European Ecolabel for vacuum cleaners

Technical study on criteria definition and updating

Final report

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Table of contents

1 Introduction

This study was entrusted to CSTB by AFNOR CERTIFICATION in march, 2001.
This report is an intermediate draft of our work on the criteria definition and updating for the European ecolabel of vacuum cleaners appliances.

The first step of our work consisted in revising and justifying the scope of application proposed by AFNOR certification in the feasibility study.

The second step of our work consisted in an inventory of all environmental impacts (ecological, nuisance and health impacts) of vacuum cleaners during their life cycle. We used a streamlining life cycle assessment (LCA) approach to identify the main impacts (energy and materials consumption and emissions).

This life cycle approach enabled us to quantify some impacts and was a support for the criteria selection and the thresholds definition for awarding. We also collected non LCA data for acoustic nuisance and health impacts (dust emissions…). The June and October meeting in Paris enabled a further discussion about criteria. This report also presents the synthesis of these discussions.

Lastly, this report propose some complementary works to finish the criteria selection and thresholds definition. The most important is the work on vacuum cleaner efficiency rely to its energy consumption. This phase will need experiments performed by a competent organism. It will be the CTTN of Lyon. Results should be available by the end of March 2002.

Then, in the final report (end of march or beginning of April), CSTB will propose a final criteria selection and threshold definition for awarding.

2 Selection of vacuum cleaners types concerned by this study

This section greatly takes up the feasibility study of AFNOR certification performed by Patricia PROIA in October 2000. We only update, complete or precise some information.

2.1 The vacuum cleaners market

2.1.1 Traditional market

In Europe the vacuum cleaner market mainly present three types of products as the sled type vacuum cleaners, upright vacuum cleaners and handheld vacuum cleaners. There are also all the extractor and injector vacuum cleaners which have others functions than aspirate dust. These vacuum cleaners concern the consumers market. There are also professional (or semi professional) vacuum cleaners as NILFISK for example which are for some of them very similar of the consumers vacuum cleaners.

In Europe the market is dominated by sled type vacuum cleaners or cylinder vacuum cleaners (between 50 percent to 94% of the market, about 10 millions of units). Upright vacuum cleaner represents a smaller market (more than 50 percent of market in Great Britain, in minority in other countries, about 4 millions of units). Lastly, 2 millions of handheld vacuum cleaners are sold each year. (Euromonitor, 98)

Upright vacuum cleaners are very similar to sled vacuum cleaners in their use and technology. There are less powerful but seem to as efficient as sled ones when used with an electrobrush. The use of handheld vacuum cleaners is very different.

Some producers indicated that the traditional European market would probably be disturbed by the Asian market trends. This market will propose cheaper products with a reduced motor durability (300 hours). This is an element for the motor durability criteria discussion.

2.1.2 New products

In the vacuum cleaners market, product innovation, at least from a technical point of view, is limited in most areas. Consequently, product development in this sector has tended to concentrate on aesthetically innovative design concepts and improved ergonomics. Recent models have featured new rounded and smooth shapes and a range of innovative colors. It is no more a traditional market with only one form, only one type of use and so on.

So we can say that the most important developments that manufacturers have introduced until now are :

- **Increased compactness** with the same or increased suction
- **Improved comfort/ease of use** (in terms of noise and bag changes)
- **Improved air quality** features (air filters)
- **Improved surface features**, including a greater ability to work on a variety of surfaces, including uncarpeted floors

➢**Improved feedback to the user**, eg the introduction of « dust sensors » which activate a light when the area is clean

Some totally new products recently appeared in the market. In Great Britain, the brand DYSON propose a vacuum cleaner without bag. This product has taken the first place in this country but it market share is smaller in the other countries. POLTI, an Italian producer, offers to the market a new vacuum cleaner The « Lecologico » without bag which filters dust in a water container. Recent consumer tests are very perplex about this new products. The "Que choisir" French magazine even advised against them. The magazine concluded the standard test is too demanding for vacuum cleaners without bag. Despite this, the without bag vacuum cleaner market will probably growth because these appliances are very efficient for air quality enhancement by a better filtering and smaller dust emissions.

2.1.3 Consumers behaviour and demand

Despite our previous notes, the quality of vacuum cleaners seems to be very homogeneous. So the consumers choice is often dictated by other consideration than cleaning efficiency and endurance. The ease of use, the noise, the air filtering quality and design are very important criteria.

Another parameter will perhaps modify the vacuum cleaning market. The consumers interest for central vacuum cleaning systems in houses growths (already important in Nordic countries).

Very recent studies suggest that vacuum cleaners are still too noisy and some without bag systems are less easy to use that traditional ones (filter cleaning, water tank emptying).

2.1.4 Producers and retailers

The vacuum cleaners market is an european market and even international.

