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EPIC
ENGINEERED PANELS IN CONSTRUCTION

Insulated Panels

Identification, end of life and re-use options

Advice and guidance on the identification, re- use and disposal options for metal faced insulated panels

Introduction and foreword

This EPIC Guide has been prepared to assist all those who may be involved in considering the end-of-life options for insulated panels used on or in buildings. This includes re-use, recycling, onward fuel source, as energy recovery, and waste.

Relatively few metal-faced insulated panels have entered the waste stream to date, so many contractors have had little experience with how to dispose of them. To help keep the industry up to date, EPIC and its members have conducted research and trials to inform this guide.

Systems covered

This guidance document specifically covers insulated panels of a sandwich type construction that have metal facings on either side of an insulation material.

These panels are commonly known as either:

- Insulated panels;
- Sandwich panels; or
- Composite panels.

Because of the very specific use and nature of metal-faced panels used in construction, the scope of the guide has been restricted to panels with steel or aluminium facings.

Systems not covered

- Insulation boards with thin foil facings — used to line buildings or in cavities;
- Roofing boards used as a separate component to insulate roofs;
- Other composite insulated panels with non-metallic facings.

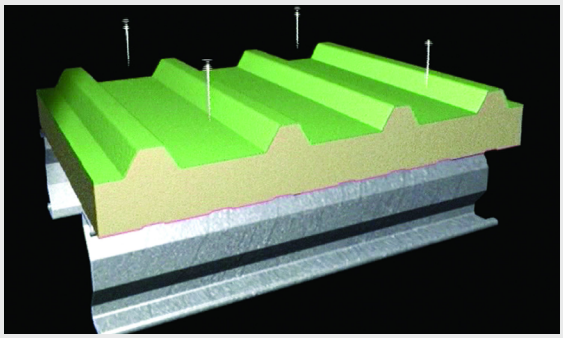
Contents

SECTION 1

What are metal-faced insulated panels?

Panels consist of three main components:

Panel joints;
Metal facings;
Core insulation materials



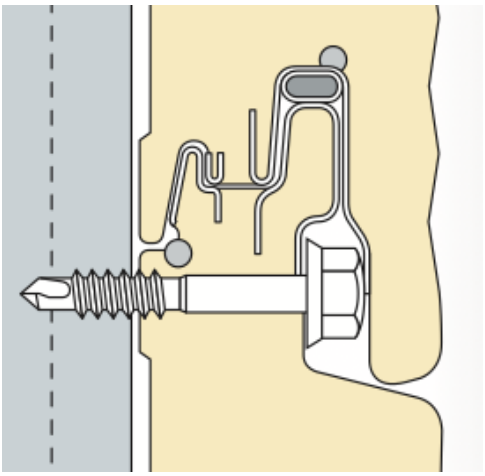
Panels used for the external roofs and walls of buildings can vary in thickness from 30 to 150 mm according to use and age.

Panels used for internal walls/linings and ceilings can vary in thickness from 50 to 300 mm according to use and degree of temperature control e.g. cold stores etc.

The metal facings protect the core insulation and provide other useful functions e.g. weather tightness, moisture barrier, hygienic surface, and fire protection.

1.1 Panel joints:

At the edges, metal facings are usually profiled to form an interlocking joint. Very occasionally, panels are held by `H' section bars or by specially designed aluminium extrusions. Some cold store panel systems use key-operated interlocking mechanisms (cam-locks).



1.2 Metal facings:

The majority of metal facings are profiled from sheet steel and can be flat or lightly profiled as used for wall panels, or deeply profiled as used for all roof panels and some wall panels. Most steel facings normally have a paint coating on the exterior facing for protection against the weather and/or other environments, and a thin paint finish on the internal facing. Other coatings are applied for specific applications such as hygienic 'food safe' coatings for use within the food industry.

A few 'architectural' and 'special application' panels have been made with aluminium facings. Small quantities of insulated composite systems are made with other facings such as plastics, Glass-reinforced plastic (GRP) and various timbers and boards. These are outside the scope of this guide.

Insulation boards with thin facings on either side e.g. aluminium foil or bituminous felts are often wrongly described as 'panels'. Insulated panels should not be confused with foil-faced boards, which are sometimes used as wall linings.

1.3 Insulating cores:

The central core can be made of various insulating materials. This is the component of an insulated panel that most affects disposal of panels at end of life. These are:

Polyurethane (PUR)

PUR was used extensively within insulated panel systems before 2004 due to its thermal properties and ease of use. Initially panels were manufactured using Chlorofluorocarbon (CFC) as a blowing agent.

From the mid-1980s, the insulating panel industry gradually moved from CFC to Hydrochlorofluorocarbon (HCFC). This blowing agent reduced the Ozone Depleting Potential (ODP) by 90% but is still classed as an Ozone Depleting Substance (ODS).

From 2000, the industry gradually changed to pentane or Hydrofluorocarbon (HFC) and to polyisocyanurate (PIR) panels. These are non-ODS.

HFC blown-panels are NOT classified as hazardous waste under the European Waste Catalogue. The Environment Agency (EA) is however considering old HFC-panels with regard to 'end of life' requirements, linked to F-Gas regulations.

HFC blown-panels contain HFCs with a Global Warming Potential (GWP) above 150. This should be stated on the duty of care/waste transfer note. However, the F-Gas regulations specifically state that gases must be captured if technically feasible and if the process does not entail disproportionate cost. Whilst ODS-capture plants are available, this system is not wholly suitable for HFCs and our recommendation is that normal recycling or shredding processes (including energy recovery) are more appropriate, whereby the foam is reduced into pellet size particles rather than dust, thus not releasing the gases to any significant extent. Based upon this specific exemption stipulated within the F-Gas regulations, HFC panels can be processed at end of life via normal recycling/shredding facilities, and still fully meet the regulatory requirements.

F-gas regulations DO NOT result in HFC-blown panels being classified as hazardous waste. This is only applicable to concentrated fridge-foams. Hence, HFC blown panels are not subject to restrictions in terms of hazardous waste transportation and the use of consignment notes.

As with all waste, it is advisable to check that the permit issued to the waste processing or recycling plant allows the facility to accept this type of panel.

Polyisocyanurate (PIR)

All panels produced in the UK since 01/01/2004 are PIR 'pentane-blown', and are non-ODS, and non-hazardous within any classification of the current hazardous waste regulations.

Mineral Wool (MW)

Mineral wool cores are used in a small number of wall panels on the external walls of buildings. Internally MW panels are used in certain applications for walls, ceilings and as internal compartment walls.

Polystyrene (PS)

Polystyrene has been used as a core material for over 40 years almost entirely for panels used internally and especially within the cold store industry. The other major use of PS cored panels has been in the food industry. Polystyrene is referred to as having two sub-categories within this guidance; Expanded (EPS) or Extruded (XPS).

