Product Definition: Domestic Laundry (Washing) Appliances

Final Issue: 2nd December 2009

1 Matrix Definition

While various standards use differing definitions, a domestic laundry appliance (more commonly known as a washing machine), may generally be defined as follows:

An appliance for cleaning and rinsing of textiles using water which is principally designed for use within a domestic environment. The appliance may draw water from a cold and/or hot water supply and may also have a means of extracting excess water from the textiles.

Within this definition, laundry appliances can be broadly sub-categorised by the matrix in Figure 1.

Figure 1: Matrix Definition of Wet Appliance Sub-Categorisation

<table>
<tr><td>A)</td><td rowspan="8">Technology</td><td>User intervention</td><td colspan="5">Automatic</td><td colspan="3">Semi-automatic/manual</td></tr>
<tr><td>B)</td><td>Orientation</td><td colspan="4">Horizontal axis
>45^0 to vertical plane
(front loaders)</td><td colspan="4">Vertical axis
<45^0 to vertical plane
(top loaders)</td></tr>
<tr><td>C)</td><td>Configuration</td><td>Washer /Dryers Single Drum</td><td>Washer /Dryers Two Drum</td><td>Drum</td><td>Impellers</td><td>Agitators</td><td>Nutators</td><td>Twin tub</td></tr>
<tr><td>D)</td><td>Coin/Card Operation</td><td colspan="3">No Coin/Card Operation</td><td colspan="4">Coin/Card Operation</td></tr>
<tr><td>E)</td><td>Water intake</td><td colspan="7">Hot fill/cold fill</td></tr>
<tr><td>F)</td><td>Water saving</td><td colspan="7">Suds save</td></tr>
<tr><td>G)</td><td>Spin Speed</td><td colspan="7">Revolutions per Minute</td></tr>
<tr><td>H)</td><td rowspan="3">Functionality</td><td>Wash quality</td><td colspan="7">Wash quality rating</td></tr>
<tr><td>I)</td><td>Spin efficiency</td><td colspan="7">Spin efficiency rating</td></tr>
<tr><td>J)</td><td>Rinse efficiency</td><td colspan="7">Rinse efficiency rating</td></tr>
<tr><td>K)</td><td rowspan="2">Other variables</td><td>Water use</td><td colspan="7">Litres of water used</td></tr>
<tr><td>L)</td><td>Capacity</td><td colspan="7">Maximum wash load (kg)</td></tr>
</table>

2 Product Sub-Category Rationalisation

2.1 Technology

Matrix Row A): User intervention

The distinction between automatic and semi-automatic/manual (where user intervention is required during the programme to enable the machine to move on to the next operation) washing machines has no impact on the function (ie the cleaning of textiles) and appears to have little direct effect on

the efficiency and overall energy consumption of the appliance (the exception being twin-tube models which are dealt with below).
Agreement: Remove any categorisation for automatic and semi-automatic/manual machines.

Matrix Row B): Orientation
It is well established that the axis orientation, along with the configuration and associated variables (eg water requirement), have a significant impact on the energy efficiency and overall energy consumption of the appliance (plus impacts on the other variables). As different countries tend to exhibit a national preference for either horizontal or vertical axis washing machines and both configurations have a significant global market share, there is an argument to treat the two orientations separately. Nevertheless, in the context of the mapping and benchmarking annex, where the aim is to inform policy makers of the difference in efficiency to deliver a particular level of service, it appears reasonable to treat horizontal and vertical axis units as one category as they both have the function to clean textiles. However, in case useful for later in-depth analysis, the data collection will include a request to specify orientation of machine.
Agreement: Remove any categorisation for machine orientation.

Matrix Row C): Configuration
i) There are two types of washer dryer:
Two Drum Washer Dryer: Where the washer and dryer components have two drums, either side by side or above and below one another, that are powered by a single power and have the control panel attached to one of the components.
Single Drum Units: Where the washer and dryer elements are combined to be formed in the same drum.