Manufacturer	% volume
Electrolux AB	15,6
Miele	8,8
BSH	7,7
DYSON	8
HOOVER	6,2
Group SEB	4,6
Philips	3,5
Moulinex SA	2,4
Delongui Spa	1,8
Matsushita Electric Industrial (Panasonic)	1,2
Daewoo Group	1,0
Samsing Group	0,7
Others	39,2

National manufacturer volume shares

BSH and Miele has a significant market in Germany and Netherlands. Electrolux has its bigger market share in Sweden and a good market share in Germany and France.

Manufacturers	Germany	Italy	Sweden	France	Spain	UK	Netherlands
BSH	15%		9%	7%	3%		12%
Miele	15%		12%	5%		3%	19%
Philips	3%		2%	11%	2-3%		15%
Electrolux	16%		55%	11%		19%	9%
Moulinex				10%	11%		8%
Tornado				12%			
Chromex				10%			
Hoover	5%	12%				11%	
Delongui		15%					
Rowenta	3,6%	18%		16%	9%		
Daewoo		8%		1,5%	1,9%		
Samsung		6%		1,3%	6,4%		3,9%
Matsushita (Panasonic)			8%		27%		
Electrodomesticos Solac					10%		
Dyson						34%	
Private label	9%		15%	3%		3%	3%
Others	30%	41%	1%	12%	36%	30%	17%

Source Euromonitor 1998

There is no leader brand in Europe but some brands leads some national markets (Electrolux in Sweden, Dyson in Great Britain). So the competition on this market is relatively strong.

The retailers communicate to consumers on price, on power, on level of filtration, on noise and on facility of use. Criteria on design and ergonomy are also important.

2.2 Selection criteria for the Ecolabel scope

To determine which vacuum cleaner types will be concerned by the ecolabel, we used three criteria :

- market quantity,
- vacuum cleaner functions,
- use type (household or professional).

These criteria influence all the life cycle of the vacuum cleaner : design, manufacturing, use and recycling possibilities. For example industrials vacuum cleaner would probably be easier to collect for recycling. The household use is also probably less intensive than the industrial one.

Regarding the market quantity for residential products, there is no reason to eliminate some products from the study. In some countries, even handheld vacuum cleaners can represent more than 20 percent of sales.

Regarding the function, upright and sled vacuum cleaners applications are the same. Handheld vacuum cleaners have an extra use for little surface or quick use. Without bag systems are more efficient for air filtering applications but are a bit less efficient for cleaning some surfaces. But they are used for general house cleaning like sled and upright vacuum cleaners. Systems with other function like water sucking can't be compared with other appliances.

The household and professional use are very different. Semi-professional systems used in public spaces (eg schools) even encounter more difficult conditions of use than household products. So if we decided to introduce some professional systems in the study we should propose different criteria or different threshold.

2.3 Our proposal

The scope of application of the French "NF environment" ecolabel is very restrictive, too restrictive.
We think the scope of application proposed in the feasibility study is not enough restrictive.

So we propose this scope of application :

All vacuum cleaners which are fit to aspirate dust like cylinder and upright vacuum cleaners on at least 10 m2 per use.

The handheld vacuum cleaners are excluded of the study. But some professional systems could be considered. All systems listed in the feasibility study could also be excluded from the scope of application.

For professional systems classification and selection we will contact producers like NILFISK. We will probably choose some criteria like system weight, system capacity, limited function to dust removing.

3 Environmental Impacts of vacuum cleaners

In this section, we describe the different potential impact of a vacuum cleaner during its life (manufacturing including raw material extraction, use, end of life and all transports needed).

3.1 Manufacturing

It is very difficult to have data on the different pieces of the vacuum cleaner (only one manufacturer gave us partial data). Very often each piece corresponds to one supplier and it is difficult to have environmental data on this part. It seems that the impact on the environment due to the assembling of the vacuum cleaner is minor in relation to others steps like extraction of raw materials and manufacturing of materials.

The vacuum cleaner manufacturing consists in assembling materials. So the environmental impacts of the manufacturing step lie in the energy consumption, the

energy content and quantity of materials used. For non thermal processes, the energy consumption is insignificant in comparison with the energy content of materials. For the ecolabel, the environmental impact of vacuum cleaners manufacturing should be taken into account by two criteria :

- energy content,
- mass of materials used.

The composition of vacuum cleaners depend of the product but , in general, we will find plastic like ABS, polycarbonate, polyethylene and others, metals, electrical equipment, rubbers, and so on.

Material family	**Material**	**Parts of the vacuum cleaner**
Metals 40%- 60%	Aluminium Steel Copper	Tubes and parts of the engine Sucker, parts of the engine Engine for the blower, electric wire
Plastic 30%- 65%	Polypropylene (PEP) ABS Polystyrene PVC POM,PA,PC	Body of the vacuum cleaner Label, electric wire High technology parts, engine, straps
Rubber 1-2%		Seal
Paper , textile 1-2%		Bag, filter

Materials generally used in a vacuum cleaner

3.2 Use

Different impacts on the environment concern this step :

3.2.1 raw material and energy

raw materials

The use of a vacuum cleaner asks the periodic renewal of paper bags and /or filters.
Raw material is used even if the bag is made in paper (renewable resources) and if it uses recycled paper.
The composition of filters is various like paper, textile, active coal..
New technologies permit to propose to the consumer filters reusable.