Phenolic (PF)

Phenolic foam is a rarely used core material in panels for specific projects, used on internal walls and ceilings.

Blowing agents

Insulated panels with cores of PUR, PIR and, where applicable, PF (each described above) are manufactured using blowing agents that are retained in a closed cell structure to create a highly effective insulant.

One of the most efficient and easiest blowing agents to use was CFC. However, this gas had a high ODP and was replaced, firstly by HCFC and then, after extensive development research, by non-ODS gases such as Pentane and HFC. The type and age of insulation therefore has a direct bearing on the end of life options available depending on whether or not the insulation contains gases with ODP.

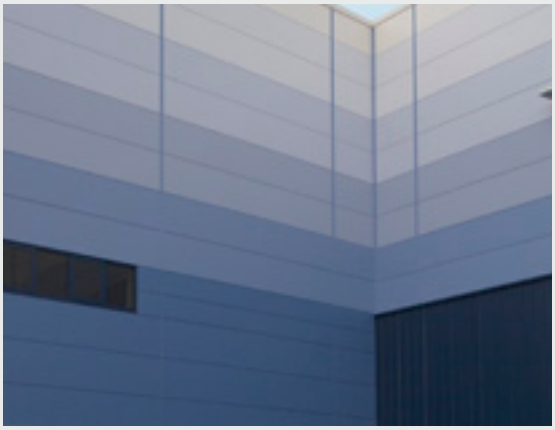
Section 3 describes the regulatory requirements concerning these gases.

SECTION 2

Where are insulated panels used?

Insulated panels can be divided into two main groups:

Panels designed for the external roofs and walls of buildings



Panels designed for internal use

2.1 External roofs and walls

Insulated panels can be seen almost anywhere as they are the most commonly used roof and wall cladding on retail and warehouse developments, industrial units, and are also used extensively on leisure, education and health buildings.

Insulated panels were first used in significant quantities in the late 1970s, mainly on industrial and warehouse buildings. However, the variety of applications continually expanded to cover:

- Factories and industrial premises;
- Warehouses and distribution;
- Workshops and transport depots;
- Retail outlets, stores and distribution depots.

From the 1990s, insulated panels have been increasingly used in the following areas:

- Offices, particularly low/medium storey height;
- Leisure, including stadiums, sports halls, cinemas;
- Education — schools and universities;
- Health — smaller hospitals; hospital extensions; clinics;
- Transport buildings — airports, bus stations, motorway services.

Which panels are used externally?

Many in the demolition trade may not have come across insulated panel systems, as they have a life expectancy in excess of 30 years. Sometimes known as ‘composite’ or ‘sandwich panels’, they consist of an insulating core between two metal facings and are designed to help speed the construction process, provide high performance insulation for the building and give an attractive, modern appearance.

The main difference between panels is the insulating core. Three types have been used for external panels: PUR (Polyurethane) or PIR (Polyisocyanurate) rigid foam, Mineral Wool (MW) and, increasingly rarely, Expanded (EPS) or Extruded (XPS) Polystyrene.

Over 90% of all panels used externally for roofs or walls have PUR or PIR rigid foam as the insulating core. These insulation materials are amongst the best that are commonly available thanks largely to the closed cell insulation structure. However, as highlighted in section 1, some of the gases used in older panels (manufactured before 2004) are classified as having ODP, thus requiring specific treatment at end of life (see sections 3 and 7).

The remaining 10% of panels have a MW core. There are also small quantities of polystyrene (PS) cored panels in use. These two cores are used only on external walls; never on external roofs.

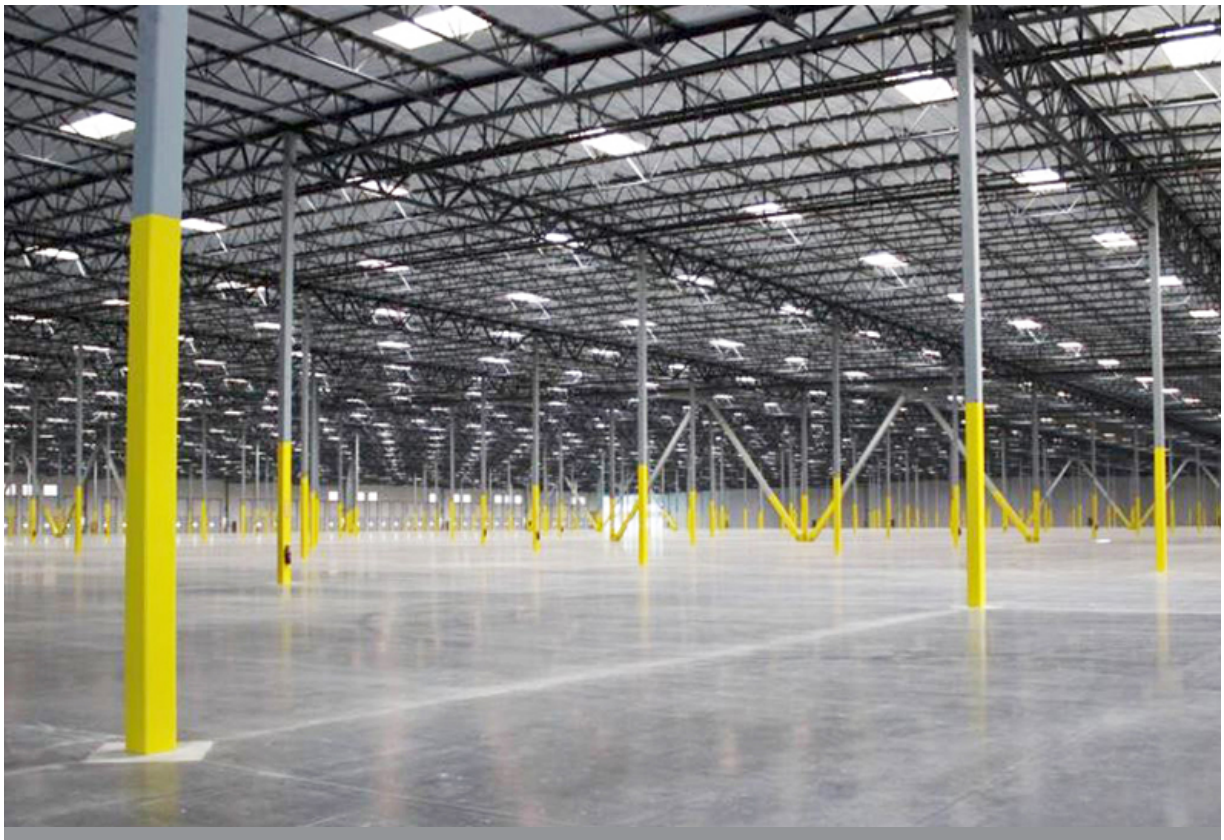
A detailed breakdown of the types of panels and where they have been used is illustrated in section 4 of this document.

