Working together for a world without waste

Case study

Specifying durability and repair in washing machines

June 2011

A case study of two washing machines by Siemens and Bosch to illustrate and encourage durability and repair.

Introduction

This case study complements WRAP's buying specifications for washing machines 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.

Although the greatest environmental impact for washing machines occurs when they are used (87% of the total energy over their lifetime), over 2.5 million are sold in the UK a year and account for one of the highest material and production impacts of householder products on the UK market. As many machines have already achieved a high level of energy efficiency (above an A-rating) – greater environmental savings could be achieved by producing more durable and longer lasting machines which avoids the significant environmental impact of producing a new one.

This case study highlights the most beneficial measures 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 savings, as well as differentiating their brand for reliability and quality.

The specifications were developed by assessing a range of washing machine price-points, through research with manufacturers, retailers and repairers, and also by carrying out machine 'teardown' to identify design features that facilitate durability and repair. Two models have been used to demonstrate the practical application of many of these good practice features.

Product information

This case study assesses the Siemens IQ-700 and the Bosch Avantixx 6 VarioPerfect washing machines, focusing on the key features that contribute to durability and repair. The key model specifications are:

	Bosch Avantixx 6 VarioPerfect	Siemens IQ-700
Energy rating	A	A
Wash performance	A	A
Spin performance	B	B
Wash Load	6kg	8kg
Spin speed	1,600 rpm	1,600 rpm
Retail price (approx.)	£320	£650

Both machines are 'A' energy rated and are at the higher quality and price-point end of the market. Siemens washing machines are guaranteed to be leak-proof and this model comes with a 5 year parts and labour guarantee. The Bosch machine has a 2 year guarantee.

General durability issues in washing machines

Washing machines are constructed with the same basic components; the agitator, motor, drive (belt or shaft), water feed tube, wash tub (with inner and outer casing) and drain tube. Product variation is demonstrated by the positioning of these parts, although the fundamental differentiator that contributes to durability and repair in washing machines is the quality of their build and components. Price-point differentiation for consumers however, tends to focus on energy rating, features such as wash programme variations (including maximum spin speed), drum size, sensor controls and type and number of displays.

A UK study on washing machines[1] found that 32% of machines in use have undergone some level of repair. On average the age of

[1] *Preparatory Studies for Eco-design Requirements of EuPs. LOT 14: Domestic Washing Machines & Dishwashers. Final Report*

the washing machines was found to be 5.5 years, and the average age of those that had been regularly serviced was 6.8 years - indicating that servicing and repair results in product life extension. According to the study the expected lifetime of a washing machine is 10 years or more.

Bosch has found that electrical failure is currently the leading fault, particularly of the PCB (printed circuit board) caused by fluctuations in mains voltage supply, although surge protection is provided with these machines.

Electrical faults can also occur as a result of water leaks from poor installation of the machine in the household and blockages in the soap drawer or inlet and outlet pipes. However Bosch have found that failures of other electrical components such as motors and pumps are becoming less common.

Research with washing machine manufacturers and the repair industry found that parts that are more prone to wear and that are more likely to need replacing are:

- door seals and hinges (items becoming caught in the seals, or deterioration of the rubber);
- inlet and outlet hoses;
- water heating elements;
- drum bearings (failure due to water leaks);
- motors (particularly from wear on brushes);
- soap drawer (misuse, or detergent solidifying causing blockages); and
- motor and drum bearings (due to overloading).

Durability

Mechanical robustness

Washing machines are subject to extreme vibration and mechanical stress during use, therefore appropriate design for strength and durability are key. It is essential that machines are designed to withstand these stresses for many years of use and thereby extend the machine's life and reduce the need for repair.

One of the components most critical to longer life is the large bearing at the back of the machine which supports the wash drum. This is required to withstand vibrations and load caused by uneven and shifting weight distribution during use, and also bending during loading and unloading.

The chassis also needs to be of high strength and rigidity to absorb the stresses from the wash drum bearings. The internal parts should remain firmly secured and electrically robust in operating conditions of high humidity and temperature, combined with vibrations.

Main body and chassis

The outer body of both the Siemens and Bosch models assessed are steel, and the chassis are coated to prevent rusting for the normal lifetime of the products. The rear panel of the Siemens model is made from stainless steel, providing greater corrosion protection and it has a solid enclosed base which provides resistance to vibration as well and good rigidity to the machine and is therefore preferable to promote longer life.

Plastic mouldings

The front control panel casing and dials are made from ABS (acrylonitrile butadiene styrene) or PCABS (a poly-carbonate ABS blend). This is clearly marked on the internal mouldings which assists in polymer identification and separation for recycling at the end of life. These robust engineering polymers are ideal for this type of application where the surface is subject to wear and tear. The inside of the detergent drawer is polypropylene, which is a material that provides good water and chemical resistance.

The front fascia mouldings are designed to provide strength and resist cracking in the event of impact. The wall thickness of the panels is sufficient to provide rigidity, limit flexing during use and also offer protection to the internal parts.

