

D2.2 - Topten ACT Criteria Paper

Washing machines

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Barbara Josephy, H el ene Rochat

Bush Energie GmbH

helene.rochat@topten.ch



Topten ACT aims at transforming the European market of energy-using products towards higher energy efficiency.

Topten ACT identifies the top energy-efficient products in 16 European countries, and makes this information available to consumers and large buyers on tailored national websites. The most energy efficient models in different product categories (such as household appliances, lighting, office equipment, consumer electronics, cars) are presented with comprehensive product information based on official labels and standardized declarations. Topten works with manufacturers and thus increases both market offer and consumer demand of high energy efficiency products. Topten is strictly neutral and independent from manufacturers and retailers, its selection criteria are always published online.

Topten ACT is supported by the European Commission's research and innovation programme Horizon 2020, and many national organisations (energy agencies, environmental and consumer organisations, research institutes). The Topten ACT project involves 17 partners in 16 European countries. It is coordinated by ADEME (Agence de l'Environnement et de la Ma trise de l'Energie).

More information and access to all national websites on the European site: www.topten.eu

WP2 European Product Analysis, Task 2.1 Determining energy efficiency criteria, D 2.2 Periodic Criteria Papers (second set)

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1. Topten.eu: Washing machines - current selection criteria and products selected

Scope

Topten.eu presents the most energy efficient household washing machines available on the European market of the three following categories:

- Washing machines with a capacity < 8 kg
- Washing machines with a capacity of 8 kg
- Washing machines with a capacity > 8 kg

Technical criteria

In order to qualify for Topten.eu, washing machines must meet the following criteria:

- Energy efficiency class: A+++ according to the EU energy label [1]
- Spin-drying efficiency class: A according to the EU energy label [1]
- Available in at least one European country.
- In addition, suppliers have to provide Topten with the following data:
 - Energy Efficiency Index (EEI)
 - Energy consumption per cycle in kWh for the 60°C programme at full load, the 60°C programme at half load and the 40°C programme at half load
 - Programme time for the 60°C programme at full load, the 60°C programme at half load and the 40°C programme at half load
 - Power in left-on-mode and off-mode
 - Maximum spin speed
 - Availability of a water protection system (Aqua Stop, waterproof, water control system etc.)
- Suppliers who are not able to provide the values cannot claim to have their appliances presented on Topten.eu.

Numbers of washing machine models currently on Topten.eu (August 2018). Similar models have not been counted if from the same brand.

	Washing machines
< 8 kg	3
8 kg	18
> 8 kg	13
Total	34

Table 1: Overview of products on topten.eu

On the Topten.eu product lists there are 34 washing machine models of 11 different brands available: AEG (3), Bauknecht (2), Blomberg (1), Bosch (3), Electrolux (5), Hoover (3), Miele (5), Samsung (4), Schulthess (2), Siemens (2) and V-Zug (4).

2. Expected selection criteria in 2019

In 2019 the Topten.eu selection criteria for washing machines will presumably be the same as in 2018 (see box above: A+++/A).

The EU energy label and Ecodesign regulations currently are under revision. This will lead to several modifications. Topten is involved in the process and will set appropriate criteria for washing machines as soon as more details are known.

3. Technical background

The most significant environmental aspects of washing machines are energy and water consumption in the use phase.

Key to reduce the energy (and water) consumption of the washing (and drying) process are:

- An effective load sensor to reduce the energy and water consumption when washing at lower loads than at full load.
- Programme duration: The cleaning process is based on the four factors known as the Sinner circle: temperature, mechanics, chemistry and time. These factors can to a certain extent, be exchanged by each other to achieve the same washing result. Prolonging the time of a cycle's duration and reducing the temperature of the water helps save energy.
- Best spinning performance with only low remaining moisture content to reduce the drier's subsequent energy consumption.
- The availability of a cold wash programme, (which nowadays is mandatory according to [2]), and especially its usage in our everyday life. The energy savings of washing at 20°C is about 60% compared to 40°C.
- Hot water supply («hot fill»): In many countries more and more households use solar energy. Several machines offering this option are available on the European market.
- Automatic dosage systems prevent users from over-dosing detergents. Correct dosage of detergents raises the rinsing quality and reduces the amount of chemicals released to the environment.

