

## Program Design Guidance Commercial Dishwashers

Commercial dishwashers are used in almost all establishments that use non-disposable dishes, glassware, and utensils, such as restaurants, bars, schools, hospitals, nursing homes, churches, and institutional cafeterias. The commercial dishwasher is able to clean and sanitize a high quantity of kitchen wares in a very short time by utilizing hot water, soap, rinse chemicals, and significant amounts of energy.

### Equipment Description

Commercial dishwashers are available in a variety of types, sizes, and flow rates. The four main types of commercial dishwashing machines are: undercounter; door type; conveyor; and flight. Other specialty machine types include glasswashers and pot and pan washers. A wide array of models and accessories are available for each category, but all commercial dishwashing machines are similar in that they employ wash, rinse and sanitizing cycles.

The two basic strategies for washing and sterilizing dishes involve high-temperature and low-temperature approaches. Low-temperature dishwashers use the hot water supplied by the kitchen's existing water heater – typically this hot water is supplied at 140°F. These dishwashers use a chemical sanitizing agent in the final rinse and in some cases, a drying agent. High-temperature dishwashers use a booster heater to raise the rinse water temperature to 180°F, hot enough to sterilize the dishes and assist in the drying process. There is also a heater in the dishwasher tank that keeps the wash water at the required temperature. Many models on the current market are available as either high or low temperature units.

Size requirements for commercial dishwashing machines can be calculated by estimating the peak number of meals per hour served by the food service establishment. This information is a key determinant of the type of dishwasher (undercounter, door-type, rack, or flight) that is most suited for a facility. Following is an overview of these four categories as well as the specialty machines.

**Undercounter dishwashers** are the smallest commercial dishwashers available and are best suited for smaller establishments that serve less than 100 meals per hour. They are commonly used in nursing homes, churches, small food service areas, office buildings, and for glass washing in taverns and bars. Undercounter machines are similar to residential dishwashers in that the door opens downward with rack(s) rolling out into the lowered door for access. A revolving wash arm handles the wash and rinse cycles, with a small holding tank being automatically drained after each cycle. An automatic timer controls cycle length. Undercounter machines come in both chemical sanitizing models and high temperature, with optional booster heaters for the latter.



**Undercounter Dishwasher**

**Door-type dishwashers** are designed for facilities that serve 100-500 meals per hour and are the most widely used commercial dishwashing machine type. Door-type machines are used in schools, hospitals, churches, restaurants, catering businesses, fast-food establishments, and as glass and utensil washers in larger operations. These box-shaped machines have singular or multiple doors that slide vertically for loading and unloading. Door-type machines are available in high temperature and chemical sanitizing models. These “dump and rinse” machines have a single tank for water and detergent, which are circulated in measured volumes and temperatures. Two revolving spray arms (one above and one below the dish rack) distribute wash solutions evenly over the dishes. Some door-type machines now have the ability to recycle rinse water to be used again during the next wash cycle. Door type machines come in both chemical sanitizing models and high temperature models, with optional booster heaters for the latter.



**Door-Type Dishwasher**

**Conveyor dishwashing machines** use a motor driven conveyor belt to move rack-loaded dishes through a large tank with separate wash and rinse compartments. Most widely-used in hotels, large restaurants, hospitals, schools, and universities, these machines are designed for establishments that serve 500-2000 meals per hour. Conveyor machines come in varying sizes, with available additions such as pre-wash units, side-loading trays, condensers, and blow-dryers. A single tank holds the water and detergent at a regulated temperature. The wash solution is pumped through multiple spray arms that run constantly once the machine is operational, regardless of the presence of a dish rack. The rack is then sent through the rinse compartment, where it is sprayed with 180°F water by spray nozzles above and below the rack. Conveyor machines are also available in low temperature and field interchangeable models.



**Conveyor Dishwasher**

**Flight type dishwashers** are similar to rack conveyor machines in that they use a conveyor belt to move items through the wash process. Dishes are loaded directly onto the conveyor belt instead of being loading into racks first as with other machine types. Flight type dishwashers are designed for locations serving over 2000 meals per hour and provide the high volume washing capability needed only in the largest institutional, commercial and industrial facilities. Possible machine add-ons include power scrapers, power wash setting, power and final rinse settings, and blower-dryers. Flight type dishwashers are typically only offered as high temperature sanitizing models. Because flight type machines are generally custom built, neither CEE nor ENERGY STAR<sup>®</sup> specifications cover them at this time, and they will not be discussed further in this document.



**Flight Type Dishwasher**

**Glasswashers** are specialty machines often used in bar applications or where large volumes of glassware are used. They come in undercounter, rotary-type, or pass-thru configurations. Neither CEE nor ENERGY STAR specifications cover this machine type at this time, and it will not be discussed further in this document.



**Rotary-type Glasswasher**

**Pot and Pan Washers** are specialty machines similar to door-type machines. They are designed with higher internal clearance to accommodate larger items and turbulent spray jets to break up baked-on food and grease. Pot and pan washers are classified under the door-type machine category in the CEE and ENERGY STAR specifications.