2.2 Internal walls and ceilings

Insulated panels used internally account for approximately 25% of the total panel usage. The principal applications are:

- As cold stores;
- As the walls and ceilings of internal compartments to control temperature and hygiene;
- As lining panels, generally within existing buildings;
- As separating, usually fire resisting, walls between different sections of a building.

With the exception of separating walls, panels designed for internal use are generally simpler in construction, designed for ease of construction and demountability to enable changes in configuration and layout to be made retrospectively.



Which panels are used internally?

There are few hard and fast rules regarding the types of panels and core insulations that can be found in the various internal applications, as all the insulation types have been specified for most applications. The most frequent use of panels for internal applications has been in cold stores, food processing, controlled assembly areas, and in some factories, warehouses and retail distribution.

Cold stores/storage buildings

Panels have been used for over 40 years to insulate buildings for cold storage purposes either as linings or to create compartments within a building. Panels with PS cores were used almost exclusively until the mid-1990s, initially using EPS and, to a lesser extent, XPS as the core material. From the mid-1990s, some MW panels and an increasing amount of PUR/PIR panels have been used.

Internal compartments — box within a box

These compartments are common within the food processing industry and in some industries where a controlled environment is required. Wall panels are generally freestanding and interlocking and are not connected to a supporting framework. Ceiling panels are generally supported by the wall panels with the addition of supporting hangars where larger spans are used.

Panels incorporating a PS core dominated this type of application until the mid-1990s, when substitution by PIR and MW panels started due to concerns about fire performance.

Lining panels

Panels used for lining are similar to the compartment panels described above in terms of core materials and joint design.

Note: Aluminium foil faced lining boards should not be confused with metal-faced insulated panels. Boards are usually supported within an H-section grid format.

Separating walls

Insulated panels are sometimes used as an alternative to the more general masonry-based compartment wall constructions. These panels are fully supported on a structural frame. Core materials are predominantly MW with some PIR.

SECTION 3

Regulatory requirements

3.1 Current requirements

The dismantling and repurposing or disposal of insulated panels is subject to the normal rules concerning end of life options pertaining to duty-of-care and waste hierarchy (i.e. recycling, re-use, energy recovery or waste to landfill). However, insulated panels that contain ODS in the form of blowing agents (gases trapped within the closed-cell structure) are subject to additional requirements, which stipulate the recovery of ODS 'where practical'. The most significant legislative requirements relating to the end of life options of metal-faced insulated panels are:

- The Landfill Directive; The Waste Directive; The Industrial Emissions Directive; ODS; F-Gas and GWP regulations

The practical application of the above is detailed within section 9 of this guidance document. As stated above, construction products such as ODS-containing insulated panels are classified as 'special' or 'hazardous' waste, and are therefore subject to restriction in terms of transportation (use of consignment notes) and dismantling (no crushing on-site for example, and processing only through ODS recovery plants, such as fridge recycling facilities). This is expanded upon further in sections 6 to 9 and, specifically, section 7.

3.2 Proportion of Insulated Panels with ODS

The following figures relate to panels with PUR/PIR and PF cores.

Panels NOT subject to any ODS regulatory restrictions relating to end of life options

Panels in use which are not subject to hazardous waste restrictions include all pentane-blown PIR insulated panels produced in the UK after 2004, including all in current production. These panels do not contain any ODS and, as such, are classed as non- hazardous. Pentane-blown panels are also not classified as hazardous under any other existing legislation, including the ecotoxicity regulations HP14 or via the A10 flammability regulations detailed via this link.

3.4 Panels subject to ODS regulatory restrictions relating to end-of-life options

The older PUR insulated panels used CFCs or HCFCs, which are Ozone Depleting Substances and are subject to regulatory requirements. CFC blowing agents were used generally until 1994, after which they were rapidly phased out in favour of HCFC blown panels which reduced the ODP content by 90%. From 2000 the industry gradually changed to pentane or HFCs and to PIR panels. These are both non-ODP panels. HFC-blown panels are not classified as hazardous waste, but are subject to F-Gas regulation restrictions (please see the specific commentaries in sections 1.3 and 5 of this document).

3.3 Types of panel by construction

The following information is for guidance only and illustrates where the various types of core materials are commonly found.

◐ very small number of buildings

◯ occasional use, often as infill panel with curtain wall stick-system.

Sector	Roof			External Wall				
	PIR core 2004-date	PIR/PUR Pre 2004	PUR Pre 1994	PIR core 2004-date	PIR/PUR Pre 2004	PUR Pre 1994	MW core	PS core
	No ODS	HCFC ODS	CFC ODS	No ODS	HCFC ODS	CFC ODS	⁄	⁄
Factories, warehouses and retail distribution	●	●	●	●	●	●		
Offices	●	●	◐	●	●	◐	●	◯
Retail - especially large out-of-town	●	●	◐	●	●	◯	●	
Leisure - stadia, sports halls and cinema	●	●	◐	●	●	◐	●	◐ ◯
Education	●	●	◐	●	●		●	◯
Health	●	●		●	●			
Transport - depots, workshops, hangars etc.	●	●	●	●	●	●		
Transport - transit buildings	●	●		●	●		●	

SECTION 4

How to identify different types of insulated panels

The need for identification

From section 3, it can be seen that it is important to correctly identify the type of panel prior to considering the end of life options available, particularly to make the distinction between PUR insulated panels produced before 2004 and PIR produced thereafter. Panels produced before 2004 may have been manufactured using ODS blowing agents such as CFCs and HCFCs. Non-ODS HFC blowing agents were also used during the transition period to pentane-blown panels. NO panels produced from 2004 onwards contain these substances. It is also important to note that while HFC is not classified as hazardous under ODS regulations, if EA permit restrictions are in place at waste processing plants in terms of receiving HFC-blown panels, testing must be performed to determine its presence as there are no physical properties or markings to distinguish these from other pre-2004 panels.

Step 1

Is the roof, wall, ceiling or lining an insulated panel or a site assembled system?

Step 2

What type of insulation is used?

Step 3

If PUR or PIR, was it manufactured before the end of 2003?

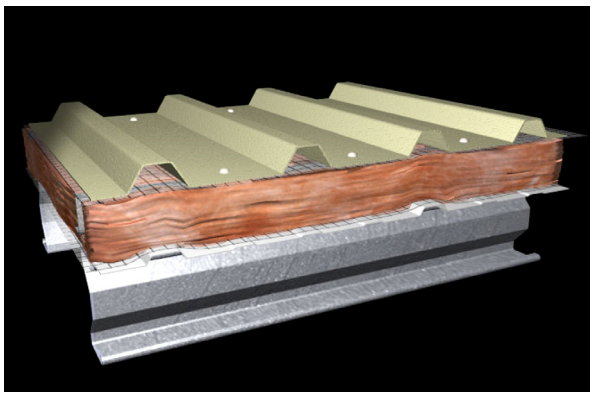
Step 1: Panels compared to other systems — EXTERNAL

Insulated panels, manufactured as factory produced cladding systems as described in Section 2, are often confused with metal cladding systems that are built-up on site.