4. Policy measures, standards and labels

The EU Energy label regulation [1] and Ecodesign regulation for washing machines [2] are currently being revised. The Joint Research Center (JRC) published a preparatory in 2017. Both regulations are expected to be voted upon in late 2018/early 2019. The Consultation Forum took place in December 2017 and the Inter-Service Consultation started in the summer of 2018.

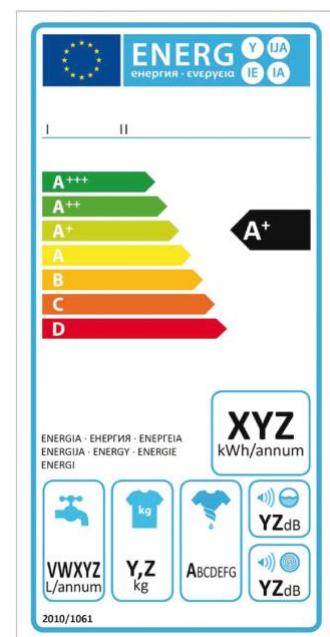
Energy Label for washing machines

The current Energy label (Regulation No 1061/2010 [1]) entered into force in December 2010 and became – after the transition period of one year – mandatory in December 2011.

The label introduced the Energy Efficiency classes A+, A++ and A+++. Note: The label classes now range from class A+++ to class D. The four classes A, B, C and D are still shown on the Energy Label, although they are prohibited on the market since December 2011 and December 2013 respectively (see table 2 and Ecodesign requirements [2]).

The calculation of the Energy Efficiency Index (EEI) is based on annual energy consumption for 220 so called «standard cycles», including low power modes (left-on and off-mode). A «standard cycle» consists of a weighted average of a 60°C full load (3x), 60°C half load (2x), 40°C half load (2x). Testing at half load was introduced in order to better reflect the real use of washing machines in homes.

Furthermore, the label provides information on the annual energy consumption (kWh/a), annual water consumption (litres/a), capacity (kg), spin-drying efficiency (class A to G) and sound power level during washing and during spinning.



The washing performance is not declared on the label anymore (which was declared on the former label). It now is regulated by the Ecodesign regulation [2] instead: the washing efficiency index has to be class A (for a «standard cycles»).

In the Energy Label fiche, the energy consumption of the «standard cycles», programme time of the «standard cycles», power in off and left-on modes, and duration of the left-on mode are also declared.

Energy Efficiency Class	Energy Efficiency Index (EEI)
A+++	EEI < 46
A++	46 ≤ EEI < 52
A+	52 ≤ EEI < 59
A	Phased out since Dec 2013
B	Phased out since Dec 2011
C	
D	

Table 2: Energy efficiency classification scale of the current Energy label for washing machines

Ecodesign requirements for washing machines

Summary (for details see Commission Delegated Regulation (EU) No 1061/2010 [2])

- **Energy Efficiency Index (EEI):** washing machines with A+, A++ and A+++ are allowed on the EU market. Washing machines with A to D are banned from the EU market.
- **Washing Efficiency Index:** has to be > 1.03, which corresponds to class A according to the former EU energy label.
- **Water consumption:** $W_t \leq 5 \times c_{1/2} + 35$, which – translated into litres – means:

Capacity (c)	Annual water consumption ($W_t \times 220$)	Water consumption per cycle (average)
6 kg	≤ 11'000 litres	≤ 50.0 litres
7 kg	≤ 11'550 litres	≤ 52.5 litres
8 kg	≤ 12'100 litres	≤ 55.0 litres
9 kg	≤ 12'650 litres	≤ 57.5 litres
10 kg	≤ 13'200 litres	≤ 60.0 litres
11 kg	≤ 13'750 litres	≤ 62.5 litres

- **A 20°C-programme (cold wash-programme)** for cotton has to be offered by each washing machine entering the EU market.
- The test programmes «standard 40°C cotton» and «standard 60°C cotton» shall be clearly identifiable on the washing machine.
- Various requirements on the booklet of instructions provided by the manufacturer.

The standby regulation No 1275/2008 [3] horizontally regulates the washing machines' maximum allowed energy consumption in standby.

The electricity saving potential until 2025 is estimated to be around 2.7 TWh [4].