**Pot and Pan Washer**

### Product Performance Metrics

Commercial dishwashers are compared in the marketplace through an array of different criteria. The most significant are as follows:

- Operating Capacity – measured in dishes per hour, meals per hour and racks per hour
- Cycle time – measured in seconds
- Quality – cleanliness of dishes
- Water consumption – measured in gallons per hour and gallons per rack

### Product Use and Lifetimes

Due to the nature of the businesses and facilities that employ commercial dishwashers, it is generally assumed that most of these units run 365 days a year. Due to the large variety of uses and capacities of these machines, the daily use of commercial dishwashers is highly variable. Typical restaurant use is estimated at 5 to 6 hours per day, though this estimate will vary based on the number of meal periods (breakfast, lunch, dinner) and the length of each meal period for each location.

Product lifetimes for each machine type covered by the CEE and ENERGY STAR specifications are listed in Table 1 below. This information was obtained by ENERGY STAR from Pacific Gas and Electric's Foodservice Technology Center.

Table 1 – Typical Product Life for Commercial Dishwashers

Machine Type	Typical Product Life (years)
Under Counter	10
Door Type	15
Conveyor	20

### Specifications and Test Methods

CEE and ENERGY STAR have both developed efficiency specifications for commercial dishwashers. Both specifications are the same with only one level of efficiency at this time. ENERGY STAR maintains a list of qualified products. Links to the current CEE and ENERGY

STAR specifications as well as the qualified product list are below. The efficiency criteria and test method are detailed in the specifications.

[CEE Specification](#)

[ENERGY STAR Specification](#)

[ENERGY STAR Qualified Product List](#)

## Product Availability

According to the Foodservice Equipment Reports 2004 Worldwide Buyers Guide, there are 24 manufacturers of rack/cabinet/tray commercial dishwashers and 23 manufacturers of under counter dishwashers (most manufacture both). Major manufacturers in the United States include: [American Dish Service](#); Auto-Chlor System; [Champion Industries \(part of the Ali Group\)](#); [CMA Dishmachines](#); [Electrolux Professional](#); [Fagor Commercial](#); [Hobart Corporation](#); [Insinger Machine Company](#); [Jackson MSC, LLC](#); [Meiko USA](#); [Moyer Diebel Ltd. \(part of the Ali Group\)](#); and [Stero, a division of Illinois Tool Works, Inc.](#) As of May 2008, 153 products across all twelve major U.S. manufacturers qualify under the CEE and ENERGY STAR specifications. See Table 2 below for a summary of the number of qualifying products by dishwasher type.

## Incremental Cost

Based on information in [ENERGY STAR's Commercial Dishwasher calculator](#), the incremental cost between a standard commercial dishwasher and a compr ranges from \$1,000 to \$4,000 depending on dishwasher type. Table 2 below includes a summary of incremental costs by dishwasher type.

**Table 2 – Number of Qualified Products Offered and Incremental Cost by Machine Type**

Dishwasher Type	Number of CEE/ENERGY STAR Qualified Products Offered	Estimated Standard Equipment Cost	Estimated CEE High Efficiency /ENERGY STAR Equipment Cost	Estimated Incremental Cost
High Temperature, Multiple Tank Conveyor	23	\$20,000	\$24,000	\$4,000
High Temperature, Single Tank Conveyor	41	\$12,000	\$15,000	\$3,000
High Temperature, Door Type	24	\$6,900	\$9,000	\$2,100
High Temperature, Under Counter	6	\$5,000	\$6,000	\$1,000
Low Temperature, Multiple Tank Conveyor	0	\$18,000	\$22,000	\$4,000
Low Temperature, Single Tank Conveyor	3	\$11,000	\$14,000	\$3,000
Low Temperature, Door Type	11	\$6,500	\$8,500	\$2,000
Low Temperature, Under Counter	19	\$4,800	\$5,800	\$1,000
High/Low Temperature, Multiple Tank Conveyor	7	Use high temp cost	Use high temp cost	Use high temp cost
High/Low Temperature, Single Tank Conveyor	15	Use high temp cost	Use high temp cost	Use high temp cost
High Low Temperature, Door Type	4	Use high temp cost	Use high temp cost	Use high temp cost

## **Energy Savings**

There are four primary energy savings opportunities in commercial dishwashers: building water heater energy consumption; booster heater energy consumption (for high temp machines), idle energy consumption, and wash energy consumption. When a dishwasher uses less water, energy is saved by heating less water at the building and booster heater levels. Idle energy refers to the energy consumed by the tank heater to maintain water temperatures within the machine between wash cycles. Wash energy consumption is the energy used during the wash cycle. Currently CEE and ENERGY STAR specifications and referenced test procedures only measure rinse water consumption and idle energy consumption. Test methods for wash energy consumption are under revision by industry.

Tables 3 through 6 provide a summary of energy and water savings by dishwasher type and building and booster heater fuel type based on [ENERGY STAR's Commercial Dishwasher calculator](#).

