

Preparatory Studies for Eco-design Requirements of Energy-using Products

Lot 24: Professional Washing Machines, Dryers and Dishwashers

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Final Report, Part: Dishwashers

Task 1: Definition

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For reasons of better readability, two Task 1 reports were prepared.

The report at hand covers ***professional dishwashers***.

The Task 1 report on *professional washing machines and dryers*
is published separately.

For the benefit of the environment, this document has been optimised for
double-sided printing.

Part: Professional Dishwashers

Table of Contents – Task 1: Definition

List of tables	VI
List of figures	VI
1 Introduction	1
1.1 General objective of the preparatory study	1
1.2 Objective of Task 1	2
2 Product category and performance assessment	3
2.1 Scope of Task 1 report, part ‘Professional Dishwashers’	3
2.2 The professional dishwashing process	4
2.3 Detergents and rinse agents for professional dishwashers	5
2.4 Delimitation and definition of professional dishwashers	5
2.4.1 Eco-design regulation on household dishwashers	6
2.4.2 Distinction according to Machinery Directive	6
2.4.3 Definition of professional dishwashers within Lot 24	8
2.4.4 Distinction according to functional performance and technological differences	8
2.5 Classification of professional dishwashers	12
2.5.1 The European PRODCOM classification	12
2.5.2 The European customs classification	12
2.5.3 The International Patent Classification	13
2.5.4 Categories according to EN- or ISO-standard(s)	15
2.5.5 Functional performance classification	17
2.5.5.1 Primary and secondary functions of professional dishwashers	17
2.5.5.2 Main properties of professional dishwashers	18
2.5.5.3 Categories of professional dishwashers used in Lot 24	20
3 Test standards on professional dishwashers	25
3.1 Performance	25
3.1.1 ASTM International Standards (USA / International)	25
3.1.1.1 ASTM F857–07	26
3.1.1.2 ASTM F858–07	26
3.1.1.3 ASTM F859–09	27
3.1.1.4 ASTM F860–07	27
3.1.1.5 ASTM F953–08	27
3.1.1.6 ASTM F1021–95(2007)	28

3.1.1.7	ASTM F1022–06	28
3.1.1.8	ASTM F1114–06	29
3.1.1.9	ASTM F1202–06	29
3.1.1.10	ASTM F1203–06	29
3.1.1.11	ASTM F1237–09	30
3.1.1.12	ASTM F1696–07	30
3.1.1.13	ASTM F1920–07	31
3.1.1.14	ASTM F2687–07	32
3.1.1.15	ASTM WK24910	33
3.1.1.16	ASTM – summarizing conclusions	33
3.1.2	IEC and European harmonised standards EN 50242 / 60436	35
3.1.3	Work on development of new performance standards for professional dishwashers	38
3.1.3.1	By EFCM (Europe)	38
3.1.3.2	By DIN (Germany)	38
3.1.4	Further used or adapted performance testing methods	39
3.1.4.1	By DTI (Denmark)	39
3.1.4.2	By ENAK (Switzerland)	40
3.2	Hygiene	41
3.2.1	ISO 15883 (International)	41
3.2.2	NSF/ANSI 3–2009 (International / USA / Canada)	42
3.2.3	NSF/ANSI 29–2009 (International / USA / Canada)	43
3.2.4	DIN 10510 / 10511 / 10512 / 10522 (Germany)	44
3.3	Safety	47
3.3.1	IEC 60335 (International)	47
3.3.2	EN 50416 (Europe)	47
3.3.3	UL 921 (USA / Canada)	48
3.4	Noise	49
3.4.1	IEC 60704 (International)	49
3.4.2	ISO 3744 (International)	49
3.4.3	ISO 3746 (International)	50
3.4.4	ISO 4871 (International)	51
3.4.5	ISO 9614 (International)	51
3.4.6	ISO 11204 (International)	51
3.5	Electromagnetic fields / Electromagnetic compatibility (EMC)	52
3.5.1	IEC 62233 (International)	52
3.5.2	IEC 61000 (International)	53
3.5.3	EN 50366 (Europe)	53
3.5.4	EN 55014 (Europe)	53
3.6	Gas	54
3.6.1	UL 921 (USA / Canada)	54

3.7	Standardisation needs for the EU	55
4	Existing legislation and environmental labelling	56
4.1	European legislation	56
4.1.1	Machinery Directive (MD) 2006/42/EC (replacing 98/37/EC)	56
4.1.2	Low Voltage Directive (LVD) 2006/95/EC	57
4.1.3	Electromagnetic Compatibility Directive (EMC) 2004/108/EC	57
4.1.4	Restriction of Hazardous Substances Directive (RoHS) 2002/95/EC	58
4.1.5	Waste Electrical and Electronic Equipment Directive (WEEE) 2002/96/EC	60
4.1.6	Biocide Directive 98/8/EC	61
4.1.7	Gas Appliances Directive (GAD) Directive 2009/142/EC	63
4.1.8	Water Framework Directive (WFD) 2000/60/EC	63
4.1.9	Commission Regulation (EC) No. 648/2004 – Detergents	64
4.1.10	Commission Regulation (EC) No. 842/2006 – Fluorinated GHG	65
4.1.11	Commission Regulation (EC) No. 1275/2008 – Standby	66
4.1.12	European labelling	66
4.2	Legislation at member state level	66
4.3	Third country legislation	66
4.3.1	USA	66
4.3.2	Canada	69
4.3.3	Australia	69
4.3.4	China	69
4.3.5	Russia	70
5	Conclusions: Scope of the study	71
6	Sources	72
7	Annex	73
7.1	Questionnaire “Task 1” for stakeholders	73
7.2	Stakeholder feedback to draft versions of Task 1	73
7.3	Method used by DTI for performance measurement of hood-type dishwashers	77

List of tables

Table 1	Main product groups of dishwashers according to customer segment	10
Table 2	Extract from PRODCOM list 2009 (Source: Eurostat)	12
Table 3	Classifications of dishwashers according to the HS-Classification (Source: World Customs Organisation)	13
Table 4	Classification of dishwashers according to International Patent Classification (IPC)	14
Table 5	Overview of dishwasher categories according to functional and performance parameters	24
Table 6	Corresponding Lot 24 dishwasher categories of ASTM standards	34
Table 7	Process temperatures for professional multi-tank conveyor-type dishwashers depending on the use of detergents with or without disinfection or oxidising component	45
Table 8	Process temperatures for professional one-tank dishwashers depending on the use of detergents with or without disinfection or oxidising component	45
Table 9	Energy Star Efficiency Requirements for Professional Dishwashers	68
Table 10	Manufacturers' and industry associations' web pages screened within EuP Lot 24	72
Table 11	Mean value of the results of 10 washes according to method used by DTI for performance measurement of hood-type dish-washers	78

List of figures

Figure 1	Different steps of a professional dishwashing process	4
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1 Introduction

1.1 General objective of the preparatory study

Many aspects of energy-using products (EuPs) have a negative impact on the environment (emissions to air including greenhouse gases, to soil, recycling, water consumption...). In line with the Integrated Product Policy (which promotes the principle that requirements on the environmental performance of products should address all environmental aspects during the complete lifecycle of the product), the Commission decided in August 2003 to propose an integrated framework for setting “eco-design” requirements for EuPs (including energy efficiency requirements) while avoiding fragmentation of the market.

By adopting Directive 2009/125/EC¹, the European Parliament and the Council have granted a mandate to the Commission, assisted by a committee and after consultation of the stakeholders forum, to regulate the environmental characteristics of energy-using products (except vehicles) through adopting implementing measures (e.g. decisions, regulations or directives) laying down eco-design requirements for particular EuPs.

First step in considering whether and which eco-design requirements should be set for a particular product is a preparatory study identifying and recommending ways to improve at the design phase the environmental performance of the product throughout its lifecycle.

Preparatory studies should provide the necessary information to prepare for the next phases (carried out by the Commission) and in particular the impact assessment, the consultation of the Forum and the possible draft implementing measure.

Each product specific preparatory study follows a defined methodology especially developed for the European Commission (Methodology Study for the Eco-design of Energy-using Products (MEEuP)²). The MEEuP approach covers the following tasks:

- Task 1: Definition,
- Task 2: Economic and market data,
- Task 3: Consumer behaviour and local infrastructure,
- Task 4: Technical analysis of existing products,
- Task 5: Definition of base case,
- Task 6: Technical analysis of best available technology (BAT),
- Task 7: Improvement potential,
- Task 8: Scenario-, policy-, impact- and sensitivity analysis.

¹ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:285:0010:0035:EN:PDF>

² http://ec.europa.eu/energy/efficiency/studies/doc/ecodesign/2005_11_28_methodoly_report.pdf

1.2 Objective of Task 1

Within Task 1, the product category and system boundaries of the ‘playing field’ for eco-design shall be defined. It is important for a realistic definition of design options and improvement potential and it is also relevant in the context of technically defining any implementing legislation or voluntary measures (if any).

Subtask 1.1 – Product category and performance assessment

The following classification schemes and documents shall be analysed to define the product categories for Lot 24:

- Prodcom category or categories (Eurostat);
- Categories according to EN- or ISO-standard(s);
- Labelling categories (EU Energy Label or Eco-label), if not defined by the above.

Categorisation will often be linked to the assessment of the primary product performance parameters (the “functional unit”). If needed, on the basis of functional performance characteristics and not on the basis of technology, a further segmentation can be applied on the basis of secondary product performance parameters.

Subtask 1.2 – Test Standards

Subtask 1.2 will identify and shortly describe the harmonised test standards and additional sector-specific directions for product-testing regarding the test procedures for:

- the primary and secondary functional performance parameters mentioned above;
- resources use (energy, water, detergent, etc.) and emissions (NO_x, CO, particulate matter) during product-life;
- safety (gas, oil, electricity, EMC, stability of the product, etc.);
- noise and vibrations (if applicable);
- other product specific test procedures.

Apart from mentioning these standards, including a short description, it should also be reported which new standards are being developed, which problems (e.g. regarding tolerances, etc.) exist and what alternatives are being developed. Furthermore, the (ongoing) work on an eco-design standard, mandated by the European Commission to standardisation bodies, shall be considered.

Subtask 1.3 – Existing legislation

Task 1.3 should identify the relevant legislation for the product. This task can be subdivided in three parts:

Subtask 1.3.1 – Legislation and Agreements at European Community level

Apart from the obvious environmental directives (RoHS, WEEE, Packaging directive), this could be building regulations (e.g. developed under the Performance of Buildings Directive), regulations on health and labour conditions (e.g. for air conditioners, copiers), minimum efficiency directives (boilers, refrigerators, ballasts, etc.), product liability, safety, electromagnetic compatibility (EMC) etc. Also EU Voluntary Agreements and already existing eco-design standards (e.g. ECMA, EIA) of the sector or related sectors need to be identified. And finally, especially in a Business-to-business context it needs to be described which quality requirements (e.g. “proven design”, maximum failure rate) are customary.

Subtask 1.3.2 – Legislation at Member State level

This section deals with the subjects as above, focussing on legislation that has been indicated as being relevant by the Member States.

Subtask 1.3.3 – Third Country Legislation

This section again deals with the subjects as above, focussing on legislation and measures in Third Countries (extra-EU) that have been indicated by stakeholders (NGOs, industry, consumers) as being relevant for the product group.

2 Product category and performance assessment

2.1 Scope of Task 1 report, part ‘Professional Dishwashers’

Objective of this task is to present and discuss the definition and scope of the product family “Lot 24: Professional washing machines, dryers and dishwashers”.

In previous preparatory studies on household appliances, washing machines and dishwashers have been jointly discussed as “wet appliances” within Lot 14, whereas laundry dryers have been dealt with in a different study (Lot 16). In Lot 24, we consider dryers as one module of the whole laundry process and therefore integrate the discussion on washing machines and dryers, whereas the research on professional dishwashers will be presented separately.

For reasons of better readability two Lot 24 reports are prepared. The report at hand covers professional dishwashers. The report on professional washing machines and dryers is published separately.

2.2 The professional dishwashing process

The entire dishwashing process, e.g. in a large canteen, consists of several steps which are depicted in the following figure.³

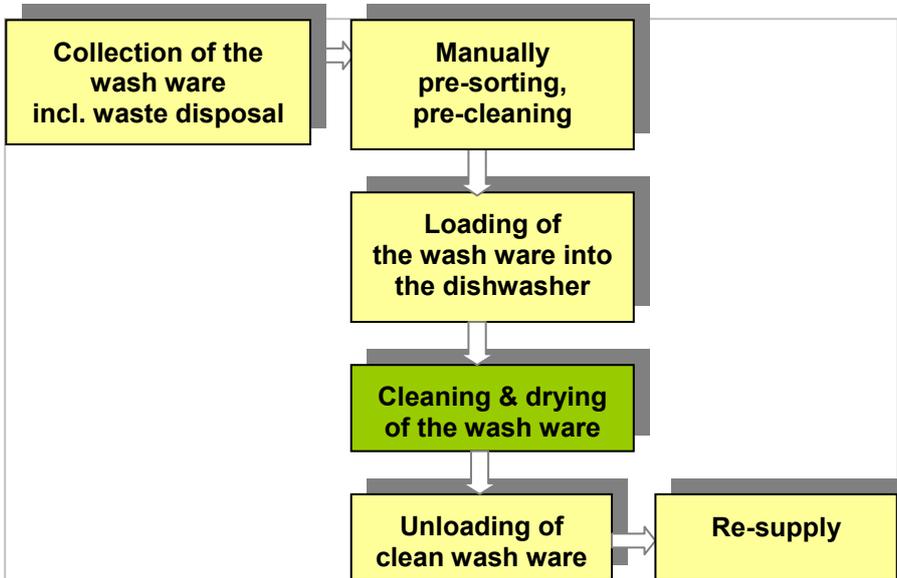


Figure 1 Different steps of a professional dishwashing process

Only the technical cleaning and drying process and the machines used for this are in the focus of the preparatory study at hand (green box), although from customers' and costs' perspective the manual parts of the dishwashing process might be also of interest.⁴

The study also concentrates on the dishwashing machine itself and does not consider the different water quality which has an influence on the result of the dishwashing process. Most of the machines are supplied with a separate water treatment system or this can be delivered on demand⁵. Finally, the analysis ignores external accessories kits not being components of the dishwashing machines, but usually supplied together with the machines (e.g. clearing station, admission table, and external baskets).

³ Own figure according to VGG-brochure "Gewerbliches Geschirrspülen und Hygiene" (professional dishwashing and hygiene), March 2006
http://www.vgg-online.de/download/merkblaetter/Gewerbliches_Geschirrspuelen_und_Hygiene.pdf

⁴ In a dishwashing process, 60% to 80% of the total costs are caused by labour costs. Source: aid Infodienst: Küche und Technik – Handbuch für gewerbliche Küchen. [Kitchen and Technology – Guide for commercial kitchens]; Bonn 2005.

⁵ Regarding dishwasher categories 1 and 2 (cf. Section 2.5.5.3), the water treatment system can be part of the machine itself or equipped separately. For the other categories, water treatment systems are usually separate.

According to the VGG glossary⁶ “dishes” is a collective term for containers and vessels which are used for preparing, cooking, arranging and serving food. It includes plates, cups, saucers and bowls made of various materials. Next to “dishes” dishwashers are also used to clean, rinse and dry glasses, cutlery, black cookware, and other cooking utensils. The more general term of all these items that may be cleaned by a dishwasher is “wash ware”. According to the VGG glossary, “wash ware” constitutes all components which are cleaned in the warewasher. Their shape and material must be suitable for cleaning by machine.

In our study, we will use “wash ware” as superordinated term for the different kinds of items to be cleaned.

2.3 Detergents and rinse agents for professional dishwashers

Treatment agents like detergents and rinse aids serve to clean, disinfect, rinse and descale wash ware of large-scale catering establishments.

Detergents come as powder mixtures, as solid blocks and in paste and liquid form. Their purpose is to remove food particles from wash ware completely and to counteract any re-soiling from the detergent solution. General decontamination performance might be enhanced by the use of a disinfecting component like for example active chlorine⁷.

The function of the rinse aid is to reduce the surface tension of the water in the final fresh water rinse cycle and, by lowering the interfacial tension, to achieve a uniform wetting of the cleaned wash ware. This, together with the heat stored up in the wash ware itself (from the hot detergent solution or a separate feed of hot drying air) means that rapid drying of the wash ware is achieved. This results in spotless, gleaming and dry surfaces on the washware (VGG 2010).⁸

2.4 Delimitation and definition of professional dishwashers

Dishwashers have already been object of research in a previous preparatory study,⁹ although focussing on domestic appliances (Lot 14: Domestic Washing Machines and

⁶ see “Commercial dishwashing: glossary of terms (technical information sheet No. 1)” published by Commercial Dishwashing Association, January 2008

http://www.vgg-online.de/download/information_sheets/01Commercial_dishwashing-glossary_of_terms.pdf

⁷ The possible usage and environmental impacts are described in Task 6 (effects of lower washing temperatures on composition of detergents)

⁸ Arbeitsgemeinschaft Gewerbliches Geschirrspülen [Commercial Dishwashing Association]: Commercial dishwashing & cleaning agents (Technical information sheet No. 05); Status: 20. April 2010. http://www.vgg-online.de/download/information_sheets/05cleaning_agents.pdf

⁹ Further information: www.ecowet-domestic.org

Dishwashers). Nevertheless, the following general definition for dishwashers of Lot 14 can also be applied to professional dishwashers:

Dishwashers are defined as machines which clean, rinse, and dry dishware, glassware, cutlery and cooking utensils by chemical, mechanical, thermal and electric means. A dishwasher may or may not have a specific drying operation at the end of the programs.

Lot 24 focuses on professional appliances. Professional dishwashers are used to clean, rinse, and dry wash ware that is connected to the preparation, cooking, arrangement or serving of food (including drinks) in commercial and industrial market segments.

Professional dishwashers are always connected to the mains (electricity used for motor and electronics), although the heating of the water can also be realised by other energy sources like steam or gas. Professional dishwashers may or may not have a specific drying operation at the end of the programmes: in large conveyor machines (cf. Section 2.5.5.3), the drying process is generally carried out in a separate drying zone within the dishwashing machine whereas in manually loaded batch dishwashers, drying takes place mainly outside the machine by virtue of the heat from the wash ware itself¹⁰.

In the following the basic differences between professional and household dishwashers are described to properly define the scope of this preparatory study.

2.4.1 Eco-design regulation on household dishwashers

The Commission Regulation¹¹ with regard to eco-design requirements for household dishwashers provides the following definition: “household dishwasher means a machine [...] which is designed to be used principally for non-professional purposes”. This distinction, on basis of the intended use of a machine, equates the Machinery Directive (cf. next section).

2.4.2 Distinction according to Machinery Directive

A possible general differentiation gives the amended version of the Machinery Directive 2006/42/EC,¹² in force since 29th December 2009. It, clarifies the borderline between machinery for household and for professional use in order to provide greater legal certainty. Whereas for the latter machinery the scope of the Machinery Directive applies, in

¹⁰ see “Commercial dishwashing: glossary of terms (technical information sheet No. 1)” published by Commercial Dishwashing Association, January 2008
http://www.vgg-online.de/download/information_sheets/01Commercial_dishwashing-glossary_of_terms.pdf

¹¹ COMMISSION REGULATION (EU) No 1016/2010 of 10 November 2010 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for household dishwashers.
<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:293:0031:0040:EN:PDF>

¹² <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2006L0042:20091215:EN:PDF>

Article 1 (2) k 'household appliances intended for domestic use' are explicitly excluded therefrom. They belong to low voltage electrical and electronic machinery with an electrical supply within the voltage limits of the Low Voltage Directive (between 50 and 1000 V for alternating current or between 75 and 1500 V for direct current) and therefore must fulfil the safety objectives of the Low Voltage Directive 2006/95/EC²⁰.

Concerning the exclusion of household appliances intended for domestic use from the scope, the following clarifications are given in the '*Guide to application of the Machinery Directive 2006/42/EC*'.¹³

- The expression 'household appliances' designates equipment intended for house-keeping functions such as washing, cleaning, heating, cooling, cooking, etc. Examples of household appliances include washing machines, dishwashers, vacuum cleaners and machinery for food preparation and cooking.
- The exclusion concerns appliances 'intended for domestic use', in other words, intended for use by private persons (consumers) in the home environment. Thus appliances for the housekeeping functions mentioned above that are intended for commercial or industrial use are not excluded from the scope of the Machinery Directive.

While it is possible for a private consumer to acquire an appliance intended for commercial use or for a commerce to acquire an appliance intended for domestic use, the criterion to be taken into account for determining the 'intended use' is the use intended and stated by the manufacturer of the appliance in his product information or his Declaration of Conformity (DoC). Evidently, this statement must accurately reflect the foreseeable use of the product.¹⁴

In general, the design and construction of machinery must take account of the intended use. Recital 15 of the Machinery Directive stresses that the machinery manufacturer must consider whether the machinery is intended to be used by a professional or a non-professional operator or is intended to provide a service to consumers. Annex I of the directive describes essential health and safety requirements relating to the design and construction of machinery, i.e. of appliances for commercial or industrial use.