Measurement standards

Washing machines are tested according to the European standard EN 60456: Clothes washing machines for household use. Methods for measuring the performance. All details are described in [5].

The Washing Efficiency Index is defined by measuring the reflectance of the five standard stains by a spectral photometer (see photo) and referencing it with the reflectance of a reference machine at 60°C.

5. Market analysis

The following sections are a summary of the Topten-paper «Monitoring the washing machines market in Europe» (2016).

Sales: about 16 million per year

From 2004 to 2007, sales of washing machines increased in EU-21 from 13.5 million to 15.1 million units. Since then, sales fluctuated around 15 million units per year. In 2015, 16 million washing machines were sold in EU-21.

Energy efficiency: more than 50% of the sold washing machines are in class A+++

Between 2004 and 2010 – at the time before the current Energy label for washing machines officially introduced the «plus»-classes A+, A++ and A+++ in December 2010 – manufacturers had no official possibility to market their energy efficient innovations. They helped themselves with expressions such as “A-10%” or “A-20%”. Based on a voluntary agreement between the Commission and CECED, some manufacturers officially labelled these products also as «A+». The same phenomenon is observed today with manufacturers labelling their products with “A+++ -20%”

In 2011 – the transition year of the new Energy label from entering into force to getting mandatory – already 14% of the sold washing machines in the EU were labelled with the then new introduced top-class A+++.

In 2015, four years later, already 55% of the sold washing machines across the EU were labelled in the top-class A+++! (see Figure 1)

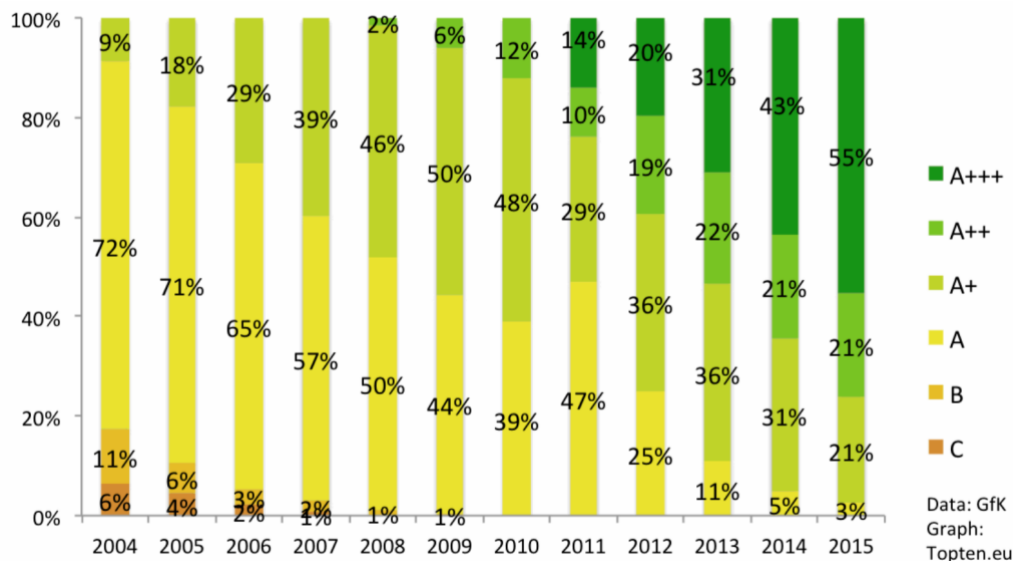


Figure 1: Energy efficiency classes of the washing machines sold in the EU (2004 - 2015)

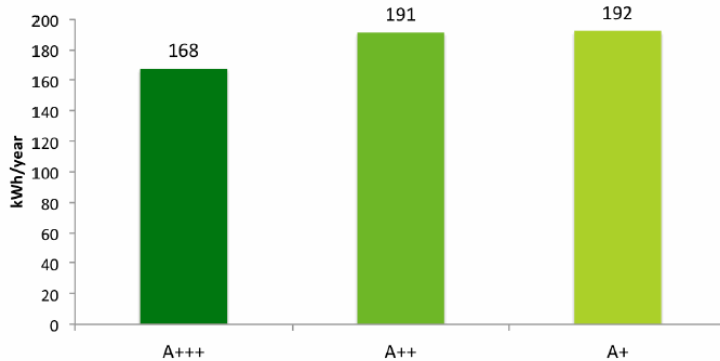
However, popularity of the efficiency classes varies on the national markets. In France for example only 39% of the sold washing machines in 2015 were class A+++. In Germany, the sales share of A+++-washing machines reached 81% (2015) and in Switzerland 80%.

