Topten Product Criteria Paper on

Vacuum Cleaners

Markus Blepp, Oeko-Institut e.V. 09/2013

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Coordinated by

The Project in brief

Topten is part of the international Euro-Topten-Max initiative supported by the European programme Intelligent Energy Europe and several national institutions (energy agencies, WWF, consumer associations, research institutes). On global level, Topten is coordinated by TIG, the Topten International Group. This association promotes to the Topten Charter, TIG statutes and Rules of Procedure (www.topten.eu).

Topten is a service that supports the market for energy efficient products. It aims at making energy efficient products the first choice for consumers, by offering them a user-friendly tool for product comparison and selection. The key element is an online information platform for consumers presenting the most energy efficient appliances currently available in various product categories, including household appliances, office equipment, consumer electronics and cars. Information on energy consumption and performance of products as well as several other characteristics (i.e. brand, model, price, picture) is provided. Product data is based on labels and standardized declarations as well as tests from accepted well-known institutions. The service is independent of manufacturers and retailers.

Consortium

The project is co-ordinated by the Agence de l'Environnement et de la Maitrise de l'Energie (ADEME). The other 20 project partners are:

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Contact

Therese Kreitz (project leader)
2 Square La Fayette
49004 Angers Cedex 01
Paris, France
+33.(0)4.9395.7984
therese.kreitz@ademe.fr

Sophie Attali
SOWATT
45 rue Bichat
75010, Paris
France
+331 8394 8209
sattali@sowatt.net

Eric Bush
Rebweg 4
7012 Felsberg
Switzerland
+41 81 252 63 64
info@topten.info

Markus Blepp
Öko-Institut e.V.
Merzhauser Straße 173
79100 Freiburg
T: + 49 761 45295-237
m.blepp@oeko.de

Dr. Dietlinde Quack
Öko-Institut e.V.
Merzhauser Straße 173
79100 Freiburg
T: + 49 761 45295-248
d.quack@oeko.de

Criteria Paper for Vacuum Cleaner

Contents

1 Introduction

The criteria papers provide a central tool for the national partners to collect and analyse product data and to establish a national Topten selection. Appropriate selection criteria and technical specifications are a crucial precondition for meaningful and well-accepted Topten websites. The purpose of this criteria paper is to provide a common basis for the definition of technical specifications of vacuum cleaners. Within the European wide Topten project, an aligned approach for technical specifications for all national Topten websites is aimed at. A high level of uniformity and congruency of the different national websites will enhance the awareness amongst manufacturers. Good quality product data at national level furthermore allows to analyse the situation at European level and to make policy recommendations, which are shown on www.topten.eu.

This paper contains information for the product specification for Topten.eu qualified vacuum cleaners, as well as suggestions for criteria. A product should meet criteria described in Chapter 4 in order to be Topten product. Hopefully this paper can be used as a guide in adding vacuum cleaners in national websites.

2 Product Specification - overview on most relevant product types and characteristics

This chapter provides an overview of vacuum cleaners (VCs). It also gives a technical analysis of the product and explains the Regulations laying down ecodesign requirements and energy labelling.

2.1 Product Definition

VCs is an appliance that removes soil from a surface to be cleaned by means of an airflow created by underpressure developed within the unit. The material thus removed is separated and stored in the appliance and the cleaned suction air is returned to the ambient. VCs are made in a variety of shapes and sizes for domestic and commercial use and for different applications [7;8].

2.2 Product Types

There are two main types of vacuum cleaners:

- **bagged** VCs: a vacuum bag is used to filter dirt out of a stream of air and
- **bagless** VCs: a removable container and reusable filter is used to trap dirt

There is no explicit correlation to cleaning ability and energy consumption, so deciding between bagged and bagless vacuum cleaners is largely a question of preference. One of the advantages of a bagless VCs is you do not have to buy replacement dust bags. However, emptying the dust container can be dirty and it is easy to spill dust that could be a big problem for allergy sufferers.

Both main types of VC are produced as electric mains-operated as well as battery operated or cordless. A mains-operated vacuum cleaner is connected to a mains voltage electrical supply during its operation.
Cordless vacuum cleaner with integrated electrical supply uses rechargeable battery storage of electricity during its operation [2]. Handheld vacuum cleaners are usually cordless. Larger battery operated vacuums may be introduced to the market in coming years as battery technology improves.
Furthermore, there are hybrid[1] canister models available on the market, which can be fully powered by the electric mains, batteries or both electric mains and batteries during operation.

In order to prevent dust and dirt from re-entering the atmosphere vacuum cleaners require filtration. The filtration system of one or more filters through which exhaust air passes to remove fine particulate matter that escapes the primary separation system. Some filters remove microscopic particulate matter and purify the exhaust air, which is an important feature for people who are sensitive to dust or other allergens. Filter types include inter alia HEPA (High Efficiency Particulate Air) which meets stringent efficiency specifications [2]. Another filter technology will use water as the main filter medium. Intake air is forced through a tank of water to dampen the dirt. The dirty water is then thrown away at the end of the cleaning process [2].

[1] http://www.miele.co.uk/vacuum-cleaners/cylinder-cleaners/hybrid-vacuum-cleaner/

A cyclonic filter directs the air in a centrifugal manner to remove different sizes of particles from the airflow via specific tapping off points within the cyclone [1]. Cyclonic filtration system is normally used in a “bagless” VC.

Some vacuum cleaners come on the market with further features inter alia extra nozzles and brushes (turbo brushes) for cleaning upholstery and curtains, or of skirting boards.

The following list gives the most common types of vacuum cleaner put on the market.

Upright Cleaner
A vacuum cleaner with the cleaning head forming an integral part of or permanently connected to the cleaner housing, the cleaning head normally being provided with an agitation device to assist dirt removal and the complete cleaner being moved over the surface to be cleaned by means of an integral handle. It is suited to cleaning carpet and floor areas [1].

