A case study of the Dyson DC25 upright and DC23 cylinder to illustrate and encourage best practice specifications for durability and repair.
Introduction

This case study complements WRAP’s buying specifications for vacuum cleaners that have been developed to assist buyers and manufacturers procure and produce higher-quality products that last longer and can be more easily repaired, leading to lower environmental impacts.

This case study highlights the most beneficial measures found in the Dyson models that extend the product’s life, and some of these can be relatively easy to achieve within the product’s price-point constraints. The buying specifications (see separate publications) include further detail for companies wanting to take a more ambitious approach and deliver greater environmental benefits, as well as differentiating their brand for quality and reliability.

The specifications were developed by assessing vacuum cleaners through discussions with brand manufacturers and repairers, and also through carrying out ‘teardown’ on a range of products to identify design features that facilitate repair.

Product information

The Dyson DC23 is a 1400 Watt compact cylinder vacuum cleaner. It has a 2 litre dust container, clip on tools and a height adjustable handle extension. The hose wraps around the base for storage.

The DC25 upright is relatively lightweight and rides on a ball for easy manoeuvrability. The 1200 Watt motor is mounted inside the ball.

Both models are representative of high-cost models, retailing at above £200. All Dyson vacuum cleaners sold in the UK come with a 5 year parts and labour guarantee.
Vacuum durability issues

A Which? survey in 2008\(^1\) reported that cylinder vacuum cleaners were found to be more reliable than uprights. At least 1 in 5 upright cleaners up to 6 years old required repairs compared to 1 in 10 for cylinder models. The survey also suggested that only 10 - 20\% of vacuum cleaners are repaired in the first 6 years of their lifespan.

The five reasons it reported for vacuum cleaner breakdowns in order of frequency were:

- split or broken hoses;
- loss of suction;
- motor failure;
- broken casing; and
- power cable faults.

Research carried out with the repair industry for this project revealed that other common faults include:

- malfunction of the on-off switch or cable rewind button due to repeated use; and
- failure of the beater bar and wearing of brushes.

The average life expectancy of a typical household vacuum cleaner is around 500 operating hours\(^2\) - which is equivalent to 10 years of household use dependent upon the quality of the machine, frequency of use and general level of maintenance.

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\(^1\)www.which.co.uk/reports_and_campaigns/house_and_home/Reports/cleaning/Cleaning%20appliances/Vacuum%20cleaners/Vacuum_cleaners_essential_guide_574_70328_5.jsp

Durability

Vacuum cleaners are particularly subject to damage by impact, compression loads and from vibration. A vacuum cleaner should be sufficiently robust (to withstand impact and compression loads) and rigid (to avoid bending and twisting) and the internal parts should be firmly secured. Parts that are critical to functionality, such as hinges, should be located in strong housings and protected from potential damage. Electrical parts such as power lead connectors and on-off switches should also be protected from thermal stress.

Mechanical robustness

Vulnerable parts

On both the Dyson models, all the buttons and clips allowing access to the machine are brightly coloured for easy identification and are located away from the front and sides of the product, so they are less likely to be damaged.

The user guides are published online and illustrate the operation of all buttons and access clips. Most are situated where they are easier to operate by hand to discourage foot operation and potential damage. The on-off and cable rewind buttons are vertical so that the user pushes downwards rather than at an angle, which also discourages foot operation.

For the DC25 upright, the lever to tilt the machine for use is a foot pedal located at the back of the machine. This is securely fastened and made of suitably rigid material to withstand damage.
Main casing

The external bodies of the vacuum cleaners are made from ABS (acrylonitrile butadiene styrene) or PC-ABS (a poly-carbonate ABS blend) which is clearly marked on the components (figure 1). These materials are robust and suitable for this type of application and machines complete 10,000 short repeated drops during testing.

The moulding designs provide strength to the housing to withstand impact and prevent them from cracking. The wall thickness of the panel is sufficient to provide rigidity to the moulding to prevent flexing during use and provide protection to the internal parts.

The bumper is a rubberised material to prevent damage to the mouldings around the soleplate, as this is the area most likely to be damaged in general use.