Energy

The use of vacuum cleaners involves an energy consumption and consequently a non renewable raw material consumption like fuel, gas (from electricity production with fossil energies)...In relation of Life cycle assessment this consumption can be easily estimated when we know the power of the vacuum cleaner and its use life.
The power of suction will depend also of the type of process. For example, between a vacuum cleaner with a bag and a vacuum cleaner without bag, we can see differences on suction power and also on maintenance in the time of suction power.

The calculation of the energy consumption can be made following the European standard Pr EN 60312 (publication date October 2001). The consumption of a vacuum cleaner is in general between 200 and 250 Wh per standard application.

3.2.2 atmospheric emissions

When we use a vacuum cleaner, there is an air movement caused by the suction and involve dust emissions in suspension in the atmosphere which can give allergy problems.

In order to reduce this problem, vacuum cleaners have more and more efficient system for the filtration (sometimes 4 or 5 filters).
These systems correspond to the use of a paper bag with a double thickness, a motor filter, one or many air filters, micro filters which guarantee 99,9% of air purity.
The bag technology also is important to reduce dust emissions.

Other systems exist like the vacuum cleaner of POLTI , the « Lecologico », which uses water for a first filtration and after until 8 filters for the smallest dust particles. Other systems use cyclones (mechanic filtration).

Some elements about dust
The household dust is a complex mixing of vegetable and animal origin pieces (acarid bodies, insect bodies, hairs, pollens, fungal spores). Most of them are allergenic particles. Lots of studies demonstrate the implication of household dust in asthma start. Vacuum cleaning is recommended to reduce the risk to be exposed to allergenic agents. But lots of vacuum cleaners in the present market may reemit in air lots of particles. That increases the risk of breathing allergies.
We proposed to add an ecolabelling criteria based on the air filtration and atmospheric emissions of vacuum cleaners. A good vacuum cleaner mustn't hold its dust back.

Indirectly, other atmospheric emissions are generated during the use phase (atmospheric emissions due to electricity production). These emissions greatly depend on the primary energy source (nuclear, hydraulic, fuel, gas, wind…).

3.2.3 noise

The noise is an environmental nuisance. The reduction of the noise depends a lot of the manufacturing of the vacuum cleaner, of the materials used and of the air tightness of the vacuum cleaner’s body. We must consider this parameter.

Sometimes the consumers think that the performance of a vacuum cleaner depends of the noise. More it is noisy more it is efficient. So if we will ask for a reduction of the noise, an information will be necessary.

The recent study on consumers requirements concerning vacuum cleaning enhancement showed a great demand for noise reducing. The feasibility study proposed a criteria with a threshold of 80 dBa (reference 1 pico Watt). Although most

of vacuum cleaners on the market display a noise power between 72 and 77 dBA, most consumers still criticise vacuum cleaners for their noise. In fact, manufacturers assert that around 75% of appliances have a sound level between 76dBa and 79 dBa. So the threshold of 80 dBa seems too high but can't be reduced a lot if we don't want to remove all appliances from the ecolabel.

3.2.4 waste

The use of a vacuum cleaners involves wastes (bags with a lot of dust, dirty filters, deodorant for vacuum cleaners). For without bag systems (cyclone filtration or water filtration) there are other waste. For water filtration systems, the consumers need to empty and to clean the water tank after each use. This generates one or two liters of dirty water per vacuum cleaner use. For cyclone filtration, the cyclone must be empty regularly. Without bag, this operation can provoke some dust reemission. For all systems, old filters are to changed.

3.3 End of life

At the end of the life, the vacuum cleaner is a waste. Many solutions exist.

The consumer gives back the vacuum cleaner to his retailer. At this moment we must think to the operation of dismantling, recovery of some pieces or materials.
The producer takes back the different vacuum cleaners in conformity with the directive on electronic and electric materials.

But, in general, vacuum cleaners still end their life in a dump or an incinerator.

So one of the best solution to reduce environmental impacts of vacuum cleaners is to increase their durability. The motor failure is not the only origin for vacuum cleaners early end of life. In some cases, the failure of the power nozzle system is a enough reason for consumer to dump its appliance. In the French recent studies, all tested systems supported more than one thousand drum rotations. So we think the 500 rotations limit is too low.

4 Discussion on criteria

4.1 General standard and test methods

For the vacuum cleaners it exists national standards for fitness for use but also CEI standards for measurement of energy consumption, for fitness for use, for measurement of dust emissions and so on. It should not have problems with the choice of standards.
Example of standards : EN 60-312 and EN 60 704-3

As we will see, there is no standardised test method that enables to directly rely aspiration efficiency and energy consuming.

4.2 Ecological criteria

4.2.1 Energy content of the materials

To validate the feasibility study, We performed a streamlining LCA to collect data on energy use and material use during the life cycle of a vacuum cleaner.