Cylinder or canister vacuum cleaners
A vacuum cleaner with the cleaning head separated from the vacuum body usually by means of a flexible hose. The body contains the motor, separation system, filtration system, and exhaust. This type of cleaner is supplied with a fixed or at least one detachable nozzle designed for cleaning both carpets and hard floors and through their long reach suited to cleaning above floor level, e.g. upholstery, stairs etc [1;2].

But they can be a pain to store away tidily and they're generally not as good at picking up pet hair as uprights.

Stick vacuum cleaner is similar to an upright vacuum but with a compact, lightweight design for increased manoeuvrability. The dirt storage facility and vacuum body (fan) mounted centrally on a handle and integrated with a rigid connection to the cleaning head [1;2].

Handheld vacuum cleaners
Handheld vacuum cleaners are compact and convenient. They are usually (though not always) cordless and rechargeable, making them handy for vacuuming cars. A handheld can also save you the hassle of finding the correct attachment on your main vacuum cleaner to suck up crumbs from sofas, cushions and upholstery[2].

Wet vacuum cleaner means a vacuum cleaner that removes dry and/or wet material (soil) from the surface by applying water-based detergent or steam to the surface to be cleaned, and removing it, and the soil by an airflow created by under pressure developed within the unit, including types commonly known as spray-extraction vacuum cleaners [7;8]

Wet and dry vacuum cleaner means a vacuum cleaner designed to remove a volume of more than 2.5 litres, of liquid, in combination with the functionality of a dry vacuum cleaner; A **dry vacuum cleaner** means a vacuum cleaner designed to remove soil that is principally dry (dust, fibre, threads), including types equipped with a battery operated active nozzle [7;8]

[2] http://www.which.co.uk/home-and-garden/laundry-and-cleaning/reviews/vacuum-cleaners/

Robot vacuum cleaner means a battery operated vacuum cleaner that is capable of operating without human intervention within a defined perimeter, consisting of a mobile part and a docking station and/or other accessories to assist its operation [7;8]

2.3 Best Available Technology

On account of the high energy saving potentials taking into account an estimated saving potential of 50 kWh/year per vacuum cleaner, manufacturers have undergone various efforts to increase the energy and motor efficiency of VCs in the last year. Many improvements were made in the last years to maintain a vacuum cleaner's high performance whilst substantially reducing its environmental impact. The available options for energy efficiency improvements and the the technical analysis and findings are summarized in the Eco-Design study Lot 17 (e.g. maximising fan efficency, improving nozzle design, improving airways design etc) [1]

However, at current stage any developments in this category of products are difficult to detect as no benchmark or overview of best available technologies are provided to enable all stakeholders to assess the practical implications and potential loopholes. Furthermore other VC´s technologies has entered in the area VC´s as battery operated vacuum cleaners, which include handheld and robot models are not comparable with the conventional appliances.

Rather it is important to understand that in the past and up till today the product development procedure have changed very often. In 1980, the average input power ratings of vacuum cleaners were around 350 watts for uprights and between 600 and 1000 watts for canister vacuum cleaners. By 2008, this had increased to between 1000 and 2000 watts for uprights and 1200-2700 watts for canister cleaners (see Figure 1) [1].

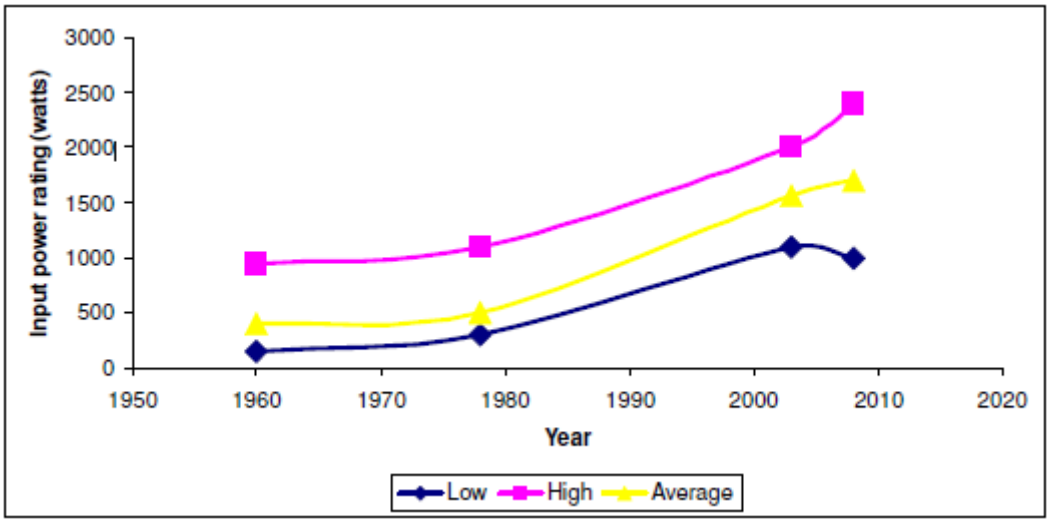


Figure 1 Increase in Input Power Rating over Time [1]

In last years the market trend appears that the input power ratings of vacuum cleaners has been little decreasing. Both input power conversions has no relationship with

cleaning performance or ability to pick up dirt where absolute levels of suction, airflow and suction power are more critical.
Cleaning performance / dust pick up can be defined as the capacity of removing dust from specific surfaces during a specified number of cleaning cycles. When it comes to cleaning performance, most vacuum cleaners clean hard floors perfectly well but not on carpets. Thus significant efforts remain to be made in the cleaning performance on carpets.
It is common that changes in measurement methods make direct comparisons difficult between input power and cleaning performance. Yet there is also no clear correlation between input power, energy consumption and cleaning performance (dust pick up) and matching their improvements. However, there should be a correlation at which level of input power the consumers reach a sufficient cleaning performance. We would like to underline, that the intended use of a VC is to remove soil from the surface and thus the main important criterion from consumer perspective.

Noise has an effect on consumers in a way that they emit noise that can be prejudicial to human health. Therefore noise is an environmental pollutant and the control of noise levels of vacuum cleaners should not be ignored. But so far there has been no real technological innovation although there are significant differences on the market.

