement system should use one or a combination of:

- cyclonic separation
- fabric filtration
- wet scrubbing

6. Your treatment plant must make sure that the blowing agent released from the foam is collected and contained in gas tight equipment and vessels. You should collect the blowing agent using one or a combination of:

- adsorption on activated carbon
- cryogenic condensation with liquid nitrogen

You should store the collected gases and send them to be destroyed off-site, for example, by incineration. Destroying the blowing agent on-site by thermal or catalytic oxidation may be an acceptable alternative.

7. Your treatment process should recover and collect water separately from the blowing agent. If they are collected together, you must:

- collect and contain the blowing agent and water mixture in gas-tight pressure vessels
- accurately monitor the quantity of water collected with the blowing agent and record this weight for weight (w/w) on a regular basis, excluding this from any blowing agent recovery calculations

8. If you use a gas adsorption process, your treatment plant should be served by at least 2 filters, which operate in parallel, so that at least one is adsorbing whilst the other one is regenerating. During filter regeneration, after removing the blowing agent from the waste gas (for example, by compression and cooling), the treated gas should be fed back into the adsorption system to minimise emissions of any residual VHC or VFC compounds.

9. If you use thermal or catalytic conversion systems on site, you should consider and use energy recovery options where possible (for example, for preheating untreated gases or reactors).

10. Your enclosed treatment plant must be designed and operated to control the concentration of gases and prevent the risk of explosion. You should do this by one of the following methods:

- inert atmosphere – continuously monitoring and maintaining the concentration of oxygen below the relevant limiting oxygen concentration by injecting nitrogen
- forced ventilation – continuously monitoring and maintaining the hydrocarbon concentration below the relevant lower explosive limit through forced aeration

11. Your plant must be fitted with appropriate gas detection and monitoring systems to:

- detect any build-up of explosive vapours
- trigger automatic safe shutdown of the plant if the relevant limiting oxygen concentration or lower explosive limit is exceeded

12. If your treatment process is not conducted under an appropriate inert or forced ventilation atmosphere, you must take appropriate measures to prevent appliances containing hydrocarbon blowing agents (or other flammable substances and materials) from entering the process.

13. You must carry out continuous indicative monitoring of the air contained in plant extraction systems for VFC gases using infrared analysers.

14. Your plant must be designed, operated and maintained in order to maximise the removal and recovery of blowing agent and prevent emissions to the environment. Your treatment process must achieve and demonstrate a blowing agent removal and recovery rate of 90% or more (see appropriate measures for [blowing agent recovery](#)).

15. If you destroy recovered refrigerants or blowing agents on-site, for example, using thermal or catalytic oxidation, you must achieve and demonstrate a 99.99% destruction efficiency through your routine process and emissions monitoring.

16. Your treatment process must be designed and operated to make sure that the residual blowing agent (VFC and VHC) content of treated foam is less than 0.1% w/w. Sampling and testing must demonstrate that the standard is met. You must be able to demonstrate this through your written sampling and testing procedures and records.

17. Your treatment process must be designed and operated to make sure that the residual content of untreated foam (foam that has not been fully treated to release the blowing agent) in the recovered metal and plastic fractions is less than:

- 0.5% w/w in metal streams (ferrous and non-ferrous)
- 1.0% w/w in plastic streams

These limits apply both to the quantity of foam attached to pieces of metal and plastic and the quantity of loose pieces of foam in the recovered fractions. You must show you meet both standards through sampling and testing. You must be able to demonstrate this through your written sampling and testing procedures and records.

The standards referred to in this measure are set with the purpose of demonstrating appropriate measures are in place to separate and treat WCE insulating foam. They are not set to determine whether an output fraction of waste should be classified and described as a mixed waste or separate fraction for onward transfer.

## 6. Process monitoring appropriate measures

1. You must monitor, assess and record the performance of your WCE treatment plant on a continual basis. You must report this to the Environment Agency in line with the measures set out in this guidance and the conditions of your environmental permit.

2. You must record the number and type of WCE that you process through your stage 1 and stage 2 treatment processes.

For stage 1 processes, you must record the number of:

- WCE by refrigerant type (halogenated, hydrocarbon or other – for example, ammonia)
- defective WCE (appliance with no compressor or low gas pressure in the cooling circuit)

For stage 2 processes, you must record the:

- number of WCE by blowing agent type (halogenated, hydrocarbon or other, such as carbon dioxide)
- number of WCE by appliance type (see [blowing agent recovery](#) for more information on the relevant types – Type 1, Type 2, Type 3 and 4)
- quantity (kg) of separate foam panel processed

3. You should use an independent laboratory to complete compliance tests and analysis on the waste fractions and residues produced by your treatment process. The laboratory should:

- be appropriately accredited, such as UKAS accredited
- use recognised accredited methods if they are available

The tests and analysis to determine the quantity of residual foam in metal and plastic fractions must not be done on-site, unless you have appropriately experienced and trained staff.