Drum housing

In both of the machines assessed, the outer tub which houses the drum is plastic and supported by springs and dampers which prevents the drum vibration being transferred to the chassis where it can cause electrical failure. The springs on the Bosch model sit over a greased metal strut, while the Siemens model has a spring and a plastic grommet which may be subject to wear and more likely to require replacement. The spring support is shown below.

Figure 1 Siemens drum spring damper support

Both machines use four steel transit bolts to secure and protect the drum during transportation which can be easily removed (by the delivery person or user) and reused for further transportation. In both cases the bolts are all the same size which simplifies the process.

Sensors

Sensors are able to effectively detect and prevent the major causes of damage and failure in washing machines. The Siemens model has a number of sensors that detect load weighting (recommending the appropriate wash programme), leaks (resulting in shut down), and too much foam or detergent to control rinse cycles. The Bosch model has some of these functions including a built-in weight sensor to improve load distribution which prevents uneven wear on the bearings and improves durability.

Electrical robustness

Motors

Siemens use an innovative motor technology to improve durability as well as energy efficiency and speed, and an anti-vibration system to increase stability and reduce damage. This is achieved by an entirely enclosed brushless motor (as brushes wear out and need replacement), which the company believe is their most durable motor.

Leak protection

Most of the electronics are located towards the top of the machines to prevent water damage. The electronic components below the tub are covered, but could still be at risk from water damage in the event of a leak. In both machines the wiring looms and connectors are positioned to minimise electrical failure. The motor cabling in the Bosch model is protected from potential leaks by a plastic shroud.

Component and cable fixings

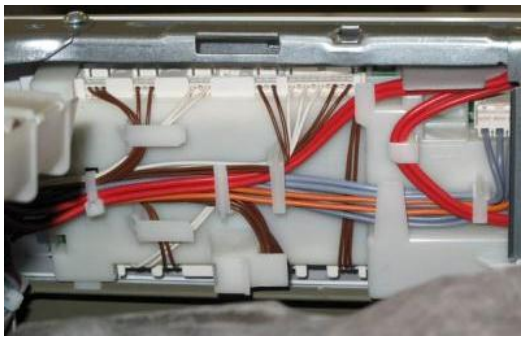
The PCBs inside both machines are secured with clips that enable quick and easy replacement over numerous access cycles – and these fixings may also dampen and resist vibration more effectively than screws giving greater security over time.

All electrical connectors are secured firmly with snap-fits that resist vibration. The use of plastic connectors rather than soldered joints also allows easier access for parts.

All internal cables are routed around the inside of the chassis and secured by cable ties or clips. The length of the wiring is kept to a minimum to prevent movement which could cause failure from flexing.

Figure 2 Bosch front panel wiring and cable ties

Figure 3 Siemens front panel wiring and cable routing clips



Repair

Fault diagnosis and technical support

Basic fault diagnosis information is provided in the user guides for both models and are downloadable from the manufacturers' websites[2], this includes how to deal with common problems.

Both companies provide users with a range of online service support[3] which includes product advice, telephone and e-mail assistance and a service engineer booking system.

As required by Section 17 of the WEEE Regulations, service manuals covering product repair are available from Bosch and Siemens covering mechanical and electrical fault diagnosis and these include exploded views of all key parts and a parts catalogue.

The service manuals are not available to users, as removal of the lid or side panel exposes electrical wiring. There is also a risk of damage to the circuit boards from electrostatic discharge if handled incorrectly.

[2] *http://www.bosch-home.co.uk/quick-links/customer-service/download-product-manuals.html. https://portal.bsh-partner.com/portal(bD1kZSZjPTAwOQ==)/PORTALFRAME.HTM*

[3] *http://www.bosch-home.co.uk/quick-links/customer-service/product-advice.html.*

Parts availability and costing

Spare parts and accessories for all models can be obtained from both companies' online 'spare parts eShop'[4] or telephone service, or from independent online suppliers.

Parts costs are not a major barrier to repair outside of the guarantee period as those most likely to fail are considered to be reasonably priced, relative to the cost of a new equivalent model.

Figure 4 Costs of common replacement parts from Bosh and Siemens

Part	Siemens	Bosch
Top cover panel	£34	£75
Drum	£153	£79
Heater element	£24	£60
Motor	£101	£128
Front control panel	£75	£46

The Siemens machine is nearly twice the price of the Bosch, however some of the Siemens parts were found to be cheaper. The motor for the Bosch machine for example is a third of the price of a new machine and for Siemens it is 14% of the price of a new machine. The relatively low cost of parts helps to encourage repair rather than replacement outside of warranty.

[4] *https://www.bosch-eshop.com/eshop(bD1lbiZjPTAwOQ==)/bosch/gb/indexa.htm*
http://www.siemens-eshop.com/eshop/siemens/gb/prodp.htm?prod=WM14S796GB/04

Access for repair

Top cover & front fascia

In general, access into the casing of the machine for repair of major parts should be addressed by good design and involve the minimal amount of screws and fixings whilst providing sufficient strength and stability - and also allowing quick and easy access for numerous repair cycles. Screws, snap-fits and lugs are commonly used and these can be standardised (in size and head type) to avoid tool changes during repair. Brass threads are found on some high-cost models that allow simple and numerous access cycles.

