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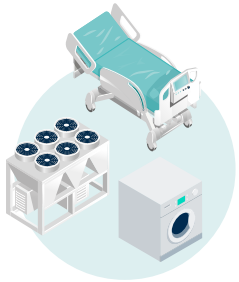
Best practices for ecodesign in anticipation of the end of life of **large equipment**



Examples of equipment concerned: washing machines, dryers, ovens, welded stations, air treatment appliances, medical beds…

Materials selection

THEMES	RECOMMENDATIONS	BACKGROUND ELEMENTS AND EXPLANATIONS
Materials to be avoided – plastics	**Limit** the variety of resins used, **preferring largely recycled resins** such as PP, ABS, PS and to a lesser extent, ABS/PC and PC.	In the WEEE sector, some resins are easier to recycle because: • Appropriate recycling operational technologies are available to produce new resins (e.g. thermoplastic vs. thermoset resins). • They have specific technical features (including their density) enabling their identification, and thereby their efficient sorting. • They are present in large quantities making their recycling efficient from a technical and economic point of view. Limiting the variety of resins used while focusing on the resins mentioned opposite thus leads to an increase in the equipment recycling rate.
Materials to be avoided – other	Whenever possible, **avoid using the materials listed below**, as they are hardly recycled as part of the treatment process of large equipment: • **wood**, • **composite materials**, • **mineral materials**, • **bio-sourced materials**.	Some materials are not commonly used in large equipment. Thus, following the different treatment stages, these parts that are present in small quantities, are not specifically detected by the sorting techniques. These remaining fractions are not recycled but only recovered to produce energy in certain cases, or even disposed of (by incineration or secure landfilling).
	Preferably use single-material components rather than composite materials whenever possible.	Multi-material components (e.g. composite materials, bi-injected or co-extruded plastics...) cannot be totally separated during grinding processes. They will thus be turned into fragments made up of several materials at the end of the process. These fragments disturb the sorting processes and/or affect the performance of downstream sectors of recycling for each of these fractions.
Coatings and surface treatments	**Promote the use of plastics dyed in the mass** instead of surface coatings, and **limit surface treatments** on plastic components whenever possible.	Coatings and surface treatments (paint, metallisation...) generate sorting errors when materials are separated using optical sorting technologies. Plastic fragments may thus be considered as non-recyclable because the optical technology will only analyse the material surface, rather than the plastic resin itself. If these plastic fragments are nonetheless directed to the relevant downstream sector of recycling, these coatings/treatments may limit the performance of plastic regeneration plants and/or affect the properties of recycled plastics.

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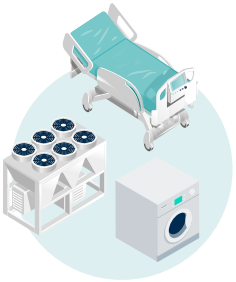

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Materials selection

THEMES	RECOMMENDATIONS	BACKGROUND ELEMENTS AND EXPLANATIONS
Coatings and surface treatments	**Avoid the use of non-ferrous metal treatments** or **coatings** on ferrous metal components.	Using non-ferrous surface treatments on ferrous metal components (e.g. copper coating on a steel component) disturbs detection operations, and thus magnetic metal separation. These parts may not be directed to the relevant downstream sector of recycling.
Presence of fillers/ additives in materials	In the absence of regulatory requirements relating to product safety, **avoid incorporating flame retardants into plastic components.** If these requirements involve the use of flame retardants on some components, **prefer non brominated flame retardants.**	The presence of brominated additives may require specific sorting prior to disposal in a hazardous waste incineration unit, as some of them are now prohibited. The technologies currently available cannot distinguish prohibited brominated additives from other authorised additives (containing bromine or not). This over-sorting process thus results in the loss of plastic material to be recycled. It is therefore important to limit, as far as possible, the use of brominated flame retardants, and more broadly, the integration of flame retardants, whenever the regulatory requirements relating to product safety allow it.
	Avoid incorporating fillers (mineral or vegetal) **into plastics** whenever possible.	The presence of fillers in plastics alters the density of resins, and thus disturbs the systems sorting plastics by resin family in preparation for their regeneration.