**Electrical robustness**

**Motor and component cooling**

Both machines use a brushed AC (alternating current) induction motor. Longer carbon brushes are used, designed for the life of the product, which reduces or eliminates the need for replacement.

The airflow through the machines is channelled upwards through a vane diffuser that cools the components. Both models have motors fitted with a heat sensitive thermal cut-out (TCO) which operates when the critical temperature is reached. The brush bars are also fitted with a TCO to avoid these being subject to overheating through excessive load.

**Component and connector fastenings**

Both machines use clip-fits for the PCBs (Printed Circuit Boards) which make them easy and quick to remove and more able to resist vibration than screw fixings.

All the connectors are securely fixed and the electrical leads are routed around the inside of the body into a channel, or are secured by clips where possible as shown in figure 2.

The length of the wiring is kept to a minimum to prevent unnecessary movement which could cause failure by repeated flexing.
Some terminal clips employ a locking mechanism and a release arm is depressed before the clips can be separated. This locking mechanism is vibration-resistant and prevents the connector from coming apart during use.

**Repair**

**Fault diagnosis and technical support**

Dyson’s online user guide\(^3\) includes basic fault diagnostics and trouble-shooting for simple repairs and they provide a customer helpline and advice for repair outside of warranty – making the process straightforward. Dyson is able to diagnose some faults over the phone by listening to the sound of the machine which can lead to quicker repair.

Simple maintenance instructions are provided in the user guide, including emptying and cleaning the dust container, removing blockages and cleaning the filters. User guides are also supplied with the product as a summary ‘quick guide’ and can be downloaded. The website has a catalogue of parts for all models manufactured to date.

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\(^3\) User guide  www.dyson.co.uk/store/
A comprehensive service manual is available online for qualified service engineers and repairers that details mechanical and electrical fault diagnosis. This includes:

- exploded view of all key parts;
- parts catalogue;
- electrical fault diagnosis and wiring schematic; and
- step-by-step guide to disassembly with photographs illustrating parts, locations and fasteners (figure 3).

**Figure 3** Disassembly instruction detail - DC23 professional service manual

**Parts availability and pricing**

Dyson’s website lists and stocks all parts for their models and the key replaceable parts are available as spares, including filters, hoses, cleaning tools and some of the sub-assemblies such as the cyclone and wheels. Some components are available as part of larger assemblies.

Dyson spare parts are also available from independent online outlets which supply both branded and universal replacement parts (that are compatible with other brand models).
The cost of spares is a key consideration to the feasibility of repairing vacuum cleaners outside of warranty. Some typical parts prices from Dyson are provided in the table below and represent feasible cost-effective repair.

**Figure 4** Typical parts prices from Dyson’s website

<table>
<thead>
<tr>
<th>Part</th>
<th>DC23</th>
<th>DC25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dust bin assembly</td>
<td>£28.89</td>
<td>£22.94</td>
</tr>
<tr>
<td>Cyclone assembly</td>
<td>£40.15</td>
<td>£33.86</td>
</tr>
<tr>
<td>Cable rewind assembly</td>
<td>£28.69</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Pre-filter</td>
<td>14.49</td>
<td>13.76</td>
</tr>
<tr>
<td>Motor</td>
<td>£63.99*</td>
<td>£39.30</td>
</tr>
</tbody>
</table>

*online price from e-Spares - the DC23 motor was not available on Dyson’s parts website at the time of the study.

**Access for repair**

Parts requiring user access for maintenance are indicated by markings or labels on the machine. Most of the components are quick and easy to access by a series of clips and don’t require specialist tools. The brush bar and bumpers however are more securely fastened with standard screws and require a screwdriver.

Access to mechanical or electrical components that could fail is restricted to the professional service engineer. Parts that have user access are clearly marked with simple to operate clips and slots, whereas for parts requiring professional repair, access is restricted by use of specialist fastening such as Torx screws. The service manual provides instructions for disassembly, parts identification and fault diagnosis. All Dyson vacuum cleaners can be fully repaired and rebuilt and replacement of more complex assemblies such as the motor for example take between 15-20 minutes.
Electrical components

The electrical diagnostics in the repair manual describe potential loose connection points, fuse failures, plug and power cord faults etc. The service manuals also list insulation test points which must be tested prior to, and upon completion of all repairs to indicate any electrical leakage.

