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1. Introduction

The UK manufactures 750,000 tonnes of flat glass each year, three quarters of which goes into glazing products for buildings.

Flat glass is produced by melting a mixture of raw materials including sand, limestone and soda ash. Recycled flat glass can also be added to the mix and re-melted to produce new glass. Currently the recycled content of flat glass produced in the UK is between 20%–30%.

Manufacturing flat glass using recycled glass has the following advantages:
- less energy is required to remelt glass compared to that needed to melt the raw materials which leads to a reduction in carbon dioxide emissions;
- it reduces the amount of raw materials required therefore saving valuable natural resources and minimising quarrying activity; and
- it reduces the volume of waste going to landfill.

All of the points above have cost implications so increasing the level of recycling will have financial benefits to business, in addition to the environmental benefits shown above.

The main barrier to using more recycled glass for flat glass manufacture is the availability of recovered glass of an acceptable quality.

Due to its end use flat glass has very strict quality requirements for optical defects. Standards for flat glass in buildings give a maximum number of three <1mm faults per jumbo pane (3m x 6m). This is the equivalent of three pound coin sized faults on a football pitch.

Any contamination of the recycled glass used to manufacture flat glass will cause rejectable defects. Once introduced into a furnace contamination can take several days to pass through the system. Thus low levels of contamination can result in several days of lost production which will cancel out the environmental and cost benefits of recycling.

The purpose of this Good Practice Guide is to help those involved in the collection and recycling of flat glass to increase the quantity of recovered glass which can be recycled into flat glass manufacture.

Figure 1 The flow of recovered flat glass for recycling

- **Cullet** – general term used for used glass
- **Clear cullet** – used glass consisting of clean off-cuts of standard flat glass only
- **Mixed cullet** – sealed units, mirrored glass, laminated glass, wired glass, tinted glass and glass from old wooden windows

Source: GTS
2. Contamination

Typically two grades of cullet are collected, mixed cullet and clear cullet. **Clear cullet** consists of standard flat glass only, whereas **mixed cullet** will contain a mixture of glass types (sealed window units, laminated glass, mirrored glass, tinted glass, printed glass, old glass from wooden frames). A lower price will be paid for mixed cullet as it requires additional processing to remove contamination.

It is imperative that contamination levels are kept to a minimum, irrespective of the type of cullet. The best way to do this is to control it at source. When a batch of cullet becomes contaminated it is very difficult and costly to remove the contaminant. The most common contaminants found in cullet are:

- Metal drinks cans
- Cutting blades
- Floppy discs
- Floor sweepings
- Silicon carbide discs
- Spacer bars from sealed units (clear cullet only)

Examples of common contaminants

- Drink cans
- Food packaging
- Spacer bars
- Cardboard and paper

These contaminants are usually introduced into the cullet at the cutting table or thrown into skips by passing staff. To prevent this it is essential that all glass skips and bins are clearly labelled, additional bins are available for other types of waste and staff are fully trained in their use.
Glass faults caused by contamination

Typical silicon carbide fault generating bubbles within the glass

Metallic pellet with green/brown coloured streaks in the surrounding glass caused by metal contamination

Poorly segregated and contaminated cullet

Implications for the supplier
If a clear cullet load is found to be contaminated it will usually be downgraded to mixed cullet resulting in a considerably lower price being paid for the load. This is to cover the additional processing costs which the load will require and the possible lower end market value.

If the contamination is particularly bad and beyond processing then it will often be sent to landfill and the subsequent costs passed on to the supplier.

Special cases
Other contaminants, although less common, can cause significant problems as they are very difficult to identify and separate at the cullet processor, these include:
- glass ceramics;
- borosilicate glass; and
- nickel containing stainless steel and alloys such as those found on machine wear plates.

Glass ceramic/borosilicate glass
Glass ceramics and borosilicate glass cannot be recycled into flat glass manufacture as they have a much higher melting point than flat glass and so do not melt in the glass furnace. This gives rise to glass defects which can cause several days of production loss. They are visually indistinguishable from standard flat glass.

A sheet of heat resistant glass will break into several hundred pieces during processing. Each shard can cause the rejection of several metres of production and collectively a sheet of heat resistant glass can contaminate hundreds of tonnes of production. The following table summarises the trade names of the most commonly used heat resistant and fire glasses for reference.