Site assembled systems

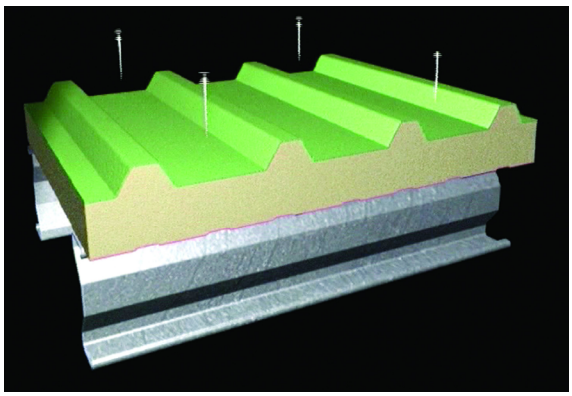
Metal clad industrial and commercial buildings built prior to the mid 1980s were mainly constructed using site-assembled cladding systems for the external roofs and walls. These systems still account for about 30% of the market and consist of:

1. A profiled metal external weather sheet
2. A glass fibre quilt type insulation
3. A lining system usually comprising plasterboard



Insulated panel systems

Insulated panels, delivered to site as a single piece component and incorporating a polyurethane (PUR) insulating core, started to be used in greater quantities from 1980, accounting for 10% of the market by 1990, 40% by the end of the 1990s.

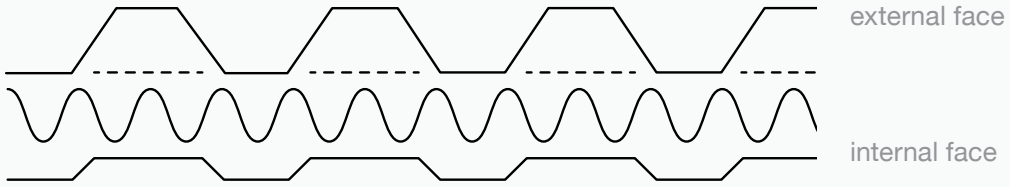


Is it an insulated panel or a site-assembled system?

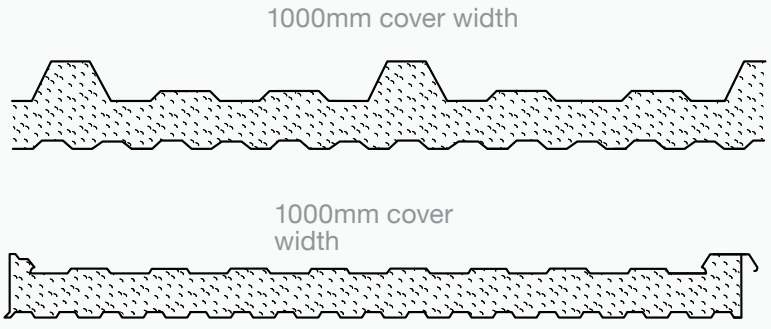
The shape of the external profile can provide a valuable clue to the type of cladding system.

Deep profiles

If the external facing is a regular deep profile, typically 35-40 mm, it is most likely to be a site assembled system with a glass or mineral fibre quilt insulation. A hollow sound when tapping the crown of the profile should indicate this type of system. This is found on roofs, and walls of older buildings.



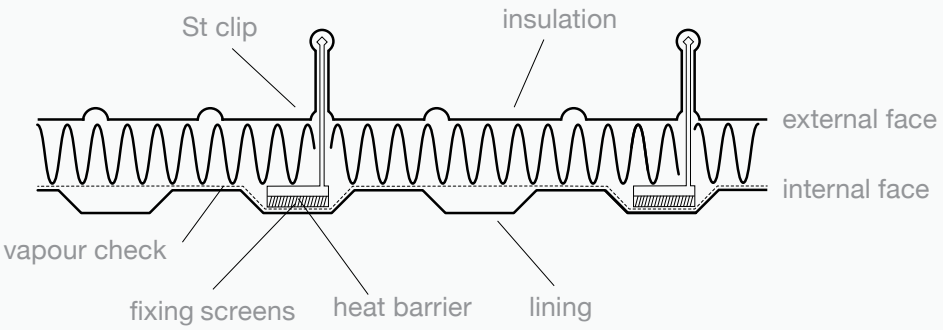
If the external face has an irregular profile with longer distance between crowns then the cladding is most likely to be an insulated panel. These panels are found on both roofs and walls of buildings.



Most likely insulated panels with rigid urethane insulating core

Standing seam profiles

Roof systems where the external sheet has a narrow raised rolled seam at the joints is most likely to be a site assembled ‘standing seam’ system with MW quilt insulation. However, a small amount of panels with standing seam joints have been used since 1998. Check for firmness and solidity of the roof system and whether the internal facing has a micro-rib profile to confirm if it is a panel.



Roofs without easy access

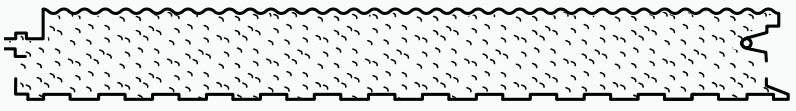
Where roof access is not easily possible to identify the cladding system, inspecting the internal lining can provide valuable clues.

The internal facing of an insulated panel will be relatively flat with a mini-box profile. The corresponding liner sheet for site assembled systems will have a profiled liner approximately 20 mm or deeper.

Micro-rib profiles

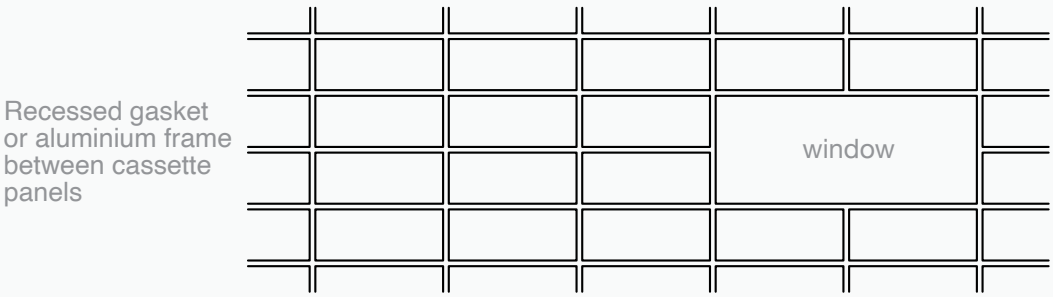
Wall claddings that run vertically from the ground or short wall to the eaves (and which have a micro-rib or flat profile) will be an insulated panel system.