In summary, the machinery directive provides a legal principle to distinguish between devices for usage in households on the one side and professional use on the other side.

¹³ Ian Fraser (General Editor): Guide to application of the Machinery Directive 2006/42/EC. Brussels, 1st Edition December 2009; revised by 2nd edition from June 2010
http://ec.europa.eu/enterprise/sectors/mechanical/files/machinery/guide_application_directive_2006-42-ec-2nd_edit_6-2010_en.pdf sighted at 15.02.2011

¹⁴ I.c., page 54/337

2.4.3 Definition of professional dishwashers within Lot 24

To date, there is no official or standardised definition or delimitation between the terms professional, commercial, and industrial. CENELEC TC59X¹⁵ proposed that the term “commercial” shall be used in connection with *market and market segments*. The term “professional”, however, shall be used in connection with *equipment* designed for use in commercial segments.

In our study, we will follow this distinction and apply the term “professional” as super-ordinated term for dishwashing appliances used in commercial and / or industrial market segments. However, please note that for example in existing standards, the term commercial or industrial might be used based on another approach (cf. Section 3). Therefore, an accurate delimitation and standardised definition of industrial equipment or market segments in comparison to other professional appliances would still be necessary.

On the basis of the Eco-design Regulation on household dishwashers and the Machinery Directive, within Lot 24 we define professional dishwashers as follows:

‘Professional dishwasher’ means a machine which cleans, rinses, and dries wash ware like dishware, glassware, cutlery, and other utensils connected to the preparation, cooking, arrangement or serving of food (including drinks) by chemical, mechanical, and thermal means; which is connected to electric mains and which is designed to be used principally for commercial and industrial purposes as stated by the manufacturer in the Declaration of Conformity (DoC).

2.4.4 Distinction according to functional performance and technological differences

With regard to functional performance and technological differences, the boundary between household and professional use is fluent. There is a semi-professional context, where some requirements of the household and some of the professional context apply.

In *private households*, a dishwasher usually runs on average 280 cycles per year, i.e. more than 5 times per week.¹⁶ Household dishwashers run with fresh water for each programme cycle meaning that for each cycle, the whole process water has to be heated. Further, in

¹⁵ CENELEC TC59X decided to clarify their understanding of the terms commercial, professional, industrial and to decide which of them are inside the scope of TC59X on one of their next meetings (cf. also Section 3.1.3)

¹⁶ Total number of standard cleaning cycles per year as used in the “Method for calculating the Energy Efficiency Index, Cleaning Efficiency Index, and the Drying Efficiency Index” in the COMMISSION REGULATION (EU) No 1016/2010 of 10 November 2010 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for household dishwashers. Official Journal of the European Union L 293/31 from 11.11.2010

household dishwashers, the wash ware often is not cleaned directly after the meals so that the soil is rather dried; thus, dishwashers for household usually have a longer soaking time; for these reasons, standard programmes of household dishwashers usually have longer cycle times of up to 3 hours. However, the duration of the programme is of less importance to private users as the device runs e.g. over night or between two meals. Household dishwashers are designed to clean various kinds of wash ware (dishes, cutlery, glasses, pots and pans) at the same time, i.e. they usually have rather unspecific programmes for general use (even though some have special programmes for glasses or “intense” programmes for highly soiled pots and pans).

In the *professional context*, the specific requirements according to space or type of wash ware differ considerably compared to household use, leading to a variety of different types of professional dishwashers varying in e.g. size and capacity (number of wash ware or baskets to be cleaned per hour). Compared to household use, usually a higher number of items have to be cleaned in professional dishwashers. Thus, they are operated more often (in case of program automats¹⁷) or for longer times (in case of conveyor-type dishwashers¹⁸). Moreover, in the professional context the programmes are required to be much faster than in private households.

The time requirement leads to the use of a tank system, where the detergent solution, i.e. the process water including the detergent in the required concentration, for the cleaning step is stored in a wash tank at high temperatures. The tank system saves the time used otherwise to heat up the water before each cleaning cycle. During operation the detergent solution is circulated through the dishwasher by means of a pump; to reuse the detergent solution for the next cleaning cycles, intensive water filtration takes place. The detergent solution is not changed between the cycles of the programme, but only partly replaced by hot fresh water from the final rinse zone (so called regeneration of detergent solution). The water in the tank is usually changed once a day or after each working shift.

Using a water-change system instead of a tank system makes sense in applications which are very similar to household use, the so called *semi-professional applications*, like Kindergartens or pre-schools, where the number of items to be cleaned per day is rather small (compared to other professional applications). Tank machines would not make sense due to this small amount of wash ware. As the time requirements in the semi-professional context are higher than in households, the programme cycles are shorter than in household

¹⁷ Program automats are dishwashers where the different steps of the dishwashing process are conducted consecutively in time. The basket(s) with the wash ware stay(s) in the same position during the whole dishwashing programme. See also Section 2.5.5.2

¹⁸ Conveyor-type dishwashers are dishwashers where the different steps of the dishwashing process are allocated to several individual treatment zones, i.e. the wash ware is transported through these zones, which are constructed as chambers, with openings in the transport direction. They are operated continuously within a certain period of time. See also Section 2.5.5.2

dishwashers (from approximately 5 to less than 30 minutes). The faster programmes compared to household appliances usually lead to a higher energy consumption of these semi-professional appliances.

Sometimes only one specific type of wash ware has to be cleaned or there is enough space and needed capacity to use several dishwashers in parallel, resulting in much more specialised dishwashers compared to household use. In bars or taverns, for example, mainly glasses have to be cleaned. Therefore, special glass washers are used. In canteens a large number of wash ware have to be cleaned. For this purpose, often several dishwashers are used, with each dishwasher being specialised for a certain kind of wash ware. In large-scale catering establishments the pots and pans used are usually much bigger compared to those used in private households and thus require more spacious dishwashers.

Further differences between appliances for household and professional use are:

- The connected load (professional dishwashers are available with higher load and three phases connectivity (400 V));
- The detergent dosage (manual dosing of cleaning agent in case of household dishwashers, use of tabs possible, vs. automatic detergent dosage in case of professional dishwashers);
- The distribution channels (professional appliances are sold directly by the manufacturers or via specialized gastronomy trade);
- The price (production costs of professional appliances are usually higher than household dishwashers).

Table 1 gives an overview of a possible delimitation between household, semi-professional and professional dishwashers.

Table 1 Main product groups of dishwashers according to customer segment

Group	Domestic Dishwashers	Semi-professional Dishwashers	Professional Dishwashers
Target group / Applications	Private households	Offices, small pensions, hospitals, hotels, nursing homes, restaurants, community kitchens, bed & breakfasts, institutional kitchens, kindergartens & pre-schools, schools, supermarkets	E.g. bakeries, bars, bistros, bread & bakery industry, butcheries, cafeterias, canteens, care homes, caterers, community centres, food processing industry, food retailing; hospitals, hotels, institutional kitchens, kindergartens & pre-school, marine, meat processing industry, restaurants, schools, supermarkets, etc.
Wash ware	Dishes, glasses, cutlery and further kitchen utensils	Dishes, glasses, cutlery and further kitchen utensils	Dishes, glasses, cutlery, crockery, black cookware, further kitchen utensils of large-scale catering establishments

Group	Domestic Dishwashers	Semi-professional Dishwashers	Professional Dishwashers
Temporal requirements	No special requirements regarding running times (cycle times up to 3 hours)	Short running times per cycle (5 to 30 min) through higher thermal, mechanical or chemical action	Very short running times per cycle (from below 1 minute per cycle) / high dishwashing capacity per hour
Water intake	Freshwater intake for each step in the programme.	Freshwater intake for each step in the programme.	Freshwater intake only for final rinse (smaller volume than for freshwater system dishwasher)
Water treatment	None (freshwater intake)	None (freshwater intake)	Intensive filtration of the detergent solution for re-use in several cycles (tank operation)
Operating principle	Discontinuous operation in cycles	Discontinuous operation in cycles	Discontinuous operation in cycles or continuous operation
Cleaning and hygienic requirements	Good cleaning efficiency important	Good cleaning efficiency important and hygienic requirements to be met	Good cleaning efficiency important and hygienic requirements to be met
Number of baskets to be cleaned at once	Dishwashing on two or three levels possible (loading of two or three baskets possible)	Dishwashing on two or three levels possible (loading of two or three baskets possible)	Dishwashing usually on one level (in front loaders loading of only one basket possible, in conveyor-type dishwashers continuous cleaning of baskets possible)
Type of programmes	Rather unspecific programmes for various items to be cleaned in one cycle	Rather unspecific programmes for various items to be cleaned in one cycle	Specific programmes or specific appliances for different kinds of items to be cleaned.
Detergent dosage	Manual detergent dosing	Manual or automatic detergent dosing	Automatic detergent dosing
Effort for maintenance	Low effort for cleaning of dishwasher	Low effort for cleaning of dishwasher	At least daily cleaning of machine necessary ¹⁹
Power supply, heating system	Normal load connection	Normal or high load connection	Usually high load and three phases (400 V) connection; partly additionally alternative energy sources (steam, gas, warm water connection)
Product categories	Typical dimension: height x width x depth 850 x 600 x 600 mm	Typical dimension: height x width x depth 850 x 600 x 600 mm	Variable dimensions depending on amount and type of items to be cleaned and spatial possibilities.

The table shows that there are only minor differences between household and semi-professional dishwashers (main differences are the shorter running times of the programmes and the possibility to connect to higher load in case of semi-professional dishwashers). However, there are significant differences between household and semi-professional appliances on the one hand and professional ones on the other hand.

¹⁹ According to VGG "Professional dishwashing & hygiene (2006)" machines have to be cleaned carefully after each end of operations (i.e. emptying of the tanks, cleaning of the interiors, the filter systems, the water intake and outlet, the partition curtains and the spraying systems). The reason is to avoid depositions in the machine and on the washware as these might accelerate the settling and breeding of microorganisms. (see http://www.vgg-online.de/download/merkblaetter/Gewerbliches_Geschirrspuelen_und_Hygiene.pdf)

After this general delimitation of professional dishwashers, the following sections describe the individual professional products in more details.

2.5 Classification of professional dishwashers

2.5.1 The European PRODCOM classification

PRODCOM is a system for the collection and dissemination of statistics on the production of manufactured goods. It is based on a product classification called the Prodcom List of the European Community²⁰ which consists of about 4 500 headings relating to manufactured products. The products are detailed on an 8-digit level; digits 1 to 4 refer to the NACE classification in which the producing enterprise is normally classified. Further to the 2008 review of the NACE codes, the following table lists the code classifications PRODCOM List 2009.

Table 2 Extract from PRODCOM list 2009 (Source: Eurostat)

Code	Description
28.29	Manufacture of other general-purpose machinery n.e.c.
28.29.50	Dish washing machines, of the industrial type
28.29.50.00	Non-domestic dish-washing machines
28.29.85	Parts of dish washing machines and machines for cleaning, filling, packing or wrapping
28.29.85.10	Parts of dish washing machines

From a practical point of view and against the overall aim of the preparatory study, the table shows that PRODCOM categorisations will be too rough to provide a basis for defining a clear scope of professional dishwashers. For example, among the dishwashers there is no further differentiation with regard to capacity or other functional performance parameters.

2.5.2 The European customs classification

The *Harmonized Commodity Description and Coding System (HS)* of tariff nomenclature is an internationally standardized system of names and numbers for classifying traded products developed and maintained by the World Customs Organization (WCO). The HS Nomenclature comprises about 5 000 commodity groups. The HS is a six-digit nomenclature. The first four digits are referred to as the heading. The first six digits are known as a subheading. Individual countries may extend a HS number to eight or ten digits for customs or export purposes. On the basis of the Harmonized System nomenclature, there is further comprised

²⁰ <http://epd.eurostat.ec.europa.eu/portal/page/portal/prodcom/introduction>

the *Combined nomenclature (CN)*²¹ which is used to classify goods when being declared to customs in the Community. Each CN subdivision has an eight digit code number, the CN code, followed by a description. The CN also include preliminary provisions, additional section or chapter notes and footnotes relating to CN subdivisions.

According to the European customs classification, the following product categories for dishwashers are distinguished. As for the PRODCOM list, this classification is not detailed enough for the purposes of EuP Lot 24.

Table 3 Classifications of dishwashers according to the HS-Classification (Source: World Customs Organisation²²)

Code	Description
84.22	Dishwashing machines; machinery for cleaning or drying bottles or other containers; machinery for filling, closing, sealing or labelling bottles, cans, boxes, bags or other containers; machinery for capsuling bottles, jars, tubes and similar containers; other packing or wrapping machinery (including heat-shrink wrapping machinery); machinery for aerating beverages
	Dishwashing machines
84.22.11.00	Of the household type
84.22.19.00	Other
84.22.20.00	Machinery for cleaning or drying bottles or other containers

The European Customs Classification will be too rough to provide a basis for defining a clear scope of professional dishwashers. For example, there is no further differentiation with regard to capacity or other functional performance parameters.

2.5.3 The International Patent Classification

The International Patent Classification (IPC) is a hierarchical patent classification system created under the Strasbourg Agreement (1971) and updated on a regular basis by a Committee of Experts, consisting of representatives of the Contracting States of that Agreement and observers from other organisations, such as the European Patent Office. The Strasbourg Agreement is one of a number of treaties administered by the World Intellectual Property Organization (WIPO). Patent publications from all of the Contracting States (and also most others) are each assigned at least one classification term, indicating the subject to which the invention relates, and may also be assigned further classification and indexing terms to give further details of the contents.

Each classification term consists of a symbol, such as A01B 1/00. The first letter is the "section symbol" consisting of a letter from A to H²³. This is followed by a two digit number to

²¹ http://ec.europa.eu/taxation_customs/customs/customs_duties/tariff_aspects/combined_nomenclature/index_e_n.htm

²² http://www.wcoomd.org/files/1.%20Public%20files/PDFandDocuments/HarmonizedSystem/2007/1684_2007E.pdf

give a "class symbol". The second letter indicates the "subclass" which is then followed by a 1 to 3 digit "group number", an oblique stroke and a number of at least two digits representing a "main group" or "subgroup".²⁴

Table 4 Classification of dishwashers according to International Patent Classification (IPC)

A47L 15/00	Washing or rinsing machines for crockery or table-ware
A47L 15/02	. with circulation and agitation of the cleaning liquid in the cleaning chamber containing a stationary basket
A47L 15/04	. . by reciprocating movement of the cleaning chamber
A47L 15/06	. . by means of an impeller in the chamber
A47L 15/08	. . by application of a pressure effect produced by pumps
A47L 15/10	. . by introducing compressed air or other gas into the liquid
A47L 15/12	. . by a boiling effect
A47L 15/13	. . using sonic or ultrasonic waves
A47L 15/14	. with stationary crockery baskets and spraying devices within the cleaning chamber
A47L 15/16	. . with rigidly-mounted spraying devices
A47L 15/18	. . with movably-mounted spraying devices
A47L 15/20	. . . Swingable spraying devices
A47L 15/22	. . . Rotary spraying devices
A47L 15/23 moved by means of the sprays
A47L 15/24	. with movement of the crockery baskets by conveyers
A47L 15/26	. with movement of the crockery baskets by other means
A47L 15/28	. . by lowering and lifting only
A47L 15/30	. . by rotating only
A47L 15/32	. . . rotated by means of spraying water
A47L 15/33	. . . with moving baskets submerged in the cleaning fluid
A47L 15/34	. . by lowering and lifting combined with a rotating movement
A47L 15/36	. . by a sideways motion
A47L 15/37	. with crockery cleaned by brushes
A47L 15/39	. . with brushes on movable supports
A47L 15/42	. Details
A47L 15/44	. . Devices for adding cleaning agents
A47L 15/46	. . Devices for the automatic control of the different phases of cleaning
A47L 15/48	. . Drying arrangements
A47L 15/50	. . Racks

²³ A: Human Necessities; B: Performing Operations, Transporting; C: Chemistry, Metallurgy; D: Textiles, Paper; E: Fixed Constructions; F: Mechanical Engineering, Lighting, Heating, Weapons; G: Physics; H: Electricity

²⁴ Sources: http://www.wipo.int/export/sites/www/classifications/ipc/en/guide/guide_ipc_2009.pdf, http://en.wikipedia.org/wiki/International_Patent_Classification

The comparison with the former statistical product classification schemes European PRODCOM and Customs classification clearly shows that the IPC scheme offers the most detailed graduation by product design and applications; for example, items A47L 15/42 to A47L 15/50 being parts of professional dishwashers are supplementary parts even not supplied by manufacturers of dishwashers but by different suppliers (e.g. devices for adding cleaning agents are produced by special manufacturers of dosing equipment). The IPC classification provides an overview of the diversity of professional dishwashing appliances. It distinguishes e.g. between machines with stationary and moving baskets (e.g. conveyor-type machines), and provides further details on working techniques of dishwashers (e.g. with or without brushes; different kinds of spraying devices or circulation techniques of the cleaning liquid).

2.5.4 Categories according to EN- or ISO-standard(s)

There are no EN- or ISO-standards covering professional dishwashers.

The U.S. Energy Star (cf. Section 4.3.1)²⁵ distinguishes the following four categorisations of professional dishwashers:

- Under Counter Dishwasher: A machine with an overall height 38 inches or less, in which a rack of dishes remains stationary within the machine while being subjected to sequential wash and rinse sprays, and is designed to be installed under food preparation workspaces. Under counter dishwashers can be either chemical or hot water sanitizing, with an internal booster heater for the latter. For purposes of this specification, only those machines designed for wash cycles of 10 minutes or less can qualify for ENERGY STAR.
- Stationary rack, single tank, door type dishwasher: A machine in which a rack of dishes remains stationary within the machine while subjected to sequential wash and rinse sprays. This definition also applies to machines in which the rack revolves on an axis during the wash and rinse cycles. Subcategories of stationary door type machines include: single and multiple wash tank, double rack, pot, pan and utensil washers, chemical dump type and hooded wash compartment (“hood type”). Stationary rack, single tank, door type models are covered by this specification and can be either chemical or hot water sanitizing, with an internal or external booster heater for the latter.
- Single tank conveyor dishwasher: A ware washing machine that employs a conveyor or similar mechanism to carry dishes through a series of wash and rinse sprays within the machine. Specifically, a single tank conveyor machine has a tank for wash water followed by a final sanitizing rinse and does not have a pumped rinse tank. This type of machine may include a pre-washing section before the washing section. Single tank

²⁵ http://www.energystar.gov/index.cfm?c=comm_dishwashers.pr_crit_comm_dishwashers

conveyor dishwashers can be either chemical or hot water sanitizing, with an internal or external booster heater for the latter.

- Multiple tank conveyor dishwasher: A conveyor type machine that has one or more tanks for wash water and one or more tanks for pumped rinse water, followed by a final sanitizing rinse. This type of machine may include one or more pre-washing sections before the washing section. Multiple tank conveyor dishwashers can be either chemical or hot water sanitizing, with an internal or external booster heater for the latter.

The German standards DIN 10510, DIN 10511, DIN 10512 and DIN 10522 provide another categorisation of professional dishwashing machines (see also Section 3). DIN 10510 and DIN 10512 classify dishwashers according to their construction and working techniques as "multi-tank conveyor-type dishwasher" or "one-tank dishwasher":

- DIN 10510 defines minimum hygiene requirements for multi-tank conveyor-type dishwashers. In these dishwashers, the wash ware is continuously transported through individual treatment zones. Those are usually constructed as chambers, with openings in the transport direction. Multi-tank dishwashers generally comprise at least one pre-cleaning zone using a reservoir tank, one cleaning zone using another reservoir tank and a final rinse zone using fresh water. With regard to the transportation of the wash ware, two construction types are distinguished:
 - Belt conveyor-type dishwasher: The wash ware is automatically transported on a conveyor belt through the machine. (further definition see below, Section 2.5.5.3)
 - Basket conveyor-type dishwasher: The wash ware is put into baskets which are then automatically transported through the machine. (further definition see below, Section 2.5.5.3)
- DIN 10512 defines minimum hygiene requirements for one-tank dishwashers: These dishwashers are professional dishwashers with one cleaning zone using a reservoir tank and a final rinse zone using fresh water. The following sub-categories are differentiated:
 - Manually loaded programme automats: The pre-cleaning of the soiled wash ware takes place manually outside of the dishwasher. The basket(s) are manually loaded and placed into the appliance. The front door or hood is shut and the cleaning cycle is started. Two construction types are distinguished:
 - Front door dishwashers (loaded and unloaded through the front door, further definition see below, Section 2.5.5.3)
 - Pass through dishwashers (loaded and unloaded from two different sides, further definition see below, Section 2.5.5.3)
 - Belt conveyor-type dishwashers
 - Basket (rack) conveyor-type dishwasher.

- Mobile dishwashers for cleaning wash ware on trailers, at festivals etc.

DIN 10511 and DIN 10522 classify the dishwashers according to the type of wash ware and hygienic needs.

- DIN 10511 defines minimum hygiene requirements for glass washing machines: These dishwashers are defined as machines commercially used for washing glasses, having a spray mechanism, a reservoir tank in which detergent solution is collected and a final hot fresh-water rinsing system.
- DIN 10522 defines minimum hygiene requirements with regard to the commercial cleaning of reusable boxes and reusable containers for unpackaged foodstuffs and describes the test procedures for the hygienic operation of dishwashers used for these purposes.