BAT – Best Energy Efficiency Index (EEI): 22.8

In September 2015, the best Energy Efficiency Index (EEI) reached by a washing machine was 22.8. Due to an integrated heat pump this value exceeds the A+++-threshold (< 46) by more than 50% (see www.topten.eu, model: V-Zug Adora SLQ-WP, 8 kg).

Energy consumption: in average 185 kWh per year

In 2014, the annual energy consumption of the sold washing machines in the EU-21 was in average 185 kWh per year. However, Figure 2 shows up, that the differences in energy consumption are not so large between the energy efficiency classes.



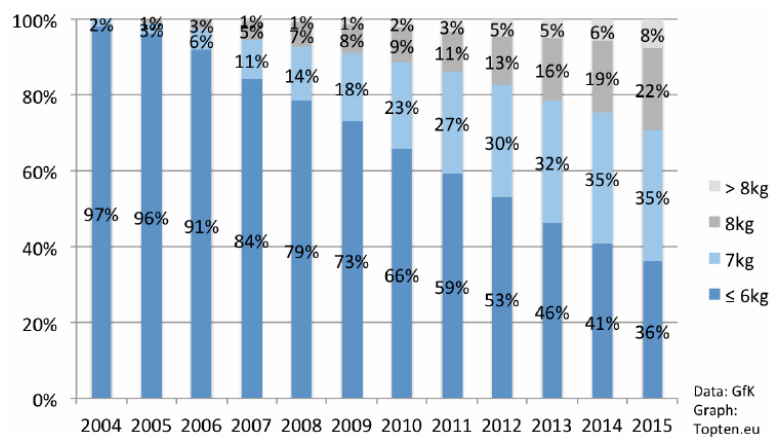
Data: GfK, Graph: Topten.eu

Figure 2: Average energy consumption of washing machines sold in 2015 in the EU

Capacity: strong trend towards larger capacities

Ten years ago, nearly all washing machines were designed for 6 kg of laundry and less. Since then, a strong trend towards larger capacities started to emerge. The biggest ones available on the European market have a capacity of 13 kg.

In 2015, more than 65% of all sold washing machines were designed for 7 kg laundry and above (see Figure 3). However, the driver of the trend appears to be the industry and not consumer demand. Washing habits of the consumers have not changed and the average load still remains at 3 kg (JRC, 2017).



Data: GfK
Graph: Topten.eu

Figure 3: Overview of capacities (kg) of washing machines sold in the EU in 2015

The Energy label might be at least partly responsible for the trend towards larger machines, since it is easier for large machines to reach a good efficiency class due to the current calculation formula (Figure 4). Even if oversized washing machines are labelled A+++, they do not contribute to energy savings at all if they are not fully loaded when operated. In case that most of the wash cycles run with low loads (e.g. 2-3 kg in an 8 kg-machine) energy and water are wasted because lower loads usually do not cut energy and water consumption linearly (e.g. half load uses only about 20% less energy and water instead of 50% less).

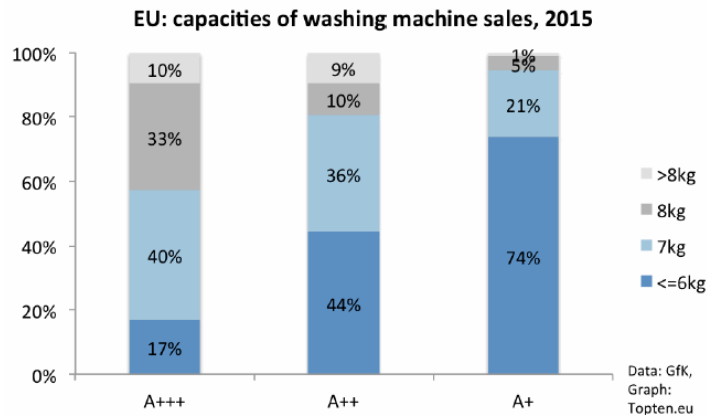


Figure 4: Capacity of washing machines in relation to their energy class for washing machines sold in the EU in 2015. Smaller machines are less represented in the higher classes because it is more difficult for them to reach higher classes as opposed to larger machines that are almost absent in A++ and A+.