Similarly, cladding running in a horizontal format between columns will be insulated panels (see also cassette panels below).



Cassette systems

Wall cladding systems that are a multiplicity of small panels i.e. 2.5 x 1.2 metres tightly supported in a support frame or grid are likely to be panels. However, the type of insulation should be carefully checked as some panel types were manufactured with polystyrene cores.



Typical cassette panel arrangements sometimes with polystyrene insulation

Curves

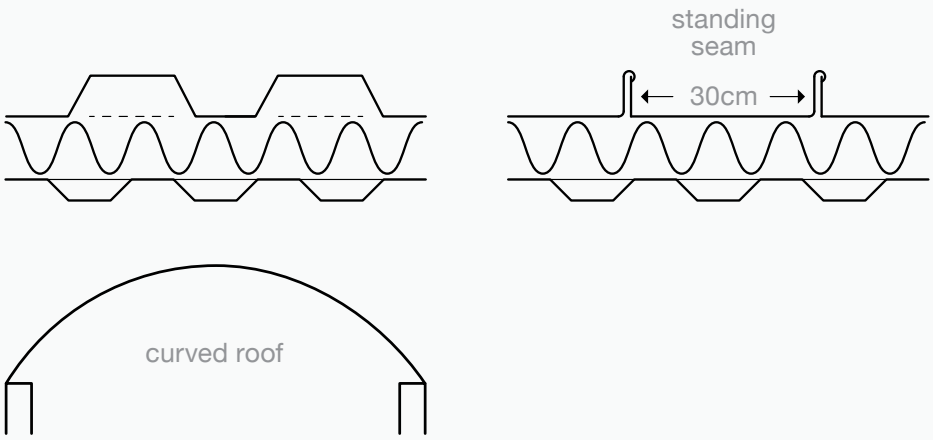
Curved roofs where the radius is quite noticeable are most likely to be constructed using the standing seam system (above).

Curved roofs with a very shallow curve with or without a standing seam joint system could be constructed from insulated panels.

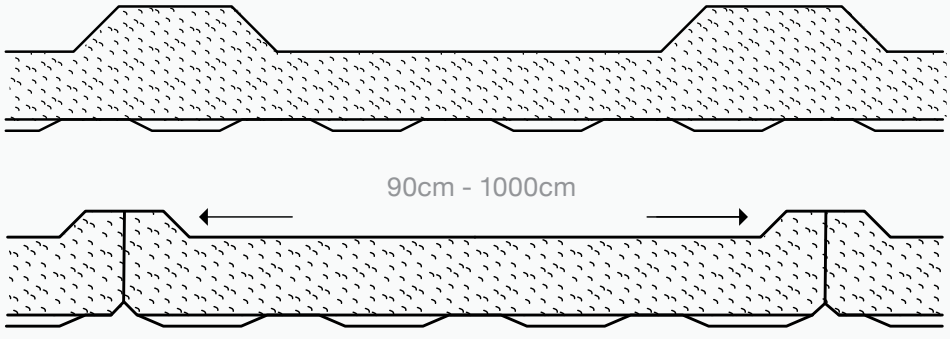
The end of the panel/cladding at the eaves or gutter should be checked to confirm the type of system that has been used.

Roofs - Identification by profile shapes

Built-up-system

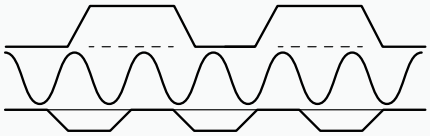


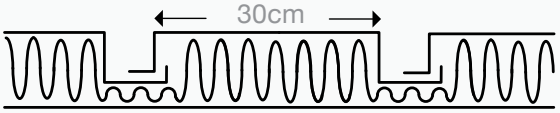
Insulated Panel

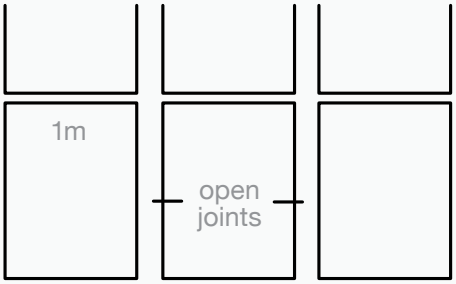


Walls - Identification by profile shapes

Built-up-system

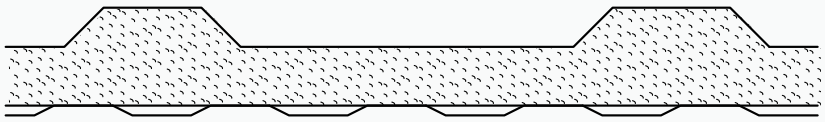




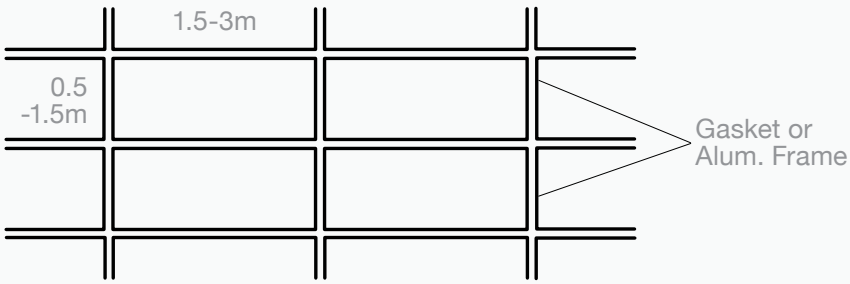


Rain Screen - Front View

Insulated Panels



flat mini rib



Cassette Panels - Front View

Internal walls and ceilings

The panels have micro-rib or flat facings and will be of varying thicknesses according to the storage temperature requirements i.e. ambient activities, chilled storage etc. The type of panel and the insulating core can only be determined by inspection at an end or cut section.

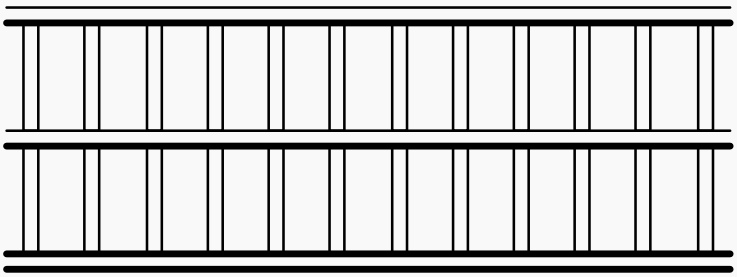
Metal liner sheets or trays

Where metal linings or claddings are used, tapping the liner for most constructions will determine if it is a solid insulated panel or a hollow built-up system. It should be noted that some thick structural linings have been used in sports halls etc, where the incidence of damage is high. These liner sheets are generally mounted horizontally and may not exhibit a hollow sound.