Emission of particles can be controlled by HEPA-filters, either used as filter bags or as an additional filter in a cyclonic system vacuum cleaner. Further improvement may be achievable by better fitting filter bags and self-sealing bags to reduce dust emission when bags are changed. The ability of a vacuum cleaner to prevent small particles from re-entering the atmosphere is an important performance criterion as insufficient filtration may negatively affect the cleaning performance and the user's health.

It seems that the pressing need to reduce energy consumption in domestic appliances presents an opportunity to engineer high performing, efficient vacuum cleaners while improving the level of cleaning performance and its environmental and health impact. Throughout a systematic product development, it should be possible to develop an environmentally friendly vacuum cleaner, which was also technically improved and should have a high marketability.

Furthermore the implementation of an energy label and Ecodesign requirements for vacuum cleaners within the scope of Directive 2009/125/EC is welcome and necessary. The directive provides for the setting of requirements which the energy-related products covered by implementing measures must fulfil in order to be placed on the market and/or put into service (see section 2.5)

2.4 Overview on basic terms and aspects regarding criteria for vacuum cleaners

2.4.1 Energy consumption

Since the 1960s input power ratings of vacuum cleaners has been increasing. The market trend shows an increase from a typical 500 watts in the 1960s to over 2500 watts today.

The JRC estimates vacuum cleaner consumption in the residential sector to be 3% of total electricity consumption in 2009 [5].

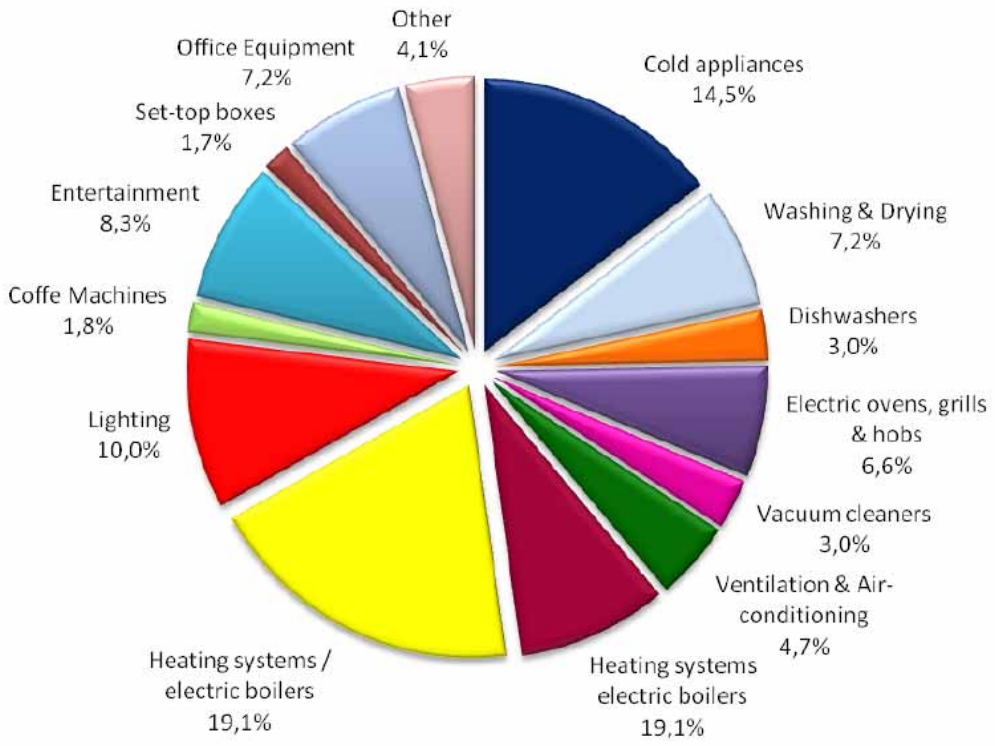


Figure 2 Residential electricity consumption breakdown in the EU-27 in 2009 [5]

The environmental impact assessment conducted showed that the environmental impact is dominated by the “In use” phase and more than 90% of the impacts of vacuum cleaners [1].

The calculation of the energy consumption can be done with the ammeter or calculated directly from the max. input power and an average user profile for vacuuming are calculated. Moreover, the European standard EN 60312-1 defines precisely how a vacuum cleaner has to be tested on carpet as well on hard floor and how its average specific energy consumption (Wh) and its dust pick-up have to be measured during the carpet test.

2.4.2 Dust removal (dust pick-up)

The nozzle design on both cylinders and uprights can have an effect on pick up performance. The higher the percentage of dust pick up, which is also measured using the IEC European test standard 60312-1, the better the performance.

Dust pickup on hard floor is higher than on carpet and can reach values > 100%.

The Preparatory study [1] does not give any examples for average, worst or best cleaning performance values. Swiss Topten indicates that 75% (carpet) and 95% (hard floor) relate to a good cleaning performance, EU ecolabel criteria are 70% for carpets and 98% for hard floor, Blue Angel 80% for carpets and 98% for hard floor and the Commission Regulation No 666/2013 sets 70% for carpets and 95% for hard floor.

According to Topten websites, at present, several vacuum cleaners with a dust removal efficiency of 80% on carpet and 100% on hard floor are available having a rated input power of 1200 W.

The current dust pickup measurements are performed with new, empty bags. The performance of most vacuum cleaners however quickly declines with the bag becoming filled. Because in daily life the vacuum cleaner is virtually never empty, a measurement with partly filled bag would better reflect real-life usage conditions

2.4.3 Filtration (dust re-emission)

The ability of a vacuum cleaner to prevent small particles from re-entering the atmosphere is an important performance aspect as insufficient filtration may negatively affect the cleaning performance and may have a negative health impact [6]

The revised measurement standard EN 60312-1 (see chapter 2.5) will include a method of measuring the re-emission of the small particles (0.2-4 micron) that are considered to be the most damaging to human health. Good quality vacuum cleaners can remove over perhaps 99% of such particulates (personal communication by industry) that are sucked up by a vacuum cleaner.