6. FAQ

Washing at 20°C (Cold wash)

1) For detailed information on the topic «cold wash» see the following documents

- Washing at 20°C is Cool (Flyer for consumers) [7]
- Cold wash – Tests on the washing performance [8]
- Cold wash – Do prejudices impede high energy saving potentials? (paper at EEDAL 2013) [9]

2) Why cold wash?

Heating-up cold tap water to 30°C, 40°C, 60°C or even 90°C uses the lion's share of washing machines' electricity consumption.

«Cold wash» – washing at 15/20°C – saves about 60% electricity compared to a cycle at 40°C. Therefore, it holds a tremendous energy saving potential. In the EU-27 «cold wash» can save up to 11 TWh per year, which equals 2'200 million Euros or the annual production of the nuclear power plant Emsland (assumptions and calculation details see [8]). This exceeds by far the estimated saving potential resulting from the Ecodesign measures (2.7 TWh, see above).

The EU Ecodesign Regulation requires washing machines to offer a washing cycle at 20°C and a variety of detergent designed for these temperatures are available in Europe. Despite all of this, prejudices and habits prevent most consumers from «cold wash» (details see [9]).

3) Good washing performance at 20°C is possible

Discussions on «cold wash» – especially on the washing performance – run often into controversial and emotional arguments. To contribute to the debate with impartial and scientific facts, Topten arranged 24 test situations to measure and compare the washing performance and energy consumption at 40°C and 20°C. Factors influencing the washing result were systematically investigated such as detergent, pre-treatment of stains, washing machines and loading. The tests were carried out in collaboration with the VDE Testing and Certification Institute and with the support of the Elektrizitätswerke des Kantons Zürich and Stiftung Warentest in December 2014.

Good washing performance at 20°C is reached when using a good machine and good detergent. «Cold wash» is absolutely appropriate for lightly and normally soiled laundry and that it is worthwhile to encourage consumers to try it out (details see [8]).

In the framework of the revision of washing machines' Ecodesign regulation it is relevant to introduce appropriate requirements regarding the washing performance at 20°C. Otherwise, if consumers do not trust that it washes well, even though it is a mandatory programme to be proposed by all machines, consumers will never use it.

4) How is the level of hygiene when washing at 20°C?

Hygiene is one of the main concerns and given as an argument against «cold wash». However, hygiene is a complex topic for itself, which should not be correlated only with temperature. One has to be aware that bacteria multiply most rapidly at warm temperatures and not as often feared at 20°C and that it is more relevant how well they get washed out. A research of the University of Bonn and Hochschule Rhein-Waal showed that energy saving washing programmes (the so called «standard programmes») remove due to their long programme time many germs from the laundry even at low temperatures. Bleach can also help. The bacteria and fungi surviving at low temperatures even with bleach are assumed to be no danger to healthy people. However, it is recommended to frequently wash the laundry at 60°C for persons having a weak immune system, a contagious disease or an allergy to house dust mites.

5) How about the environment-friendliness of the detergents that are appropriate for cold wash?

In general, all detergents – except some explicitly ecological ones, which remain niche products (e.g. "Held" by ecover in Switzerland or Germany) – do harm the environment. All common detergents of all well-known detergent manufacturers nowadays are designed to wash in the temperature range of 15°C/20°C, 30°C, 60°C and sometimes even 90°C. Thus, it's one and the same detergent which is appropriate for all typical washing temperatures. To achieve good washing results at 15°C/20°C the detergent contains enzymes. These enzymes develop their enzymatic activity best at these low temperatures. High(er) temperatures destroyed them. These enzymes usually are genetically-modified. The consumer has the choice: either to use these enzymes – which are in the detergent anyway – for the purpose they are made for (good washing results at 20°C!) or to destroy and not use them when choosing high temperatures.

5) What is the biofilm from washing at 20°C and how can it be avoided?

Biofilm is a film of bacteria and fungi which multiplies in the humid environment of the washing machine and likes to settle especially on plastic parts, hard to reach areas and on the washing machine's drum.