Structural metal liner trays

Other internal wall linings

A variety of wall linings have been used particularly in industrial and warehouse applications that should not be confused with panels. Most pre-1920 industrial buildings have non-metallic linings. These are typically made from plasterboard sheets in 7-bars as part of a built on site system. Alternatively, many older buildings have been retrofitted with faced insulation boards where the internal joint has been sealed with a tape. The facing of some boards comprises aluminium foil and has been mistaken for metal-faced panels.

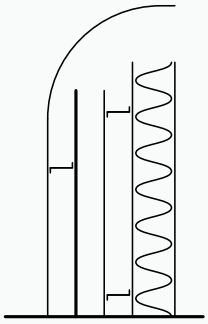


Typically
1200 x 600 cm

Plasterboard/insulated boards - as internal
wall linings to the external cladding

Lined-out buildings

Some buildings are constructed of a basic shell with roof and wall cladding that acts as a weather sheet and which has been lined out with panels. In most of these lined-out buildings the panel core will be polystyrene.



Internal insulation behind
sheet weather cladding

Step 2: Identifying the core insulation material

The earlier sections of this guide have emphasised the importance of identifying the type of core insulation as part of the process to determine the appropriate method of disposal. It is therefore important to know whether the type of insulant is PUR/PIR of an age that might contain ODS in the core, or whether the panel has a MW or PS core.

Records

The first stage should be to check whether the panel description is recorded, for example in the Construction Design and Management (CDM) Health and Safety file or architects/contractor's records. If no record is available a visual check is the only alternative.

Visual checks

Where panels are to be re-used it is sometimes possible to find a small exposed area at the side, top, or end of a panel or wall section. The core can also be exposed by unscrewing or removing a short section of flashing at a corner, reveal, or edge detail.

If the panels are to be sent for recycling/processing, rather than dismantled for re-use, then an area can be cut away to reveal the core.

Other helpful guidelines

Roofs: In the UK, only panels with a PIR/PUR core insulation have been used for roofs. The only task therefore is to determine that the roof system is constructed using insulated panels and not a site assembled system.

Walls: PIR/PUR is also the main core material for external walls. However, mineral wool has been used for wall panels and very occasionally PS has been used for some infill panels and a few 'architectural' panels. It is necessary to visually check the core.

Checking the different types of insulation

Normal procedure is to check whether the core used is MW, EPS or XPS. If the insulation is none of these then it is most likely PUR or PIR.

Polystyrene (EPS and XPS): EPS is well known, white in colour, and recognisable from its use as a packaging material. EPS was used in cold store panels from the 1960s to mid-1990s and in food industry panels from the 1970s to the mid-1990s. XPS has a closed cell consistency and can be confused with PUR if both samples are not available for comparison. However, XPS can be identified by its colour, usually blue or green, and it does not feel friable (crumbly) if the surface is rubbed.

Mineral Wool (MW) and glass fibre: MW insulated panels use a specific high-density form of MW with the fibres running perpendicular to the panel facings. This core material is quite distinctive and obviously fibrous in nature. Site assembled systems use a quilt form of this insulation. It is of low density, spongy and very similar to loft insulation.

Step 3: PUR and PIR cores

Rigid Urethane - Polyurethane (PUR) and polyisocyanurate (PIR)

The earlier sections of this guide have emphasised that, if not MW or PS, it is most likely to be PUR or PIR, which is used in the majority of insulated panels. It is not possible to visually distinguish between PUR and PIR. For demolition purposes the important point is how to tell the difference between an ODS containing pre-2004 panel and post-2004 panels.

Panel markings

For post-2004 panels, most have clear markings on the tape at the panel/panel joint and/or UV marking on the face. This gives information about the manufacturer, date and type of core. If in doubt the manufacturer can be contacted for more information.

Records

Panel marking started around 2002 and is in addition to records held within standard Construction Design and Management (CDM) regulatory files or health and safety records. In addition, some EPIC members have project records for contracts dating from 1995 onwards, and it is worthwhile contacting them in the first instance.

Date and thickness

Reference has been made throughout this guide to approximate dates when changes were made, especially from CFC to HCFC and to the current non-ODS panels. There is no definitive feature that will identify these changes and hence the age of the panel. However, it can generally be assumed that for external roofs and walls, panels of 30 or 35 mm thickness were produced before the 1990s and will contain ODS blowing agents. Otherwise thickness is not a reliable guide as panels as low as 40 mm are still manufactured.

Testing

Testing for pentane: Many panels produced after 2000 used pentane as a blowing agent. ALL panels after 2004 are pentane-blown. These are non-ODS panels and are not classified as hazardous waste. If panels cannot be identified from records or by identification marks, pentane can be detected using a small portable detector.

Testing for HFC: Testing must be performed to determine its presence, as there are no physical properties or markings to distinguish these from other pre-2004 panels. Duty of Care regulations require the waste producer to properly describe their waste, so the presence of F-Gas should be clearly noted. HFC-blown panels should therefore be referenced as being above GWP 150 on the waste transfer note. As with all waste, it is advisable to check that the permit issued to the waste processing or recycling plant allows the facility to accept this type of panel.

Laboratory tests: If required, there are simple scientific tests that can identify whether a PUR or PIR material contains an ODS blowing agent. This may be helpful to contractors to make an informed decision on what action to take. Suitable laboratories should be contacted for this service. EPIC can offer further guidance on this also.

SECTION 5

Demolition

Fire and the use of oxy-propane torches

Extensive studies have been carried out on the performance of insulated panels when subjected to fire. Information has been gained from both large-scale fire tests and also case studies of actual fires. The results can be viewed or downloaded from: https://www.epic.uk.com/fire-performance/fire-case-studies/fire-research-case-studies/

MW, PF and PIR are generally unaffected in the developing stage of a fire or if an oxy-propane torch is applied to the surface of a panel.

- PIR or PUR cored panels, in common with all panels, are protected by the metal facings. The large-scale tests and fire case studies illustrate that fire does not travel down the core and that there should be no particular problems from the panels if an oxy-propane torch is used to cut through supporting steel framework for a short duration in the proximity of a panel. Care should always be taken to ensure that there are no other flammable materials in the vicinity.

- PS cored panels do, however, present a fire-risk if an oxy-propane torch is used. Fire risk management procedures should be set up if PS has been identified as the core material. Of the common core materials used in insulated panels, PS is the only one that is affected by heat, flame and fire to the extent that it will propagate a fire in a building. This is despite the fact that the panels have metal facings. Oxy-propane torches should never be used in the vicinity of Insulated panels which have an insulating core made from PS.

Cutting panels to manageable size

Insulated panels can be up to 20 m in length, especially when used on roofs and are usually between 3 and 10 m on walls. They are generally cut to smaller lengths for transportation. Recycling plants can only take panels up to 2 m in length.

