DISHWASHING MACHINES

PERFORMANCE STANDARDS — TESTING AND FIELD OBSERVATIONS[1]

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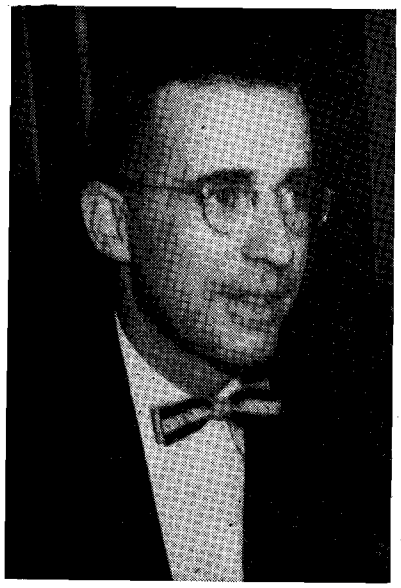

Mr. McAllister received the B.S. degree in Public Health from Indiana University in 1945 and the M.P.H. degree from the University of Michigan in 1952. He was appointed to the staff of the National Sanitation Foundation Testing Laboratory in 1953 where he now serves as a field Representative.

The popular appeal of good eating establishments, and the vast number of dishes resulting from mass feeding, and the ever-increasing difficulty in securing help willing to wash dishes by hand, served to stimulate the inventions and development of dishwashing machines. Dishwashing machines in the earlier years had the fundamentals of present-day machines and served the practical purpose of turning out clean dishes with a minimum of help. Recently, the opinions of public health officials and the restaurant and hotel operators were solicited as to what constitutes good sanitation in the dishwashing field. Kitchen sanitation and especially clean eating utensils headed the list. Since then manufacturers of dishwashing machines have instructed their engineers to keep sanitation foremost in their minds in the development and construction of new models.

The long experience of manufacturers of dishwashing machines made them quick to see the importance of standardizing the essential factors of mechanical dishwashing such as time, temperature, volume of water, pressure, spray pattern, size of equipment, and the necessity for making the operation easy and as nearly fool-proof as possible. With these thoughts in mind the development of National Sanitation Foundation Spray-Type Dishwashing Machines Standard No. 3 was prepared.

The following discussion will cover the single tank door type machine and the two tank conveyor type dishwashing machine which are commonly used.

Wash cycles for a single tank stationary rack, hood, curtain and door types are different for each size rack used. But the minimum temperatures of 140° to 160° F. is specified and the minimum time required for the water to be pumped over the dishes is 40 seconds. The easiest way to compute the water needed for a particular sized rack is to multiply the rack's length by the width times 0.23. (Example: 20″ x 20″ = 400 sq. in. x .23 gal/sq. in. = 92 gal. rack) This figure then gives you a rough approximation of water which will fall on each rack of dishes. As an example the minimum requirement for the 20″, the 18″ and the 16″ rack is .23 gallons for every square inch; or 92 gallons for a 20″ x 20″ rack, 75 gallons for a 18″ x 18″ rack, and 60 gallons for a 16″ x 16″ rack. During this discussion we must keep in mind the fact that each pump delivery capacity is rated to deliver so many gallons per minute. If the pump capacity is below a certain minimum, the wash time may be increased as necessary to deliver the required number of gallons over each rack of dishes.

In checking the pump capacities it is generally found that the pump capacities exceed the minimum requirements to deliver the wash water volumes per rack calculated as stated above. In all cases the pressure of the wash water had a cutting velocity. The jet velocity must be just under that which will dislodge standard restaurant coffee cups from the dish rack (usually about 3 to 4 pounds per square inch at the nozzle).

For the final rinse, on single tank machines the time interval is 10 seconds, in which ⅜ gallons of water shall be uniformly sprayed over each 100 square inches. For example the 20″ x 20″ rack will receive a minimum of 1½ gallons, the 18″ x 18″ rack will receive a minimum of 1¼ gallons and the 16″ x 16″ rack will receive a minimum of 1 gallon of hot water at not less than 180° F. The temperature will be registered at the entrance to the rinse manifold and a flow pressure of not less than 15 pounds per square inch on the line adjacent to the machine and not less than 10 pounds per square inch at the rinse nozzle is required. (The effects of high pressure above 30 pounds per square inch atomizes the rinse which reduces temperature and general effectiveness of rinse).