4.2.1.1 Streamlining (simplified) Life Cycle assessment of vacuum cleaner

Because of the lack of available data, CSTB only performed a streamlining LCA based on general data collected on Internet, LCA database or given by a manufacturer. The data quality is low but this streamlining LCA enabled us to get a quantitative rough assessment of the energy major consumption during the vacuum cleaner life cycle.

Hypothesis :
Average power of appliances: 1200 W (lots of appliances are 1400-1500W)
Service life : 550 h of use (around 1 hour per week during 10-11 years)
All energy value are primary energy value. (We took 1 MJ electric = about 3 MJ of primary energy)
Transport from manufacturing site to distribution shop : 200 km
Transport from shop to user : 20 km
Transport from user to a collect site for recycling : 20 km (the shop is supposed to collect the old appliances)

Data sources :
Data given by a manufacturer for the materials used in the appliances.
With these data, we establish that four materials are significant (more than 2% in mass) in the described vacuum cleaner (body only) :

- PP : 76,5%
- ABS : 14,3%
- PS : 2,7%
- PC/ABS : 2,7%

Seven other materials are used in low quantities (SBR, POM, santoprene, PA, PC, PBT, polymetallic alloy).

The total mass of described body was 4,55 kg. The data for vacuum cleaner motor were not included. For the motor we have only the materials used, but not their mass in appliance. Seven materials are used : PPO, PA6, PA66; Polyesterimidhars, PETP and superflex.

For generic models and energy data we used the Simapro5 and Ivam3database. For PC/ABS composite material, we used the average value for PC and ABS. We didn't included the feedstock energy in our study (feedstock energy is the potential energy contained in raw material used for plastics manufacturing). For example, if you use 1,5 t of petrol to manufacture 1 t of plastic, the feedstock energy of the plastic is 1,5 Tep.

We also used the Afnor XP P01-010-1 (French standard) (see annexes) for energy data and transport models.

On a site we find some information about the manufacturing energy consumption (see address in contacts and sources) :

Manufacturing is equivalent to 72 hours of vacuum cleaner use. But is it only process energy for vacuum cleaner assembly ? (it is not clear)

Data used for energy consumption of raw materials production

Material	Energy consumption per kg (MJ)*
PP	68
ABS	50
PS	53
PC	80

*The feedstock energy was not included. It represents about 50% of the energy content for polymers.

Data used for car transport

	Consumption (kg/km)	PCI (MJ/kg)
Fuel	0,06	44 MJ/kg

Data used for truck transport

	Consumption (kg/100km)	PCI (MJ/kg)
Fuel	32	44 MJ/kg

We considered that a truck contains 350 appliances (70 m^3).

Results :

With the data given by Philips, we determine a energy consumption for raw material production of about 300 MJ/appliance. But it represents only the energy consumption for the body of the vacuum cleaner.

Life cycle step	Energy consumption (MJ)
Raw material production (body of vacuum cleaner only)	300
Manufacturing	Unknown but low
Transport before use	61
Use	7128
Transport before recycling	53

Detail energy consumption calculation
E = 550h x 1200W = 660 kWh = 660 x 3,6 = 2376 MJelec = 2376*3 = 7128 MJ primary energy

These figures must be used with care. But they enable us to know the approximate contribution of each step of the life cycle to energy consumption

Manufacturing : [500 ; 1000] MJ/vacuum cleaner
Use phase : [5000 ; 10000] MJ/vacuum cleaner
Transport phases : [100 ; 200] MJ/vacuum cleaner

The use phase represents about 90% of all energy consumed during the life cycle of a vacuum cleaner. The simplified energy balance proposed in this part demonstrates that the energy content criterion is no longer relevant.

4.2.1.2 Other arguments for criteria discussion

The criteria proposed by the French ecolabel is :

Energy content of the vacuum cleaner ≤ 700 MJ

Only parts having a mass > 50 g have to be taken into account.

This requirement could be checked by the auditor. The manufacturer could provide a declaration stating the product's constituent materials as well as their respective masses.

4.2.1.3 Decision about the energy content criterion

After the results given by the streamlining LCA and the two meetings discussions, the working group decided to omit this criterion (not a real source of environmental improvement and not a selective criterion).

These discussions lead to perform a new study to couple the energy efficiency with the cleaning efficiency. This study is described in §5.

4.2.2 Durability

4.2.2.1 Proposed values

Durability of the motor (according to standard IEC 312 article 19.1)

t ≥ 550 hours

Today a lot of vacuum cleaners have a life time between 500 and 600 hours. In its comments, Nilfisk proposed a 700 hours lifetime as a more reasonable value. Other manufacturers explained that this limit had low sense for household appliances. Most of vacuum cleaners premature ends of life are not due to a motor dysfunction. 550 hours also is the lifetime asked by consumers associations and by

testing organizations and it is not so easy for domestic vacuum cleaners. The producers suggested Nilfisk to communicate about their best lifetime.

Durability of the power nozzles (according to standard IEC 312 article 20.1)

durability ≥ 1000 drum rotations

Today a lot of vacuum cleaners endure more than 1000 drum rotations.