The recommended method of cutting is to use an 'Evolution' type circular saw with a tungsten tipped blade or reciprocating saw that will cut the majority of panels up to a thickness of 80 mm. Much thicker panels may require larger diameter blades or cutting from either side.

The small amount of ODS or F-Gas that is released in the cutting process is within the proportion allowable as a practical solution to the reclamation and capturing process. EPIC does not recommend that an oxy-propane torch should be used to cut panels to smaller lengths due to the small quantities of imported panels with less well defined fire properties. Oxy-propane torches should never be used to cut insulated panels.

Crushing

ODS and F-Gas containing panels should not be crushed using plant, equipment or vehicles in an attempt to 'powder' the insulating foam and separate it from the metal facings. ODS panels must be treated as hazardous waste and processed via appropriate facilities. See section 7 of this guidance.

Shredding on construction/ demolition sites

Non-ODS pentane-blown panels and HFC-blown panels (classified as non-hazardous under all current EU regulations) can be shredded through a normal scrap metal-shredder (subject to facility permits), which then separates the PIR and the steel. The steel can be recycled. The PIR 'ball- bearing' sized particles can be used as a fuel source or for energy recovery (see section 8 for more details). This would be the preferred option (in accordance with waste hierarchy protocols) rather than sending the product as 'waste' to landfill. Shredding performed on-site (i.e. construction sites) must meet site-specific permit restrictions in terms of dust control and abatement. See section 4 for specific HFC-panel restrictions that may apply.

SECTION 6

Dismantling for re-use

There is a growing market for the re-use of undamaged insulated panels and particularly panels that have an LPS 1181 fire certification (Loss Prevention Standard). In accordance with waste hierarchy protocols, we would encourage this wherever possible rather than classifying products as waste and sending them to landfill or other recycling facilities. Immediate re-use (without further processing) is the most environmentally friendly, cost effective and efficient option available.

Panels are secured by external fixings to the building's secondary steelwork. The fixings are either visible or may be covered by a flashing or coverstrip and can be readily removed. Standard precautions for working at heights should be observed at all times.

For further information on LPS certificated panels see the EPIC Fire Safety Order guide, which offers guidance on determining whether panels have the LPS classification. Only panels produced in the UK from 2004 onwards can be guaranteed to have this certification.

Safe and efficient handling of panels

The panel industry has developed a range of mechanical handling techniques and crane lifting devices that enable panels to be safely placed or removed from the roofs and walls of buildings. These can be of equal value to demolition contractors.

The advantage of mechanical handling equipment goes beyond the health and safety aspects of on-site handling and lifting. These techniques also offer significant time savings and earlier project completion, reduced labour costs and the reduced likelihood of damage to panels.

One of the more recent innovations in terms of mechanical handling equipment involves the use of vacuum suction seals specifically developed for the insulated panel industry. The soft suction seals help to avoid damage to panel finishes and surfaces.

Example of re-use

Re-use of insulated panels at end of life is always the preferred option and case studies have shown it to be a viable option. Using insulated panels in this manner at end of life has many benefits including significant financial savings for all involved. As an example, MACFAB Systems in Ireland re-used insulated panels from the Liffey Valley Shopping Centre in Dublin to great effect.

SECTION 7

End of life options (Ozone Depleting Substances - ODS)

Most pre-2004 insulated panels contain ODS. These panels are classified as hazardous waste.

The exception to this is HFC-blown panels. See section 4 for specific Environment Agency (EA) restrictions applied via permits to some processing facilities when handling HFC-blown panels.

Commercially viable end of life solutions are available using existing refrigerator recycling plants for the recovery of ODS blowing agents from steel-faced insulated panels manufactured prior to 2004.

At present, due to the excellent long-term thermal and structural performance properties of insulated panels, the waste stream levels for pre-2004 products are very low. It is also important to recognise that the majority of these panels are less than 50 mm in thickness, and thus have a correspondingly low ODS content.

The insulated panel industry carried out numerous trials to assess suitable end of life options for ODS containing panels some years ago. This led to the development of a simple process where panels are easily cut to the right size (2 m maximum length) and fed into existing refrigerator recycling plants.

Refrigerator recycling plants have been used for processing ODS containing panels ever since.

The process offers an effective and efficient method of handling ODS and meeting all current EU regulations in terms of hazardous waste protocols. As part of the process:

- Any/all ODS gases are captured
- Metal shreddings are collected for recycling
- The foam dust can be pelletised or bagged for further use as a fuel source or for energy recovery
- After processing, the foam dust can also be disposed of as landfill (with no further hazardous waste classification restrictions). See note below.

In accordance with waste hierarchy protocols, disposal to landfill should only be considered if no other options are available and as such should be viewed as a last resort.

Available information indicates that the cost of the process is approximately £5 per m^2. However, it seems likely that energy recovery schemes and carbon offsetting can effectively reduce or eliminate this cost completely. This is in sharp contrast to the rising cost of landfill disposal.

SECTION 8

End of life options (Non-ODS)

Post-2004 pentane-blown insulated panels do not contain ODS and are non-hazardous. Pentane-blown panels are also not classified as hazardous under any other existing legislation, including the ecotoxicity regulations HP14 or via the A10 flammability regulations detailed via this link.

Compliance with HP14 has been proven by ‘calculation’ and by ‘test’ methodology. A10 flammability has been proven by ‘test’ methodology.

In accordance with waste hierarchy protocols, where the re-use of insulated panels is not possible (i.e. re-use in their existing state), they can be taken to a conventional shredder plant or processing facility, which will separate the metal facings from the insulation core. This can also be undertaken on-site (construction/demolition sites) subject to permitting restrictions.

Shredding allows the metal facings to become instantly available for re-use or re-sale. The foam insulation can also be re-used within industrial processes (as a fuel source – often used within cement works). Where re-use and/or use as a fuel source is not available, foam should be processed via registered ‘energy recovery’ incineration plants.

Pentane has been used as a non-ODS blowing agent within insulated panels since 2004. Full-scale trials and continuous use at shredding plants across the UK have shown that, contrary to uninformed reports surrounding the use of pentane in insulated panels, the small amounts of pentane present cause no problems whatsoever for shredder plants in terms of a fire or explosion risk, and pose no threat to individuals dismantling the panels.

Notwithstanding the above, as with any industrial operation, safe working procedures (including fire prevention plans) must be in place with regard to the handling of insulated panels containing pentane.

To aid in the development of the above, and purely as a precautionary measure, we would therefore recommend that pentane-blown panels are mixed with other items as the shredding process commences in order to reduce the already small risk of fire even further. Thereby undeniably meeting the Health and Safety Executive (HSE) requirements in terms of ‘duty of care’.

With regards to pentane, insulated panels have historically used three types of pentane, n-, ISO- and Cyclo-. The respective CAS numbers are given below:

- n-Pentane 109-66-0
- ISO-pentane 78-78-4
- Cyclopentane 287-92-3

PIR panels are constructed as a finished product, combining the PIR and panel substructure during the construction process. The shredding, recycling or disposal process also deals with the whole/final panel. The panel as whole is therefore subject to waste regulation.