For the manually operated machines there shall be a legible plate giving the minimum wash and rinse times of 40 sec. wash—10 sec. rinse. Automatic controlled wash and rinse cycles shall comply with the minimum requirements.

For the wash cycle on multiple tank conveyor types having dishes inclined on a conveyor or in a rack they shall be so constructed that each lineal inch of conveyor belt shall be effectively sprayed from above and below with not less than 1.65 gallons (for a 20″ x 20″ rack) of pumped wash water at 140° to 160° F. A minimum of seven seconds is required for a given point to traverse the wash spray area. The pump must have a minimum capacity of 125 gallons per minute. Pressure at the nozzles shall be sufficient to deliver the wash water to

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all portions of the dishes with a cutting velocity. There shall be an adjustable device for automatically adding made-up water in sufficient quantity to skim off any grease which may be present. To measure the time, the following formula should be used:

$$\text{Time} = \frac{\text{Effective spread (of arm) in inches (measured)}}{\text{Conveyor speed inches per second (timed)}}$$

The formula for measuring gallons per inch is:

$$\frac{\text{Gallons per sec. x time in sec.}}{\text{Spread in inches (effective spray area in direction of travel)}}$$

The recirculated rinse requirements shall be the same as that of the wash tank with the exception of the water temperature which shall be 170° F. or more.

The final rinse temperature shall be not less than 180° F. at the manifold entrance. Flow shall not be less than 4 gallons per minute at not less than 15 pounds nor more than 30 pounds per square inch at the machine and not less than 10 pounds per square inch at the rinse nozzle.

One of the most important factors for proper dishwashing procedures is to have an adequate supply of hot water with the proper line pressure. The dishwashing machine can have the National Sanitation Foundation seal of approval, but if it does not have adequate hot water and pressure the machine cannot clean dishes. It is one of the main responsibilities of the local sanitarian, and also an important function of distributors of dishwashing machines, to see that all new dishwashers are properly installed. I cannot over-emphasize the point that *personal* or *unnecessary requirements* should not be added to the existing requirement. If deficiencies in the Standard are found they should be taken up with your Committee for consideration in revising the Standard.

To determine compliance with Standard No. 3, performance tests were conducted in the plants of twelve manufacturers on 228 models. In addition to the performance tests, compliance with materials, design and construction were checked.

Our primary concern in testing dishwashing machines was to determine whether or not the machine washed dishes. We were able to do this with a standard soiled dish which was subjected to the prescribed detergent and hot water and then analyzed for per cent soil removal. By this method we were able to determine coverage of wash and rinse sprays. In determining volume of wash water delivered, a flow meter was installed in the wash tank. This volume was checked by means of a pressure meter attached to the pump discharge. The pressure reading was referred to pump discharge curves from which the gallons pumped per minute could be read directly. These tables and our actual pump readings were almost identical (confirming accuracy of pump manufacturers' discharge curves). By use of a stop watch, conveyor speeds were checked, and wash and rinse cycles were determined. The volume of final rinse water was measured by collecting the entire supply of rinse water for a period of ten seconds. This volume then could be related to the timed requirements for the particular model tested. In testing we checked the accuracy of temperature gauges by means of a recording potentiometer. Gauges which varied more than ± 2° F. were not accepted. All manufacturers were advised to have gauges standardized with ± 2° F. before installing on models bearing the National Sanitation Foundation seal of approval.

During the development of the standards there was some discussion about the temperature increases of china which occur during a normal wash and rinse cycle. By using thermocouples we were able to obtain a new temperature picture. A standard dinner plate was used and a hole was drilled from the back, until it was just under the surface of the glaze. On another plate a thermocouple was placed on the outside of the plate and another thermocouple was located in the wash tank, and another in the final rinse manifold. All of these readings were then recorded simultaneously so that we could tell where the temperature increases occurred, and at what time interval. These results together with similar data from studies with utensils, are being analyzed and will be available for distribution in the near future. We now can state that the temperatures of the surface of the plate will vary from two to fifteen degrees from that of the glaze under the surface, and that the glaze temperature will vary from three to thirty degrees from the highest temperature of the water used during the wash and rinse cycles of machines tested. One of the greatest influences on temperature is the time of the complete operation. The interesting fact is that china dishes which have reached the temperature giving heat treatment equivalent to pasteurization, will retain that heat for 10 to 15 seconds after the rack is removed from the washing machine.