Durability of the hoses (according to standard IEC 312 article 20.2)

durability ≥ 40 000 oscillations

The applicant could provide the results of the tests carried out by an authorized laboratory or by the producer's laboratory according to standard IEC 312 or EN 60-312.
In fact a lot of applicant's laboratories are very well equipped and we could accept their own tests

Nilfisk-Advance suggests to also include the durability of the electrical chord rewind.

Durability of the electrical chord rewind (which standard ?)

Durability ≥ 3000 full pull outs

This value is not tested very often but seems to be acceptable.

4.2.2.2 Decision

The proposal is 550 hours for motor, 1000 drums rotation for the power nozzle and 40000 oscillations for the hoses. No proposal was made to introduce the durability of the electrical chord rewind.

4.2.3 Reparability - Maintenance

All spare parts required for ensuring correct operation of the appliance will remain available during a period of 10 years after the appliance has stopped being produced.

This requirement could be checked by the auditor.

The working group agreed on a 10 years availability.

4.2.4 Energy consumption

4.2.4.1 About a compromise between efficiency and energy consumption

In the first draft, the two following criteria were proposed.

Consumption for 5 strokes over a 10 m2 area (according to standard NF C 73-161)

E < 250 Wh for a vacuum cleaner without power-driven brush **E < 275 Wh** for a vacuum cleaner with power-driven brush

Nilfisk suggested that the criterion should be the same with or without the power-driven brush because it's just another way of realising a cleaning machine for the same job.
The CTTN tests suggest that these limitations are too strict. CTTN tests on three vacuum cleaners showed an average energy consumption of about 350 Wh for five strokes.

Efficiency according to standard IEC 312

Output : η_{max} > 18%

The applicant will provide the results of the tests carried out by an authorised laboratory or by the producer's laboratory according to standard IEC 312.
The results of the producer's laboratory will be accepted subject to a previous agreement of the competent body.

Efficiency according to IEC 312 is measured without the floor nozzle, so this parameter is completely misleading and irrelevant.

Producers told that the actual tests don't correspond to the reality and there are works to modify the type of dust for having a more realistic test. But even there are some disagreements on the test relative to the EN 60 312 it is the best test for the moment.
COFACE proposed to test the efficiency and energy with a hard floor covering.

Nilfisk suggested an efficiency in terms of cleaning ability per consumed energy. The working group agreed it is necessary to have data on different energy consumed by vacuum cleaners in relation with the different results of efficiency as dust removal to define this criterion.

CTTN made clear that we need to write a protocol for carrying out this test in which we should describe the number of cycles for the efficiency (probably the same than the European method), the different times where we must do the measures, the type of chosen surface in order to define the energy required related to the number of cycles.
The test would be made with a bag half full.
This test will enable to have an idea of the energy consumed for an efficiency minimum and for an high efficiency.

4.2.4.2 Prospects on this criterion

CTTN will test three appliances, on two floors with an empty bag and an half full bag. These tests will enable to propose a new criterion. The results of CTTN tests are described in §5.

4.2.5 Maintenance

Level indicator

A level indicator could be required for vacuum with bags or without bags.

Information

Instructions intended for the consumer will indicate the vacuum cleaner's maintenance procedures (changing of filters, of bags). The consumer must be able to access these instructions easily. By way of example, the instructions may be located inside the vacuum cleaner in the part housing the bag or on the bag itself if there is a bag.

These informative instructions could be checked by the auditor.

4.2.6 Vacuum cleaner dust emission

Another CSTB team is working on the allergen emissions of the vacuum cleaner. This study started at the beginning of 2001 and will finish at the end of 2002. They are working on a dust model to study the allergen properties. This dust model is almost finished and they started to work on the appliances performances.

Dust emission rate (according to EN 60-312 or English method with NaCl)

Let Q be the quantity of dust rejected per m^3 sucked up

Q < 0,05 mg/m³

The applicant could provide the results of the tests carried out by an authorised laboratory according to the standard EN 60 312 or a method using NaCl (English method)

About filters we should be decide on the type of filters . Some of them use biocide.

The problem is that the dust emission according to EN 60312 is obsolete due to the high content of large particles. They are actually thinking about this problem and a working group works on it.
Nilfisk suggests to use smaller particles for the test and to use standard EN1822. Nilfisk also suggests an efficiency higher than 99,5% (HEPA H12).

The working group does not wish to follow the proposition of Nilfisk and would rather to keep the proposal of AFNOR CERTIFICATION with the standard EN 60 312.

CSTB is working on vacuum cleaners dust emission and their impact on human health.

Description of CSTB study for AQCEN
The CSTB study includes three parts:
- standard dust seeding methodology definition,
- development of a new experimental room to measure and compare the dust reemission of vacuum cleaners,
- validation and writing of a new pre-standard protocol : this protocol will be based on experimental testing and will be proposed by AFNOR to the ecolabel working group.

This protocol will enable to define a sanitary criterion for the European ecolabel of vacuum cleaners.

The experimental testing phase is currently running. The results of the study would be available by the end of 2002.