Although n-pentane and iso-pentane are both classified R51/53 (toxic to aquatic organisms - may cause long-term adverse effects in the aquatic environment), according to the EU list of waste and HP14 ecotoxicity regulations, only products containing more than 2.5% w/w of these pentanes are classified as hazardous waste.

Cyclo-pentane is classified only as harmful (R52/53) and not hazardous. According to the EU list of waste and HP14 ecotoxicity regulations, only products containing more than 25% w/w of Cyclo-pentane are classified as hazardous waste.

All EPIC-member produced insulated panels are below these thresholds, proven by both the 'calculation and test' methods required by the regulations.

In terms of flame retardant materials added to either the foam or the insulated panels, and the possibility of hazardous materials being present, this issue has been examined in detail within EPIC & PU Europe and we can confirm that, with regard to Tris (1-chloro-2propyl) phosphate (TCPP), which is now named Unknown or Variable composition, Complex reaction products or of Biological materials - UVCB, no issues exist.

Some, but not all, PIR panels manufactured in the UK contain UVCB flame retardants. UVCB is not environmentally nor aquatic classified at this stage. Based upon the CLP rules, there might be an Aquatic Cat.3 Chronic toxicity label needed (equals 'harmful'), which will be introduced in the update of the dossier, but this is not confirmed as yet. If/when updates are available, this EPIC publication will be amended accordingly.

Please note that waste products containing 'harmful' substances are not considered as hazardous, according to the European list of waste.

Older PU panels (not manufactured in the UK since 2000) may contain Tris(2 carboxyethyl)phosphine - TCEP, which has an aquatic label (TCEP was R51/53, toxic to the environment - may cause long-term adverse effects to the environment). Hence, depending on the level of content, TCEP-containing products might therefore have to be considered as hazardous waste. However, these are only contained within older ODS-Panels (i.e. CFC & HCFC panels), and as such are already classified as hazardous and dealt with accordingly (see Section 7).

In terms of EPS & XPS panels, these can be treated by stripping the steel facings from the foam. The steel can then be separately recycled. The EPS foam should be incinerated to destroy any Hexabromocyclododecane (HBCD) within the polymer structure.

SECTION 9

Duty of care, waste hierarchy protocols and Best Available Techniques (BAT) for insulated panels

Careful consideration should be always be given as to whether insulated panels can be maintained or reused before demolition or dismantling of a building takes place.

For panels that do become waste, there are different recording and reporting requirements, depending on whether the core has been identified as hazardous or non-hazardous.

Non-hazardous waste recording and reporting requirements

Record keeping (moving or receiving)

You must maintain records, in a register or list, of each waste moved. Non-hazardous waste is moved by the simple application of a 'Duty of care: waste transfer note' supplied to or by the waste carrier. Annual waste transfer notes can also be used to simplify the documentation process further, thus eradicating the need for individual transfer notes to be completed. However, a record of the tonnages and movements must still be maintained within a register or list.

Hazardous waste recording and reporting requirements

Definitions & records

The following is an extract from the EA guidance document and gives the definitions of the main terms used throughout the process:

Term	What it means
Carrier	A person who collects or carries waste. A carrier must be registered with the Environment Agency (EA) or Scottish Environmental Protection Agency, unless they are exempt (excused) from doing so.
Consignee	A person who receives waste to recover or dispose of it. A consignee must have a written permit or be exempt from having a permit to accept waste.
Producer	A person who produces waste. A producer must hold a hazardous-waste registration, unless they are exempt from doing so.
Holder	A person who holds waste that was not originally produced by them. A holder must hold a hazardous-waste registration, unless they are exempt from doing so.
Consignor	A person who causes waste to be removed from a site. This is usually the holder or producer. In some cases (for example, when a managing agent is on site and has authority from the producer or holder), this can be the consignor. A carrier is not usually a consignor.

Record keeping (moving or receiving)

Any/all hazardous waste moved (even to an intermediate location owned by the same company) must have a 'consignment note' generated by or on behalf of the producer.

This must be signed by the producer and carrier. The consignment note must include the classification of waste, producer premises code (starting with EXE, if exempt), and a unique consignment code for each ticket.

You must therefore maintain records in a register, of each waste involved, if you are involved in the movement of hazardous waste.

This includes:

- Its removal from your premises;
- Transport/carrier used;
- Intermediate storage;
- Disposal or recovery.

Record keeping (disposal or recovery)

You must also maintain records where hazardous waste is disposed, or recovered, at the same site as its production or storage. As a producer, consignor, holder, carrier or consignee you need to:

- Keep records in a register of hazardous waste movements
- Supply specified information to the EA, or emergency services, as required

Records from the consignee

The consignee must:

- Keep records (showing waste locations on your site)
- Provide returns to producers, holders or consignors

Within four months, the consignee must send you a 'consignee's return' to show that they have received the waste. This should indicate what they have done with it (e.g. burnt it, taken it to landfill, transferred it etc.). They must also return a copy of this to the EA. You must maintain copies of the consignment notes, and these returns.

Waste hierarchy (applicable to insulated panels that are classified as both hazardous and non-hazardous)

You must declare that you have applied the waste management hierarchy on all documentation. The process is described below:

A. Using less material in design and manufacture. Keeping products for longer; re-use. Using less hazardous material.

B. Checking, cleaning, repairing, refurbishing, repair, whole items or spare parts.

C. Turning waste into a new substance or product including composting if it meets quality protocols.

D. Including anaerobic digestion, incineration with energy recovery, gasification and pyrolysis which produce energy (fuels, heat and power) and materials from waste; some backfilling operations.

E. Landfill and incineration without energy recovery.

EPIC suggests that the following end of life options are considered (applicable to insulated panels that are classified as both hazardous and non-hazardous)

Our suggestions, applying Best Available Techniques are:

Prevention: Consider maintaining insulated panels in position unless damaged, even during re-fits

Re-use: Panels can be re-used if not damaged (please see section 6 of this guidance document)

Recycling: Recycling options exist for panels classified as both non-hazardous and hazardous (please see sections 6 to 9 of this guidance document)

Other: Metal facings can be recycled and sold (after either non-hazardous or hazardous panels processing has taken place). The foam element of the panels can be used as a fuel source within cement kilns

Recovery: The foam element of the panels can also be incinerated (with energy recovery) at various locations across the UK

Disposal: As a last resort, panels and/or individual constituents (after either non-hazardous or hazardous panels processing has taken place) can be disposed of to landfill.

Notes: After ODS processing, the metal facings and foam that result are no longer classified as hazardous waste.

EWC codes for insulated panels are 17-06-03 (Hazardous) and 17-06-04 (Non-Hazardous)

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