Dust re-emission is an important performance criterion and health aspect, in particular for those consumers with respect to allergies ,household members suffering from asthma or other lung conditions.

Filters vary enormously in efficiency and effectiveness and there are standard test methods to determine how effective a vacuum cleaner is at retaining its dirt and dust once it has been picked up.

2.4.4 Noise

Different noise values according to producers‘ declarations depends on the measurement standard that has been used and can lead to misunderstandings. Generally noise levels are measured as Sound Power (LwA) according IEC 60704-3 and presented in Decibels (dBA). Sound Power is an absolute measurement of noise level and is what is generated by the vacuum cleaner. It is independent of environment and gives a more accurate representation of the power of a vacuum cleaner to produce noise. As the decibel scale is logarithmic, an increase of 3dB means that the sound power is doubled. However a difference of 3dB is the smallest difference that is normally audible to the human ear.
The eco-label criteria for vacuum cleaners [8] which has not yet come into force included criteria for noise, <76 dBA. The Ecodesign requirements (see chapter 2.5.2)

suggest asound power level shall be less than or equal to 80 dBA. At present the best available noise value on the market is according to http://www.guidetopten.fr/home/electromenager/aspirateurs.html 61 dBA.

2.5 Legislations and labels

2.5.1 Backgorund

The scope of ecodesign and labelling measurers includes all electric mains-operated vacuum cleaners, including hybrid vacuum cleaners. This excludes wet, wet and dry, battery operated, robot, industrial, or central vacuum cleaners as well floor polishers and outdoor vacuums.

2.5.2 Ecodesign requirements for vacuum cleaners

The Commission Regulation No 666/2013 will enter into force 1 September 2014. It establishes eco-design requirements for the placing on the market of electric mains-operated vacuum cleaners, including hybrid vacuum cleaners. The aim of the Ecodesign regulation is to phase out the least inefficient vacuum cleaners (in two phases) [7]:

1. From 1 September 2014
    - annual energy consumption shall be less than 62.0 kWh/year.;
    - rated input power shall be less than 1600W;
    - dust pick up on carpet (dpuc) shall be greater than or equal to 0.70[3].
    - dust pick up on hard floor (dpuhf) shall be greater than or equal to 0.95.
    - These limits shall not apply to water filter vacuum cleaners.

2. From 1 September 2017
    - annual energy consumption shall be less than 43.0 kWh/year;
    - rated input power shall be less than 900W;
    - dust pick up on carpet (dpuc) shall be greater than or equal to 0.75;
    - dust pick up on hard floor (dpuhf) shall be greater than or equal to 0.98;
    - dust re-emission shall be no more than 1.00%;
    - sound power level shall be less than or equal to 80 dB(A);
    - the hose, if any, shall be durable so that it is still useable after 40 000 oscillations under strain;
    - operational motor lifetime shall be greater than or equal to 500 hours

The annual energy consumption, rated input power, dpuc (dust pick up on carpet), dpuhf (dust pick up on hard floor), dust re-emission, and noise power is measured and calculated in accordance with the regulation [8, see annex II]. .

[3] It was changed to 0.70 within the RC

2.5.3 Energy labelling requirements of vacuum cleaners

The Commission Delegated Regulation No 665/2013 of 3 May 2013 establishes requirements for the labelling and the provision of supplementary product information for electric mains-operated vacuum cleaners, including hybrid vacuum cleaners. From 1. September 2014 Label 1 with the energy efficiency classes A to G applies. From 1. September 2017 Label 2 applies with the energy efficiency classes A+++ to D.

The Regulation provides labels for three types of products: It distinguishes vacuum cleaners for hard floors, for carpets and for 'general purpose'. Energy efficiency classes are the same for all types, vacuum cleaners for hard floors, for carpets and for 'general purpose'.

2.5.3.1 Energy efficiency scales for vacuum cleaners (proposal) [8]

The energy efficiency class of a vacuum cleaner shall be determined in accordance with its annual energy consumption as set out in Table 1. The annual energy consumption AE is calculated, in kWh/year, measured according to the standards set in the regulation [8, see annex VI]. It bases on 50 cleaning cycles per year and a standard dwelling surface to be cleaned of 87m² that is passed over 4 times in each cleaning cycle.

Table 1 Energy efficiency classes [8, see annex 1]

Energy efficiency class	Annual energy consumption (AE) [kWh/yr]	
	Label 1 (A to G)	**Label 2 (A+++ to D)**
A+++ (most efficient)	n/a	AE ≤ 10.0
A++	n/a	10.0 < AE ≤ 16.0
A+	n/a	16.0 < AE ≤ 22.0
A	AE ≤ 28.0	22.0 < AE ≤ 28.0
B	28.0 < AE ≤ 34.0	28.0 < AE ≤ 34.0
C	34.0 < AE ≤ 40.0	34.0 < AE ≤ 40.0
D (least efficient)	40.0 < AE ≤ 46.0	AE > 40.0
E	46.0 < AE ≤ 52.0	n/a
F	52.0 < AE ≤ 58.0	n/a
G	AE > 58.0	n/a

2.5.3.2 Cleaning efficiency classes [8, see annex 1]

The cleaning performance class of a vacuum cleaner shall be determined in accordance with its dust pick up (dpu) as set out in Table 2. The dust pick-up on hard floor (dpuhf) and on carpet (dpuc) shall be the determined as the average of the results of the each two cleaning cycles in a hard floor test and respectively a carpet test.

The dust pick up of a vacuum cleaner shall be determined in accordance with the standards set in the regulation [see annex VI, point 4].