<table>
<thead>
<tr>
<th>Product</th>
<th>Glass type</th>
<th>Applications</th>
<th>Supplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Borofloat</td>
<td>Borosilicate Float</td>
<td>Oven doors, chemical industry, lighting</td>
<td>Schott</td>
</tr>
<tr>
<td>Pyran</td>
<td>Toughened Borosilicate Float</td>
<td>Fire doors, windows, partitions etc.</td>
<td>Schott</td>
</tr>
<tr>
<td>Robax</td>
<td>Glass ceramic</td>
<td>Gas fires and cooker tops.</td>
<td>Schott</td>
</tr>
<tr>
<td>Ceran</td>
<td>Glass ceramic panel</td>
<td>Cooker tops</td>
<td>Schott</td>
</tr>
<tr>
<td>Pyrostop</td>
<td>Laminated fire glass</td>
<td>Fire doors and partitioning</td>
<td>Pilkington</td>
</tr>
<tr>
<td>Pyrodur</td>
<td>Laminated fire glass</td>
<td>Fire doors and partitioning</td>
<td>Pilkington</td>
</tr>
<tr>
<td>Pyroguard</td>
<td>Laminated fire glass</td>
<td>Fire doors and partitioning</td>
<td>CGI International</td>
</tr>
</tbody>
</table>
Nickel-containing stainless steel and alloys
Nickel contamination will produce defects within the glass which are impossible to detect on the production line but can cause critical failure of products later in the products life. For this reason tools and machinery containing nickel should not be used for processing and transport of cullet. This includes the majority of stainless steels and all nickel containing alloys.

3. Collection

Contamination of flat glass cullet will usually occur at the point of collection. The following good practice should be used to avoid contamination at this point:

- full training should be given to all staff handling cullet;
- all waste on site should be segregated using clearly labelled, colour coded bins;
- there should be a sufficient number of bins on each site to cover all types of waste; these should be placed in all relevant areas; and
- labels on all glass collection bins and skips shall clearly state what can and cannot be placed in the bin. (See Appendix 1).

4. Transportation, handling and storage

For good practice in transportation, handling and storage:

- the handling of recovered glass shall be minimised to reduce the potential for breakage and contamination;
- dedicated transport shall be used where possible. Where it is not possible, transport skips must be thoroughly cleaned and inspected to ensure no contamination is present;
- everyone involved in the cullet collection process shall receive training in order to understand the implications of contamination;
- cullet shall be stored in bays that are of sufficient size to avoid spillage and mixing of loads;
- when picking up cullet the loader must avoid touching the floor or sides of the bays to reduce the risk of chipping the bays adding contamination into the load;
- keep records of the source of glass in each bay to allow the sources of problems to be traced;
- arrange drainage to minimise the flow of rainwater into the bays; and
- night time deliveries shall be avoided so that any contamination can be more easily spotted when loads are tipped.
### CLEAR CULLET

**Off-cuts of clear flat glass ONLY**

#### THE FOLLOWING ARE NOT PERMITTED

<table>
<thead>
<tr>
<th>Heat resistant glass</th>
<th>Laminated fire glass</th>
<th>Other glass</th>
<th>Metals</th>
<th>Other waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>Borofloat</td>
<td>Pyrostop</td>
<td>Sealed units</td>
<td>Drink cans</td>
<td>Foam spacers</td>
</tr>
<tr>
<td>Pyran</td>
<td>Pyrodur</td>
<td>Mirrored</td>
<td>Spacer bars</td>
<td>Paper</td>
</tr>
<tr>
<td>Robax</td>
<td>Pyroguard</td>
<td>Laminated</td>
<td>Cutting blades</td>
<td>Floppy disks</td>
</tr>
<tr>
<td>Ceran</td>
<td></td>
<td>Windscreen</td>
<td></td>
<td>Cutting disks</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wired</td>
<td></td>
<td>Stones</td>
</tr>
</tbody>
</table>

### MIXED CULLET

All clean off-cuts of standard flat glass should be placed in a clear cullet bin/skip

**Sealed units**  
**Mirrored glass**  
**Tinted glass**  
**Laminated glass**  
**Wired glass**  
**Printed glass**

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<table>
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<td>Floppy disks</td>
</tr>
<tr>
<td>Ceran</td>
<td></td>
<td></td>
<td>Cutting disks</td>
</tr>
</tbody>
</table>

Source: GTS
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