However, it can be avoided with simple measures such as taking the laundry as soon as possible out of the machine after washing, leaving the door of the washing machine and of the detergent compartment open so that the residual moisture can evaporate and running a load of laundry at 60°C with heavy-duty detergent occasionally (see also [7]).

Why is a good spinning performance (A) important?

There is a strong trend towards drying the laundry using a tumble drier, while hanging up laundry outdoor is decreasing more and more. Drying laundry with a tumble drier consumes far more energy than the washing process itself and spinning is much more efficient than tumble-drying.

Hence, the better the laundry is spun in the washing machine, the less electric energy is needed to dry it in the tumble drier. Therefore, machines with the best spin-drying efficiency (A) should be taken as a relevant parameter when assessing the overall electric energy consumption of the laundry process.



Topten recommends opting for best energy efficiency (A+++) and best spin-drying efficiency (class A), when buying a new washing machine.

When is hot fill reasonable?

The higher the washing temperature, the higher are the potential electricity savings from hot water supply (up to 70% less electricity consumption by the washing machine).

In many countries more and more households use solar energy, and «hot fill» thus can contribute to energy savings.

On the European market several washing machines are available offering the option for «hot fill» (see Topten.eu).

Which option should be preferred: combined washer-drier or separate washing machine and separate tumble drier?

Washer-driers combine the functions of a washing machine and a tumble drier in one drum. The appliance therefore can combine the processes «washing» and «drying» in one non-stop cycle (no interaction by the user is needed in between).

In the non-stop cycle the load capacity is the one of «only drying», which normally is smaller than the one for «only washing». If it is washed at full load, then a part of the washed load has to be taken out after spinning, and two separate drying cycles have to be run (one after another) in order to dry the complete load (e.g.: washing separately: 9 kg; non-stop cycle washing-drying: 6 kg; drying separately: 6 kg).

The advantage of washer-driers over a separate washing machine and a separate drier is not so much comfort, but space (only one appliance instead of two appliances) and the lower purchase price. However, running costs for electricity and water can be much higher, because a washer-drier usually is *per se* less efficient than a separate washing machine and tumble drier. The energy consumption for washing plus drying when using Topten-models accounts for max 3.8 kWh, while inefficient washer-driers use > 6 kWh for this process.

Within the washer-driers product group, there are large difference in energy as well as in water consumption between high efficient models and inefficient ones. Typically, the water consumption of washer-driers is generally quite high as they not only use water for washing but additionally also (cooling) water for drying!

Topten.eu presents the most efficient washer-driers. In order to qualify for Topten.eu, washer-driers must meet the following criteria (September 2015):

- Energy efficiency: max. 0.5 kWh per kg laundry (full wash and dry cycle / washing capacity)
- Water consumption: max. 12 litres per kg laundry (full wash and dry cycle / washing capacity)

The Topten-criteria currently only are reached by appliances which are equipped with an integrated heat pump. Thanks to this technology these BAT-models consume 40% less energy than inefficient washer-driers.

Furthermore, washer-driers with an integrated heat pump use no cooling water for drying. Therefore, water is only needed for washing, which saves 30% of the water consumption compared to conventional washer-driers without heat pump. (Topten-models: 69 litres / cycle; inefficient models: around 100 litres and more.)

7. References and links

Useful links

Topten.eu washing machines product lists:

- < 8 kg:
<http://www.topten.eu/english/household/washing-machines/8kg.html>
- 8 kg:
<http://www.topten.eu/english/household/washing-machines/8kg-2.html>
- > 8 kg:
<http://www.topten.eu/english/household/washing-machines/8kg-3.html>

Topten.eu washing machines selection criteria:

<http://www.topten.eu/english/criteria/washing-machines-2.html&fromid=>

Topten.eu washing machines recommendations:

- <http://www.topten.eu/?page=washing-machines-3&fromid=>
- http://www.topten.eu/uploads/File/Topten_recommendations_Washing_machines.pdf

Topten.eu washer driers product list and selection criteria:

- <http://www.topten.eu/english/household/washer-driers.html>
- <http://www.topten.eu/english/criteria/washer-dryers.html&fromid=>

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- [3] Commission Regulation (EC) No 1275/2008 of 17 December 2008 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for standby and off mode electric power consumption of electrical and electronic household and office equipment.
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