Table 2 Cleaning performance classes

Cleaning performance class	Dust pick up on carpet (dpuc)	Dust pick up on hard floor (dpuhf)
A	dpuc 0,91	dpuhf 1,11
B	0,87 dpuc < 0,91	1,08 dpuhf < 1,11
C	0,83 dpuc < 0,87	1,05 dpuhf < 1,08
D	0,79 dpuc < 0,83	1,02 dpuhf < 1,05
E	0,75 dpuc < 0,79	0,99 dpuhf < 1,02
F	0,71 dpuc < 0,75	0,96 dpuhf < 0,99
G	dpuc < 0,71	dpuhf < 0,96

2.5.3.3 Dust re-emission efficiency classes [8, see annex 1]

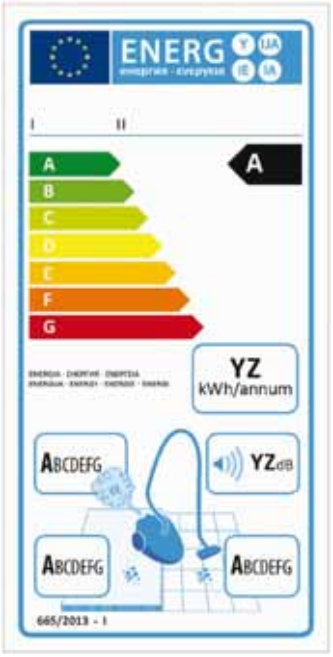
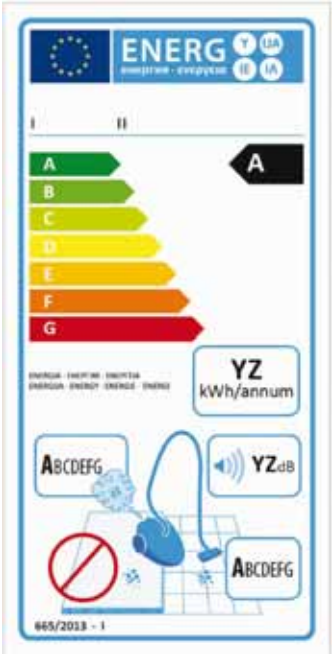
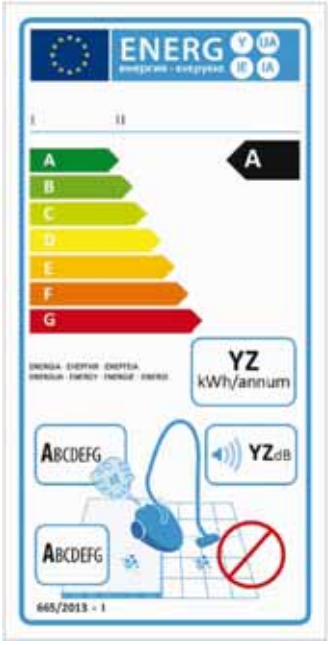
The dust re-emission class of a vacuum cleaner shall be determined in accordance with its dust re-emission as set out in Table 3. The dust re-emission test shall be determined as the average of the results of the two cleaning cycles in a carpet, respectively hard floor test.

The dust re-emission of a vacuum cleaner shall be determined in accordance with Annex VI. [4, see also annex VII, point 5.].

Table 3 Dust re-emission classes

Dust re-emission class	Dust re-emission (dre)
A	dre 0,02%
B	0,02% < dre 0,08%
C	0,08% < dre 0,20%
D	0,20% < dre 0,35%
E	0,35% < dre 0,60%
F	0,60% < dre 1,00%
G	dre > 1,00%

Label 1 according to Commission Delegated Regulation No 665/2013:

Label 1		
General purpose vacuum cleaners	Hard floor vacuum cleaners	Carpet vacuum cleaners
		

2.6 Other Labels or benchmarks

2.6.1 Blue Angel (not yet adopted)

The Blue Angel is also about to introduce requirements for vacuum cleaners, a product group which has not yet been covered by the environmental label. The following criteria are foreseen to be adopted in mid-2013:

Table 4 Foreseen criteria for Blue Angel

Criteria	
Average power input	1200 W
Energy consumption (cleaning of 10 m2 carpet with 5 times passing per cleaning cycle	250 Wh
Minimum dust pickup on carpet after 5 double strokes and a 200g dust loading	80%
Minimum dust pickup on hardflor after 5 double strokes and a 200g dust loading	98%
Maximal Dust re-emission (0.4 - 4 µm)	0,2%
Noise	80 db(A)

In addition to the criteria set out in Table 4 the following criteria shall apply for the purpose of the Blue Angel:

- Durability (substaniated by life time of components like motors, suction hose etc.)
- material requirements of plastics
- recycling requirements
- provision of spare parts
- User instruction

2.6.2 EU Eco-Labelling Scheme (no longer valid)

The criteria in Figure 3 was valid from 1 April 2003 until 31 March 2007 with an extension to 31 March 2008. However, as there were no applications made for an Ecolabel, these vacuum cleaner criteria have now expired, and the European Commission had no plans to extend them.