Filters

Maintenance of the filters is critical to keep the machines working efficiently and for longer and the Dyson models make this process very easy. The DC25 has two filters - filter ‘A’ is a pre-filter located in the top compartment of the dust container as shown in figure 5 below and is easily accessed by two clips.

Figure 5 DC25 Access to filter ‘A’ – from manual

Filter ‘B’ can also be easily accessed by a button on the ball assembly to release the cover. The filter is then removed from the cyclone assembly as shown below.
Figure 6 DC25 Access to filter ‘B’

The DC23 has one filter located in the wheel assembly accessed by rotating a simple coin-operated lock fastener and removing the filter as illustrated below.

Figure 7 DC23 Access of filter

Users are encouraged to wash the filters every 3-6 months to extend their lifetime rather than replacing them.

Hose

The design of the hoses on both models makes it very easy to remove blockages and check for cracks. The end that attaches to the handle assembly unclips by depressing a button.
**Brush bar**

The brush bar in the DC25 can be quickly and easily accessed by a coin slot or flat headed screwdriver (figure 10). In the DC23 cylinder an end cap is simply twisted off by hand.

**Bumper strip**

The bumper strips on the front of the vacuum cleaners can be subject to damage during use and may require replacement. Both Dyson machines use 6 or 7 standard screws (the number is considered sufficient to hold the soleplate firmly in place) to be removed for replacement. This process takes approximately 5 minutes.

**Mains power lead**

The mains lead can be subject to damage during use, and if this occurs, may need replacing during the lifetime of the product by a professional repairer. Removal requires the release of 3 Torx screws, lifting a catch and separating the three spade connectors from the machine (figure 11). This is a straightforward and effective way of securing the mains lead and only takes about 3 minutes to complete.
Cable rewind mechanism

On the DC23 machine, removal of the cable rewind mechanism (figure 12) is more complex and requires a professional service engineer or repairer to undertake. The unit is secured by only 7 standard screws but requires a series of individual operations to disassemble.

The process is facilitated by a step-by-step instructions are included in the service manual and it would take an estimated 15 minutes to complete this task. Trained engineers however would be able to undertake this far quicker.

Motor

The motor is the most complex part of the machines to remove and replace. According to the service manual, the DC25 upright ball requires a series of operations, including accessing 13 Torx screws and disconnecting 7 spade connectors.

The DC23 cylinder motor removal is less complex, but still requires 15 different operations and accessing 18 screws (of two different types). Ideally the same screw types and sizes should be used throughout to prevent a tool change for the repairer.

Due to the complexity and safety implications Dyson do not recommend non-professional users undertake motor replacement. Step-by-step guidance is provided in the service manual for qualified repairers.
Conclusion

Both the Dyson DC25 and DC23 are robustly designed for durability and repair and enable many of the key components to be easily removed and replaced relatively easily. Parts that would normally only be replaced by a qualified repairer, such as hoses and the brush bar or sole plate, can be replaced by users through following the clear step-by-step guidance in the user manual or calling Dyson’s call centre. Also key to the machines’ longer life is the 5 year guarantee where Dyson carry out the repair.

WRAP recommends that retailers and procurement professionals seek to adopt as many of these features in their buying specifications, achievable within their price constraints to improve the quality and durability of their products.

Key ‘easy to replicate’ specifications include:

- online user guide that includes basic fault diagnostics and maintenance;
- service manuals for repair professionals that includes comprehensive fault diagnostic information and exploded diagrams;
- step-by-step repair instructions with photographs;
- detailed parts listings; and
- clear distinction between repairs that the user can undertake and those that require professional repair.

Good design to prevent mechanical damage:

- robust outer casing with bumper protection;
- protected external parts;
- hand operated switches on the DC25 upright;
- well secured internal components; and
- vibration-resistant fasteners.
Good electrical design to reduce parts failure:
- thermal cut-out protection mechanism;
- secure anti-vibration PCB fixings and connectors; and
- power leads of minimum length to prevent movement wear.

Ease of access for repair:
- clearly labelled and easy to open buttons and clips that are easy to operate;
- minimum number of standard screws (in most cases); and
- comprehensive parts availability and reasonable spares pricing.