For the two drum classification, the washer element appears to function exactly as a standard washing unit. However, given the integral nature of these units with their combined power supply, it is generally not possible to isolate the performance of the washing only element.

Within the single drum classification, the distinction between combination washer/dryers and their wash only drum counterparts appears to have an impact on the performance of the washing element caused by the more complex internal construction of the washer/dryer units.

In both cases, although the washing element of the unit is functionally the same, the overall functionality of the entire unit (ie washer and dryer combined) is not the same as a washing only unit. Therefore, it is proposed that they are categorised separately. However, in the vast majority of countries participating in the Annex, washer/dryer units have limited market share and therefore are of limited interest to policy makers and should consequently be excluded from the analysis.
Agreement: Do not consider washer/dryer units in the analysis

ii) Within the vertical axis classification, little appears to have been published on the comparative efficiency (or water consumption) of washing machines that use agitators, impellers and nutators to provide the mechanical action during washing. As the service provided by the machines is similar and, in general it appears that data sources do not disaggregate between the various machine types, it is proposed units are not sub-categorised on this basis. However, information on the method of washing agitation will be requested where available to facilitate later analysis if required.
Agreement: Remove any categorisation for impellor, agitator and nutator washing machines.

iii) Twin tub machines are typically side by side two tub units where one tube provides the washing service and the second tub spins the load. The user is required to transfer the load between tubs.

These units are significantly less efficient than other vertical axis washing machines and their overall energy consumption is highly dependent on the individual operator. Further, their mechanical make up (ie separate elements for washing and spinning) would probably require a separate sub-categorisation. However, twin tubs appear to account for a small (and falling) proportion of the market for vertical axis washing machines in countries participating in the Annex and therefore it is proposed they are excluded from the analysis.
Agreement: Exclude twin-tubs from the mapping and benchmarking analysis.

Matrix Row D): Coin/Card operation
In most markets units whose operation requires the insertion of a coin or card are restricted to the commercial sector. However, in some markets they are also used in the domestic environment. The coin/card facility appears to have no impact on the functionality of the unit and so the element should have no impact on the mapping and benchmarking analysis. Therefore card/coin operated (domestic) units should be included with no adjustment.
Agreement: Include all coin/card operated domestic units with no adjustment in data.

Matrix Row E): Water intake
Cold fill is the predominant water intake method globally and there is an increasing tendency to move towards cold fill even where there was a historic tendency to use hot fill. Further, almost all test methodologies used specify cold fill only as the test procedure. Therefore it proposed that type of water intake is not considered in comparison of unit efficiency. However, data will be requested on fill method (where available) to facilitate calculation of actual consumption in use.
Agreement: Remove any categorisation for hot or cold fill for efficiency calculations but request data on fill type for analysis of energy consumption.

Matrix Row F): Water (suds) saving
Suds saving is a water saving technology that for a time became widespread, in particular in the US and Australia. It allows the user to collect the rinsing water in a separate laundry tub for reuse in subsequent washes. This is predominantly a water saving measure and, because it is achieved by means of a mechanical valve and an alternative draining mechanism, it does not affect the energy efficiency and overall energy consumption of the washing machine. Measurement of its impact does not appear to have been included in any current test standards. Therefore, no sub-categorisation will be made for suds saving machines, nor will the water saving potential be considered in the water consumption calculation (see below). However, data will be requested (where available) on whether machines are suds saving or not to allow later investigation if required.
Agreement: Remove any categorisation for suds saving machines.

Matrix Row G): Spin Speed
Maximum spin speed is increasingly being used as a marketing tool in a number of countries. For the purposes of the Annex, the energy consumption impact is captured in the test methodology and he effect of the spin speed is captured in the spin-efficiency (see Row I below). Thus, in-principle, spin speed should not be considered as a variable. However, there is a possibility that spin speed will become an increasingly important consumer purchase criteria and impact on the perceived value of display of spin efficiency. Therefore, the variable will be of interest to policy makers.
Agreement: Do not differentiate on spin speed but collect data in case required in future analysis.