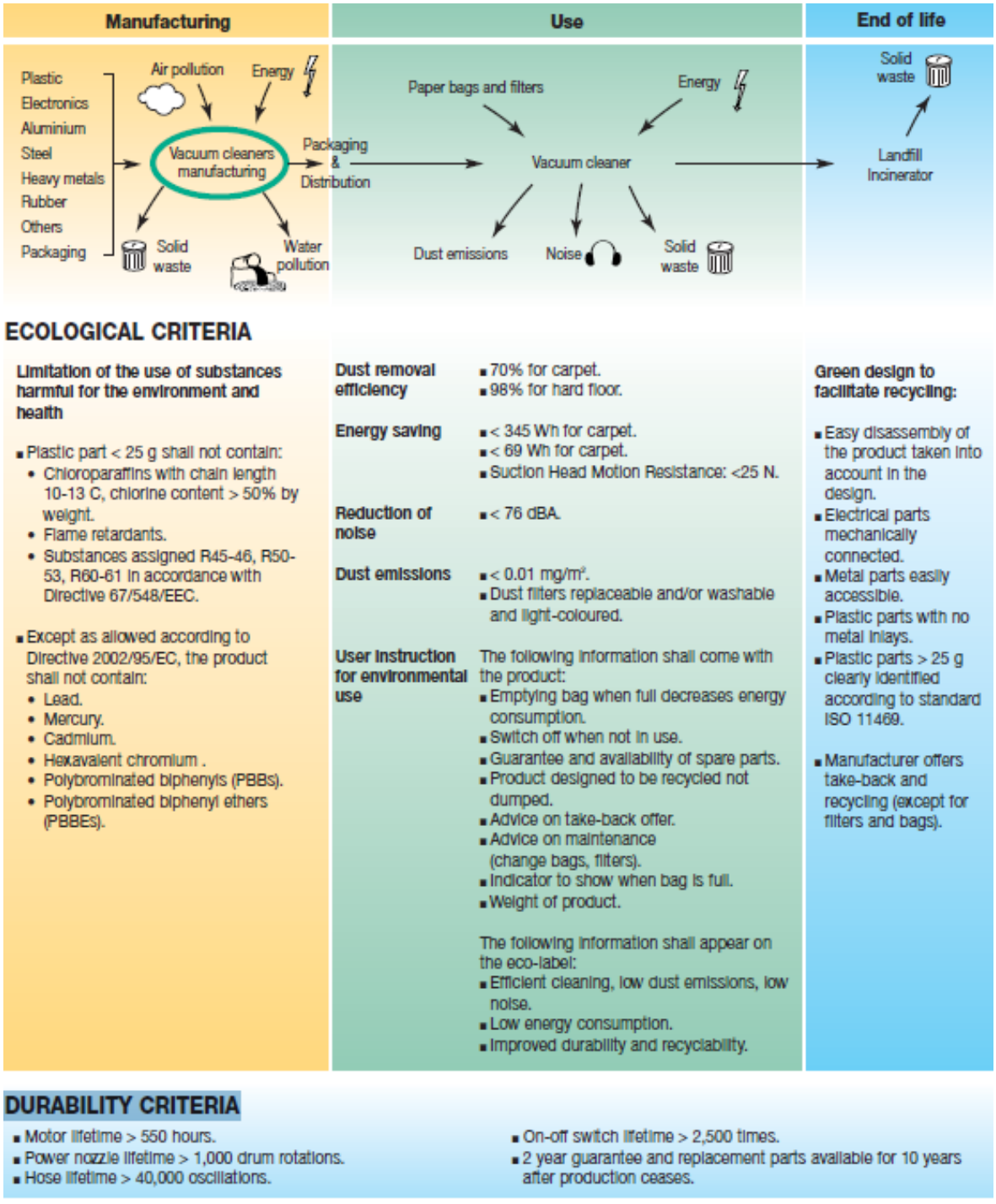


Figure 3 The European eco-label for vacuum cleaners (no longer valid)

2.6.3 Energy Star (under observation)

The U.S. Environmental Protection Agency (EPA) consistently looks for new opportunities to expand ENERGY STAR to new product categories that will deliver significant benefits to consumers and the environment. The current state of the implementation of possible Energy Star requirements for vacuum cleaners is a scoping report [2]

2.7 Test Standards

2.7.1 Europe

There is one major long established standard applicable to vacuum cleaners in Europe: EN 60312. The latest edition of the standard is IEC/EN 60312-1 Ed 1.0 Vacuum cleaners for household use - Part 1: Dry vacuum cleaners - Methods for Measuring the Performance. This procedure includes an energy consumption test to measure energy and cleaning performance on different surfaces and with different types of soiling. This standard is not intended for battery-operated vacuum cleaners.

IEC/EN 60312-1 Ed 1.0 has replaced standard of the IEC 60312 Ed 4.0. Changes include new dust emission and filtration efficiency tests as well as improvements to air data measurement.

The EN standard represents the basis of the current European energy labelling system for vacuum cleaners.

2.7.2 International

There is one other major, international test organisation which has published extensive vacuum cleaner performance test methods and that is the US based ASTM International. Following test methods and standards are correlated to vacuum cleaners

- ASTM F2756 – 09 Standard Test Method for Determining Energy Consumption of Vacuum Cleaner. This procedure provides an indication of the amount of energy usage of the vacuum cleaner while operating over a specified cleaning area at a specified stoke speed and total number of cleaning strokes. This method applies to household and commercial upright, canister, stick, and wet/dry vacuum cleaners.

- ASTM F608–07 Standard Test Method for Evaluation of Carpet Embedded Dirt Removal Effectiveness of Household/Commercial Vacuum Cleaners. This procedure measures relative carpet dirt removal effectiveness and applies to

residential and commercial upright, canister, and combination vacuum cleaners. This standard differs from IEC 60312-1 in that it measures cleaning on four different types of carpet rather than a single type.

- ASTM F2608 – 07 Standard Test Method for Determining the Change in Room Air Particulate Counts as a Result of the Vacuum Cleaning Process. In this test method, the amount of particulate generated into the air by operating a vacuum cleaner over a specific floor covering that is contaminated with dust will be determined. Particles from the motor, floor covering, and the test dust will all be measured. A standardized test chamber, equipment, floor covering material, and dust particulate are used in this test method.

- CRI TM 112 Standard Test Method for Evaluation of Solid Particulate Removal Effectiveness Using X-Ray Fluorescence Techniques. This procedure describes X-ray fluorescence techniques for measuring the percentage of soil compounds removed from a test carpet.

- CRI TM 115: Standard Laboratory Test Practice for Determining the Power Use Effectiveness of Residential and Commercial Vacuum Cleaners. This procedure evaluates soil removal performance versus power consumption to determine Power Use Effectiveness (PUE). A high PUE indicates removal of more soil with less power consumption.