Replacement of the filters

Filters will be light coloured so as to reveal the degree of clogging up to the user.

This requirement could be checked by the auditor.

This criterion was not discussed but Nilfisk asserts that a light coloured filter will not give an indication of clogging. This criterion should be omitted.

4.2.7 Noise (according to standards EN 60 704-2-1 and EN 60 704-3)

Declared sound power ≤ 80 dBA reference 1 picoWatt

The Noise criterion should be measured according to standard NF EN 60 704-2-1 and the declaration will be checked according to standard NF EN 60 704-3.

As we say in part 2, we think the limit of 80 dBA is no longer appropriate to new consumers requirements. We will discuss for a new limit. We don't want a too high limit reduction because the noise requirement could become contradictory with other criteria like raw material consumption.
Manufacturers asserts that 75% of appliances have a noise level between 76 dB(A) and 79 dB(A). Nilfisk suggested to reduce this criteria threshold from 80 to 73 dB(A).

After the two meetings, we think the proposition of Nilfisk is unacceptable because too selective. We will try to collect new data on vacuum cleaner sound levels. But

for the European Commission, the objective of selecting the best 25-30% of appliances enables us to propose à 77 dB(A) limit.

This threshold will be discussed during the next meeting.

Note :
During our data search, we saw that it was very important to well distinguish the sound power and the sound level. In fact, the sound level is lower than the sound power because it depends on the chosen distance to the source. By example, when manufacturers assert a 50-60 dBA value they often assert a sound level at 2 meter.

The applicant could provide the results of the tests carried out by an authorised laboratory or by the producer's laboratory according to standards EN 60704-2-1 and EN 60704-3.

4.2.8 Prevention of ecotoxicological hazards and incitement towards recovery

4.2.8.1 Recovery and recycling

The difficulties encountered when we study the recycling of polymers are transports and materials sorting. Polymers recycling is very difficult if all materials are mixed.

So, one of the best solution to avoid materials mixing is to reduce the number of materials used. About fifteen polymers families are used in a vacuum cleaners that can correspond to twenty or thirty different materials !

To increase automobile recycling, the car industry reduce the number of polymers used in cars from more than thirty to less than ten.

But this solution is not environmentally relevant for vacuum cleaners. The most important thing for vacuum cleaner materials recovery and recycling is the electric "octopus" recovery. A suitable vacuum cleaner design is needed to ensure an optimal recovery of electric and electronic parts. Furthermore, materials' counting is not so easy.

So the working group is not very in favour of a material number reduction.

We would rather move towards a criterion on a marking for plastics for improving the dismantling, with an easy access to different pieces of the vacuum cleaner and a best information on the end of life.

For plastic components having a mass > 50 g, permanent marking must make it possible to identify the following substances : polypropylene, polystyrene, PVC, HDPE, LDPE, ABS, polyamide and others.

The marking is carried out according to standard ISO 1043. This requirement could be checked by the auditor.

4.2.8.2 Prevention of ecotoxicological hazards

Absence of heavy metals such as cadmium, lead, chromium (VI) oxide, mercury and arsenic in the plastics (with the exception of the electrical and electronic components), in particular owing to dyes.

The tolerance threshold on the basis of the analytical results is 1000 ppm per element except for Cadmium for which the tolerance threshold is 100 ppm.

Electrical and electronic components containing heavy metals must be able to be easily isolated (when conducting repair operations or at the end of the vacuum cleaner's life).

This criterion could be checked by the auditor.

4.3 Fitness for use criteria

Functional unit : To suck up an embedded quantity of dust present on a defined, standardised surface area, complying with the requirements laid down by the fitness for use criteria.

We proposed to add a new criterion which is either a ecological criterion and a fitness for use criterion.

4.3.1 Vacuum cleaner weight

The limitation of weight enables a control of material quantity used in the vacuum cleaner manufacturing. The consumers study also showed that heavy appliances are difficult to use and could indirectly provoke some health effects (backache for example). The weight should be measured with all functional elements of vacuum cleaners including bags, full water filter…

vacuum cleaner weight with all functional elements ≤ 12 kg

This criterion could be checked by the auditor.

The 12 kg limit was chosen according to the heaviest appliance tested in the recent French studies.
Nilfisk suggest to put a 9 kg limit.
In fact, for producers the weight represents very often the quality of a vacuum cleaner. BEE proposed not to keep this criterion.

After discussion, the working group decided to omit this criterion.

4.3.2 Dust removal test

on a standardised Wilton carpet : without power-driven brush	**k > 60 %** for a vacuum cleaner

on a standardised Wilton carpet **k > 70 %** for a vacuum cleaner with power-driven brush on hard, flat floors : **k > 98 %** on floors with crevices : **k > 90 %** where k = dust removal capacity

The applicant could provide the results of the tests carried out by an authorized laboratory or by the producer's laboratory according to standards IEC 312, amendment 1 (excluding amendments 2 and 3 or EN 60-312). The results of the producer's laboratory should be accepted subject to a previous agreement of the competent body.