In checking dishwashing machines various deficiencies were disclosed. We now can state that in every instance the manufacturer has made the necessary changes to comply with the standards. Several manufacturers have completely redesigned their pumps and spray systems to meet the requirements; others made major changes in the spray systems to obtain better and proper distribution of water upon dishes. Some are still re-designing and making changes in certain models before they can affix the National Sanitation Foundation seal of approval.

The Testing Laboratory has published an "official listing" showing names and addresses of manufacturers whose equipment has been found to comply with the standards including the model numbers of machines. The "official listings" are re-issued annually following the re-examination of equipment at the approved plants. These listings have been sent out to all health departments. If you have not received your copy one may be requested from the National Sanitation Foundation.

The National Sanitation Foundation testing program now is a reality. This program does not in any way restrict or limit any responsibility of the local Sanitarian for

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tion for generalized work, followed by a brief period of field training before assignment. After a short period of general work experience, these sanitarians are provided additional training and experience in more technical jobs. Over a two year period, a Sanitarian I will receive experience in milk, food, housing, industrial hygiene, pest control, swimming pools, and other activities.

Plans to train large numbers of personnel in both food and restaurant inspection and milk and milk plant inspection have evoked considerable interest. Heretofore, many jurisdictions, particularly the larger cities, have considered each a specialty in which proficiency is not readily obtained. Selecting five Sanitarians I at a time – one from each district – they have been trained in a period of six weeks to begin routine milk sanitation work. Of course, training must be continued on-the-job. In Philadelphia, the local health department inspects each milk and ice cream plant. There is an industry system for inspecting dairy farms; however, the health department will guide this work through sample surveys. After training, the Sanitarian I is able to perform the routine inspections and also perform the various tests normally made to check high temperature-short time equipment. This does not mean that he is a specialist that can handle all milk problems, but such competency to a practical extent is quickly available in the central office. Ten field personnel and supervisors have already been trained in this manner. It is intended ultimately to train about 25 sanitarians to do all types of food and milk work. In addition, they will be instructed in other sanitation activities.

Generalization will be practiced to the greatest extent feasible. It is possible, however, that engineering graduates will be utilized to a greater extent on industrial hygiene, radiation hazards, and water and waste problems.

PROFESSIONAL RECOGNITION

While many benefits have accrued to the Department from this reorganization and generalization, the personnel have not been without reward. Where else can a young graduate enter the field of Public Health and receive training and experience in all phases of environmental sanitation?

The Department will ultimately reap this benefit by developing supervisors with broad experience.

Admittedly, this system requires greater effort by the employee to maintain proficiency in a number of activities. This has been recognized by establishing a higher pay scale than previously set for inspectors.

For many years, sanitarians have strived to receive professional recognition similar to that accorded physicians and engineers. One does not attain professional stature through desire alone. While activities were confined to narrow specialties, only high school education and two years limited experience were required for appointment. When duties were broadened, the minimum requirements were advanced to require professional training in sanitary science or engineering or their equivalents. The result was the unusual classification of engineers and sanitarians at the same professional level and the establishment of identical salaries for comparable responsibilities.

Thus by requiring professional qualifications and by demanding professional ability and job performance, professional status was awarded without question.

SUMMARY

In conclusion, the recent reorganization of the city government in Philadelphia has afforded an unusual opportunity to observe the effects of a complete revamping of environmental sanitation services in a comparatively short period of time. On the basis of the limited experience to date, these statements can be verified:

1. A generalized inspection program is practical to an extent greater than practiced in many areas.
2. Personnel with limited education can, through in-service training, improve job performance and perform many generalized inspection duties.
3. Personnel with professional education and training in sanitary science can satisfactorily perform a variety of sanitation inspections, including both food and milk.
4. Professional status as a sanitarian is recognized when there exists professional training, a broad sphere of technical interest and responsibility, and ability to do a professional job.

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checking equipment in the field, or seeing that it is properly installed, maintained or operated. *The "approval program" does aid in making available equipment that will do a satisfactory sanitation job if it is properly installed and operated.* We believe the Sanitarian can feel confident that when a dishwashing machine bearing the National Sanitation Foundation seal of approval is purchased, the cleaning function will be accomplished if the equipment is properly installed, maintained and operated.