2.2 Functionality

Matrix Row H): Wash quality
It is important to be able to make a distinction between machines which have similar energy efficiency but have differing levels of wash quality, ie a machine that produces very clean laundry has better overall performance (higher functionality), and should be differentiated from, a machine

that uses the same amount of energy to deliver significantly lower laundry cleansing (lesser functionality). Almost all testing methodologies now include a mechanism for measurement of the degree of "cleanliness" of the wash along with energy performance. Unfortunately, measures of wash quality are not always consistent, and there is no known conversion factor where wash quality and efficiency may be combined to produce a single value. Hence it is provisionally proposed that wash quality will not act as a differentiator between products (as there currently appears to be no way of normalising energy and wash quality between products/markets), but wash quality information (using local measurement methodology) will be collected and presented in parallel with the energy performance in Annex outputs (ie to demonstrate whether energy performance is improving for fixed wash quality, energy performance is stationary but wash quality is improving, etc).
Agreement: Collect information on wash quality and present in parallel to energy performance data, but do not sub-categorise product on this basis.

Matrix Row I): Spin efficiency
In line with the approach for wash quality, in a number of markets it is important to be able to make a distinction between machines which have differing levels spin performance, ie the degree to which they remove water from the textiles prior to the completion of the washing cycle. A machine that removes a large proportion of the water at the end of the cycle has better overall performance (higher functionality), and should be differentiated from, a machine that uses the same amount of energy but with washing load wetter at cycle completion (lesser functionality). Almost all testing methodologies now include a mechanism for measurement of the degree of this "dryness" along with energy performance. Unfortunately, measures of spin efficiency are not always consistent, and there is no known conversion factor where spin efficiency and energy efficiency/consumption may be combined to produce a single value. Further, in some cases spin efficiency is not considered significant due to local natural drying conditions. Hence it is provisionally proposed that spin efficiency will not act as a differentiator between products (as there currently appears to be no way of normalising energy and spin efficiency between products/markets), but spin efficiency information (using local measurement methodology) will be collected and presented in parallel with the energy performance in Annex outputs (ie to demonstrate whether energy performance is improving for fixed spin efficiency, energy performance is stationary but spin efficiency is improving, etc, or indeed if there is a relationship between spin speed and spin efficiency).
Agreement: Collect information on spin efficiency and present in parallel to energy performance data, but do not sub-categorise product on this basis.

Matrix Row I): Rinse quality/efficiency
There is increasing levels of interest/importance being attached to rinse efficiency/quality, ie the amount of detergent removed from the wash load prior to the completion of cycle. Clearly this has the potential to impact on the water and energy consumption in a similar way to wash quality[1]. A number of organisations/countries are investigating and developing standards for rinse quality, but currently there appears to be limited agreement and adoption therefore material available is expected to be limited. Therefore any data that is currently available on standards and the particular rinse quality of individual products will be collected and made available to inform participants for their own development purposes.
Proposal: Collect information on rinse quality and present as appropriate depending on material available, but do not sub-categorise product on this basis.

2.3 Other Variables

Matrix Row J): Water use

[1] This also has an energy impact on the dryer energy consumption in areas where non-natural drying is required.

The performance of a washing machine is dependent upon the degree of agitation the textiles experience, the detergent[2] used and both the volume and temperature of the water. Therefore water consumption is an important variable for consideration and varies considerably between models of the same type and especially between models with different orientation and configuration. Further, in a number of countries, water consumption is a key policy issue and in some cases regulated. However, not all test methodologies measure water consumption and so differentiating machines on this basis is a challenge. Therefore, provisionally, in line with wash quality and spin efficiency, data will be collected and where available displayed in parallel with other performance measures.
Agreement: Collect information on water usage and present in parallel to energy performance data, but do not sub-categorise product on this basis.