The compositional tests and analysis carried out on oil, foam and gases must not be done on-site, unless you have an appropriately accredited laboratory and qualified staff.

You must have, and be able to provide, a full description of the material testing and analysis procedures and methods used. This must include details of relevant calibration methods and reference standards.

4. You must weigh waste fractions and residues produced by your treatment process using calibrated electric scales of an appropriate precision.

5. Because of the high volatility of VFCs and VHCs, you must:

- send all samples containing (or suspected of containing) these substances to the laboratory as quickly as possible – on the same day if possible
- store samples below 4°C whenever possible

Fill sample containers to the top and close them immediately after filling, to avoid any loss of refrigerant or blowing agent gases. Close and seal the containers and vessels that samples have been taken from immediately after sampling.

6. You must tell your Environment Agency inspector about the dates of sampling in advance, providing at least 5 working days' notice.

7. If process monitoring shows that the performance of your treatment plant does not meet any of the standards stated in this guidance, you must send a report to the Environment Agency summarising:

- the actions you will take to improve performance
- the dates you will complete these actions by

For example, this could be if you do not meet the refrigerant or blowing agent recovery rate standards, or compositional standards for waste fractions and residues.

## 6.1 Refrigerant recovery

1. You must assess and report plant performance against the refrigerant removal and recovery rate stated in appropriate measure 11 of [stage 1 treatment](#) (minimum of 90% recovery) on a 6-monthly basis. You may need to assess and report more frequently if your assessed recovery rate falls below the target recovery rate.

2. You must assess refrigerant recovery using a representative sample of the WCE treated at your facility. The sample must reflect the range of WCE types accepted for treatment and include a minimum of 100 intact appliances. You should select the WCE to make sure it is in good condition, with the cooling circuit and compressor intact, rating plate in place, and inspected to confirm there are no leaks.

3. You must weigh the appliances before and after treatment, using calibrated electronic scales of an appropriate precision, and the quantity of refrigerant and oil removed and collected.

To provide a comparison with the performance standard, you must assess the amount of refrigerant collected from the treated appliances against the total amount of refrigerant contained in the untreated appliances. Base this on a mass balance calculation comparing the weight of the WCE before and after treatment, and the weight of refrigerant and oil

collected. Where possible, support the assessment by comparing the amount collected to the refrigerant charge stated on the appliance's rating plate or label.

4. You must make sure that the treatment plant and containers used are empty and cleaned before the assessment is carried out.

5. In addition to the detailed 6-monthly assessment, you must report the total number and type of WCE processed and quantity of refrigerant and oil recovered to the Environment Agency on a quarterly basis. You must identify and record defective WCE (appliances that have no or low pressure in the cooling circuit, for example, due to damage or removal of the compressor) and exclude this from any refrigerant recovery calculations.

## 6.2 Blowing agent recovery

1. You must report the total number and type of WCE processed and the quantity of blowing agent recovered to the Environment Agency on a quarterly basis. Where WCE has been dismantled into panels before treatment (for example, cold room panels or large commercial refrigeration units), then you must report the quantity (kg) of foam treated.

2. You must assess and report plant performance against the blowing agent removal and recovery rate stated in appropriate measure 14 of [stage 2 treatment](#) (minimum of 90% recovery) on a quarterly basis. More frequent assessment and reporting may be required if your assessed recovery rate falls below the target recovery rate.

3. You must base the assessment of plant performance on the total number of WCE and total quantity of dismantled panels treated during that quarter. You must compare the measured and recorded amount of blowing agent recovered from the WCE and dismantled panels treated to the theoretical quantity available for recovery (based upon the number and type of appliances treated). You should calculate the theoretical quantity of blowing agent available for recovery using the relevant values from the following tables. You must exclude recovered water from the calculation of recovered blowing agent.

If you process WCE with missing doors, you should assume the amount of foam contained in the appliance is 20% lower than the figure in the following tables for the relevant type. If you process separate doors, you should assume the treatment of 5 doors is equal to 1 WCE of the relevant type.

## Theoretical foam and blowing agent (BA) content of untreated WCE by type (in grams):

### WCE containing VFC blowing agents

WCE Type	Type 1	Type 2	Type 3 and 4
Foam content	3,660	4,880	6,100
Blowing agent content	300	400	500

The figures above are calculated on the basis that the BA content of VFC foam is 8.2% w/w (82g per kg).

### WCE containing VHC blowing agents

WCE Type	Type 1	Type 2	Type 3 and 4
Foam content	3,300	6,300	8,300
Blowing agent content	125	239	315

The figures above are calculated on the basis that the BA content of VHC foam is 3.8% w/w (38g per kg).