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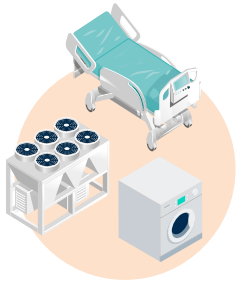

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Selection of joining types

THEMES	RECOMMENDATIONS	BACKGROUND ELEMENTS AND EXPLANATIONS
Irreversible materials combination – plastics combined together	**Limit the irreversible assemblies** of different resins whenever possible. If no suitable alternative can be found, **use resin couples** with substantial compatibility during recycled plastic regeneration processes * as soon as possible: • ABS and PC • ABS and ASA • PP and PE	Treatment processes cannot separate different resins that would be combined irreversibly (e.g. gluing, bi-injection, co-extrusion ..) Yet, most resins are not chemically compatible, and the fractions combined irreversibly thus cause significant disruption in the downstream sectors of plastic recycling. For that reason, limiting the use of different resins for the same component is a real action lever in favour of plastic recycling. If no suitable alternative can be found, prefer the combinations mentioned in the opposite list.
Irreversible materials combination – plastics combined with other materials	Whenever possible, **avoid over-moulding** and **gluing plastics on other materials** such as glass or metals.	Grinding processes cannot totally separate components that have been combined irreversibly. These parts will thus be turned into fragments made up of several materials at the end of the process. These fragments disturb the sorting processes and/or affect the performance of downstream sectors of recycling for each of these fractions.
Irreversible materials combination – metals combined together	Whenever possible, **limit the irreversible combination** (e.g. riveting) **of ferrous and non-ferrous metals**, in particular copper and steel components.	These combinations prevent the efficient separation of these materials, while they must follow different downstream sectors of recycling. These fragments, mixing ferrous and non-ferrous metals, therefore disturb the downstream sectors of treatment for each of these fractions.
Joining methods	**Use clips instead of screws** to fix parts that will rarely be separated.	Fixing techniques including clipping enable the easy separation of components during the different hand operations, but particularly in the disintegrator or the grinding machine. It is thus possible to collect fragments consisting of one material, which will be more easily detected and sorted, before being treated in relevant downstream sectors.
	Limit the number of screws and prefer standard screws with similar screw heads whenever possible.	Some equipment (large appliances with outer metal components …) is partially dismantled to remove various materials that can be easily recovered, prior to the grinding stage. In this case, limiting and harmonising assembly screws facilitates the manual intervention of operators.

* In these examples, the first of the two resins should account for more than 80%

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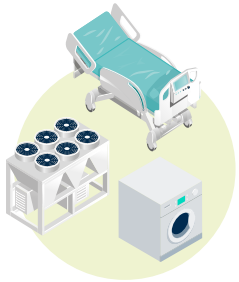

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Issues surrounding decontamination

THEMES	RECOMMENDATIONS	BACKGROUND ELEMENTS AND EXPLANATIONS
Cells and batteries	Preferably **place cells and batteries** so they are **readily accessible** without dismantling the product, using for example, a hatch, a snap-fit cover...	Cells and batteries must be removed from the early treatment stages in order to be directed to specific treatment sectors, and before contaminating the other fractions. These parts are hard to identify and sort after the grinding stage. Operators must therefore remove them easily during the hand decontamination stage, prior to grinding.
	Avoid welding cells directly on circuit boards.	The cells that are directly welded on circuit boards are hardly identified by sorting operators and may be end up in the circuit board fraction. Therefore, they will not go through any treatment process specific to cells and batteries.
	Whenever possible, **avoid using Lithium-based technologies** for cells and batteries. If using this type of cells and batteries is essential, indicate the presence of these elements on the product, and **make the right design choices for easy removal** (see recommendations above).	"Lithium" cells and batteries are very sensitive to short circuits. Their use entails a risk of explosion as operators may cause a short circuit trying to remove them during the manual sorting stages. If cells and batteries are not removed during the early manual sorting stages, explosions may take place and fires may break out near the disintegrator or the grinding machine.
Circuit boards	**For easy removal** of circuit boards: • **prefer clipping** to fix them on the support, • **limit the number of fixing points.**	Circuit boards are components requiring a specific treatment as described in the WEEE Directive (Directive 2012/19/EU). They must be removed from the early treatment stages in order to be directed to specific treatment sectors. Moreover, they contain critical metals whose recycling is an important challenge in environmental and economic terms and resource availability. Some assembly methods make their removal more difficult, thus reducing the recycling rate of these critical metals.

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