2.7.3 Noise

IEC 60704-2-1:2000 ed. 2.0: Household and similar electrical appliances – Test code for the determination of airborne acoustical noise, Part 2-1: P Particular requirements for vacuum cleaners. These particular requirements apply to the determination of airborne acoustical noise of electrical vacuum cleaners operated in dry conditions

3 Market data

3.1 Market and Stock data

The market for vacuum cleaners is big and competition is fierce. According to the EuP preparatory study on vacuum cleaners 46 million vacuum cleaners have been sold in the EU in 2005 [1]. Surveys on a national level indicate that vacuum cleaner ownership varies between 0.67 and 0.96 per household. In some countries, it is common to have more than one vacuum cleaner per household. This multiple ownership is likely to increase.

3.2 Growth and Trends

Within the most important segment of vacuum cleaner in particular bagless vacuum cleaner have increased slightly. In general, a trend for a brand and the other a trading-up is observed by the consumer investment decisions.

In addition, the significant increase in demand revives after robot vacuum cleaner, the now account for 3 percent of european total sales.

The european sales of robot vacuum cleaner in 2011 has doubled compared to the previous year 2010. Worldwide a number of robo vacuum cleaner sold 8.8 million is expected in 2011.

The hand vacuum cleaners the market increase as well. Their growth can be attributed mainly to new products and competitors for the cordless vacuum cleaner

Service lifetime of vacuum cleaners is assumed 8 years [1]. However, consumer behaviour differs and market data suggests that many consumers buy new models earlier.

3.3 Manufacturers

Dyson, Vax[4], AEG-Electrolux, Hoover, Miele, Bosch Siemens, Rowenta and Philips are probably the main relevant market players for the entire EU market. Additionally, brands from the Far East have produced products for the EU market, including LG, Dirt Devil, Sebo, Progress, Panasonic and Samsung. Own brand products sold by retailers also have a part in the EU market.

[4] Vax are part of TTI, the world's largest vacuum cleaner manufacturer)

4 Concept and Criteria

According to the Topten concept, each country has to develop its specific Topten lists which depend on the products available on the national market. Thus, the specific thresholds for Topten lists depend on the products offered at national level and will be more or less stringent depending on the number of efficient products available. The intention of this paper is to provide some recommendations regarding the criteria to be considered in Topten product listings and to give an idea of the efficiency of products currently offered on the market.

The proposed Topten selection criteria are basically based on the COMMISSION REGULATION (EU) No 666/2013and the COMMISSION DELEGATED REGULATION (EU) No 665/2013 for vacuum cleaners as described in chapter 2.5.2. and the the other Labels or benchmarks in chapter 2.5.2

4.1 Current Topten Europe

Topten Europe (www.topten.eu) lists the vacuum cleaners with lowest input power and good performance. It shall apply to upright and cylinder cleaners, with or without dustbag, and handhelds.

In order to be displayed on topten.eu, vacuum cleaners must meet until yet[5] the following technical criteria[6]:

- Maximum power: 1300 W (According to the type plate. In reality the power is often lower than declared).
- Minimum dust pickup on carpet: 75% (Dust pickup on carpet according to EN 60312: five strokes on a Wilton carpet).
- Minimum dust pickup on hard floor[7]: 95% (Dust pickup on hard floor according to EN 60312: five strokes on a specified hard floor surface)
- Maximum dust re-emissions: 0.04 mg/m^3 (Dust re-emissions in accordance with EN 60312)

Further information displayed on-line

- Brand and Model
- Similar Models: Products of similar construction and identical technical values are displayed only once. Similar models' names are listed under 'similar models'.
- Electricity costs (€ in 10 years)[8]

[5] Latest version: 01.06.2013

[6] Criteria will be adapted to the market situation.

[7] Dust pickup on hard floor is higher than on carpet and can reach values > 100%

- Energy consumption (Wh): Energy consumed for cleaning 10 m2, in accordance with EN 60312.
- Dust re-emissions (mg/m3): Dust re-emissions in accordance with EN 60312.
- Weight in kg according to producers‘ declarations
- Bagless or with a bag
- Dust capacity (l): Volume of dust in liters which can theoretically be stored in the dust bag or canister.
- Available in countries: Countries in which a product is available according to producers declarations; country codes according to ISO.

The appliance must be available in at least one European country. Relevant values have to be provided by the suppliers. Suppliers who are not able to provide these values cannot claim to have their appliances displayed on topten.eu. All declarations can be verified by random measurements. The data sources are declarations by producers and suppliers, national data-bases and topten-sites (e.g. www.topten.ch , www.topprodukte.at, www.guidetopten.fr)

4.2 Recommendation for new vacuum cleaners criteria for Topten sites

4.2.1 Recommendation for main criteria and value setting

In order to be displayed on Topten, vacuum cleaners must meet the following main criteria and as a starting point we suggest to stick to following value settings.

- Annual energy consumption (AE) [kWh/yr] or energy efficiency class at least A / AE ≤ 28.0. If A-class vacuum cleaners are not available, at least B-class should be fulfilled.
- Despite the inclusion of input power and the dust pickup into of the calculation formula of the annual energy consumption there is a need and important to display any information on input power and dust pickup on carper and hardfloor
    - We recommend the rated input power shall be less than 1300W (according to the existing criteria on topten.eu)
    - Dust pickup on carpet after 5 double strokes and a 200g dust loading shall be greater than or equal to 80% (according the draft proposal Blue Angel)
    - Dust pickup on hard floor after 5 double strokes and a 200g dust loading shall be greater than or equal to 98% (according the draft proposal Blue Angel)[9]

[8] Costs for electricity during 10 years (product’s lifetime); tariff of electricity: 0.15 €/kWh (should be understood as order of magnitude as there can be large differences depending on country or electrical utility). Cleaning of 150 m2 per week (75m2 twice a week)

[9] If it is not possible to provide this value by the suppliers, we recommend dust pick up on carpet shall be greater than or equal to 0.80 (Class C) and for hard floor 1.04 (according the cleaning performance classes to the draft proposal energy labelling)

- The vacuum cleaners should dispose a value for the dust re-emission (0.4 – 4 µm). Value shall be no more than 0,2%. (according the draft proposal Blue Angel)

4.2.2 Quality related product features

Apart from the above mentioned main criteria following product specification may qualify for additional quality related product features or are recommended for additional user information.