2.5.5 Functional performance classification

Building on the categorisation in the IPC and German DIN standards professional dishwashers are classified in this section according to functional performance parameters. To better understand the differences between the described categories, first of all an overview of the primary and secondary functions and important framework requirements of professional dishwashers is given (Section 2.5.5.1). Then the main properties to distinguish between different professional dishwashers are described (Section 2.5.5.2). Some of these aspects were already shortly described in Section 2.4 on the differences between household and professional dishwashers. Finally, in Section 2.5.5.3, six product categories were identified as a result of this analysis of functions and the respective properties of professional dishwashers.

2.5.5.1 Primary and secondary functions of professional dishwashers

In general, the *primary function* of a dishwasher is to clean, rinse, and dry a certain amount of dishware, glassware, cutlery, and / or cooking utensils by chemical, mechanical, thermal and electric means within a given time and with respect to the spatial possibilities (see definition of dishwashers in Section 2.4). Primary performance parameters are the cleaning and hygienic performance.

Important *secondary functions* that have to be met by professional dishwashers are related to the costs in use, they include:

- short programme duration,
- energy efficiency,
- water efficiency, and
- low detergent consumption.

In contrast to household dishwashers there are some *framework requirements* that have to be taken into account and that vary to a great extent for different customer groups of professional dishwashers. These framework requirements are:

- amount of items to be cleaned,
- types of items to be cleaned, and
- spatial requirements.

While short running cycles are an important requirement for almost each professional application, the other requirements might be very different depending on the application. These variations in the framework requirements that have to be met by professional dishwashers are the main reason for a range of different product categories on the market, compared to e.g. dishwashers for household use which are quite similar regarding the design (i.e. mainly undercounter dishwashers using fresh water for each dishwashing cycle, with a capacity of 12-14 place settings).

2.5.5.2 Main properties of professional dishwashers

The following properties of professional dishwashing can be used to facilitate the classification of professional dishwashers into different categories (see Section 2.5.5.3):

- **Water supply:** water-change operation vs. tank systems (one-tank or multi-tank):
 Devices with *water-change operation* use fresh water for each step of the programme (prewash (optional), cleaning, and final rinsing). They are used in the semi-professional area, where comparatively few wash ware has to be cleaned and time is not as relevant as in the professional areas. In the professional customer segment, the fresh water system is rather seldom. Usually, professional dishwashers are run with tank systems to reduce programme duration.
 Devices with *tank systems* are either one-tank or multi-tank machines. In *one-tank dishwashers* the detergent solution for the cleaning step is stored in a reservoir tank at high temperatures; the final rinsing is conducted with hot fresh water. During operation the detergent solution is circulated through the dishwasher by means of a pump and intensive water filtration takes place. The detergent solution is not changed between two programme cycles, but only partly replaced by hot fresh water from the final rinsing step (so called regeneration of detergent solution). The water in the tank is usually changed once a day or after each working shift. The pre-cleaning is usually conducted manually, e.g. with rinsing hoses before the wash ware is put into the dishwasher. *Multi-tank dishwashers* comprise at least one prewash zone using a reservoir tank, one cleaning zone using a reservoir tank, and a final rinse zone using hot fresh water. Before the items are put into the machine, only loose waste and leftovers are manually removed. Tank dishwashers do not make sense if only a small amount of items has to

be cleaned, as time requirements are usually not as high and tank dishwashers need more effort for the cleaning of the appliance itself.

- **Operating principle of machine dishwashing:** program automats vs. conveyor-type dishwashers

In case of *program automats* the different steps of the dishwashing process are conducted consecutively. The baskets with the wash ware stay in the same position during the whole dishwashing programme. In case of *conveyor-type dishwashers* the different steps of the dishwashing process are allocated to several individual treatment zones, i.e. the wash ware is transported through these zones, which are constructed as chambers, with openings in the transport direction. Program automats need much less space than the spacious conveyor-type dishwashers. However, the latter allow for continuous dishwashing of large amounts of wash ware in a short time.

- **Type of loading** (with regard to program automats): front loading vs. pass through

In case of program automats two types can be distinguished: either the basket(s) is/are put into and taken out of the dishwasher from the front (*front loading dishwasher*) or the basket(s) is/are put into the dishwasher from one side and is/are taken out of the dishwasher from the other side (*pass through or 'hood type' dishwasher*). Depending on the spatial requirements, available space and organisation of the dishwashing process (number of personnel, storing capacity of soiled wash ware, hygienic requirements and total amount of wash ware to be cleaned in a certain timeframe), these differences might impact the choice of machine categories by customers: The front loading automats need less space than pass through dishwashers; the latter are ergonomically easier to operate. Further, a separation of a dirty and a clean area is possible when using the pass through type.

- **Type of wash ware:** dishes, glasses, cutlery, pots and pans, utensils, etc.

Some customers have to clean a certain type of items or use several dishwashers at once (e.g. bars usually mainly have to clean glasses, in large kitchens several dishwashers for different types of wash ware may be used in parallel). This means professional dishwashers are usually more specialised with regard to the wash ware compared to dishwashers for household use. Pot dishwashers for instance operate with extremely high scavenging pressure in order to dissolve incrustations. They can therefore not be loaded with glass or ordinary crockery.

In addition to these distinguishing criteria between different categories of professional dishwashers, dishwashers also vary according to the following criteria. These criteria, however, do not justify further product categories (too little technological difference or these differences inherently come along with one of the above mentioned properties):

- **Means of transport** (relevant for conveyor-type dishwashers): basket vs. conveyor belt
 In case of *basket transport* the items to be cleaned are put into baskets which are transported through the dishwasher. The items can be sorted in advance of dishwashing. In case of *belt conveyor dishwashers*, the items to be cleaned are put directly on a conveyor belt which continuously moves through the dishwasher. The items can either be sorted after dishwashing, when unloading the machine or, if there are several belt conveyor dishwashers for a different kind of items, in advance of the dishwashing process.
- **Number of baskets** that can be cleaned at the same time (relevant for program automats):
 In case of semi-professional program automats with water-change operation (see above), it is possible to put two or three baskets at the same time into the appliance (like in case of dishwashers for household use). In program automats with tank system (front loaders or pass through) usually only one basket can be cleaned as the tank also needs space and only one level for the basket is possible. However, there are also pass through appliances, where two baskets can be cleaned next to each other at the same time. These appliances are like two pass through appliances connected next to each other.
- **Size / format:** undercounter, cupboard size or large conveyor-type dishwashers
 Obviously, the different construction types come along with different sizes and formats of the different dishwashers. Pass through dishwashers are usually cupboard size, whereas front loading devices might be undercounter or also cupboard size.
- **Way of utilisation:** stationary or mobile
 Most professional dishwashers are used stationary in kitchens, bistros or similar locations. There are, however, also dishwashers that can be used on mobile devices (like in vehicles, tents or similar locations). These devices are usually one-tank undercounter front loaders or one-tank pass through dishwashers. There are only minor technological differences to those for stationary use, e.g. they can be operated at lower surrounding temperatures or the water can be removed completely. Therefore dishwashers for mobile use are subsumed under the respective category of dishwashers for stationary use.

2.5.5.3 Categories of professional dishwashers used in Lot 24

The following categories are derived by the authors from the analysis of functions and framework requirements and the respective properties of professional dishwashers in the previous sections (Sections 2.5.5.1 and 2.5.5.2). Also other information (e.g. from the official product categories or from standards) were considered for this categorisation.

These categories form the concluding categorisation that is used for the forthcoming tasks in this preparatory study.

1. Undercounter water-change dishwashers (semi-professional)

These manually, front loaded program automats use fresh water for each step of the programme (prewash (optional), cleaning, final rinsing). They are used in the semi-professional area, where usually only a small amount of wash ware has to be cleaned and time is not as relevant as in the professional context. These dishwashers are very similar to those for household use, whereas main differences namely are shorter programme duration and the possibility to connect them to higher loads (400 V).

The different steps of the dishwashing process are conducted consecutively in time, the baskets with the items to be cleaned staying in the same position during the whole dishwashing programme. Usually two baskets can be put into the dishwasher from the front side.

As for dishwashers for household use, these devices are designed to clean various kinds of items (dishes, cutlery, and glasses) at the same time, i.e. they usually have rather unspecific programmes for general use. They are undercounter dishwashers, with only small differences in size and capacity, which can be sub-categorised in free standing, integrated, fully-integrated and build-in models as in case of dishwashers for household use. Typical dimensions are (height/width/depth): 850 mm (without lit 820 mm)/600 mm/600 mm.

2. Undercounter one-tank dishwashers

These manually front loaded program automats use one reservoir tank with detergent solution for cleaning, and fresh water for the final rinsing. The detergent solution is constantly filtrated / regenerated. The pre-cleaning is usually conducted manually before the items are put into the dishwasher.

The different steps of the dishwashing process are conducted consecutively in time, the baskets with the items to be cleaned stay in the same position during the whole dishwashing programme. Usually only one basket can be placed into the dishwasher (loading and unloading from the front side), as the tank needs space as well. The appliances are undercounter dishwashers that can be constructed as “generalists” for different items (dishes, glasses, and cutlery) or in specialised versions, i.e. only for dishes, for glasses or for cutlery respectively.

3. Hood-type dishwashers

These one-tank pass through dishwashers use one reservoir tank with detergent solution for cleaning, and fresh water for the final rinsing. The detergent solution is constantly filtrated / regenerated. Pre-cleaning is conducted manually, e.g. with rinsing hoses before the items are put into the dishwasher. The different steps of the dishwashing process are conducted

consecutively in time, the baskets with the items to be cleaned stay in the same position during the whole dishwashing programme. The basket(s) is/are put into the dishwasher from one side and is/are taken out of the dishwasher from the other side. Only *one basket* can be cleaned on one level, as the tank also needs space. There are appliances, where *two baskets* can be cleaned next to each other at the same time. The appliances are usually constructed to clean different items: dishes, glasses, cutlery, pots and pans, utensils, etc.

4. Utensil / pot dishwashers

These dishwashers are especially constructed for the cleaning of other items than dishes, glasses and cutlery, i.e. black cookware, pots, pans, containers, trays or other mostly large utensils. The cleaning performance is usually higher, e.g. by means of higher scavenging pressure or other stronger mechanical and chemical treatment.

Two construction types can be distinguished:

- Front loading dishwashers;
- Pass through dishwashers.

Both types are one-tank dishwashers (i.e. they use one reservoir tank with detergent solution for cleaning, and fresh water for the final rinsing, if necessary manual pre-cleaning). The pass-through dishwashers are usually loaded manually, however, some manufacturers offer special roll containers that can be filled outside the machine and then pushed into the dishwasher. The dimensions are often bigger than those of undercounter front loaders or pass through dishwashers for dishes, glasses and cutlery as the items to be cleaned are bulkier, too.

A special type of these dishwashers is the so-called **granulate dishwasher**. In these dishwashers (both front loaders and pass through) the mechanical cleaning is intensified through scouring of the wash ware (mainly black cookware) with plastic granules of different size. A granule collector catches the plastic pellets during the granule washing program. The granules can be subsequently cleaned out in a sink with a pipe-mounted sprayer.

5. One-tank conveyor-type dishwashers

The different steps of the dishwashing process are allocated to several individual treatment zones, i.e. the items to be cleaned are transported through these zones, which are constructed as chambers, with openings in the transport direction. These dishwashers use one reservoir tank for cleaning and fresh water for the final rinsing. Pre-cleaning may be conducted manually. The dishwashers can be used for different wash ware: dishes, glasses, cutlery, black cookware (pots and pans), utensils, etc. Two different transport systems are available:

- In case of the *basket transport system* the wash ware is put into baskets which are transported through the dishwasher. The items can be sorted in advance of

dishwashing. The pre-cleaning is usually conducted manually with rinsing hoses before the items are put into the dishwasher.

- In case of *belt conveyor (also: flight type) dishwashers*, the wash ware is put directly on a conveyor belt which continuously moves through the dishwasher. The items can either be sorted after dishwashing, when unloading the machine or, if there are several belt conveyor dishwashers for a different kind of items, in advance of the dishwashing process. Before the items are put into the machine, usually only loose waste and leftovers are manually removed.

6. Multi-tank conveyor-type dishwashers

The different steps of the dishwashing process are allocated to several individual treatment zones, i.e. the items to be cleaned are transported through these zones, which are constructed as chambers, with openings in the transport direction. These dishwashers comprise at least one prewash zone using a reservoir tank, one cleaning zone using a reservoir tank and a final rinse zone using fresh water. The dishwashers can be used for different wash ware: dishes, glasses, cutlery, black cookware (pots and pans), utensils, etc. As with one-tank conveyor-type dishwashers, two different transport systems are available:

- *Basket transport system* (see above at one-tank conveyor-type dishwashers).
- *Belt conveyor dishwashers* (see above at one-tank conveyor-type dishwashers).

A special type of multi-tank conveyor-type dishwashers are **dishwashers for the commercial cleaning of reusable boxes and containers**. Serially produced dishwashers for standard packaging boxes and container dishwashers can be assigned to the professional dishwashers.

Table 5 Overview of dishwasher categories according to functional and performance parameters

	No 1 Undercounter water-change dishwasher	No 2 Undercounter one-tank dishwasher	No 3 Hood-type dishwasher	No 4 Utensil / Pot dishwasher	No 5 One-tank conveyor-type dishwasher	No 6 Multi-tank conveyor-type dishwasher
Main properties						
Water supply	water-change operation	tank system / one-tank	tank system / one-tank	tank system / one-tank	tank system / one-tank	tank system / multi-tank
Operating principle of dishwashing machine	program automat	program automat	program automat	program automat	conveyor-type dishwasher	conveyor-type dishwasher
Type of loading	front loading	front loading	pass through	front loading or pass through	n.a.	n.a.
Type of wash ware to be cleaned	dishes, glasses, cutlery, pots and pans, utensils	mainly plates, glasses, cups, cutlery	mainly plates, glasses, cups, cutlery	black cookware, large utensils	mainly plates, glasses, cups, cutlery, trays	mainly plates, glasses, cups, cutlery, trays
Further properties						
Means of transport	n.a.	n.a.	n.a.	n.a.	basket transport or conveyor belt	basket transport or conveyor belt
Number of baskets to be cleaned at the same time	two or three (on two or three levels)	one (on one level)	one or two (on one level)	one (on one level)	n.a.	n.a.
Size / format	undercounter	undercounter	cupboard size	undercounter or cupboard size	large conveyor-type dishwashers	large conveyor-type dishwashers
Way of utilisation	stationary	stationary or mobile	stationary or mobile	stationary	stationary	stationary
Heat sources	electricity	electricity	electricity	electricity, low pressure steam or hot water	electricity, low pressure steam or hot water, (natural gas)	electricity, low pressure steam or hot water, (natural gas)
Variants	freestanding, built-under, integrated and fully integrated models	freestanding and built-under models		granulate dishwasher for black cookware		dishwashers for cleaning of reusable boxes and containers

n.a. = not applicable

3 Test standards on professional dishwashers

This subtask aims to specify the relevant test standards for professional dishwashers concerning test procedures for functional performance parameters, resource use, safety and hygiene as well as noise and vibrations and (if any) other specific test procedures. A short overview on existing test standards is given, including household standards whose scope has currently been modified to 'household and similar electrical appliances' thus including standardisation work on professional machines.

3.1 Performance

3.1.1 ASTM International Standards (USA / International)

ASTM International (ASTM), originally known as the American Society for Testing and Materials, is an international standards organization that develops and publishes voluntary consensus technical standards for a wide range of materials, products, systems, and services. In 2001, ASTM changed its name to ASTM International to reflect global participation in ASTM and worldwide use of its standards. As of 2007, ASTM has more than 30 000 members, including over 1 100 organizational members from more than 120 countries, including 120 members in China as of 2005. The application of ASTM standards is voluntarily expect for publicly funded areas in the USA ²⁶.

ASTM International has no role in requiring or enforcing compliance with its standards. The standards, however, may become mandatory when referenced by an external contract, corporation, or government. For example, ASTM Standards F1696 and F1920 are referenced in the U.S. ENERGY STAR criteria and used by manufacturers to obtain an ENERGY STAR qualification or rating (cf. Sections 3.1.1.12, 3.1.1.13, and 4.3.1).

The following ASTM International standards refer to professional dishwashers, sorted in ascending order.²⁷ They have been developed by Technical Committee F26 on Food Service Equipment²⁸ and belong to the work of the following subcommittees:

²⁶ ASTM standards are voluntary in the sense that their use is not mandated by ASTM. However, government regulators often give voluntary standards the force of law by citing them in laws, regulations and codes. In the United States, the relationship between private-sector standards developers and the public sector has been strengthened with the 1995 passage of the National Technology Transfer and Advancement Act (Public Law 104-113). The law requires government agencies to use privately developed standards whenever it is at all possible. Source: www.astm.org

²⁷ Source: www.astm.org

²⁸ "Food service equipment is apparatus intended for use in commercial and institutional establishments for handling, storage, preparation, cooking, holding, display, dispensing, and/or the serving of food which, at the time of serving, is ready for direct consumption on or off the premises. Also included are cleaning, sanitation

- F26.01: Cleaning and Sanitation Equipment (Sections 3.1.1.1 to 3.1.1.11)
- F26.06: Productivity and Energy Protocol (Sections 3.1.1.12 and 3.1.1.13)
- F26.05: Life Cycle Cost and Sustainability (Sections 3.1.1.14 and 3.1.1.15). These two standards generally apply to all product categories subsumed under 'Food Service Equipment' and only refer to the respective product specific standards.

Finally, Section 3.1.1.16 provides an overview to which Lot 24 product categories the ASTM standards correspond and conclusions with regard to the applicability of the standards in the EU.

3.1.1.1 ASTM F857-07

ASTM F857-07: Standard specification for hot water sanitizing commercial dishwashing machines, stationary rack type

This specification covers the material, design, and performance requirements pertinent to the construction of spray-type, stationary rack commercial dishwashing machines that are manually loaded yet automatically controlled to uniformly wash, rinse, and sanitize eating and drinking utensils. Representative production models of the washers shall pass performance, operation, leakage, and energy and productivity tests, and should function satisfactorily as specified. Certification, product marking, and packaging are also considered.

3.1.1.2 ASTM F858-07

ASTM F858-07: Standard specification for hot water sanitizing commercial dishwashing machines, single tank, conveyor rack type

This specification covers single tank, automatic rack type, hot water sanitizing professional dishwashing machines. Covered by this specification are dishwashing machines of various types (types I and II based on feed direction, from right or left, respectively), styles (styles 1 to 3 based on method of heating: steam, electric, or gas), classes (classes A-D based on heat source: injector, heat exchange coil, natural gas, or LP gas), sizes, and capacities. Components comprising the dishwashing machine shall be manufactured from corrosion-resistant steel (tank, scrap trays or strainers, overflow drain, access door/s, and legs), corrosion-resisting materials (conveyor, piping and fittings, valves, and spray assemblies), nickel-copper alloys, and plastics. Pump casings shall be of cast iron or corrosion-resisting material. When specified, the dishwashing machine assembly may include a final rinse booster, detergent feeder, and rinse agent feeder. The dishwashing machine shall be tested for performance standards compliance and noise level as well as for operational, leakage, and performance profile requirements. All tests shall comply with the requirements specified.

and ancillary items associated with food preparation and service." Source:
<http://www.astm.org/COMMIT/SCOPES/F26.htm>

3.1.1.3 ASTM F859–09

ASTM F859–09: Standard specification for heat-sanitizing commercial dishwashing machines, multiple tank, conveyor rack type

This specification covers multiple tank automatic rack-type commercial dishwashing machines. Dishwashing machines shall be of various types (types I and II based on feed direction, from right or left, respectively), styles (styles 1 to 4 based on method of heating: steam, electric, or gas; style 4: pre-wash unit), and classes (classes A-D based on heat source: injector, heat exchange coil, natural gas, or LP gas). The standard includes requirements with regard to construction; electrical, steam and gas equipment; lubrication; treatment and painting; and performance.

3.1.1.4 ASTM F860–07

ASTM F860–07: Standard specification for hot water sanitizing commercial dishwashing machines, multiple tank, rackless conveyor-type

This specification covers multiple-tank, automatic rackless conveyor-type, commercial dishwashing machines. These machines can be classified into various types (types I and II based on feed direction, from right or left, respectively), styles (styles 1 to 4 based on method of heating: steam, electric, or gas), and classes (classes A-D based on heat source: injector, heat exchange coil, natural gas, or LP gas). In addition, these dishwashing machines can be classified into three groups A to C according to size and capacity. The standard includes several requirements: Materials used in the manufacture of these machines shall consist of corrosion-resistant steel, corrosion resisting material, nickel-copper alloy and plastics. The dishwashing machine shall be complete so that when connected to the specified source of power, water supply, heating means (steam, electric, or gas), drainage, detergent, and rinse agent feeder as applicable, the unit can be used for its intended function. Dishwashers shall be rigid, quiet in operation, free from objectionable vibration, and so constructed as to prevent objectionable splashing of water to the outside of the machine. Operational test, leakage test, and performance profiles shall be done in order to determine the overall efficiency of the dishwashing machine.