Nilfisk proposed the threshold should be the same with or without a power driven brush. For Wilton Carpet, Nilfisk suggest a **65%** limit.

This criterion will probably be linked with the future criterion efficiency/energy. That will be discussed during the next meeting, following the CTTN tests results.

4.3.3 Suction head motion resistance

R < 40 N

The applicant will provide the results of the tests carried out by an authorized laboratory (see annex 7) or by the producer's laboratory according to standard IEC 312 article 18 or EN 60-312.

The results of the producer's laboratory will be accepted subject to a previous agreement of the Competent Body.

Nilfisk propose a 30N limit to encourage manufacturers to use a high quality nozzle to moderate the power consumption.

4.4 Consumers information criterion

We proposed to add a consumer information criteria.

Presence in vacuum cleaner packaging of an information note on the ecolabel criteria, the energy consumption and the recycling of materials

The principle of this note was accepted by the working group during the discussion about the maintenance criterion.

This note should present explanation on:
- ecolabel criteria,
- how to save energy,
- how to improve end of life recovery of vacuum cleaners…

5 The CTTN Study

The CTTN studied three appliances :
- NILFISK 510 (rated power 1200W, Max Power 1400W, average capacity 4,640 L),
- PHILIPS FC 9106 (rated power 1600W, max power 1800W, average capacity 2,593 L)
- ROWENTA RS 064 (rated power 1200W, max power 1400W, average capacity 1,817 L).

The CTTN performed four different tests:
- Dust removal (efficiency and energy consumption) from wilton carpet with empty bag,
- Dust removal (efficiency and energy consumption) from wilton carpet with partly filled bag,
- Dust removal (efficiency and energy consumption) from hard floor with empty bag,
- Dust removal (efficiency and energy consumption) from hard floor with partly filled bag.

5.1 Dust removal from wilton carpet

The object of this test is to determine the ability of the vacuum cleaner to remove dust from velvet carpets.

The test was performed according to IEC 60312. Appliances were tested with empty dust bag and partly filled dust bag. In this case the amount of dust was 150g/L of dust bag capacity. Dust was composed of 2/3 of mineral dust and 1/3 of wood flour.
Three tests were performed for each vacuum cleaner.

The following table presents the average results of the tests on wilton carpet:

<u>Main conclusions of the tests on wilton carpet</u>
- The cleaning efficiency regularly increase with the number of strokes, but it seems to tend to an asymptotical maximum not reached with 5 cycles,
- The asymptotical maximum seems to be around 70% (against about 98% for hard floor),
- This maximum can be influenced by the dust bag filling ; on the ROWENTA model the efficiency is reduced by around 10% in case of partly filled bag.
- The energy consumption seems to vary in the same way that cleaning efficiency for all tested appliances,
- There are no significant differences between the tested appliances,
- The 200W rated power difference between the PHILIPS model and the two other model neither leads to a significant energy consumption difference nor to a significant better cleaning efficiency.

<u>Cleaning efficiency and energy consumption on wilton carpet</u>

Vacuum cleaner	Efficiency (%) after 1 cycle	Efficiency (%) after 2 cycle	Efficiency (%) after 3 cycle	Efficiency (%) after 4 cycle	Efficiency (%) after 5 cycle	Energy (Wh) After 5 cycle*
NILFISK 510 (empty bag)	42,7	54,4	60,1	63,5	65,9	348,3
NILFISK 510 (partly filled bag)	43,5	55,3	60,8	64,4	66,7	362,2
PHILIPS FC 9106 (empty bag)	42,5	55,2	61,6	65,5	68,3	360,5
PHILIPS FC 9106 (partly filled bag)	42,7	55,1	61,2	64,7	66,7	348,4
ROWENTA RS 064 (empty bag)	40,7	53,5	60,3	64,6	67,6	347,7
ROWENTA RS 064 (partly filled bag)	38,0	49,5	55,5	59,2	61,9	333,3
Average (empty bag)	42,0	54,4	60,7	64,5	67,3	Not pertinent
Average (partly filled bag)	41,4	53,3	59,2	62,8	65,1	Not pertinent

*The CTTN report only gives the energy consumption after 5 cycles. The energy consumption after each cycle can be estimated with the curves (§ IV.2. of CTTN report). These curves show that the energy consumed is roughly the same for each cycle.

5.2 Dust removal on hard floor

The object of this test is to determine the ability of the vacuum cleaner to remove dust from hard floor.

The test was performed according to CTTN methodology (IEC 60312 on wilton carpet). Appliances were tested with empty dust bag and partly filled dust bag. In this case the amount of dust was 150g/L of dust bag capacity. Dust was composed of 2/3 of mineral dust and 1/3 of wood flour.
Three tests were performed for each vacuum cleaner.