The Siemens IQ-700 has a simple design and illustrates good practice by using only three screws and two snap-fits to secure the front fascia and allow quick and easy access to key parts. Removal of the cover takes just two minutes to complete.

PCBs

Once the top cover is removed the PCBs can be quickly and easily accessed on both models using screws, lugs and snap-fits. On the Bosch the PCBs are fixed to the inner panel with locating lugs and snap-fits - making them easy to replace. Most snap-fits don’t need tools, although some require a flat screw driver to push open.

Back panel

The Bosch machine provides good access for repair to some key components. The rear of the drum, drive belt, internal water hoses and motor can all be accessed by removal of a single cover plate and one screw which can be done in under 15 seconds, however due to its shape it gives limited manoeuvrability and access to parts.

Plate removal on the Siemens model takes longer (2-3 minutes), however it allows greater access to components and so facilitates better access for major repairs.

Figure 6 Siemens IQ-700 with access panel removed

Figure 5 Bosch Avantixx with access panel removed

Motor and drive belts

The Bosch motor has just two bolts and locator lugs and is relatively easy to unhook, however it is less easy to access due to the profile of the back panel. The Siemens motor is also secured with two bolts which are much easier to access but slightly more difficult to unhook the motor from the locator lugs. A qualified repairer would carry out motor replacement and the step-by-step guides in the manuals facilitate this process. The drive belts can be easily accessed and removed by hand and no tooling is required.

Figure 7 Bosch Avantixx motor access

Figure 8 Siemens IQ-700 motor access

Internal hose

The hose from the water inlet to the drum in both machines is held in place by simple metal spring clips as shown below, making removal and replacement easy. This is a better solution than jubilee clips that can seize through corrosion.

Figure 9 Compression clips on the internal hose

Mains lead

The leads into both washing machines have three spade connectors and a rubber grommet, which is a straightforward and effective way to securing it, and replacement only takes about 2 minutes to complete.

Rubber door seals

Seals can become damaged through misuse (such as through clothes caught in the door, or mould accumulation by lack of ventilation after use). On both machines the door seals are secured with two metal tension rings, on the inside and outside of the drum. These are unclipped and the seal lifted out which takes 10 minutes – here simplicity and removal of the tension rings is key.

Doors

The doors on both machines are held in place with bolts making replacement quick and easy (taking about three minutes). The Bosch model has a plastic bracket and the Siemens, an equivalent metal one which is likely to be more robust. In both cases bolts are a good solution.

Figure10 Siemens IQ-700 metal door bracket

Conclusion

Both the Bosch Avantixx 6 and Siemens IQ-700 models are robustly designed providing durability and easy and effective access to the major parts for repair and replacement. Clear step-by-step guidance on replacement of key spare parts, such as the motor and drum, are available to qualified repairers. Other parts like the door and door seal can be easily replaced by the general user following the online user guide.

Overall, both machines enable easy access to internal components through the top and back panels. The Siemens model has a larger rear access panel giving a greater degree of overall access to internal components. The motor, concrete block and dampers in both models are firmly bolted in place, preventing unnecessary movement and damage by vibration. The major differentiator is that the Siemens model provides additional dampening material which reduces vibration significantly during use.

Both models demonstrate relatively easy replacement of the circuit boards, hoses, motor and drive belt – and in almost all cases aid repair by using a minimal but effective number and type of fixings (screws, bolts, cable routing systems and snap-fits) – again making the replacement of key parts straightforward.

Key 'easy to replicate' features

Access of information to avoid and diagnose repair:

- online user support;
- user guides (basic maintenance instructions); and
- service manuals (with fault diagnostic information, step-by-step instructions, exploded views and detailed parts listings).

Good design to prevent mechanical damage:

- robust and corrosion–resistant case and chassis;
- dampening to withstand vibration during use;
- well-secured internal components, using a combination of locator lugs and bolts; and
- sensors and electronic controls to reduce vibration and wear.

Robust electrical design to reduce parts failure:

- brushless low-maintenance motors;
- leak protection on vulnerable parts such as PCBs;
- wiring runs secured by clips;
- leads minimised in length to prevent breakage; and
- parts well protected from potential internal leaks.

Access and spare parts availability for repair:

- large and easily accessible back and top covers (allowing multiple access cycles and good access to key parts);
- using a minimum number of standard screws and bolts;
- internal clips and connectors that are easy to operate; and
- good parts availability and reasonable spares pricing to enable repair outside of warranty.

WRAP recommends that retail buyers and procurement professionals specify as many of these features as possible within the product's price-point constraints. Companies wanting to gain greater environmental benefits and brand differentiation can work towards designing products that are higher quality, more durable and last longer

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