3.1.1.5 ASTM F953–08

ASTM F953–08: Standard Specification for Commercial Dishwashing Machines (Stationary Rack, Dump Type) Chemical Sanitizing

This specification covers manually fed, spray-type, stationary rack, automatically controlled, dump type, chemical sanitizing commercial dishwashing machines. Dishwashing machines shall be of the following types, styles, classes: Type I - straight-through model. This machine is used in line with table on each side; Type II - corner model. Type III - undercounter, front

load. Style A - single rack, and Style B - double rack. This standard includes several requirements: No leakage shall occur when tested at pressures up to 125% of the manufacturer's recommended supply line pressure. The dishwasher materials, construction, operation cycle, electrical equipment, lubrication, and coating shall meet the requirements prescribed.

3.1.1.6 ASTM F1021–95(2007)

ASTM F1021–95(2007): Standard specification for feeders, detergent, rinse agent, and sanitizing agent for commercial dishwashing and glasswashing machines

This specification covers detergent feeders, rinse additive feeders, and sanitizing agent feeders intended to automatically maintain the concentration of additives in the wash, recirculated rinse, or non-recirculated rinse water of commercial spray-type dish-washing and glasswashing machines. Detergents, rinse additives, and sanitizing agent feeders are classified according to different types and styles. Materials used shall be free from defects that would adversely affect the performance or maintainability of individual components or of the overall assembly. The feeder shall be complete so that when connected to the specified source of power (electrical or water, or both), the unit can be used for its intended function. Feeders shall be tested in accordance with specified requirements.

3.1.1.7 ASTM F1022–06

ASTM F1022–06: Standard specification for chemical sanitizing commercial dishwashing machines, recirculated wash, fresh water rinse type

This specification covers manually fed, spray-type, stationary rack, automatically controlled chemical sanitizing commercial dishwashing machines. These machines can be classified into two types: Type I is used in line with the table on each side and Type II is used in corner placement forming a 90° side. In terms of mode of heating, there are three styles of dishwashing machines: Style 1 is steam heated with two classes namely Class A which uses injector and Class B which uses heat exchange coil; Style 2 is electrically heated; and Style 3 is gas heated with two classes namely Class C which uses natural gas and Class D which uses LP gas. The standard includes several requirements: Materials used shall be free from defects that would adversely affect the performance or maintainability of individual components of the overall assembly. These materials shall consist of corrosion-resistant steel, corrosion-resisting material, and nickel-copper alloy. The dishwashing machine shall be complete so that when connected to the specified source of power, water supply, heating means (steam, electric, or gas), drainage, detergent, sanitizer and rinse agent feeder as applicable, the unit can be used for its intended function. Dishwashers shall be rigid, quiet in operation, free from objectionable vibration, and so constructed as to prevent objectionable splashing of water or overflow of water to the outside of the machine. Parts requiring adjustment or service, or both shall be readily accessible. Requirements of electrical

equipment, gas equipment, steam equipment, lubrication, and painting for the dishwashing machine are specified.

3.1.1.8 ASTM F1114–06

ASTM F1114–06: Standard Specification for Heat Sanitizing Commercial Pot, Pan, and Utensil Station Rack Type Water-Driven Rotary Spray

This specification covers material, design, and performance requirements pertinent to the construction of water-driven rotary spray type, stationary rack commercial pot, pan, and utensil washing machines that are manually loaded yet automatically controlled to uniformly wash, rinse, and heat-sanitize food preparation utensils. Representative production models of the washers shall pass performance, operation, leakage, and energy and productivity tests, and should function satisfactorily as specified. Certification, product marking, and packaging are also specified.

3.1.1.9 ASTM F1202–06

ASTM F1202–06: Standard Specification for Washing Machines, Heat Sanitizing, Commercial, Pot, Pan, and Utensil Vertically Oscillating Arm Type

This specification covers the requirements for manually fed, motor-driven vertically oscillating arm type, automatically controlled, commercial pot, pan, and utensil washing machine (also referred to as "the washer"). The washer is of one rack capacity (Type I) and is available in either Style A (one door/front loading) or Style B (three door/pass-through with front load door). Heat shall be provided to the washer through steam (Style 1) by injection (Class A) or heat exchange coil (Class B) or through electric means (Style 2). The standard includes several requirements: The washer and its components shall be manufactured free of defects. Piping and fittings shall be manufactured from corrosion-resisting material or heat-resisting plastic material. Valves, spray assemblies, and overflow drain shall be manufactured from corrosion-resisting materials. Tank and housing shall be constructed of corrosion-resistant steel. Scrap trays (strainers), access door/s, and legs shall be constructed of corrosion-resistant steel or other corrosion-resisting material. The pump motor shall be mounted on the tank or rigid steel base, with the pump casing being of cast iron or corrosion-resisting material. When specified, a final rinse booster heater and/or detergent feeder may be provided. The washer shall be operated at ambient room temperature. Tests for performance standards and operational compliance as well as for noise level, leakage, energy, and productivity requirements shall be performed and shall conform to the requirements specified.

3.1.1.10 ASTM F1203–06

ASTM F1203–06: Standard specification for washing machines-pot, pan, and utensil, heat sanitizing, commercial rotary conveyor-type

This specification covers manually loaded, motor-driven rotary conveyor-type, automatically controlled, commercial pot, pan, and utensil washing machines. The washer shall be of the following type, and class as specified. Motor-driven continuous rotary conveyor: Type I - one door (front loading); Type II - one or two door (pass-through corner operation); and Type III - one or two door (pass-through straight line operation). Style and class: Style 1 - steam heated; Style 2 - electric heat; Class A - injection; and Class B - heat exchange coil. The design, construction, and performance requirements of the washing machine are presented in details. The operational test; leakage test; and energy and productivity test shall be performed to meet the requirements prescribed.

3.1.1.11 ASTM F1237–09

ASTM F1237–09: Standard specification for commercial dishwashing machines, multiple-tank, continuous oval-conveyor-type, heat sanitizing

This specification covers commercial multiple-tank dishwashing machines of the continuous type, oval shaped, with horizontal table conveyor systems. According to direction of rotation, the dishwashing machines can be classified into two types: Type I-CW (clockwise) rotation is designed and supplied to accept the feeding of soiled wash ware from the right side, when viewed from above and Type II-CCW (counter clockwise) rotation is designed and supplied to accept the feeding of soiled wash ware from the left side.

These dishwashing machines can also be classified into three styles: Style 1 is a steam heated machine, with two classes (Class A using injectors, Class B heat exchange coils). Style 2 is an electrically heated dishwashing machine. Style 3 on the other hand is gas heated with two classes (Class C using natural gas, Class D LP gas).

The standard includes several requirements: Materials used in the manufacture of these machines shall consist of corrosion-resistant steel, corrosion resisting material, nickel-copper alloy and plastics. These materials used shall be free from defects that would affect the performance or maintainability of individual components of the overall assembly. The dishwashing machine shall be complete so that when connected to the specified source of power, water supply, heating means (steam or electric) and drainage, detergent and rinse agent feeder as applicable, the unit can be used for its intended function. Dishwashers shall be quiet in operation, free from objectionable splashing of water to the outside of the machine. Operational test, leakage test, and performance profiles shall be done.

3.1.1.12 ASTM F1696–07

ASTM International F1696–07: Energy performance of single-rack, door-type commercial dishwashing machines

This test method covers the evaluation of the energy and water consumption of single-rack, door-type commercial dishwashers (hereafter referred to as dishwashers). It is applicable to

both hot water sanitizing and chemical sanitizing stationary rack machines, which include undercounter single rack machines; upright door-type machines; pot, pan, and utensil machines; fresh water rinse machines; and fill-and-dump machines. Dishwashers may have a remote or self-contained booster heater²⁹. Dishwasher tank heaters are evaluated separately from the booster heater. The following procedures are included in this test method:

- Procedures to confirm dishwasher is operating properly prior to performance testing:
 - Maximum energy input rate of the tank heaters.
 - Maximum energy input rate of the booster heater, if applicable.
 - Water consumption calibration.
 - Booster temperature calibration, if applicable.
 - Wash tank temperature calibration.
- Energy consumption (kWh/rack) and cycle rate (racks/h) performance tests:
 - Washing energy test.
 - Tank heater idle energy rate (door(s) open and door(s) closed).
 - Booster idle energy rate, if provided.

This test method does not address cleaning or sanitizing performance³⁰. This standard does not address safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

3.1.1.13 ASTM F1920–07

ASTM International F1920–07: Standard test method for performance of rack conveyor, commercial dishwashing machines

This standard is equivalent to ASTM International F 1696–07, i.e. it evaluates the energy and water consumption of rack conveyor, professional dishwashing machines, hereafter referred to as dishwashers. It is applicable to both hot water sanitizing and chemical sanitizing rack conveyor machines, which include both single tank and multiple tank machines. Dishwashers may have remote or self-contained booster heater²⁹. Dishwasher tank heaters are evaluated separately from the booster heater. The following procedures are included in this test method:

- Procedures to confirm that the dishwasher is operating properly prior to performance testing:

²⁹ Booster heater: water heater for taking supply hot water (typically 140°F / 60°C) up to 180°F / 82°C for sanitizing rinse; the booster heater may be separate from dishwasher or integrated.

³⁰ i.e. the wash ware used for testing the energy consumption per rack is not soiled at all.

- Maximum energy input rate of the tank heaters.
- Maximum energy input rate of the booster heater, if applicable.
- Final sanitizing rinse water consumption calibration.
- Booster temperature calibration, if applicable.
- Wash tank temperature calibration.
- Wash tank pump and conveyor motor calibration.
- Energy consumption (kWh/rack) and cycle rate (racks/h) performance tests
 - Washing energy performance test.
 - Tank heater idle energy rate.
 - Booster idle energy rate, if provided.

This procedure does not address cleaning or sanitizing performance³⁰. This standard does not address safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

3.1.1.14 ASTM F2687–07

ASTM F2687–07: Standard practice for life cycle cost analysis of commercial food service equipment

This standard practice³¹ for life cycle cost (LCC) analysis of commercial food service equipment is designed for producers and end-users to utilize when forecasting and (or) evaluating the life cycle costs of equipment by accounting for tangible differences in operating and maintenance costs of commercial food service equipment³². Inter alia, the standards refer to “F1696 Test Method for Energy Performance of Single-Rack, Door-Type Commercial Dishwashing Machines” and “F1920 Test Method for Performance of Rack Conveyor, Commercial Dishwashing Machines”.

The standard practice provides a detailed list of terminology with regard to specific cost factors and other parameters like lifespan or consumption values being relevant for calculating life cycle costs. A procedure to calculate the LCC is proposed, a tabular sample of a spreadsheet-based tool provided by the North American Association of Food Equipment Manufacturers (NAFEM) is shown in the appendix.

Major categories included in this analysis include total purchase price, service and repair costs, preventative maintenance costs, utility operating costs and disposal costs. The results

³¹ A standard practice by ASTM defines a sequence of operations that, unlike a standard test method, does not produce a result.

³² A range of product groups, inter alia professional dishwashing machines as covered by ASTM standards F1696 and F1920 (single-rack door-type and rack conveyor commercial dishwashing machines).

may be quantified as a yearly running total and a net present value. Inputs for this life cycle analysis will need to come from a variety of sources, including manufacturers, service agents, utility companies, and end users.

Results of the analysis detailed in this standard practice are intended for budgetary purposes. The results may also be used to compare projected life cycle cost of different models from a single manufacturer, or models manufactured by multiple suppliers, or to establish when it is cost effective to replace specific equipment versus incurring continued maintenance expenses.

3.1.1.15 ASTM WK24910

ASTM WK24910 – New practice for determining the sustainability rating of commercial food service equipment (status: draft under development)

This standard practice³¹ for determining the sustainability rating of commercial food service equipment³² is designed for producers and end-users to identify the environmental impact of using the equipment in a green building project.

Major categories included in this analysis include total recycled content of materials, impact of materials used in the construction of the equipment, energy consumption of the equipment and water consumption of the equipment. The results may be combined with life cycle cost analysis to present a complete environmental impact of using a particular piece of commercial food service equipment in an operation. To calculate the life cycle analysis, inputs have to be gathered from a variety of sources, including manufacturers, service agents, utility companies, and end users. Not all proposed input variables need to be considered for effective analysis.

The commercial food service industry is continually being challenged to assess the total environmental impact of their equipment. The new ASTM practice intends to provide a consistent framework for developing a sustainability rating of the equipment that can be used to compare equipment models and vendors for green buildings.

3.1.1.16 ASTM – summarizing conclusions

ASTM standards correspond to the following professional dishwasher categories as defined in Lot 24:

Table 6 Corresponding Lot 24 dishwasher categories of ASTM standards

Lot 24 categories	Corresponding ASTM standards ³³	
Cat. 1: Undercounter water-change	F1696 Hot water sanitizing / chemical sanitizing; stationary single-rack door type: fresh water rinse machines	
Cat. 2: Undercounter one-tank	F1696 Hot water sanitizing / chemical sanitizing; stationary single-rack door type: undercounter single-rack machines	
Cat. 3: Hood-type dishwasher	F1696 Hot water sanitizing / chemical sanitizing; stationary single-rack door type: upright door-type machines	
Cat. 4: Utensil/pot dishwasher	F1114 Heat sanitizing, stationary rack; pot, pan and utensil washing machines; water driven rotary spray F1202 Heat sanitizing; pot, pan and utensil washing machines; motor-driven vertically oscillating arm type F1696 Hot water sanitizing / chemical sanitizing; stationary single-rack door type: pot, pan and utensil machines	
Cat. 5: conveyor-type, one-tank	F858 Hot water sanitizing, single tank, automatic conveyor rack type F1203 Heat sanitizing; pot, pan and utensil washing machines; motor-driven rotary conveyor type F1920 Hot water sanitizing / chemical sanitizing; rack conveyor; single tank machines	
Cat. 6: conveyor-type, multi-tank	F859 Heat-sanitizing, multiple tank, automatic conveyor rack type F860 Hot water sanitizing, multiple tank, automatic rackless conveyor type F1237 Heat sanitizing; multiple tank, continuous - oval shaped - conveyor type F1920 Hot water sanitizing / chemical sanitizing; rack conveyor; multiple tank machines	
Cat. 1-4	F857 Hot water sanitizing, stationary rack type	
Cat. 1-6	F2687 Standard practice for life cycle cost analysis of commercial food service equipment WK24910 New practice for determining the sustainability rating of commercial food service equipment	
-*	F953	Chemical sanitizing, stationary rack, dump type
-*	F1022	Chemical sanitizing, stationary rack, fresh water rinse type

* Note: Lot 24 does not take into account chemical sanitizing machinery

Summarizing, ASTM standards cover material, design, and performance requirements for the different dishwasher categories addressed. The standards are typically used by end-use customers such as the federal government when purchasing products from manufacturers. They are a means to ensure the customers receive a consistent product each time they place an order. The standards include the following issues:

³³ Note: ASTM standards operate with hot water *sanitizing* processes in comparison to Lot 24 dishwashers being defined as machines operating with cleaning principle (cf. Task 6 for details)

- Description of the material, design and construction requirements such as metal types and thickness.
- Descriptions of the different styles such as straight thru and corner type.
- Various heat sources such as electric, steam or gas.
- Details that should be specified when ordering a dishwasher.
- Performance requirements stating the machines must conform to the requirements of Organisational Safety and Health Administration (OSHA), UL 921 (safety requirements, see Section 3.3.3), and NSF/ANSI 3 (hygienic performance, see Section 3.2.2).
- Maximum noise level of the dishwasher only, when operating, exclusive of loading, unloading, and servicing.
- Requirements for appropriate markings such as the operating times, temperatures, etc.

Finally, there is typically a reference to performance profiles such as operating energy consumption, water consumption, and productivity.

ASTM specifications apply to hot water and chemical *sanitizing* machines (for further details: see Task 6). These machines and processes, commonly used on the US market, generally require higher (sanitizing) temperatures compared to the (cleaning) temperatures of dishwashers in Europe³⁴. This higher thermal minimum requirement results in higher energy consumption and lower efficiency, respectively. Therefore the ASTM standards are regarded to be not appropriate to cover European requirements and market trends and are not applied by European manufacturers.

3.1.2 IEC and European harmonised standards EN 50242 / 60436

EN 50242:2008-09, EN 60436:2008-09 Electric dishwashers for household use – Methods for measuring the performance (IEC 60436:2004, modified)

This standard is the main harmonised international standard regarding the performance measurement of household dishwashers. It is valid for electric mains-operated household dishwashers. The standard is used to measure the information required by Commission Directive 97/17/EC implementing Council Directive 92/75/EEC with regard to energy labelling of household dishwashers. In summary this standard defines the general test conditions and specific test methods for the following information:

- cleaning performance,

³⁴ Hot water sanitizing: according to NSF/ANSI minimum washing temperatures of 66 to 74°C required depending on the dishwashing machine category; cleaning: according to DIN 10512 washing temperatures of 60 to 65°C required, see Section 3.2.4.

- drying performance,
- energy consumption,
- water consumption,
- time, and
- airborne acoustical noise (reference to IEC 60704-3).

For measuring each of the information, the same programme has to be used.

Since adoption of IEC 60436 in 2004, the standard has repeatedly been amended and modified, currently IEC 60436 amendment 1 / edition 3.0 from 16.09.2009 being in effect.

Following activities are ongoing:

- a) In July 2012 IEC 60436 amendment 2 / edition 3.0 is expected to be first published³⁵. By parallel voting, this amendment shall be adopted in EN 50242. It is expected that the corrected draft version (CDV) will be circulated in March 2011. If no comments will be done the phase for final draft for decision (FDIS) could be skipped and the publishing can be done already by the end of 2011. Changes to be discussed are for example the use of another dishwasher model as reference machine for the performance measurements, another load scheme for the oven for burning the soil of the washware and the replacement of some parts of the standard washware (cutlery, small bowl, as the former are not produced anymore).
- b) Further, IEC currently works on a revision of the third into the IEC 60436 fourth edition; this would result in a completely revised measurement method, e.g. with regard to the load (new: including pots, pans and plastic materials). This revision will come into effect in a time period of 3 to 5 years. In this edition, the scope of the standard will be extended to 'electric dishwashers for household *and similar use*', i.e. covering household appliances being used in a commercial context, e.g. in offices.
- c) The Technical Committee CENELEC TC 59X "Performance of household and similar electrical appliances" is the body responsible for providing harmonized standards in support of European legislation. CENELEC/TC59X dealing with the standards EN 50242 / 60436 on household dishwashers has been currently mandated (no. M481) by the European Commission to review the standards with regard to
 1. the adoption of Commission Regulations 1059/2010 and 1016/2010 on eco-design and energy labelling,
 2. the inclusion of low power modes and partial mode in the calculation of the energy efficiency index.
- d) In 2009, TC59X settled two Sub Working Groups with the scope to develop performance standards for laundry machines for commercial use

³⁵ [http://www.iec.ch/dyn/www/f?p=103:38:0::::FSP_ORG_ID,FSP_LANG_ID,FSP_PROJECT:1389,25,IEC60436 am2 Ed. 3.0](http://www.iec.ch/dyn/www/f?p=103:38:0::::FSP_ORG_ID,FSP_LANG_ID,FSP_PROJECT:1389,25,IEC60436%20am2%20Ed.%203.0)

(CLC/TC59X/SWG1.12) and for dishwashing machines for commercial use (CLC/TC59X/SWG2.1). The TC59X SWG2.1 kick off meeting held at 6 January 2011 aimed to present a project related to the energy consumption measurement of professional dishwashers. The next meeting will be on 24 February 2011. Points for discussion are

1. an analysis of the mandate M481 (in order to clarify that it is not related to professional dishwashers),
2. a comparison between ASTM (F1696) standard and the European household dishwasher standard EN 50242.
3. a discussion on how to consider a currently proposed document by EFCEM for a new performance measurement methodology for professional dishwashers (see Section 3.1.3.1 below).

The standard project is divided into two parallel parts: the first one is related to the measurement procedure of the energy consumption (appliance, environmental condition etc.), the second one is related to the performance test (hygienic test or similar which has to be developed). The time plan will be discussed in SWG 2.1. In a first step, the scope of the standard will only cover undercounter and hood type dishwashers.

To coordinate the norm activities of national and European standardisation bodies in parallel, in Germany, within the DKE³⁶ a national working group on professional dishwashers has been constituted as mirror committee to promote CENELEC/TC59X work on the performance of household and similar electrical appliances.

According to stakeholder information it is impractical to apply harmonised standards EN 50242 / 60436 to professional dishwashers as the defined soiling of the items is mainly related to the soiling in household use (the soiled wash ware undergoes an oven drying procedure for two hours to simulate stubborn soiling). In professional use, the dry-on time is usually very short (less than two hours at room temperature). Thus, the soil remains relatively soft and can be washed-off rapidly. The programs of professional dishwashers are adjusted to this kind of soiling. Measurement with EN 50242 / 60436 would therefore lead to rather poor cleaning performance of professional dishwashers which would not reflect real performances during use. Further, the kind of standard soiling (spinach) is for example not representative for specialized professional dishwashers like glasswashers. Finally, the standard measurement method includes a reference machine for household use being only

³⁶ DKE: Deutsche Kommission Elektrotechnik Elektronik Informationstechnik im DIN und VDE (German Commission for Electrical, Electronic & Information Technologies of DIN and VDE)

limited comparable to professional machines. Due to these inappropriate test procedures, up to now this test has not been applied to professional dishwashers.