**Table 3 – Water and energy savings by dishwasher type with electric building hot water heater and electric booster heater.**

	Typical Product Life	Typical Racks / Day	CEE/ENERGY STAR			Conventional			Savings/Unit		
			gallons/yr	kwh/yr	therms/yr	gallons/yr	kwh/yr	therms/yr	gallons/yr	kwh/yr	therms/yr
Under Counter, Low Temp	10	75	45,900	8,965	0	52,650	10,161	0	6750	1196	0
Under Counter, High Temp	10	75	27,000	9,844	0	53,460	17,212	0	26460	7369	0
Door Type, Low Temp	15	280	118,944	21,534	0	186,480	33,502	0	67536	11969	0
Door Type, High Temp	15	280	95,760	28,867	0	145,152	42,817	0	49392	13950	0
Single Tank Conveyor, Low Temp	20	400	113,760	24,135	0	177,120	35,363	0	63360	11228	0
Single Tank Conveyor, High Temp	20	400	100,800	39,591	0	162,720	58,563	0	61920	18972	0
Multi Tank Conveyor, Low Temp	20	600	116,640	29,311	0	213,840	46,536	0	97200	17225	0
Multi Tank Conveyor, High Temp	20	600	116,640	46,306	0	237,600	79,992	0	120960	33685	0

**Table 4 - Water and energy savings by dishwasher type with electric building hot water heater and gas booster heater.**

	Typical Product Life	Typical Racks / Day	CEE/ENERGY STAR			Conventional			Savings/Unit		
			gallons/yr	kwh/yr	therms/yr	gallons/yr	kwh/yr	therms/yr	gallons/yr	kwh/yr	therms/yr
Under Counter, Low Temp	10	75	45,900	8,965	0	52,650	10,161	0	6750	1196	0
Under Counter, High Temp	10	75	27,000	7,110	111	53,460	11,799	219	26460	4689	109
Door Type, Low Temp	15	280	118,944	21,534	0	186,480	33,502	0	67536	11969	0
Door Type, High Temp	15	280	95,760	19,170	393	145,152	28,118	596	49392	8948	203
Single Tank Conveyor, Low Temp	20	400	113,760	24,135	0	177,120	35,363	0	63360	11228	0
Single Tank Conveyor, High Temp	20	400	100,800	29,383	414	162,720	42,085	668	61920	12701	254
Multi Tank Conveyor, Low Temp	20	600	116,640	29,311	0	213,840	46,536	0	97200	17225	0
Multi Tank Conveyor, High Temp	20	600	116,640	34,495	479	237,600	55,931	975	120960	21436	496

**Table 5 - Water and energy savings by dishwasher type with gas building hot water heater and electric booster heater.**

	Typical Product Life	Typical Racks / Day	CEE/ENERGY STAR			Conventional			Savings/Unit		
			gallons/yr	kwh/yr	therms/yr	gallons/yr	kwh/yr	therms/yr	gallons/yr	kwh/yr	therms/yr
Under Counter, Low Temp	10	75	45,900	830	377	52,650	830	432	6750	0	55
Under Counter, High Temp	10	75	27,000	5,059	222	53,460	7,738	439	26460	2680	217
Door Type, Low Temp	15	280	118,944	455	976	186,480	455	1,531	67536	0	554
Door Type, High Temp	15	280	95,760	11,897	786	145,152	17,093	1,191	49392	5197	405
Single Tank Conveyor, Low Temp	20	400	113,760	3,974	934	177,120	3,974	1,454	63360	0	520
Single Tank Conveyor, High Temp	20	400	100,800	21,728	827	162,720	29,726	1,336	61920	7998	508
Multi Tank Conveyor, Low Temp	20	600	116,640	8,640	957	213,840	8,640	1,755	97200	0	798
Multi Tank Conveyor, High Temp	20	600	116,640	25,636	957	237,600	37,885	1,950	120960	12249	993

**Table 6 - Water and energy savings by dishwasher type with gas building hot water heater and gas booster heater.**

	Typical Product Life	Typical Racks / Day	CEE/ENERGY STAR			Conventional			Savings/Unit		
			gallons/yr	kwh/yr	therms/yr	gallons/yr	kwh/yr	therms/yr	gallons/yr	kwh/yr	therms/yr
Under Counter, Low Temp	10	75	45,900	830	377	52,650	830	432	6750	0	55
Under Counter, High Temp	10	75	27,000	2,325	332	53,460	2,325	658	26460	0	326
Door Type, Low Temp	15	280	118,944	455	976	186,480	455	1,531	67536	0	554
Door Type, High Temp	15	280	95,760	2,199	1,179	145,152	2,394	1,787	49392	195	608
Single Tank Conveyor, Low Temp	20	400	113,760	3,974	934	177,120	3,974	1,454	63360	0	520
Single Tank Conveyor, High Temp	20	400	100,800	11,520	1,241	162,720	13,248	2,004	61920	1728	762
Multi Tank Conveyor, Low Temp	20	600	116,640	8,640	957	213,840	8,640	1,755	97200	0	798
Multi Tank Conveyor, High Temp	20	600	116,640	13,824	1,436	237,600	13,824	2,926	120960	0	1489