Matrix Row K): Capacity
All known test methodologies and local regulations normalise energy consumption for capacity of the textile load (eg data is presented in kWh/Kg). However, machines below 1Kg capacity are niche markets and those greater than 13Kg are generally designed for commercial use, hence both are not representative of the domestic market and will be excluded as not being of interest to policy makers in this context. Therefore, data will be requested for units between 1-13Kg, but analysis will use the kWh/KG as the measurement metric for efficiency.
Agreement: Analyse units between 1-13Kg only, and use capacity as an input metric.

3 Revised Categorisation

Based on the proposals made, Figure 2 provides a rationalised version of the original Matrix Definitions.

[2] Detergent and water temperature are normally standardised in each test methodology (although neither is always the same between test methodologies)

Figure 2: Rationalised Matrix Definition of Wet Appliance Sub-Categorisation

A)	Technology	User intervention	All Types - Automatic, semi-automatic and manual (no differentiation)
B)		Orientation	All Types - Horizontal (front loaders) and Vertical Plane (top loader) (No differentiation, but collect data for potential future analysis)
C)		Configuration	All Types - Drum, Impeller, Agitator, Nutators (No differentiation, but collect data for potential future analysis) Exclude all types of Washer/Dryer
D)		Coin/Card Operation	All Types (No differentiation, but collect data for potential future analysis)
E)		Water intake	All Types - Hot fill/cold fill (No differentiation, but collect data for calculation of overall energy consumption)
G)		Spin Speed	All Speeds (No differentiation, but collect data for potential future analysis)
H)	Functionality	Wash quality	Wash quality rating (No differentiation, but presentation in parallel to efficiency)
I)		Spin efficiency	Spin efficiency rating (No differentiation, but presentation in parallel to efficiency)
J)		Rinse efficiency	Rinse efficiency rating (No differentiation, but presentation of limited available information)
K)	Other variables	Water use	Litres of water used (No differentiation, but presentation in parallel to efficiency)
L)		Capacity	Consider only units between 1Kg - 13kg (Use kWh/Kg as metric)

4 Participating Country Requirements

A limited number of countries responded to the previous draft and request for levels of interest. Of these all have indicated they have interest in mapping and benchmarking of Washing Machines as now defined.

5 Final Mapping and Benchmarking Specification

Combining the revised categorisation and participating country requirements, the simplified product matrix is now as follows:

> All Types (automatic, semi-automatic and manual) of Washing Machines *excluding* washer/dryer combination units and twin-tubs and *excluding* units less than 1kg and more than 13kg load. Do not differentiate between, but collect data and *potentially* "normalise" for:

Orientation (vertical and horizontal)	Water intake	Wash quality
Configuration	Spin speed	Rinse efficiency
Coin/card operation	Spin efficiency	Water use

6 Metrics

In line with almost all testing methodologies and regulations worldwide, it is proposed to define the energy consumed by a unit over one year as:

Unit Energy Consumption:	*kWh/year (total unit annual consumption, not corrected for capacity or other variables)* *Overall calculation to be based on test consumption per cycle, with average number of washes per year for specific country/region or, where not known, average washes per year for all know countries/regions*

Energy efficiency will be defined as:

Unit Energy Efficiency:	*kWh/Kg (test cycle)* *Normalisation between differing test cycles to be made whenever possible. Normalisation may include corrections for cycle water temperature differences, water usage, spin efficiency, wash and rinse quality (to be determined based on data available/received).*

Also to be presented (as declared):

Wash Quality:	*Local measure (test cycle)*
Water Usage	*Litres (test cycle)*
Spin Efficiency	*Percent of residual moisture (test cycle)*
Rinse Efficiency	*Not known at present (research underway)*

7 Data requirements

To enable the most effective analysis and presentation of data and comparison between countries, we propose to collect the data defined below. This data requirement is divided into:

- **Black text** indicates the main data requirements for this process.
- **Blue text** indicates data that is not necessary to undertake the mapping and benchmarking for this product but that will bring other benefits to the process and/or allow more detailed analysis at a later date.
- Where the data is not available in the format requested, ***italic text*** indicates alternative formats in which the data may be provided.