### Notes about table data

Source of data: CENELEC, 2017, Collection, logistics and treatment requirements for WEEE, Part 3-4: Specification for de-pollution - Temperature exchange equipment, PD CLC/TS 50625-3-4:2017, BSI Standards Publication).

Types of WCE:

- Type 1 are refrigerators with storage capacity  $\leq 0.18\text{m}^3$
- Type 2 are refrigerators or combined fridge-freezers with storage capacity  $> 0.18\text{m}^3$  and  $< 0.35\text{m}^3$
- Type 3 are freezers with storage capacity  $< 0.5\text{m}^3$
- Type 4 are any refrigerators or freezers that are not covered by Types 1 to 3

You should record and report (in terms of type and number processed) treated WCE that is not fridges, freezers or combined fridge-freezers and exclude them from blowing agent recovery rate calculations, unless you can determine a theoretical foam and blowing agent content for them.

Theoretical blowing agent content of WCE is calculated by multiplying foam content of WCE type by blowing agent content (% w/w). The Environment Agency will periodically review these benchmark figures.



You should calculate the theoretical blowing agent content of dismantled foam panels from large commercial or industrial WCE (for example, commercial refrigerators and freezers used in retail premises) by multiplying the blowing agent content (% w/w) by the weight of panel processed. You may need to agree alternative BA content of foam figures with the Environment Agency for reporting and assessing blowing agent recovery for the treatment of dismantled panels from large commercial or industrial WCE.

## 6.3 Residual materials

1. You must report the quantity of waste fractions and residues produced by your treatment process to the Environment Agency every quarter, in line with your permit conditions. This must include quantities of refrigerant and blowing agents, oil, foam, metals and plastics.
2. Every quarter, you must get a representative, composite sample (consisting of at least 3 individual samples) of relevant waste fractions and residues and send them for testing and analysis. This is to assess their composition against the standards set out in appropriate measure 12 of [stage 1 treatment](#) and appropriate measures 16 and 17 of [stage 2 treatment](#). You must report the results of the analysis and comparison to the relevant material standards to the Environment Agency, in line with your permit conditions.
3. You must test the waste fractions and residues for the following parameters, quantity of:
  - refrigerant in degassed oil (% w/w) – limit 0.9%
  - blowing agent in treated foam (% w/w) – limit 0.1%
  - untreated foam in plastic fraction (% w/w) – limit 1.0%
  - untreated foam in non-ferrous metal fraction (% w/w) – limit 0.5%
  - untreated foam in ferrous metal fraction (% w/w) – limit 0.5%

## 7. Emission monitoring and limits appropriate measures

These are the additional appropriate measures for monitoring emissions from regulated facilities with an environmental permit for the treatment or transfer of WCE.

### 7.1 Point source emissions to air

1. You must carry out emissions monitoring when the plant is operating at or near to full treatment capacity. You must record information on the plant treatment processing rate and air flow rate at the time of monitoring and submit this with the monitoring results.
2. You must monitor point source emissions to air from your treatment plant for the following substances, using the monitoring standards and frequencies stated. You must meet the relevant emission limits and comply with any other monitoring requirements or limits that are set in your environmental permit.
3. You must assess and report emissions against relevant emission limits as the average over the sampling period. This is the average value of 3 consecutive measurements of at least 30 minutes each.

#### **CFCs**

Monitoring standard – follow the procedures in CEN/TS 13649.

Frequency – every 6 months.

Emission limit – 10 mg/m<sup>3</sup>,

#### **Dust (total particulate matter)**

Monitoring standard – EN 13284-1.

Frequency – every 6 months.

Emission limit – 5 mg/m<sup>3</sup>.

#### **Total VOCs (volatile organic compounds)**

Monitoring standard – EN 12619.

Frequency – every 6 months.

Emission limit – 15 mg/m<sup>3</sup>.

## **Brominated flame retardants**

Monitoring standard – should be adapted from BS EN 1948.

Frequency – annually if the substance is identified in emissions inventory.

## **Dioxin-like PCBs**

Monitoring standard – EN 1948-1, 2, 4.

Frequency – annually if the substance is identified in emissions inventory.

## **Metals (arsenic, cadmium, cobalt, chromium, copper, manganese, nickel, lead, antimony, selenium, thallium and vanadium)**

Monitoring standard – EN 14385.

Frequency – annually if the substance is identified in emissions inventory.

## **PCDD/F (dioxins and furans)**

Monitoring standard – EN 1948-1, 2, 3

Frequency – annually if the substance is identified in emissions inventory.

## **Total VFCs and VHCs (mass emission)**

Monitoring standard – follow the procedures in CEN/TS 13649.

Frequency – monthly for first 6 months of operation, then quarterly with written agreement from the Environment Agency.

Emission limit – 5g per 100 appliances processed, per hour. Calculate and report this on a pro-rata basis, per 100 appliances processed per hour. You must also monitor and report air flow, following standard EN 16911-1.