An appropriate standard for measuring the performance of professional dishwashers does not exist at EU level. Manufacturers use internal test procedures which allow direct comparison between models of similar performance characteristics. However, these are not suitable for a performance classification of professional dishwashers because of insufficient reproducibility.

3.1.3 Work on development of new performance standards for professional dishwashers

3.1.3.1 By EFCEM (Europe)

Within the European Federation of Catering Equipment Manufacturers (EFCEM), a European Working Group is organised: „Energy Performance Standards Committee“. The goal is to develop a new standard on the cleaning performance and energy efficiency of professional dishwashers.³⁷ CECED Italia as member of EFCEM has proposed a draft standard for measuring the energy consumption (based on ASTM F1696-07), the washing performance (derived from EN 50242), and rinsing performance. The document proposed in EFCEM has been discussed at EFCEM meeting on 17 February 2011 and is intended to be published in order to consider and discuss it officially in TC 59X SWG 2.1 (see Section 3.1.2 above)

The German industry association HKI (Industrieverband Haus-, Heiz- und Küchentechnik e.V.), representing some manufacturers of professional dishwashers, has asked to exclude the category “utensil/pot dishwashers” from the scope of this standard as the proposed soiling of wash ware within the measurement method is not applicable for heavily soiled pots and utensils; due to this reason, a working group within HKI started to prepare a proposal for a separate performance standard on utensil/pot dishwashers (see next Section 3.1.3.2),

3.1.3.2 By DIN (Germany)

Based on the work of EFCEM on the development of a new standard on the cleaning performance and energy efficiency of professional dishwashers (see Section 3.1.3.1 above) the German industry association HKI (Industrieverband Haus-, Heiz- und Küchentechnik e.V.) asked to exclude the category “utensil/pot dishwashers” from the currently proposed measurement method. Due to the heavy soiling of pots and utensils compared to usual wash ware like dishes, cutlery or glasses, the defined soiling requirements of the proposed standard measurement method will not be applicable.

³⁷ Input by HKI Industrieverband e.V. as a member of EFCEM.

As customers nevertheless demand for independent tests for this product category, in Germany TÜV Süd tests utensil/pot dishwashers based on an own measurement method adapted to the conditions for those appliances. Based on this method, HKI has prepared a proposal for a separate standard measurement method specifically for utensil/pot dishwashers (for appliances both with and without granules). The standard shall comprise measurement of energy and water consumption and hygienic performance. The HKI working group working on the proposal is supported by several manufacturers (Miele, Ecolab, Granuldisk, Scandisk (German branch of Wexiödisk)), VDE and TÜV Süd³⁸. According to HKI, the further proceedings of the proposed standard depend on the decision if this product category is being included in the scope for eco-design measures.

3.1.4 Further used or adapted performance testing methods

3.1.4.1 By DTI (Denmark)

The Danish Technological Institute (DTI)³⁹ has tested the energy and water consumption and cleaning performance of ten hood-type dishwashers using the following measurement method: „VGG Prüfverfahren zur Reinigungs-Index-Bestimmung von gewerblichen Geschirrspülmaschinen, Blatt 1 Kleinmaschinen; Entwurf 1970, ergänzt 1973“, with some modifications (for details, cf. Annex, Section 7.3).⁴⁰ These modifications follow as far as possible the European standard EN 50242 for household dishwashers.

Since three years, the laboratory has tested hood type dishwashers. The test started as a project for the Danish Energy Association (the association of Danish electric energy producing companies) in an energy saving programme for the Government. The idea was to have a list of a number of tested hood-type dishwashers with a data sheet for each machine showing consumption and performance parameters to help persons buying those appliances to select the machine appropriate for their needs and to make the manufacturers compete in delivering the most efficient dishwasher to the market. Meanwhile, manufacturers of dishwashers can at any time ask the laboratory to test (for their own cost) their new machines or programmes and after reviewing the test results they can ask the DTI to place the data sheet on the web site of the Danish Energy Association. They may also have older datasheets exchanged with new ones.

³⁸ TÜV Süd (TÜV = Technischer Überwachungsverein) is a testing and inspection organization providing consulting, testing, certification and training services to their clients.

³⁹ www.dti.dk

⁴⁰ The following information is based on personal communication with Danish Technological Institute

At the beginning, 10 machines have been tested. The mean values of the results are provided in the Annex, Section 7.3; some of the original datasheets and a number of datasheets for professional dishwashers tested later also can be found on the internet.⁴¹

At the interim and final EuP Lot 24 stakeholder meeting on professional dishwashers,⁴² some stakeholders argued that the VGG methodology had not been updated in a long time and should be ignored (low repeatability), and that discussions should now take place within CENELEC. However, DTI argued that in their tests, the repeatability was sufficient for energy and water consumption and that the soiling method of VGG is today's only applicable soiling method for professional dishwashers.

3.1.4.2 By ENAK (Switzerland)

ENAK⁴³ (Energetischer Anforderungskatalog an Geräte für die Verpflegung und Beherbergung) is an association for the promotion of the energy efficiency of professional appliances in the business sectors hotels, catering and communal feeding. ENAK supports the provision of energy efficient exemplary appliances and their rational use. Members of ENAK are designers, users, engineers and manufacturers.

ENAK seeks to provide transparency with regard to comparable data for consumption⁴⁴ and standby values of professional dishwashers. Thus, ENAK has developed specific test definitions for the measurement of different professional dishwasher categories (undercounter, hood-type, pot/utensil, conveyor-type (basket / belt) dishwashers). To some extent, they are based on IEC 60436 "Methods for measuring the performance of electric dishwashers" (cf. Section 3.1.2).

At ENAK's homepage there is no public access to further information with regard to the detailed measurement method or data on tested appliances.

⁴¹ www.sparelisten.dk/spareopvaskemaskiner, select "Sparelisten"

⁴² http://www.ecowet-commercial.org/open_docs/Minutes_Final%20SH%20meeting%20dishwashers_09.12.2010.pdf

⁴³ www.enak.ch

⁴⁴ Regarding the cleaning performance, ENAK only carries out very few tests due to the high costs for this test.

3.2 Hygiene

3.2.1 ISO 15883 (International)

- ISO 15883-1 Washer-disinfectors – Part 1: General requirements, terms and definitions and tests:

This norm specifies general performance requirements for washer-disinfectors and their accessories that are intended to be used for cleaning and disinfection of re-usable medical devices and other articles used in the context of medical, dental, pharmaceutical and veterinary practice. It specifies performance requirements for cleaning and disinfection as well as for the accessories which can be required to achieve the necessary performance. The methods and instrumentation required for validation, routine control and monitoring and re-validation, periodically and after essential repairs, are also specified. ISO 15883-1:2006 does not specify requirements intended for machines for general catering purposes.

- ISO 15883-2:2006 Washer-disinfectors – Part 2: Requirements and tests for washer-disinfectors employing thermal disinfection for surgical instruments, anaesthetic equipment, bowls, dishes, receivers, utensils, glassware, etc.:

This norm specifies particular requirements for washer disinfectors that are intended for use for the cleaning and thermal disinfection, in a single operating cycle, of re-usable medical devices such as surgical instruments, anaesthetic equipment, bowls, dishes and receivers, utensils and glassware.

- ISO 15883-3:2006 Washer-disinfectors – Part 3: Requirements and tests for washer-disinfectors employing thermal disinfection for human waste containers:

This norm specifies particular requirements for washer-disinfectors that are intended to be used for emptying, flushing, cleaning and thermal disinfection of containers used to hold human waste for disposal by one operating cycle.

- ISO 15883-4:2008 Washer-disinfectors – Part 4: Requirements and tests for washer-disinfectors employing chemical disinfection for thermo-labile endoscopes:

This norm specifies the particular requirements, including performance, for washer-disinfectors that are intended to be used for cleaning and chemical disinfection of thermo-labile endoscopes. It also specifies the performance requirements for the cleaning and disinfection of the washer-disinfector and its components and accessories which may be required to achieve the necessary performance. The methods, instrumentation and instructions required for type testing, works testing, validation (installation, operational and performance qualification on first installation), routine control and monitoring and re-validation, periodically and after essential repairs, are also specified.

- ISO/TS 15883-5:2005 Washer-disinfectors – Part 5: Test soils and methods for demonstrating cleaning efficacy:

This standard includes the test soils and methods that can be used to demonstrate the cleaning efficacy of washer-disinfectors. Acceptance criteria are included, based on visual inspection and/or a microbiological end-point as stated for each method. Where chemical detection of residual soiling is required / sought, methods can be complemented by the specific determination of a residual component of the applied test soil.

ISO 15883 is a special standard for washer-disinfectors. Washer disinfectors are used in medical as well as pharmaceutical applications (e.g. healthcare facilities or laboratories) to either prepare goods (e.g. surgery instruments, utensils, anaesthesia sets, and glassware) for later autoclaving (i.e. to remove residues like blood, protein) or to disinfect (semi sterilize) goods for later use. Temperatures range from 40 to 100°C.

According to the definition of professional dishwashers provided in Section 2.4, the scope of Lot 24 is on machines being used to clean, rinse, and dry wash ware like dishware, glassware, cutlery, and other utensils *that are connected to the preparation, cooking, arrangement or serving of food (including drinks)*. Thus, washer disinfectors do not fall under the scope of this preparatory study. The standard has been listed for completeness with regard to hygienic requirements.

3.2.2 NSF/ANSI 3–2009 (International / USA / Canada)

NSF/ANSI 3-2009: Commercial warewashing equipment

NSF/ANSI 3-2009 standard establishes minimum public health and sanitation requirements for the materials, design, construction, and performance of commercial spray-type dishwashing, glasswashing, and pot, pan, and utensil washing machines

It applies to commercial dishwashing, glasswashing, and pot, pan and utensil washing machines that wash their contents by applying sprays of detergent solutions and sanitize their contents by applying either hot water sprays or chemical sanitisation solutions. Covered by this standard are stationary rack and conveyor machines.

In particular this standard sets requirements regarding

- materials used in the manufacture of warewashing machines (e.g. corrosion resistance, smoothness and cleanability etc.),
- design and construction (e.g. general sanitation requirements, temperature indicating devices at the wash tanks, thermostatic control of the water temperature in the tanks, etc.),

- performance (soil removal⁴⁵, sanitization efficacy (hot water and chemical sanitizing), thermostat differential of dishwashing, glasswashing and pot, pan and utensil washing machines, including description of test method) and
- manufacturer's specifications (data to be stated on a data plate (e.g. minimum temperature of wash water in the tank, minimum and maximum pressure in the final sanitizing rinse line, etc.), equipment labelling (however, no information requirements on energy and water consumption but only regarding the intended use), and operating instructions.
- Both for hot water and chemical sanitizing machines requirements regarding the water temperature and pressure are set.

NSF/ANSI 3-2009 additionally contains requirements and exemptions for warewashing equipment provided with a security package (e.g. for use in prisons etc.) and for warewashing equipment for use in marine environments (under shipboard conditions).

This standard established and adopted by NSF as minimum voluntary consensus standard is used internationally as well as an American National Standard (ANS). The NSF/ANSI 3 standard is currently being under revision and should be finalized in 2011.

NSF/ANSI 3-2009 specifications apply to hot water and chemical *sanitizing* machines (for further details: see Task 6). These machines and processes, commonly used on the US market, generally require higher (sanitizing) temperatures compared to the (cleaning) temperatures of dishwashers in Europe⁴⁶.

This higher thermal minimum requirement results in higher energy consumption and lower efficiency, respectively. Therefore the NSF is regarded to be not appropriate to cover European requirements and market trends.

3.2.3 NSF/ANSI 29–2009 (International / USA / Canada)

NSF/ANSI 29–2009: Detergent and chemical feeders for commercial spray-type dishwashing machines

NSF/ANSI 29–2009 establishes minimum public health and sanitation requirements for chemical sanitizing feeders, detergent feeders, rinse agent feeders, and similar devices for commercial spray-type dishwashing machines that automatically maintain the concentration

⁴⁵ The soil removal efficacy of dishwashing machines shall be evaluated by observing the machine's ability to remove a dry coating of buttermilk from the surfaces of dinner plates and glasses; for pot, pan, and utensil washing machines: to remove a baked coating of pie filling from the surface of cookware respectively. For acceptance of the soil removal, the surfaces of the washware shall be visually inspected.

⁴⁶ Hot water sanitizing: according to NSF/ANSI minimum washing temperatures of 66 to 74°C required depending on the dishwashing machine category; cleaning: according to DIN 10512 washing temperatures of 60 to 65°C required, see Section 3.2.4.

of additives in the prewash, wash, pumped rinse, or final rinse of commercial spray-type dishwashing machines. In particular the requirements by this standard cover

- the materials used,
- the design and construction,
- the performance (e.g. hydrostatic test, maintenance of solution concentration, reliability, chemical resistance, etc.) and
- the installation, operation and maintenance instructions (manual, operating instructions).

This standard established and adopted by NSF as minimum voluntary consensus standard is used internationally as well as an American National Standard (ANS).

3.2.4 DIN 10510 / 10511 / 10512 / 10522 (Germany)

This family of standards covers hygienic requirements regarding the construction, operation and maintenance of different types of professional dishwashers. In the professional dishwasher context, hygienic requirements are an important performance parameter. However, the hygienic requirements are not mandatory by a legal regulation. They are used by manufacturers for marketing purposes to show the customer that certain hygienic requirements are met. The standards are described shortly in the following:

DIN 10510:2008 Food hygiene – Professional dishwashing with multi-tank conveyor-type dishwashers – Hygiene requirements, procedure testing

This standard defines minimum hygiene requirements of professional multi-tank conveyor-type dishwashers. In particular it gives advice for hygienic and professional use, for cleaning and disinfection of the items to be cleaned, and for maintenance of the devices. Furthermore it covers details regarding the appropriate spatial-functional alignment of the devices within the kitchen area and regarding appropriate and hygienic organisation of the handling of the items to be cleaned. Also the procedures to test the hygienic operation of the devices are described.

DIN 10511:1999 Food hygiene – Professional glasswashing with glasswashing machines – Hygiene requirements, testing

This standard defines the technical and hygienic requirements for professional glasswashing with glasswashing machines and the washing results, to ensure hygiene when washing glasses. It also describes the procedure for testing machines.

DIN 10512:2008 Food hygiene – Professional dishwashing with one-tank-dishwashers – Hygiene requirements, type testing

This standard defines minimum hygiene requirements of professional one-tank-dishwashers. In particular it gives advice for hygienic and professional use, for cleaning and disinfection of the items to be cleaned, and for maintenance of the devices. Furthermore it contains details regarding the appropriate spatial-functional alignment of the devices within the kitchen area and regarding appropriate and hygienic organisation of the handling of the items to be cleaned. Also the test procedures for the hygienic operation of the devices are described.

Hygienic requirements to some extent also influence the use and composition of the treatment agents for dishwashing machines. The hygiene requirements for glass- and dishwashing machines inter alia require a decontamination performance of 5 log₁₀ stages for 90% of the wash ware. In order to provide for these hygiene requirements the standards for multi-tank conveyor-type dishwashers (DIN 10510) and for one-tank dishwashers (DIN 10512) require the following process temperatures depending on the use of detergents with or without disinfection or oxidising component:

Table 7 Process temperatures for professional multi-tank conveyor-type dishwashers depending on the use of detergents with or without disinfection or oxidising component

DIN 10510 – Multi-tank conveyor-type dishwashers	Temperature without disinfection component	Temperature with sufficient amount of disinfection component
Pre-wash zone (fresh water)	up to 40°C	25 – 40°C
Pre-wash zone (wash tank)	40 – 50°C	40 – 50°C
Cleaning zone (wash tank)	60 – 65°C	55 – 65°C
Rinse zone (wash tank)	60 – 70°C	60 – 70°C
Final rinse zone (fresh water)	80 – 85°C	80 – 85°C

Table 8 Process temperatures for professional one-tank dishwashers depending on the use of detergents with or without disinfection or oxidising component

DIN 10512 – One-tank dishwashers	Temperature without disinfection or oxidising component in alkaline detergent solution	Temperature with sufficient amount of disinfection or oxidising component in alkaline detergent solution
Cleaning zone (wash tank)	60 – 65°C	55 – 65°C
Rinse zone (fresh water)	80 – 85°C	80 – 85°C

DIN 10512 explicitly requires the use of detergents with disinfection or oxidising components if the above given requested temperatures cannot be maintained or to improve the decontamination performance.

DIN 10522:2006 Food hygiene – Professional cleaning of reusable boxes and reusable containers for unpackaged foodstuffs – Hygiene requirements, testing

Analogue to the standards DIN 10510, 10511 and 10512, this standard defines minimum hygiene requirements with regard to the professional cleaning of reusable boxes and reusable containers for unpackaged foodstuffs and describes the test procedures for the hygienic operation of dishwashers used for these purposes.

The main focus of these standards is the hygienic performance. There are minimum requirements for the decontamination performance (e.g. in case of glasswashers and one-tank dishwashers a certain reduction of 5 log₁₀ stages shall be achieved for 90% of the wash ware, for all dishwashers only a certain, maximum number of colony forming units (cfu) is allowed per surface area of the wash ware) measured according to a certain test procedure. The standards also require certain minimum temperatures and contact times in order to achieve the given decontamination performance. The cleaning and drying performance of the respective dishwashers are not covered in a detailed manner but only assessed by a “pass-of-fail” indication (see e.g. DIN 10511, Section 5.3.2 on hygienic requirements: “the glasses shall be optically clean” and “the outside of the glasses shall be dry 2 minutes after being removed from the glasswasher basket, whereby remaining droplets on the base and a remnant dampness inside the glass may be tolerated.”)

The German standards DIN 10510, 10511, 10512 and 10522 are currently under revision by a working group⁴⁷ under the Food and Agricultural Products Standards Committee (NAL, Normenausschuss Lebensmittel und landwirtschaftliche Produkte) at the German Institute for Standardization (DIN, Deutsches Institut für Normung e.V.). A major point of the revision is that the required minimum temperatures and contact times will be removed. Only minimum requirements regarding the decontamination performance will still be included in the standards. Further goal of the working group is to consolidate the separate standards within one document (planned to be document number DIN SPEC 10534), to translate the new document into English and to publish it via CEN at European level.

On 6 October 2010, the revised document has been adopted as draft standard for publication.⁴⁸ After publication as DIN SPEC, it is intended to apply for the preparation of a European standard. In case of rejection at European level, only the current German DIN standards would then be replaced by the new standard at national level.

⁴⁷ Working group „Hygieneanforderungen an die maschinelle Reinigung von Lebensmittelbedarfsgegenständen“

⁴⁸ <http://www.nal.din.de/cmd?contextid=nal&bcrumblevel=1&subcommitteeid=54756512&projid=119887354&level=tpl-proj-detailansicht&committeeid=54738971&languageid=de>

3.3 Safety

3.3.1 IEC 60335 (International)

IEC 60335 Household and similar electrical appliances – Safety

- IEC 60335-1: Household and similar electrical appliances – Safety – Part 1: General requirements

The standard covers safety issues of household and similar electrical appliances. Part 1 defines general elements and is common to all electric motor appliances. Product specific issues are addressed in the Part 2-series. The relevant standards of Part 2 for dishwashers are listed in the following.

- IEC 60335-2: Household and similar electrical appliances – Safety – Part 2:
 - IEC 60335-2-58:2008: Household and similar electrical appliances – Safety – Part 2: Particular requirements for commercial electric dishwashing machines
- Deals with the safety of electrically operated dishwashing machines for washing plates, dishes, glassware, cutlery and similar articles, with or without means of heating water or drying, not intended for household use. The rated voltage being not more than 250 V for single-phase appliances connected between one phase and neutral, and 480 V for other appliances. Appliances within the scope of this standard are used in restaurants, canteens, hospitals, and commercial enterprises such as bakeries, butcheries, etc. Examples of appliances within the scope of this standard are conveyor dishwashers (Lot 24 categories 5 and 6) and batch dishwashers (Lot 24 categories 1 to 4).

3.3.2 EN 50416 (Europe)

EN 50416 Household and similar electrical appliances – Safety – Particular requirements for commercial electric conveyor dishwashing machines

This European Standard deals with the safety of electrically operated conveyor dishwashing machines for washing plates, dishes, glassware, cutlery and similar articles (e.g. trays, food containers), with or without means for water heating or forced hot air drying, not intended for household use, their rated voltage being not more than 250 V for single-phase machines connected between one phase and neutral and 480 V for other machines. These machines are used for example in restaurants, canteens, hospitals, and commercial enterprises such as bakeries, butcheries, etc. Examples of such machines are flight type dishwashers, and rack conveyor dishwashers. These machines are designed to be connected to hot and/or cold water supply.