The following table is divided into two sections, "product features" and "user information ".

"Product features" cover the most important quality related product features and as well as product specification that are seen crucial for the success of the Topten websites. The information can be shown on the Topten websites (in the tables) to ensure that the consumer gets sufficient information also on the main criteria.

Additional **"user information"** displayed on Topten can give the consumer a more thorough outlook on the product. Additional "user information" is not additional selection criteria, but can give more wider view of the product.

However, please bare in mind that the Topten tables must remain user-friendly and readable (i.e. not too many lines). However, Table 5 can be used in the Recommendation page to point out to consumers important features.

Table 5 Quality related product features or additional user information

Product specification	Qualifies for product features	Only for user information
Brand and Model	✓	
Similar Models (Products of similar construction and identical technical values are displayed only once. Similar models' names are listed under 'similar models')	✓	
Purchase price in €	✓	
Noise in dB(A)	✓	
Electricity costs (€ in 1-10 years or lifetime)	✓	
Weight in kg	✓	
Bagless (yes or no)	✓	
Corldless (yes or no) if no please indicate the cable length		✓
Cost for bags and filters (€ in 1-10 years or lifetime)	✓	

Product specification	**Qualifies for product features**	**Only for user information**
Dust capacity in litres (Volume of dust in litres, which can theoretically be stored in the dust bag or canister)	✓	
Available in countries (Countries in which a product is available according to producers declarations; country codes according to ISO.	✓	
Durability criteria o Motor lifetime > 600 hours. Obligatory from 1 September 2017 on due to Ecodesign o Power nozzle lifetime > 600 drum rotations. o Hose lifetime > 40,000 oscillations. Obligatory from 1 September 2017 on due to Ecodesign o On-off switch lifetime > 2,500 times. o 2 year guarantee and replacement parts available for 8 years after production ceases		✓ (✓) ✓ (✓) (✓)
Material requirements of plastics		✓
Products awarded with the Ecolabel Blue Angel (if products are available)		✓
Rating by Quality tests (Ecotopten (www.ecotopten.de) in Germany requires a further quality criterion at least a “good” rating from Stiftung Warentest has to be achieved if a quality test exists. The absence of a test result does not lead to devaluation.		✓
User and manual instruction of the product (for instance o Advice on emptying bag when full decreases energy consumption. o Indicator to show when bag is full. o Advice on maintenance (change bags, filters or empty the dust box). o Advice on take-back offer. o Instructions for the use of the vacuum cleaner on carpet and hard floor using recognizable and selectable power input setting on the vacuum cleaner o Advice on allergy sufferers to household dust, Vacuum cleaners should fitted with highly efficient particulate air filters, also known as HEPA filters)		✓

The appliance must be available in at least one European country. Relevant values have to be provided by the suppliers. Suppliers who are not able to provide these values cannot claim to have their appliances displayed on topten.eu. All declarations can be verified by random measurements. The data sources are declarations by producers and suppliers, national data-bases and topten-sites (e.g. www.topten.ch, www.topprodukte.at, www.guidetopten.fr) and measurements by test laboratories.
The products can be ranked according to their electricity consumption and annual emissions in CO2 equivalents (www.ecotopten.de) or to their their electricity costs during 1 or 10 years (www.topten.eu).

5 References

[1] AEA Energy & Environment: Work on Preparatory Studies for Eco-Design Requirements of EuPs (II) Lot 17 Vacuum Cleaners TREN/D3/390-2006; Final Report, February 2009 http://ec.europa.eu/energy/efficiency/studies/doc/ecodesign/eup_lot17_final_report_issue_1.pdf

[2] ENERGY STAR Market & Industry Scoping Report Vacuum Cleaners; November 2011

[3] Anette Michel, Eric Bush; TIG (Topten International Group), Vacuum cleaners: Recommendations for policy design; Paris February 2013 (www.topten.eu).

[4] Marianne Gehring; TIG (Topten International Group), Vacuum cleaners: Recommendations for policy design; Paris July 2011 (www.topten.eu).

[5] JRC - Joint Research Centre Institute for Energy and Transport - Energy Efficiency Status Report 2012 Electricity Consumption and Efficiency Trends in the EU-27; Paolo Bertoldi; Bettina Hirl; Nicola Labanca; ISBN 978-92-79-25604-2 (pdf); Italy 2012

[6] ANEC/BEUC comments on the updated Ecodesign and Energy Labelling proposal for vacuum cleaners; Updated European Commission drafts of December 2012; Angeliki Malizou – Ref.: ANEC-PT-2013-ErP-001; http://www.anec.eu/attachments/ANEC-PT-2013-ErP-001.pdf

[7] COMMISSION REGULATION (EU) No 666/2013 of 8 July 2013 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to Ecodesign requirements for vacuum: http://www.eup-network.de/fileadmin/user_upload/REG_666-2013_Vacuum_cleaners.pdf

[8] COMMISSION DELEGATED REGULATION (EU) No 665/2013 of 3 May 2013 supplementing Directive 2009/125/EC of the European Parliament and of the Council with regard to Ecodesign requirements for vacuum cleaners:

http://www.eup-network.de/fileadmin/user_upload/REG_665-2013_Vacuum_cleaners.pdf

[9] CECED comments on the Commission draft measures for Energy Labeling and Ecodesign requirements for vacuum cleaners, Brussels, 12 February 2013

http://www.ceced.org/EFEDE//easnet.dll/GetDoc?APPL=1&DAT_IM=213AB2&DWNLD=2013-03-11%20CECED%20Position%20Paper_F-Gas%20regulation%20revision_final_2013-03.pdf

[##] www.topten.eu - Best Products of Europe
[##] www.topten.info – International Platform for Best products
[##] www.guidetopten.fr - Best Products of France
[##] www.topprodukte.at
[##] www.ecotopten.de - Best Products of Germany