The following table presents the average results of the tests on hard floor:

Cleaning efficiency and energy consumption on hard floor

Vacuum cleaner	Efficiency (%) after 1 cycle	Efficiency (%) after 2 cycle	Efficiency (%) after 3 cycle	Efficiency (%) after 4 cycle	Efficiency (%) after 5 cycle	Energy (Wh) After 5 cycle*
NILFISK 510 (empty bag)	97,4	97,9	98,0	98,0	98,1	362,2
NILFISK 510 (partly filled bag)	98,0	98,9	99,3	99,3	99,3	362,2
PHILIPS FC 9106 (empty bag)	96,6	97,7	97,8	97,9	98,0	337,2
PHILIPS FC 9106 (partly filled bag)	94,1	96,1	96,3	96,7	96,8	348,4
ROWENTA RS 064 (empty bag)	97,4	97,6	97,7	97,7	97,7	347,7
ROWENTA RS 064 (partly filled bag)	95,1	95,5	95,6	95,7	95,8	333,3
Average (empty bag)	97,1	97,7	97,8	97,9	97,9	Not pertinent
Average (partly filled bag)	95,7	96,8	97,1	97,2	97,3	Not pertinent

* The CTTN report only gives the energy consumption after 5 cycles. The energy consumption after each cycle can be estimated with the curves (§ IV.2. of CTTN

report). These curves show that the energy consumed is roughly the same for each cycle.

Main conclusions of these tests

- An asymptotical maximum cleaning efficiency is reached after 2 our 3 cycles,
- The maximum cleaning efficiency is around 98% (sometimes 99%),
- The cleaning efficiency and energy consumption are not very influenced by the partly filled dust bag,
- This test confirms that the energy consumption is not directly influenced by the vacuum cleaner rated power,
- The NILFISK model consumes slightly more energy that the two others model on hard floor.

5.3 Conclusions for criterion definition

For energy consumption and cleaning efficiency test, an empty dust bag test seems to be sufficient. This test is less realistic than a partly filled dust bag test. Nevertheless, the CTTN tests showed that it is possible to propose a very high threshold for cleaning efficiency on hard floor for only 1 cycle. To limit the energy consumption, we propose to couple this cleaning efficiency threshold with a number of strokes to reach the threshold. On hard floor, there is no real cleaning efficiency difference between models after 5 cycles.

For the three tested models, the average cleaning efficiency is 67,1% on wilton carpet and 97,9% on hard floor after 5 strokes.

Proposal for coupled energy consumption and cleaning efficiency criterion:

- dust removal efficiency >= 67% after 5 strokes on standard wilton carpet (test with empty dust bag),
- dust removal efficiency >= 97% after 1 stroke on hard floor (test with empty dust bag)

We think the limitation to one stroke on hard floor will enable a satisfactory energy saving (energy consumed divided by 5, for an efficiency of 97%,versus 98% after 5 cycles). The environmental efficiency of this criterion will depend on users' information.

To complete energy saving from the use phase of vacuum cleaners, the criterion on suction head motion resistance will be kept.

6 Final criteria proposal

SUMMARY TABLE

CRITERION	SUB-CRITERION	ACCEPTANCE THRESHOLDS or requirement level	METHOD OF PROOF
DURABILITY and REPARABILITY	Durability of motor	**≥ 550** hours	test report according to EN 60-312
	Durability of power nozzles	≥ **1000** drum rotations	test report according to EN 60-312
	Durability of hoses	**≥ 40 000** oscillations	test report according to EN 60-312
	Reparability	Spare parts availability during **10 years**	Declaration on one's honour Checking by auditor
CLEANING EFFICIENCY and ENERGY CONSUMPTION	Dust removal on wilton carpet	on standardised Wilton carpet: **k ≥ 67 %** after **5** strokes	test report according to EN 60-312
	Dust removal on hard floor	On hard floor : **k ≥ 97%** after **1** stroke	test report according to EN 60-312
	Suction head motion resistance	**R< 30N**	test report according to EN 60-312
RECOVERY and PREVENTION OF ECOTOXICOLOGICAL HAZARDS	End of life Recovery	Plastics marking and easy access to electric and electronic parts	Checking by auditor
	Prevention of ecotoxicological hazards	absence of heavy metals in the plastics electrical and electronic components containing heavy metals able to be easily isolated	Checking by auditor
EMISSION OF REJECTED DUST	Emission of rejected dust	quantity **< 0,05 mg/m^3** a new criterion will be proposed after the end of CSTB study	test report according to EN 60-312 A new method will be proposed after the end of CSTB study
NOISE	Noise	sound level ≤ **77 dBA**	test report according to EN 60 704-2-1 and EN 60 704-3
CONSUMER INFORMATION	Consumers information note	Information Note in packaging	Checking by auditor

7 Conclusions and prospects

The summary table presents the six criteria proposed for the vacuum cleaners european ecolabel :

- durability and reparability,
- cleaning efficiency and energy consumption,
- incitements towards recovery and recycling; prevention of ecotoxicological hazards
- Dust emission,
- Noise
- Consumers information

These criteria will be proposed to the working group on the European ecolabel for vacuum cleaners during the next meeting in Brussels in September the 4th.

The dust emission criterion will be probably revised when CSTB will have finished its study on the sanitary impacts of vacuum cleaners dust reemissions.

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Other LCA Data sources

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