Requirements to avoid backsiphonage of non-potable water into the public water supply are specified in Annex CC. Machines making use of steam or hot water for heating purposes are also within the scope of this standard. This standard does not apply to

- machines which are moveable,
- gas heating appliances which are part of conveyor dishwashing machines,
- machines intended for disinfection,
- machines intended to be used on board of sea-going vessels and aircraft,
- machines designed exclusively for industrial purposes, for example machines used in the food industry for cleaning receptacles that serve as packaging for final products (e.g. bottle-cleaning machines), and machines used in manufacturing processes,
- separately driven transport devices not confined in the machine, and
- machines intended to be used in locations where special conditions prevail, such as the presence of a corrosive or explosive atmosphere (dust, vapour or gas).

3.3.3 UL 921 (USA / Canada)

UL 921 Commercial dishwashers

This standard covers commercial, freestanding, undercounter, and counter-insert dishwashers, utensil-washers, and glasswashers intended for use in commercial establishments, such as kitchens of restaurants and hospitals, where they are not intended to be accessible to the public. The standard sets requirements in the areas of construction, safety, performance, rating and marking, as well as installation instructions.

Performance tests⁴⁹ do not cover any requirements regarding energy, water or detergent consumption or the cleaning and hygienic performance.

⁴⁹ General requirements; electrical input test; starting current test; normal temperature test; temperature measuring equipment and enclosure setup; dielectric voltage-withstand test; flexing test; insulation resistance following humidity conditioning test; water exposure tests; flooding of current-carrying parts test; hydrostatic pressure test; reservoir overflow test; liquid containers, seals, and diaphragms tests; limited short-circuit test (motor protection); abnormal operation test; blocked plunger test; overvoltage for electrolytic capacitors test; overload on switches test; transformer overcurrent protection test; transformer burnout test; door interlock endurance test; loading door/drawer moment load test; strain relief test; push-back relief test. Source: <http://ulstandardsinfontet.ul.com/tocs/tocs.asp?fn=0921.toc>

3.4 Noise

3.4.1 IEC 60704 (International)

IEC 60704:1997 Household and similar electrical appliances – Test code for the determination of airborne acoustical noise

- IEC 60704-1: Household and similar electrical appliances – Test code for the determination of airborne acoustical noise, Part 1: General requirements
Applies to the methods of determination of airborne acoustical noise emitted by household and similar electrical appliances supplied from mains or from batteries.
- IEC 60704-2-3:2005 Household and similar electrical appliances – Test code for the determination of airborne acoustical noise – Part 2-3: Particular requirements for dishwashers

This standard applies to single-unit electric dishwashers for household and similar use, with or without automatic programme control, for cold and/or hot water supply, for detachable or permanent connection to water supply or sewage systems, intended for placing on the floor against a wall, for building-in or placing under a counter, a kitchen worktop or under a sink, and for mounting to a wall or on a counter. Limitations for the use of this test code are given in IEC 60704-1.

3.4.2 ISO 3744 (International)

ISO 3744:2010 Acoustics – Determination of sound power levels and sound energy levels of noise sources using sound pressure – Engineering methods for an essentially free field over a reflecting plane

ISO 3744:2010 specifies methods for determining the sound power level or sound energy level of a noise source from sound pressure levels measured on a surface enveloping the noise source (machinery or equipment) in an environment that approximates to an acoustic free field near one or more reflecting planes. The sound power level (or, in the case of noise bursts or transient noise emission, the sound energy level) produced by the noise source, in frequency bands or with frequency A-weighting applied, is calculated using those measurements. The methods specified in ISO 3744:2010 are suitable for all types of noise (steady, non-steady, fluctuating, isolated bursts of sound energy, etc.) defined in ISO 12001.

ISO 3744:2010 is applicable to all types and sizes of noise source (e.g. stationary or slowly moving plant, installation, machine, component or sub-assembly), provided the conditions for the measurements can be met.

The test environments that are applicable for measurements made in accordance with ISO 3744:2010 can be located indoors or outdoors, with one or more sound-reflecting planes

present on or near which the noise source under test is mounted. The ideal environment is a completely open space with no bounding or reflecting surfaces other than the reflecting plane(s) (such as that provided by a qualified hemi-anechoic chamber), but procedures are given for applying corrections (within limits that are specified) in the case of environments that are less than ideal.

Information is given on the uncertainty of the sound power levels and sound energy levels determined in accordance with ISO 3744:2010, for measurements made in limited bands of frequency and with frequency A-weighting applied. The uncertainty conforms to ISO 12001:1996, accuracy grade 2 (engineering grade).

3.4.3 ISO 3746 (International)

ISO 3746:2010 Acoustics – Determination of sound power levels and sound energy levels of noise sources using sound pressure – Survey method using an enveloping measurement surface over a reflecting plane

ISO 3746:2010 specifies methods for determining the sound power level or sound energy level of a noise source from sound pressure levels measured on a surface enveloping a noise source (machinery or equipment) in a test environment for which requirements are given. The sound power level (or, in the case of noise bursts or transient noise emission, the sound energy level) produced by the noise source with frequency A-weighting applied is calculated using those measurements. The methods specified in ISO 3746:2010 are suitable for all types of noise (steady, non-steady, fluctuating, isolated bursts of sound energy, etc.) defined in ISO 12001. ISO 3746:2010 is applicable to all types and sizes of noise source (e.g. stationary or slowly moving plant, installation, machine, component or sub-assembly), provided the conditions for the measurements can be met.

The test environments that are applicable for measurements made in accordance with ISO 3746:2010 can be located indoors or outdoors, with one or more sound-reflecting planes present on or near which the noise source under test is mounted.

Information is given on the uncertainty of the sound power levels and sound energy levels determined in accordance with ISO 3746:2010, for measurements made with frequency A-weighting applied. The uncertainty conforms to that of ISO 12001:1996, accuracy grade 3 (survey grade).

3.4.4 ISO 4871 (International)

ISO 4871:1996 Acoustics – Declaration and verification of noise emission values of machinery and equipment

Gives information on the declaration of noise emission values, describes acoustical information to be presented in technical documents and specifies a method for verifying the noise emission declaration.

3.4.5 ISO 9614 (International)

ISO 9614-2:1996 Acoustics – Determination of sound power levels of noise sources using sound intensity – Part 2: Measurement by scanning

Specifies a method for measuring the component of sound intensity normal to a measurement surface which is chosen so as to enclose the noise source(s) of which the sound power level is to be determined.

3.4.6 ISO 11204 (International)

ISO 11204:2010 Acoustics – Noise emitted by machinery and equipment – Determination of emission sound pressure levels at a work station and at other specified positions applying accurate environmental corrections

ISO 11204:2010 specifies a method for determining the emission sound pressure levels of machinery or equipment, at a work station and at other specified positions nearby, in any environment which meets certain qualification requirements. A work station is occupied by an operator and may be located in open space, in the room where the source under test operates, in a cab fixed to the source under test, or in an enclosure remote from the source under test. One or more specified positions may be located in the vicinity of a work station, or in the vicinity of an attended or unattended machine. Such positions are sometimes referred to as bystander positions. Emission sound pressure levels are determined as A-weighted levels. Additionally, levels in frequency bands and C-weighted peak emission sound pressure levels can be determined in accordance with ISO 11204:2010, if required.

A method is given for determining a local environmental correction (subject to a specified limiting maximum value) to be applied to the measured sound pressure levels to exclude the effects of reflections from reflecting surfaces other than the plane on which the source under test is placed. This correction is based upon the mean sound pressure level on a measurement surface, the sound pressure level measured at a specified position, and either an environmental correction or the equivalent absorption area of the test room.

With the method specified in ISO 11204:2010 results of accuracy grade 2 (engineering grade) or accuracy grade 3 (survey grade) are obtained. Corrections are applied for background noise and, as described above, for the acoustic environment. Instructions are

given for the mounting and operation of the source under test and for the choice of microphone positions for the work station and for other specified positions. One purpose of the measurements is to permit comparison of the performance of different units of a given family of machines, under defined environmental conditions and standardized mounting and operating conditions.

The method specified in ISO 11204:2010 is suitable for all types of noise (steady, non-steady, fluctuating, isolated bursts of sound energy, etc.) defined in ISO 12001. The method specified in ISO 11204:2010 is applicable to all types and sizes of noise sources.

The type of test environment influences the accuracy of the determination of emission sound pressure levels. ISO 11204:2010 is applicable to an indoor or outdoor environment with one or more reflecting planes present, meeting specified requirements. These requirements on the room are less strict than those of ISO 11201, in particular regarding the acoustical quality of the environment. ISO 11204:2010 is applicable to work stations and other specified positions where emission sound pressure levels are to be determined.

Appropriate positions where measurements may be made include the following: a) work station located in the vicinity of the source under test; this is the case for many industrial machines and domestic appliances; b) work station within a cab which is an integral part of the source under test; this is the case for many industrial trucks and earth-moving machines; c) work station within a partial or total enclosure (or behind a screen) supplied by the manufacturer as an integral part of the source under test; d) work station partially or totally enclosed by the source under test – this situation may be encountered with some large industrial machines; e) bystander positions occupied by individuals not responsible for the operation of the source under test, but who may be in its immediate vicinity, either occasionally or continuously; f) other specified positions, not necessarily work stations or bystander positions.

The work station may also lie on a specified path along which an operator moves.

3.5 Electromagnetic fields / Electromagnetic compatibility (EMC)

3.5.1 IEC 62233 (International)

IEC 62233:2005 Measurement methods for electromagnetic fields of household appliances and similar apparatus with regard to human exposure

This standard deals with electromagnetic fields up to 300 GHz and defines methods for evaluating the electric field strength and magnetic flux density around household and similar electrical appliances, including the conditions during testing as well as the measuring of distances and positions. Appliances may incorporate motors, heating elements or their combination, may contain electric or electronic circuitry, and may be powered by the mains,

by batteries or by any other electrical power source. Appliances include such household electrical appliances, electric tools and electric toys. Appliances that are not intended for regular household use but may nevertheless be approached by the public or may be used by laymen are within the scope of this standard. This standard includes specific elements to assess human exposure:

- definition of sensor,
- definition of measuring methods,
- definition of operating mode for appliance under test,
- definition of measuring distance and position.

The measurement methods specified are valid for appliances that range from 10 Hz to 400 kHz. In the frequency range above 400 kHz and below 10 Hz, appliances in the scope of this standard are deemed to comply without testing, unless otherwise specified within the IEC 60335 series.

3.5.2 IEC 61000 (International)

IEC 61000 Electromagnetic compatibility

- IEC 61000-3-2 ed3.2 Consol. with am1&2: Limits – Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)
- IEC 61000-3-3 ed2.0: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection

3.5.3 EN 50366 (Europe)

EN 50366:2003 Household and similar electrical appliances – Electromagnetic fields – Methods for evaluation and measurement

Several test methods by which the magnetic field emissions from products can be compared to the general public restrictions and levels over the frequency range of 10Hz to 400 kHz.

3.5.4 EN 55014 (Europe)

EN 55014 Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus

- EN 55014-1:2007 Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus, Part 1: Emission (IEC/CISPR 14-1:2005)

- EN 55014-2:2009 Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus, Part 2: Immunity – Product family standard (IEC/CISPR 14-2:1997 + A1:2001 + A2:2008)

3.6 Gas

3.6.1 UL 921 (USA / Canada)

UL 921 Commercial dishwashers (USA / Canada)

This standard covers commercial, freestanding, undercounter, and counter-insert dishwashers, utensil-washers, and glasswashers using water as the principal cleaning medium, hereafter referred to as dishwashers.

The contents of the standard have already been described in Section 3.3.3. However, this standard covers not only electric dishwashers, but also the gas-handling, gas-burning, and gas-control features of gas-fired dishwashers having inputs of 400 000 Btu (420 MJ) per hour or less, limited to 0.5 psig (3.45 kPa) inlet pressure for use with natural gas, manufactured gas, mixed gas, propane gas, liquefied petroleum gases, or LP gas-air mixtures. Thus, UL 921 provides further construction and performance⁵⁰ and marking requirements being unique to gas-fired dishwashers.

⁵⁰ General requirements, test gases, test pressures and burner adjustments test, normal operation, undervoltage combustion test, combustion air failure test, burner operating characteristics test, pilot ignition systems test, direct ignition systems tests, and flue gas temperature for draft hood appliances test; source: <http://ulstandardsinfontet.ul.com/tocs/tocs.asp?fn=0921.toc>

3.7 Standardisation needs for the EU

The following table identifies the gaps in current performance test standards.

Standard / work on standards	Scope	Comment	Energy consumption	Water consumption	Cleaning / rinsing performance	Hygiene performance	Drying performance
ASTM standards	Professional dishwashers Cat. 1 to 6	Only applied to <i>sanitizing</i> machinery	x	x		x	
EN 50242 / 60436	Dishwashers for household / similar use	not covered: <i>professional</i> appliances	x	x	x		x
ISO 15883	Washer disinfectors for medical devices	Not applicable to <i>dishwashers</i>				x	
NSF/ANSI 3	Professional dishwashers Cat. 1-6	Only applied to <i>sanitizing</i> machinery				x	
DIN 10510 / 10511 / 10512	Professional dishwashers Cat. 2-6 (one-tank / multi-tank)	Not covered: cat. 1 (undercounter water-change); including: specific requirements for glasswashers				x	
Work in progress: CENELEC TC59X, SWG 2.1	Professional dishwashers Cat. 1-3 (Undercounter / hood-type dishwashers)	Not covered: cat. 4-6 (utensil/pot; conveyor-types)	x			x	
Work in progress: EFCEM "Energy Performance Standards Committee"	Professional dishwashers Cat. 1-6	Possibly without cat. 4 (utensil/pot)	x	x	x		
Work in progress: DIN	Professional dishwashers Cat. 4 (utensil/pot)	Not covered: cat. 1-3; cat. 5-6	x	x	x	x	

4 Existing legislation and environmental labelling

Aim of this work package is to identify the relevant existing legislation for professional dishwashers subdivided in four parts:

- Legislation and Agreements at European Community level,
- Legislation at Member State level,
- Third Country Legislation, and
- Environmental Labelling.

A short overview of existing legislation and environmental labelling is given, also including legislation on household appliances whose scope has currently been modified to 'household and similar electrical appliances' thus including professional machines.

4.1 European legislation

4.1.1 Machinery Directive (MD) 2006/42/EC (replacing 98/37/EC)

The new Machinery Directive 2006/42/EC⁵¹ is a revised version of Directive 98/37/EC, and is applicable since 29th December 2009. The Directive has the dual aim of harmonising the health and safety requirements applicable to machinery, while ensuring the free circulation of machinery on the Community market. Machinery is defined as an assembly, fitted with or intended to be fitted with a drive system other than directly applied human or animal effort, consisting of linked parts or components, at least one of which moves, and which are joined together for a specific application.

The manufacturer or his authorised representative shall ensure that a risk assessment is carried out for the machinery which he wishes to place on the market. For this purpose, he should determine which are the essential health and safety requirements applicable to his machinery and in respect of which he must take measures. The CE marking should be fully recognised as being the only marking which guarantees that machinery conforms to the requirements of this Directive. All other markings which are likely to mislead third parties as to the meaning or the form of the CE marking, or both, are prohibited.

One of the objectives of the revision of the Machinery Directive was to clarify the borderline between the scope of the Machinery Directive (MD) and the Low Voltage Directive (LVD) 2006/95/EC⁵² (formerly Directive 73/23/EEC as amended) in order to provide greater legal certainty. Article 1 (2) (k) lists the categories of low voltage electrical and electronic machinery that are excluded from the scope of the Machinery Directive, amongst others

⁵¹ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2006L0042:20091215:EN:PDF>

⁵² <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:374:0010:0019:EN:PDF>

'household appliances intended for domestic use'. When such machinery has an electrical supply within the voltage limits of the Low Voltage Directive (between 50 and 1000 V for alternating current or between 75 and 1500 V for direct current), it must fulfil the safety objectives of the LVD instead. For machinery beyond these voltage limits the requirements of the Machinery Directive apply.

The Machinery Directive applies to all professional dishwasher categories being in the scope of Lot 24 (for the borderline between machinery for household and professional use, see also Section 2.4). The requirements of the Directive are sufficient to cover all health and safety aspects related to those appliances.

4.1.2 Low Voltage Directive (LVD) 2006/95/EC

The Low Voltage Directive (LVD) 2006/95/EC⁵² (formerly Directive 73/23/EEC as amended) seeks to ensure that electrical equipment within certain voltage limits both provides a high level of protection for European citizens and enjoys a Single Market in the European Union.

The Directive requires electrical equipment to have protection against hazards that could arise from within the electrical equipment itself or from external influences. The directive covers all risks arising from the use of electrical equipment, including mechanical, chemical (such as, in particular, emission of aggressive substances). The LVD also covers noise and vibration, and ergonomic aspects which could cause hazards within the scope of the Directive. The LVD covers electrical equipment designed for use with a voltage rating of between 50 V and 1000 V for alternating current and between 75 V and 1500 V for direct current. It should be noted that these voltage ratings refer to the voltage of the electrical input or output, not to voltages that may appear inside the equipment.

Since 29th December 2010 (revision of Machinery Directive (see also Sections 2.4 and 4.1.1), dishwashers being stated by the manufacturer for professional use in the Declaration of Conformity, do clearly not fall under the Low Voltage Directive any more.

4.1.3 Electromagnetic Compatibility Directive (EMC) 2004/108/EC

Directive 2004/108/EC⁵³ on the approximation of the laws of Member States regulates the electromagnetic compatibility (EMC) of both apparatus and fixed installations. The directive applies to most electrical and electronic apparatuses including professional dishwashers, which are finished products and systems that include electrical and electronic equipment that may generate or be affected by electromagnetic disturbance.

The main objective of the EMC Directive, thus, is to regulate the compatibility of equipment regarding EMC. In order to achieve this objective, provisions have been put in place so that equipment needs to comply with the requirements of the EMC Directive when it is placed on

⁵³ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:390:0024:0037:en:PDF>

the market and/or taken into service. On the one hand it has to be ensured that the electromagnetic emissions of this equipment in its intended use do not disturb radio and telecommunication as well as other equipment. On the other hand the Directive also governs the immunity of such equipment to interference and seeks to ensure that this equipment is not disturbed by radio emissions when normally used as intended.

4.1.4 Restriction of Hazardous Substances Directive (RoHS) 2002/95/EC

The Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment 2002/95/EC⁵⁴ (commonly referred to as the Restriction of Hazardous Substances Directive or RoHS) restricts the use of six hazardous substances in the manufacture of various types of electronic and electrical equipment (EEE).

The restrictions apply to EEE belonging to several categories as set out in Annex I A to Directive 2002/96/EC (WEEE). One of the categories of Annex I A falling under the RoHS Directive is category 1 “Large Household Appliances”, covering inter alia washing machines, clothes dryers and dish washing machines.

According to the Commission's "Frequently Asked Questions on Directive 2002/95/EC on the Restriction of the Use of certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) and Directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE)"⁵⁵ professional equipment, like professional washing machines, dryers and dishwashers, is covered by the RoHS Directive.

Article 5(1) (b) of the Directive provides that materials and components can be exempted from the substance restrictions contained in Article 4(1) if their elimination or substitution via design changes or materials and components which do not require any of the materials or substances referred to therein is technically or scientifically impracticable, or where the negative environmental, health and/or consumer safety impacts caused by substitution outweigh the environmental, health and/or consumer safety benefits thereof.

Currently, there are 39 exemptions listed in the Annex of the RoHS Directive. In the course of Task 4 (Technical analysis of existing products) we will evaluate whether there are existing exemptions which are of importance for the scope of Lot 24 “Professional washing machines, dryers and dishwashers”.

Currently (status January 2011), the Commission proposal for a recast of the RoHS Directive is in the co-decision adoption procedure by the Council and the European Parliament (EP). The Parliament voted in first reading on a compromise text negotiated between the European

⁵⁴ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:037:0019:0023:EN:PDF>

⁵⁵ http://ec.europa.eu/environment/waste/weee/pdf/faq_weee.pdf, FAQ 1.8 “Do the WEEE and the RoHS Directives apply to electrical and electronic products for professional use?” Answer: “The RoHS Directive does not differentiate between households or professional EEE, so products for professional use are covered by the RoHS Directive.”

Parliament and the Council in November 2010. It is now needed to be formally adopted by the Council. The new Directive will enter into force 20 days after its publication in the Official Journal of the European Union. Member States will then have 18 months to transpose it into national law. Until then, the existing RoHS Directive (Directive 2002/95/EC) continues to apply.

The revised Directive aims to improve implementation and enforcement and introduces greater coherence with other EU legislation, such as REACH and the new legislative framework for the marketing of products. Main elements include:⁵⁶

- “The extension of the scope to all electrical and electronic equipment, including medical devices and monitoring and control instruments.
- Electrical and electronic equipment that was outside the scope of the current RoHS Directive but which will be covered by the revised Directive, does not need to comply with the requirements during a transitional period of 8 years, giving producers time to adapt;
- A lighter and more effective mechanism for reviewing or amending the list of banned substances is introduced, enabling further substances to be considered on the basis of scientific evidence and specific criteria, and in line with REACH. Changes may then be made through comitology;
- The rules for granting exemptions from the substance ban are further streamlined to provide legal certainty for the economic operators and to ensure coherence with REACH;
- Important definitions are clarified to ensure the directive is applied in a harmonised manner throughout the EU.
- Better enforcement of the Directive at national level will be achieved through alignment with the marketing of products legislative package.”