7.1 Product Groups

It is proposed that data should be collected on **ALL washing machines *excluding*:**

- **Twin-tub units**
- **Washer/dryers (single and two drum)**
- **Washers with capacity less than 1Kg or bigger than 13Kg**

7.2 Specific Data Requirement

7.2.1 New Product Information (i.e. products for sale)

Ideally this information will be supplied on an individual model basis for all years available from 1996 through to 2008, and for all product categories defined in section 5.1:

1. "Type of Unit" if defined locally (eg if different machine types have different test methodology)
2. Cycle Efficiency (kWh/Kg) of the model under test conditions (or most similar local unit)
3. Capacity of the model (Kg) (or drum capacity if basis for local unit)
4. Annual sales volume of the model
5. Whether the model has the capacity for hot fill
6. Wash quality rating (using local regulations under test conditions)
7. Water usage under test conditions (using local regulations under test conditions)
8. Spin efficiency (using local regulations under test conditions)
9. Rinse efficiency/quality (using local regulations under test conditions)
10. Label classification, if used locally, of model (using local regulation, eg A rated in EU, or 5-star in Aus)

11. Model name/number (unique identifier)
12. Further details on the type of Appliance:
    a. Orientation of machine (top loader or front loader)
    b. If top loader, what type of configuration (impeller, agitator, nutator)
    c. Automatic, semi-automatic, manual
    d. Spin speed
    e. If coin operated
13. If available, include any information on models that are anticipated to enter the local market within two years that are more efficient than anything currently on the market

Where data is unavailable in this format:
Where it is not possible to provide information on a model level, please provide other information that allows the identification of best, worse and sales-weighted average efficiency of products within the market.

7.2.2 Information on Stock (i.e. products already installed in homes)

Ideally this information will include the following information on stock (products in homes) for all years available from 1996 through to 2008:

1. Overall number of products installed in homes (or average number per household)
2. Average efficiency, capacity, water use, wash quality, spin efficiency, spin speed and rinse efficiency of installed products (or as many details as possible).
3. Percentage of products using hot fill (and heat source for hot water provision)
4. Average product lifetime

Where data is unavailable in this format:
Where it is not possible to provide the specific information requested, please provide other available information on stock, e.g. overall average energy consumption (GWh/year), number in stock, etc.

7.2.3 Additional Information Required for Data Processing

For effective comparison between countries, the following information is required

1. All test methodologies used for washing machine testing and regulation locally and their relationship to known international standards (e.g. clone, clone with amendments X Y and Z).

   In particular it is important to provide information on the temperature of feed water and wash/rinse water for the test cycle, and details of the test cycle itself (including characteristics/type of load and detergent)

   Where used locally, it is important to include testing methodologies for energy consumption/efficiency, water consumption, spin efficiency and wash quality (cleanness).

2. Known differences in consumption during test wash cycle and actual user washes
3. Average number of washes per year per household
4. Local regulations (eg labels, MEPS) that define products (e.g. regulations that define product groups within efficiency bands and the associated algorithms that allow calculation of efficiency classes within those bands)

7.2.4 Additional Policy and Cultural Information Required for Other Analysis

1. Summary of all major policy actions (e.g. voluntary labels, mandatory labels, MEPS, rebates, information/promotion campaigns or other policy actions) over the period data are available including the times when policy were first considered, the time of formal announcement of the policy plans and the date when policy came into force.
2. Summary of major cultural issues that are thought to affect this product at the local level (eg small households/kitchens, second/holiday homes, etc)