Should these changes come into force in the near future manufacturers would need to verify whether they still comply with the requirements of the Directive, inter alia:

- If, for example, products were considered out of scope until now, they might be covered by the revision which would possibly entail need for substitution and / or exemption requests.
- In that case, companies will need to link their efforts in respect with REACH to those under the context of RoHS.

⁵⁶ <http://europa.eu/rapid/pressReleasesAction.do?reference=IP/10/1596&format=HTML>

4.1.5 Waste Electrical and Electronic Equipment Directive (WEEE) 2002/96/EC

The Waste Electrical and Electronic Equipment Directive (WEEE Directive) is the European Community Directive 2002/96/EC⁵⁷ regulating the collection, treatment, recycling and disposal of WEEE as well the financial provisions for this waste stream's treatment which, together with the RoHS Directive 2002/95/EC (cf. Section 4.1.4), came into force in February 2003. The Directive assigns the responsibility for the management of waste electrical and electronic equipment to the manufacturers of such equipment.

The Directive applies to the product categories set out in Annex I A that includes "Large household appliances". Article 5 differentiates between WEEE from private households and WEEE from other than private households. According to the Commission's "Frequently Asked Questions on Directive 2002/95/EC on the Restriction of the Use of certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) and Directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE)"⁵⁸ professional equipment, like professional washing machines, dryers and dishwashers, is covered by the WEEE Directive⁵⁹.

For WEEE from other than private households, Article 5 (3) points out that "Member States shall ensure that producers or third parties acting on their behalf provide for the collection of such waste." Also Article 9 on financing applies to WEEE from users other than private households. Article 9 (1) sets out that "Member States shall ensure that [...] the financing of the costs for the collection, treatment, recovery and environmentally sound disposal of WEEE from users other than private households from products put on the market after 13 August 2005 is to be provided for by producers." Article 9 (2) points out, however, that "producers and users other than private households may, without prejudice to this Directive, conclude agreements stipulating other financing methods."

In parallel to the revision of the RoHS Directive, the WEEE Directive is currently also being revised under the co-decision procedure (status January 2011). The WEEE revision however is progressing at a much slower pace. The European Commission initially wanted to link the RoHS revision to discussions on a strengthening of the WEEE directive, but the Council

⁵⁷ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:037:0024:0038:EN:PDF>

⁵⁸ http://ec.europa.eu/environment/waste/weee/pdf/faq_weee.pdf, FAQ 1.8 "Do the WEEE and the RoHS Directives apply to electrical and electronic products for professional use?" Answer: "The WEEE Directive contains provisions that cover WEEE from households and WEEE from users other than private households. WEEE from private households means WEEE which comes from private households and from commercial, industrial, institutional and other sources which, because of its nature and quantity, is similar to that from private households. WEEE from other users than private households can then be all WEEE that is not defined as WEEE from private households. Financing provisions in respect of WEEE from private households are laid down in Article 8 while Article 9 covers WEEE from users other than private households. In addition, Article 10(3) does not specifically limit the marking obligation to electrical and electronic equipment (EEE) for private households because in some cases it is difficult to distinguish between households and professional electrical and electronic equipment. Therefore, the marking obligation also applies to EEE for professional use."

⁵⁹ However, e.g. in Germany the general requirements set out in article 9 (1) of WEEE were not yet incorporated into national legislation (ElektroG).

wanted to keep the two dossiers separate. A parliament first reading vote on the WEEE revision is scheduled for February 2011, and the council will not issue its position until after the vote has taken place. Legislators are thus aiming for a second reading agreement late 2011.

The main issues are the possible shift of burden for reaching collection targets to EEE manufacturers as well as new collection targets that are adapted to country specificities and in relation to the number of products placed on the market. “Currently, the majority of member states are resisting a proposal by the European Commission, backed by the European Parliament's environment committee, to set a 65% collection rate for waste from electrical and electronic equipment (WEEE) by 2016. According to a progress report from the Council of Ministers, the Belgian presidency has proposed a phased approach according to which a 45% target would be set four years after the rules' entry into force, followed by a 65% target two years later. A majority of delegations favour this approach though some still want a longer transition period, according to the report.”⁶⁰

Also the scope of the Directive shall be clarified as currently the scope of the WEEE directive is unclear, e.g. types of appliances shall be categorized as household (B2C – business to consumer) and non-household appliances (B2B – business to business). “Twelve countries support giving the WEEE directive an open scope as demanded by the environment committee. Twelve other states want to limit the law's scope to specific products. As a compromise Belgium suggested a narrow definition of what constitutes EEE equipment, which would limit the number of products falling into an open scope. Other issues of disagreement remain, for example whether a producer of electrical and electronic equipment should be defined at national or EU level and whether the cost of managing WEEE should be displayed on product labels.”⁶⁰

Should these changes come into force, industry would be forced to make sure that they control the waste stream more than they do now in order to meet the (more demanding) collection and recycling targets.

4.1.6 Biocide Directive 98/8/EC

This Directive⁶¹ concerns: (a) the authorisation and the placing on the market for use of biocidal products within the Member States; (b) the mutual recognition of authorisations within the Community; and (c) the establishment at Community level of a positive list of active substances which may be used in biocidal products.

Biocidal products are defined as active substances and preparations containing one or more active substances, put up in the form in which they are supplied to the user, intended to

⁶⁰ <http://www.endseurope.com/25218?referrer=channel%2Dwaste>

⁶¹ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:1998:123:0001:0063:EN:PDF>

destroy, deter, render harmless, prevent the action of, or otherwise exert a controlling effect on any harmful organism by chemical or biological means.

The guidance document for the Biocidal Products Directive (BPD)⁶² provides the following explanations:

- Human hygiene biocidal products: Detergents and cleaning products (auxiliary aids for washing processes like fabric conditioners are included) intended to have a biocidal activity (reliably controlling micro-organisms like fungi and bacteria) are biocidal products. The Commission services and all Member States except Austria agreed to the following clarification: When associated with cleaning products, the word ‘hygiene’ can be used without immediately causing the product to fall under the scope of the BPD as long as no reference (words, pictures, etc.) to antimicrobial or disinfecting action is made.
- Private area and public health area disinfectants and other biocidal products: Detergents containing in-can preservatives, but not intended to have biocidal effects, are not in the scope of BPD. However, detergents containing a biocidal active substance, *intended to have biocidal effects under conditions of use, with or without biocidal claim*, should be regarded as biocidal products. The definition of a biocidal product in Directive 98/8/EC is that it is “intended” as such and does not necessitate a claim to be made. However, it is reasonable to expect that an intended biocidal action would be reflected in a relevant claim. In the absence of such a claim, on the label or elsewhere, some other relevant matter in the context in which the product is presented beyond its formulation (e.g. presentation of the product, use instruction etc.) would be needed to justify a conclusion that it was ‘intended’ to be biocidal. The current wording reflects the definition. In case of a divergence of views concerning a particular product between the authorities and the person responsible for placing the product on the market, it is up to the latter to demonstrate that no biocidal effect was intended.

Currently, the approval procedure for biocidal active substances of the product types 1 to 4 (related to disinfectants) is ongoing. Active substances being approved in the EU will be listed in Annex 1 of the BPD in the coming years. Only after that, national product approvals in the Member States will be starting, i.e. the disinfectants with biocidal active substances will be approved at national level according to the BPD. Meanwhile transitional agreements apply.

Both the professional laundry (e.g. in health care laundry) and the dishwashing sector use biocidal detergent systems to achieve a certain level of hygiene; thus being affected by the Biocidal Products Directive. In the dishwashing process, hygienic requirements are usually

⁶² Source: Guidance document agreed between the Commission services and the competent authorities of the Member States for the Biocidal Products Directive 98/8/EC (Doc-Biocides-2002/04-Rev3; 31.10.2003); <http://ec.europa.eu/environment/biocides/pdf/definitions.pdf>

met by a predefined level of process temperatures, however depending on the use of detergents with or without disinfection components of the detergents (see Section 3.2.4).

4.1.7 Gas Appliances Directive (GAD) Directive 2009/142/EC

The Directive regulates appliances burning gaseous fuels used for cooking, heating, hot water production, refrigeration, lighting or washing with (where applicable) a normal water temperature not exceeding 105°C. The GAD applies to all gas heated and combined gas-heated applications. Although the Directive mainly covers common consumer and commercial products, so-called fittings are comprised, too. Appliances specifically designed for use in industrial processes carried out on industrial premises are excluded.

The GAD has been subject to a recent codification which is a process of incorporating a legislative act and all its amendments into a single new act. The new codified version is referred to as Directive 2009/142/EC and came into force on 4 January 2010. From this date, any references to the repealed Directive 90/396/EEC⁶³ shall be construed as references to Directive 2009/142/EC.

4.1.8 Water Framework Directive (WFD) 2000/60/EC

The Water Framework Directive⁶⁴ establishes a legal framework to protect and restore clean water across Europe and ensure its long-term, sustainable use. The directive establishes an innovative approach for water management based on river basins, the natural geographical and hydrological units, and it sets specific deadlines for Member States to protect aquatic ecosystems. The directive addresses inland surface waters, transitional waters, coastal waters and groundwater, and it establishes innovative principles for water management, including public participation in planning and economic approaches, including the recovery of the cost of water services.

Inter alia, the Water Framework Directive introduces two key economic principles. First, it calls on water users – such as industries, farmers and households – to pay for the full costs of the water services they receive. Second, the directive calls on Member States to use economic analysis in the management of their water resources and to assess both the cost-effectiveness and overall costs of alternatives when making key decisions. Under the directive the recovery of costs refers to several elements. The prices users pay for water should cover the operational and maintenance costs of its supply and treatment and the costs invested in infrastructure. The directive goes further and requires that prices paid by users also cover environmental and resource costs. This is a key step towards implementing

⁶³ <http://eur-lex.europa.eu/LexUriServ/site/en/consleg/1990/L/01990L0396-19930802-en.pdf>

⁶⁴ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:327:0001:0072:EN:PDF>
http://ec.europa.eu/environment/water/participation/notes_en.htm

the economic principle that polluters and users should pay for the natural resources they use and the damage they create.

Further, Articles 4, 10, 11 and 16 and Annexes V, VIII, IX and X of the directive address chemical pollution. By targeting priority substances, the Water Framework Directive focuses on individual pollutants or groups of pollutants that present significant risk to or via the aquatic environment. The substances are identified through rigorous risk assessments, which involve examining scientific evidence of the hazardous properties of the substances, their contamination of European waters, and other factors such as volumes used. Among the 33 chemicals categorised as priority substances, 13 are designated as priority hazardous substances due to their persistence, bioaccumulation and toxicity. The European Commission will review this list every four years, to allow for the inclusion of additional substances of concern. The Water Framework Directive seeks to progressively reduce emissions, discharges and losses of priority substances to waters. Priority hazardous substances are to be phased out completely within 20 years.

None of the 33 listed priority substances is expected to be in detergents used for professional laundry and dishwashing processes. Amongst the 13 substances being designated as priority hazardous substances, EDTA⁶⁵ is still used in detergents. In Germany, for example, since 1991 several industrial associations (e.g. IKW and IHO⁶⁶) have voluntarily committed to abandon the use of EDTA to a large extent. Thus, in Germany EDTA is only found in few specialised detergent products of the industrial and institutional (I&I) sector.

In general, the WFD prescribes the creation of incentives for an efficient use of water resources and focuses on improvement of sustainability of production.

4.1.9 Commission Regulation (EC) No. 648/2004 – Detergents

Detergents and rinse aids have to fulfil the requirements laid down by Regulation (EC) No. 648/2004⁶⁷ on detergents⁶⁸. This regulation establishes rules designed to achieve the free movement of detergents and surfactants for detergents in the internal market while, at the same time, ensuring a high degree of protection of the environment and human health. For

⁶⁵ EDTA (ethylene-diamino-tetra-acetate): A class of synthetic, phosphate-alternative compounds used to reduce calcium and magnesium hardness in water. EDTA is also used to prevent bleaching agents from becoming active before they're immersed in water and as a foaming stabilizer.

⁶⁶ IKW: Industrieverband Körperpflege- und Waschmittel; IHO: Industrieverband Hygiene und Oberflächenschutz

⁶⁷ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:104:0001:0035:EN:PDF>

⁶⁸ For the purpose of Regulation (EC) No. 648/2004 'detergents' means any substance or mixture containing soaps and/or other surfactants intended for washing and cleaning processes. Detergents may be in any form (liquid, powder, paste, bar, cake, moulded piece, shape, etc.) and marketed for or used in household, or institutional or industrial purposes. Other products to be considered as detergents are: 'Auxiliary washing mixture', 'Laundry fabric-softener', 'Cleaning mixture', 'Other cleaning and washing mixtures', intended for any other washing and cleaning processes.

this purpose, this Regulation harmonises the following rules for the placing on the market of detergents and of surfactants for detergents:

- the biodegradability of surfactants in detergents;
- restrictions or bans on surfactants on grounds of biodegradability;
- the additional labelling⁶⁹ of detergents, including fragrance allergens; and
- the information that manufacturers must hold at the disposal of the Member States competent authorities and medical personnel.

4.1.10 Commission Regulation (EC) No. 842/2006 – Fluorinated GHG

The objective of this Regulation⁷⁰ is to contain, prevent and thereby reduce emissions of the fluorinated greenhouse gases covered by the Kyoto Protocol. Annex I to this Regulation contains a list of the fluorinated greenhouse gases currently covered by this Regulation, together with their global warming potentials.

Fluorinated gases are powerful greenhouse gases with global warming potentials many times that of natural greenhouse gases such as carbon dioxide. They also tend to remain much longer in the atmosphere than natural greenhouse gases. Because of this, they are included in the basket of gases controlled by the Kyoto Protocol and Parties to the Protocol that have an emissions target are required to control and reduce emissions of Fluorinated gases. Fluorinated gases are man made substances and Regulation 842/2006 defines them as follows: fluorinated greenhouse gases' means hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF₆) as listed in Annex I of the Regulation.

This Regulation addresses the containment, use, recovery and destruction of the fluorinated greenhouse gases listed in Annex I; the labelling and disposal of products and equipment containing those gases; the reporting of information on those gases; the control of uses and the placing on the market prohibitions of the products and equipment; and the training and certification of personnel and companies involved in activities provided for by this Regulation. For professional dishwashers, this Regulation applies in those cases when the appliances are equipped with heat pumps containing refrigerants.

⁶⁹ The Detergent Regulation sets the requirement for more specific detergent package labelling on issues including the ingredient datasheet, the number of standard washing machine loads and the enterprise's contact details. The labelling requirements vary depending on whether the product is sold to the general public or for use in the industrial sector only. Specific provisions regarding labelling are laid down in Annex VII to the Regulation. In addition, the packaging of detergents regarded as biocides, such as disinfectants, will be required to have special biocidal product labelling following a transitional period.

⁷⁰ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:161:0001:0011:EN:PDF>

4.1.11 Commission Regulation (EC) No. 1275/2008 – Standby

The Regulation⁷¹ sets out eco-design requirements for standby and off mode electric power consumption. The application is limited to products corresponding to household and office equipment intended for use in the domestic environment. ‘Electrical and electronic household and office equipment’ is defined as energy-using products which:

- a) are made commercially available as a single functional unit and are intended for the end-user;
 - b) fall under the list of energy-using products of Annex I of the Directive (inter alia dishwashing machines);
 - c) are dependent on energy input from the mains power source in order to work as intended; and
 - d) are designed for use with a nominal voltage rating of 250 V or below,
- also when marketed for non-household or non-office use.

The Standby Directive only covers appliances being in the scope of the Low Voltage Directive (LVD). As professional dishwashers do not fall under the LVD but under the Machinery Directive (see Sections 2.4.2 and 4.1.1), they are also not covered by the scope of the Standby Regulation.

4.1.12 European labelling

So far, there are no European environmental or energy labels that apply to professional dishwashing appliances.

4.2 Legislation at member state level

No legislation at member state level regarding professional dishwashers has been found.

4.3 Third country legislation

4.3.1 USA

The Energy Policy Act of 1992 set standards for certain commercial equipment and set schedules requiring the U.S. Department of Energy (DOE) to make, review, and update standards. DOE currently is active in standards development for a range of commercial products. However, with regard to dishwashers, the US Energy Conservation Standard⁷² only applies to residential products; they are not in the scope of the designated commercial

⁷¹ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:339:0045:0052:EN:PDF>

⁷² Source: http://www1.eere.energy.gov/buildings/appliance_standards/commercial_products.html

equipment to be included (in contrast to commercial clothes washers; cf. EuP Lot 24 Task 1 report, part “Professional washing machines and dryers”).

California's Appliance Efficiency Regulations were established in 1976 in response to a legislative mandate to reduce California's energy consumption. The regulations are updated periodically to allow consideration and possible incorporation of new energy efficiency technologies and methods. The 2009 Appliance Efficiency Regulations, (California Code of Regulations, Title 20, Sections 1601 through 1608)⁷³ effective August 9, 2009, were adopted by the California Energy Commission (CEC) on December 3, 2008, and approved by the California Office of Administrative Law on July 10, 2009. The Appliance Efficiency Regulations include standards for both federally-regulated appliances and non-federally-regulated appliances. Twenty-one categories of appliances are included in the scope of these regulations. Professional dishwashers do not fall under the scope of the current Californian Appliance Efficiency Regulations.

ENERGY STAR[®] for commercial dishwashers (USA / Canada)

ENERGY STAR[®] is a joint voluntary labelling program of the U.S. Environmental Protection Agency and the U.S. Department of Energy supporting energy efficient products and practices. Products that comply with the performance criteria set by ENERGY STAR may use the Energy Star certification mark (after the manufacturer became an ENERGY STAR partner, which comes along with some further, however not product specific requirements).

The ENERGY STAR program key product criteria for commercial dishwashers⁷⁴ apply to dishwashing machines, defined as “a machine designed to clean and sanitize plates, glasses, cups, bowls, utensils, and trays by applying sprays of detergent solution (with or without blasting media granules) and a sanitizing final rinse.”

Several dishwasher categories eligible for ENERGY STAR are defined:

- Undercounter dishwashers (corresponding to Lot 24 category 1),
- Stationary rack, single tank, door type dishwashers (subcategories: single and multiple wash tank, double rack, pot, pan and utensil washers, chemical dump type and hooded wash compartment (“hood type”)) (corresponding to Lot 24 categories 2, 3 and 4),
- Single tank conveyor dishwashers (corresponding to Lot 24 category 5),
- Multiple tank conveyor dishwashers (corresponding to Lot 24 category 6).

In each category sanitizing might take place through hot water (high temperature machines) or through chemical sanitizing (low temperature machines).

Efficiency requirements that have to be met cover the idle energy rate (in kilowatt (kW)) and the water consumption (in gallons per rack (gal/rack)). Each ENERGY STAR qualified model

⁷³ Source: <http://www.energy.ca.gov/2009publications/CEC-400-2009-013/CEC-400-2009-013.PDF>

⁷⁴ http://www.energystar.gov/index.cfm?c=comm_dishwashers.pr_crit_comm_dishwashers

must meet both metrics. There are different requirements for each dishwasher category and both for high temperature and low temperature machines in each category (see also current Commercial Dishwashers Program Requirements Version 1.2).⁷⁵

Table 9 Energy Star Efficiency Requirements for Professional Dishwashers

Machine Type	High Temperature Efficiency Requirements		Low Temperature Efficiency Requirements	
	Idle Energy Rate*	Water Consumption**	Idle Energy Rate*	Water Consumption**
Undercounter	< = 0.9 kW	< = 1.00 gal/rack	< = 0.5 kW	< = 1.70 gal/rack
Stationary Single Tank Door**	< = 1.0 kW	< = 0.95 gal/rack	< = 0.6 kW	< = 1.18 gal/rack
Single Tank Conveyor	< = 2.0 kW	< = 0.70 gal/rack	< = 1.6 kW	< = 0.79 gal/rack
Multiple Tank Conveyor	< = 2.6 kW	< = 0.54 gal/rack	< = 2.0 kW	< = 0.54 gal/rack

* Idle energy rate as measured with door closed and representative of the energy used by the tank heater only

** Includes pot, pan, and utensil machines. 1 US Gallon = 3.785 Litres

Water consumption has to be measured according to the NSF/ANSI 3-2007 standard (Commercial Warewashing equipment, see Section 3.2.2). The idle energy rate has to be measured according to ASTM Standard F1696 (Hot Water and Chemical Sanitizing Undercounter and Stationary Rack Single Tank Door-Type Dishwashers, see Section 3.1.1.12) and to ASTM F1920 (Hot Water and Chemical Sanitizing Single and Multiple Tank Rack Conveyor Dishwashers, see Section 3.1.1.13).

The requirements are effective since October 11, 2007. The market penetration of ENERGY STAR qualified models for the US is estimated at 45 to 50% of the market⁷⁶. According to the “Commercial Dishwashers Qualified Product List” posted on February 16, 2011, around 280 professional dishwashers have qualified for the ENERGY STAR⁷⁷. Due to this high market penetration, US EPA is currently revising the specifications⁷⁸. The updated version 2.0 is expected to become effective from 1 February 2012.

ENERGY STAR specifications based on ASTM and NSF/ANSI requirements apply to hot water and chemical *sanitizing* machines (for further details: see Task 6). These machines and processes, commonly used on the US market, generally require higher (sanitizing) temperatures compared to the (cleaning) temperatures of dishwashers in Europe⁷⁹. This

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http://www.energystar.gov/ia/partners/product_specs/program_reqs/Commercial_Dishwashers_Program_Requirements.pdf

⁷⁶ Personal information by US EPA, Climate Protection Partnerships Division / Energy Star

⁷⁷ http://www.energystar.gov/ia/products/prod_lists/comm_dishwashers_prod_list.pdf

⁷⁸ For more information on the interim status with regard to draft specifications and stakeholder comments, see http://www.energystar.gov/index.cfm?c=revisions.commercial_dishwasher_spec

higher thermal minimum requirement results in higher energy consumption and lower efficiency, respectively. Therefore the ENERGY STAR requirements are regarded to be not appropriate to cover European requirements and market trends and the label is not applied by European manufacturers.

4.3.2 Canada

Regulations under the Energy Efficiency Act,⁸⁰ in effect since 1995, set minimum energy-performance levels for a number of energy-using products such as appliances, lighting, and heating and air-conditioning products. Broadening and strengthening the Act means that 80 percent of the energy used in homes and businesses will soon be regulated. Over time, the set of planned new regulations will address about 20 currently unregulated products such as commercial clothes washers and boilers, and will tighten requirements for 10 products such as residential dishwashers and dehumidifiers. Professional dishwashers⁸¹ do not fall under the scope of the Canadian Energy Efficiency Act.

4.3.3 Australia

A wide range of products are regulated for energy efficiency in Australia. Also, new products are continually being considered for regulation or other types of programs in order to improve energy efficiency. Other than for commercial refrigeration appliances, professional dishwashing appliances do not fall under the (considered) scope of the Australian energy efficiency regulation so far.⁸²

4.3.4 China

The China Standard Certification Center (CSC),⁸³ formerly known as China Certification Center for Energy Conservation Products (CECP), was officially founded in October 1998, by the former China State Economic and Trade Commission (SETC) with an approval from the former State Bureau of Quality and Technical Supervision. CSC has been administrated by China National Institute of Standardization. Over the past several years, CSC has

⁷⁹ Hot water sanitizing: according to NSF/ANSI minimum washing temperatures of 66 to 74°C required depending on the dishwashing machine category; cleaning: according to DIN 10512 washing temperatures of 60 to 65°C required, see Section 3.2.4.

⁸⁰ Source: http://oee.nrcan.gc.ca/regulations/home_page.cfm

⁸¹ Under the new products to be regulated, inter alia there are pre-rinse spray valves. These devices use a spray of water to remove food waste from dishes prior to cleaning in a commercial dishwasher. They are usually placed at the entrance to a commercial dishwasher or may also be located over a sink, in conjunction with a faucet fixture. Therefore, they do not belong to professional dishwashing appliances, but are a separate product category.

⁸² Source: <http://www.energyrating.gov.au/considered.html>

⁸³ <http://www.cecp.org.cn/english/index.asp>

continuously introduced various product certification programs to promote the use of energy conservation, water conservation and environmental-friendly products and equipment. In addition to lighting products, CSC's energy conservation certification programs now cover over other 35 product categories, for example home appliances, electronic, industrial, office equipments, building materials, etc. To date, more than 2 000 individual products from approximately 250 manufacturers have participated in the certification program. However, no information on professional dishwashers has been found.

4.3.5 Russia

No information on Russian regulations with regard to professional dishwashers has been found.

5 Conclusions: Scope of the study

Within Lot 24 we define professional dishwashers as follows (cf. Section 2.4.3):

‘Professional dishwasher’ means a machine which cleans, rinses, and dries wash ware like dishware, glassware, cutlery, and other utensils connected to the preparation, cooking, arrangement or serving of food (including drinks) by chemical, mechanical, and thermal means; which is connected to electric mains and which is designed to be used principally for commercial and industrial purposes as stated by the manufacturer in the Declaration of Conformity (DoC).

The delimitation of professional dishwashers to dishwashers for household use is determined from the ‘intended use’ (domestic or commercial / industrial use) as declared by the manufacturer in the product information or the Declaration of Conformity (cf. Section 2.4.2).

Besides this formal distinction, professional and household dishwashers can be distinguished by functional performance and technological differences resulting from different requirements regarding the dishwashing process (see Section 2.4.4). Professional dishwashers need to take into account important framework requirements (short running cycles, high throughput, amount and type of wash ware, spatial requirements) to fulfil their primary function (to clean, rinse, and dry a certain amount of dishware, glassware, cutlery, and/or other cooking utensils). Reflecting these framework requirements and taking into account functional and technological differences, professional dishwashers can be categorised into the following six categories (cf. Section 2.5.5.3):

- Dishwashers with fresh-water system
 - Category 1: Undercounter water-change dishwashers (semi-professional)
- Dishwashers with tank systems
 - One-tank dishwasher
 - Category 2: Undercounter one-tank dishwashers
 - Category 3: Hood-type dishwashers
 - Category 4: Utensil / Pot dishwashers
 - Category 5: One-tank conveyor-type dishwashers (belt/basket)
 - Multi-tank dishwasher
 - Category 6: Multi-tank conveyor-type dishwashers (belt/basket).

6 Sources

For the categorisation of product types, numerous web pages and product brochures of manufacturers and industry associations have been analysed.

Table 10 Manufacturers' and industry associations' web pages screened within EuP Lot 24

Manufacturer	Web address
ASKO	http://www.askousa.com/
Electrolux Professional	http://www.electrolux-professional.de/
Granuldisk	http://www.granuldisk.com/
Hamony Business	http://www.harmonybusiness.co.uk/Products-2.html
Hobart	http://www.hobart-export.com/wExport_en/products/index.php
Industrieverband Haus-, Heiz- und Küchentechnik e.V. (HKI)	http://www.hki-online.de
Krefft	http://www.krefft.de/cms/front_content.php?idcat=11
Maytag	http://www.maytag.com/catalog/all_products.jsp
Meiko	http://www.meiko.info
Miele Professional	http://www.miele-professional.com
Stierlen	http://www.stierlen.de/index-en.html
Verband Gewerbliches Geschirrspülen (VGG)	http://www.vgg-online.de/ (with background information regarding professional dishwashing (see http://www.vgg-online.de/merkblaetter/default_engl.htm))
Wexiödisk	http://www.wexiodisk.co.uk/
Winterhalter	http://www.winterhalter.de/ http://www.winterhalter.co.uk/winterhalter/products/index.html
Zanussi Professional	http://www.zanussiprofessional.com/node584.asp

Further valuable sources for professional dishwashers have been:

- Expertly guided on-site visit at main kitchens of University Medical Hospital Freiburg (Germany)
- Personal information by
 - CENELEC TC59X,
 - Danish Technological Institute DTI
 - HKI,
 - Hobart,
 - Meiko,
 - Miele Professional,
 - VGG, and
 - Winterhalter.

7 Annex

7.1 Questionnaire “Task 1” for stakeholders

The questionnaire is provided separately (EuP_Lot24_Dish_T1_Annex_Questionnaire.pdf).

7.2 Stakeholder feedback to draft versions of Task 1

Please note that the feedback refers to prior versions of Task 1 report; thus the indicated numerations of chapters, tables, figures or pages might have changed.

Feedback	Comment
<i>Hobart (answers to the questions in annex)</i>	
<p>Q-2.1 Delimitation between professional and private use:</p> <ul style="list-style-type: none"> – Performance (number of dishes per hour, power consumption) – Working principle (fresh water rinse versus water-change principle) – Continuous operation (conveyor dishwasher) – Specific dish carriers (racks) – MD 2006/42/EC is applicable to professional dishwasher = work equipment – LVD 2006/95/EC is applicable to dishwashers for private use = consumer Product – Distribution channel – Price 	<p>Included in report.</p>
<p>Q-2.2 Distinction between professional and industrial appliances (machines):</p> <ul style="list-style-type: none"> – What means “Industrial”? (Series production, high output, etc.) – What means “Professional”? (Commercial, no private use, may include “industrial”...) – One can’t really distinct between “industrial” and “professional” pertaining to dishwashers. 	<p>Included in report.</p>
<p>Q-2.3 Properties of dishwashers: Additional properties to distinguish between flight type dishwashers:</p> <ul style="list-style-type: none"> – Fully automated systems (automated cutlery, plate, bowl and tray separation and dishwasher loading as well as unloading and storing of cleaned items) – Semi automated systems (automated cutlery and tray loading as well as unloading) – Manual loading and unloading of dishes 	<p>Not seen to be of relevance for the purpose of EuP Lot 24.</p>

Feedback		Comment
Q-2.4	<p>Categories:</p> <ul style="list-style-type: none"> - The given categorisation is OK to us as far as items 1 to 6 are concerned. - Item 7 refers to trolleys which can't be designated as "dishes". This topic should be deleted. - Pass through dishwashers with water-change operation (fill and dump types) are unknown by us. - Pass through dishwashers with two racks which can be cleaned during one single cycle are available - The capacity of program automats ranges from approx. 5 to 70 racks/h. - DW with water-change operation are only known as undercounters. - The technological difference is insignificant between rack conveyor and flight type dishwashers. - "Transport dishwashers" are exclusively used for dishes like plates, cutlery, cups, trays, etc. Similar (maybe identical) machines are sometimes used for other applications like animal cages, industrial products in production lines. These are no DW! - The size of transport dishwashers ranges from 1,5m to 20m in length, from 0,8m to 2m in width and 1,2m to 3m in height. The capacity may range from 1 500 to 14 000 plates/h. - Specialized DW are designed for special applications. This may affect: dish carrier, cycle time respectively conveyor speed, spray pressure, dryer configuration, robustness of the machine, etc.... - Every category can be used for mobile application but the majority of mobile application applies to categories 2 and 3. - There are no significant differences between dishwashers for stationary and mobile applications. - Significant technological differences between granulate DW and comparable utensil washers of category 4 are unknown. 	<p>Trolley washers had been already excluded in the report, Rest: Considered in report</p>
Q-2.5	<p>Legislation and standards:</p> <ul style="list-style-type: none"> - EN 50242 / 60456 is exclusively applicable to long cycled cleaning processes. It is impractical to apply this standard to professional dishwashers because of their very short cycle times. Reason: As per EN 50242 / 60456, the soiled items undergo the oven drying procedure for two hours to simulate stubborn soiling which is related to household use. In commercial establishments, the dry-on time is usually very short (less than two hours at room temperature). Thus, the soil remains relatively soft and can be washed-off rapidly. - An accordant standard for measuring the performance of professional dishwashers does not exist. Manufacturers use internal test procedures which allow direct comparison between models of similar performance characteristic. These test procedures are not suitable for a performance classification of professional dishwashers because of insufficient reproducibility. 	<p>Included in report (Task 1 and Task 4)</p>

Feedback		Comment
	<ul style="list-style-type: none"> - Following parameters should be subject of a possibly to be developed standard: <ul style="list-style-type: none"> - simply to apply - proportional to the task of the EuP-Directive - to ensure minimum performance - to ensure hygienic results as specified in DIN 10510-10512. - energy demand - demand of water, detergent, rinse aid - General aspects of particular importance for standardization: <ul style="list-style-type: none"> - a possible standard should match the practical utilization. - it shall be prevented that future professional dishwashers are primarily designed to meet the standard requirements and fail under practical use conditions. - Hygiene requirements should be applied to all profess. DW. - Differentiation between “industrial” / “professional” doesn’t make sense in this context because the only difference is the wording. 	
Miele		
Table 2, p. 11	<p>Target group / Applications for Semi-professional Dishwashers: High-end households, offices, small pensions</p> <p>Please add: hospitals, hotels, Nursing homes, restaurants, community kitchens, Bed & Breakfasts, institutional kitchens, Kindergartens & pre-schools, schools, Supermarkets.</p> <p>Please remove: High-end households</p>	Included in report.
Table 2, p. 11	<p>Cleaning and Hygienic requirements</p> <p>Domestic Dishwashers and Semi-professional Dishwashers also have high cleaning and hygienic requirements. The hygienic requirements of Semi-professional Dishwashers are typical similar to Professional Dishwashers, due to the fact that they have similar target groups.</p> <p>In fact some Semi-professional Dishwashers reach final rinse temperatures as high as 90°C. In conjunction with a certain holding time they achieve an “A0 value of 600”, which is considered thermal disinfection (90°C for 60 sec., according EN ISO 15883).</p> <p>Professional Dishwashers reach only an “A0 value of 60”</p>	We do not say that household appliances have low hygienic performance. They however do not underlay certain hygienic requirements, and the hygienic performance is no measured in the performance standard (EN 50242/60456). We added hygienic requirements for the semi-professional dishwashers.

Feedback	Comment	
Winterhalter		
1.3, p. 10	<p>Water-change system It is mentioned, that dishwashers with water-change operation are more hygienic and need less effort for cleaning the machine. We do not believe, that this is proved, so this should not be stated as fact</p>	Sentence deleted.
2.1.2, p. 25	<p>DIN normatives It is mentioned, that the DIN Hygiene normatives do not cover cleaning or other performance parameters. But they do. For example in DIN10512 Section 5.4.2 there are requirements concerning cleaning, drying and hygiene. Experience shows, that when hygienic requirements are fulfilled, the basic functionalities for a good cleaning result are a precondition.</p>	Revised in report.
Danish Technological Institute		
Draft final report, Section 3.1.4.1	<p>First line: ...has measured data on energy and water consumption... should be changed to: ...has measured data on energy and water consumption and cleaning performance...</p>	Revised in report.
Draft final report, Section 3.1.4.1	<p>Last sentence: The last sentence: "However, the VGG standard has not been updated since 40 years and is neither applicable nor used according to feed back at the interim stakeholder meeting of EuP Lot 24" The sentence will give a wrong impression if it is not added that it was said by a couple of manufacturers who said that the work in counting the grains on the dishes in this cleaning test was much too large. I took part in the stakeholder meeting and remember that this was said by Diplom-Ökonom Siegfried Päsler, Geschäftsfürer for VGG, Verband der Hersteller von Gewerblichen Geschirrspülmaschinen E.V. and Markus Gessler from Winterhalter They tried to convince the participants that standardized test for dishwashers were of no use because what the dishwasher was going to wash was not known before it was sold and that they always made good adaption of the machine to the use at the buyer. Karl J. Büttner from Hobart and Matthias Meiwes from Miele told me that they use the method. But they did not mention it during the meeting. Miele helped us in developing the modernised test that we use in Denmark as a voluntary test for suppliers who want their test data on the official web site www.sparelisten.dk/spareopvaskemaskiner We therefore suggest that the last sentence is deleted or changed to: A couple of manufacturers and the Geschäftsfürer for VGG had the opinion that the work in performing the VGG cleaning test is too large.</p>	Specified in report.

Feedback		Comment
Hobart		
Section 3.3	Safety standards add: EN 50416 Household and similar electrical appliances – Safety – Particular requirements for commercial electric conveyor dishwashing machines	Included in report.
Section 3.4 Noise	Noise standards add: Following Standards apply to professional dishwashers (as per EN 50416 as well as per EN 60335-2-58): EN ISO 3744 Acoustics – Determination of sound power levels of noise sources using sound pressure – Engineering method in an essentially free field over a reflecting plane EN ISO 3746 Acoustics – Determination of sound power levels of noise sources using sound pressure – Survey method using an enveloping measurement surface over a reflecting plane EN ISO 4871 Acoustics – Declaration and verification of noise emission values of machinery and equipment EN ISO 9614-2 Acoustics – Determination of sound power levels of noise sources using sound intensity – Part 2: Measurement by scanning EN ISO 11204 Acoustics – Noise emitted by machinery and equipment – Measurement of emission sound pressure levels at a work station and at other specified positions – Method requiring environmental corrections	Included in report

7.3 Method used by DTI for performance measurement of hood-type dishwashers⁸⁴

The data have been determined according to „VGG Prüfverfahren zur Reinigungs-Index-Bestimmung von gewerblichen Geschirrspülmaschinen, Blatt 1, Kleinmaschinen; Entwurf 1970-06-12 ergänzt 1973-02-15, (Ref 1)“ with some modifications. The modifications follow as far as possible the European standard EN 50242 for household dishwashers.

- Ambient conditions: Temperature (23 +/- 2) °C, air humidity (55 +/- 5)% RH
- Power supply: Regulated voltage 230/400 V, 3N, neutral and ground
- Water supply: Temperature (15 +/- 2) °C, pressure (240 +/- 50) kPa, soft water.

The machine was selected, installed and started by the machine supplier including selection of programme (standard dish programme with duration about 2 minutes). Soil has been prepared as in Ref 1 and applied with 7 gram per dish. Washing has been started immediately after the soiling of dishes for the machine was finished.

⁸⁴ Source: Danish Technological Institute / 2009-01-22 / J H Kjeldgaard for Danish Energy Association

Detergent in liquid form of the make Dr. Weigert, neodisher, Alka300 is manually dosed in an amount of 2 ml per litre water in the wash tank. After the first five washes an additional amount is supplied corresponding to the amount of water taken in during the first five washes. Rinse agent of make Dr. Weigert, neodisher, TS is added automatically in a rate arranged by the supplier of the machine.

The machine was started from an emptied and cleaned condition, and after being ready, 10 washes were performed successively on the machine all with the prescribed number of soiled dishes arranged as described by the supplier in the delivered baskets. A reference machine was run in parallel to monitor possible variations in test conditions such as e.g. preparation and application of soiling. For every second wash the dishes were inspected for cleaning result as described in Ref 1⁸⁵.

The following table provides the mean value of 10 datasheets with regard to the different measured parameters. The detailed results of the machine specific performance tests are published on the internet.⁸⁶

Table 11 Mean value of the results of 10 washes according to method used by DTI for performance measurement of hood-type dish-washers

Data sheet for Tank dishwasher MEAN (of machines)	Dishes per wash DN	Energy per wash kWh	Water per wash l	Time per wash sec	Max wash temp C	Max rinse temp C	Wash result front x	Wash result back y	Cleaning index front F	Cleaning index back B	Cleaning index total J	Clean index refmean/ref corr	Cleaning index total *corr Jc
Wash	17,3	0,547	3,77	133	54,0	83,1	17,3	41,1	74,3	70,52	72,40	1,0003	72,39
		Energy kWh	Water l	Time min									
Start to ready mode		3,438	46,86	31,0									
Ready mode 4h		1,273	0,07	240									

Notes:

- Dishes per wash are the number of dishes soiled and washed in each wash.
- Energy per wash is the mean energy consumption for the 10 washes. It is determined as the total energy consumption during the time period for performing the 10 washes subtracted by the energy consumption for the ready mode in an equal period of time.
- Water per wash is the mean water consumption during the wash.

⁸⁵ The method used by DTI for measuring the cleaning index is done by counting number of grains on the wash ware. It does not explicitly measure residues of detergent as one Swedish manufacturer asked for. DTI argued against that if the cleaning index is good it means that fresh rinsing water has been applied in an efficient way so that also the detergent will have been rinsed well of. On the other hand, DTI offered to the Danish and Swedish suppliers to develop a method for testing detergent residues if they could agree to finance the development; however there has not been sufficient interest.

⁸⁶ http://www.sparelisten.dk/spareopvaskemaskiner/vaskemaskine_liste.asp?m=3

- Time is the mean duration of the wash measured in seconds by a stopwatch from start of the wash until the machine signals that the wash is finished.
- Max wash temp is the mean of maximum wash temperature measured every 10 seconds by a thermocouple placed between the dishes.
- Max rinse temp is the mean of the maximum rinse temperature measured every 1 second by a thermocouple placed in the rinse water flow upstream of the rinse spray arm but as close to the rinse spray arm as possible for the given construction of the machine.
- Wash result front and back is judged by visual inspection as in Ref 1.
- Cleaning index total is the mean of results computed as in Ref 1 for the single wash.
- Clean index ref_{mean}/ref is the correction factor found by dividing the mean value of the cleaning index for the reference machine for all the tests performed in this series of tank washing machine tests with the mean value found for the reference machine when running in parallel with this specific machine.
- Cleaning index total_{corr} is the final cleaning result after correction with the results of the reference machine.
- Start to ready mode The machine has been started from an emptied and ambient temperature condition. Energy and water consumption and time have been measured from the start until the machine has reached a ready mode characterized by the water temperature in the wash tank being in the wash temperature range for this machine and that the energy consumption has stopped. Two tests are performed and the mean value is determined.
- Ready mode 4h Energy and water consumption and time have been measured from a condition where the water temperature in the wash tank is in the wash temperature range for this machine and until 4 hours later where the same situation exists / is established. The test is performed with a closed top if possible. Two tests are performed and the mean value is determined.