Standard Test Method for Prerinse Spray Valves[1]

This standard is issued under the fixed designation F2324; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the water consumption flow rate and spray force of prerinse spray valves. The food service operator can use this evaluation to select a prerinse spray valve and understand its water consumption and spray force.

1.2 The following procedures are included in this test method:

1.2.1 Water consumption (see 10.2).

1.2.2 Spray force test (see 10.3).

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4 *This test method may involve hazardous materials, operations, and equipment. It does not address all of the potential safety problems associated with its use. It is the responsibility of the users of this test method to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to its use.*

2. Referenced Documents

2.1 *NSF Documents:*[2]

NSF Listings Food Equipment and Related Products, Components and Materials, NSF International

2.2 *ASME Standard:*[3]

ASME A112.18.1/CSA B125.1 Plumbing Supply Fittings

3. Terminology

3.1 *Definitions:*

3.1.1 *prerinse spray valve*—a handheld device containing a release to close mechanism that is used to spray water on dishes, flatware, etc.

3.1.2 *spray force*—the amount of force exerted onto the spray disc.

3.1.3 *test method*—a definitive procedure for the identification, measurement, and evaluation of one or more qualities, characteristics, or properties of a material, product, system, or service that produces a test result.

3.1.4 *uncertainty*—measure of systematic and precision errors in specified instrumentation or measure of repeatability of a reported test result.

3.2 *Abbreviations:*

3.2.1 *gpm*—gallons per minute.

4. Summary of Test Method

4.1 The flow rate of the prerinse spray valve is measured at a water pressure of 60 ± 2 psi (413.7 ± 13.8 kPa) and 60 ± 10°F (15.6 ± 2.6°C) to verify that the prerinse spray valve is operating at the manufacturer's rated flow rate. If the measured flow rate is not within 5 % of the rated flow rate, all further testing ceases and the manufacturer is contacted. The manufacturer may make appropriate changes or adjustments to the prerinse spray valve.

4.2 The amount of force exerted by the prerinse spray valve is determined by the spray force test.

5. Significance and Use

5.1 The flow rate test is used to confirm that the prerinse spray valve is operating at the manufacturer's rated flow rate at the specified water pressure. The result from this test would also assist the operator in controlling the water and sewer consumption and reduce water heating bills.

5.2 The spray force is a measure of the impact from a prerinse spray valve on the target surface and can be used to select a model that meets an end-user's force profile.

5.3 Flow rate and spray force can be used along with spray pattern, coverage area, usage time, and flow control to select a prerinse spray valve that meets an end-user's performance requirements.

6. Apparatus

6.1 *Analytical Balance Scale,* or equivalent, for measuring the weight of the water carboy. It shall have a resolution of 0.01 lb (5 g) and an uncertainty of 0.01 lb (5 g).

[1] This test method is under the jurisdiction of ASTM Committee F26 on Food Service Equipment and is the direct responsibility of Subcommittee F26.06 on Productivity and Energy Protocol.

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[2] Available from NSF International, P.O. Box 130140, 789 N. Dixboro Rd., Ann Arbor, MI 48113-0140.

[3] Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990, http://www.asme.org.

6.2 *Calibrated Exposed Junction Thermocouple Probes,* with a range from 50 to 200°F (10 to 93.3°C), with a resolution of 0.2°F (0.1°C) and an uncertainty of 1.0°F (0.5°C), for measuring water line temperatures. Calibrated K-type 24-GA thermocouple wire with stainless steel sheath and ceramic insulation is the recommended choice for measuring the water line temperatures. The thermocouple probe can be fed through a compression fitting so as to submerse exposed junction in the water lines.

6.3 *Carboy,* or equivalent container, for measuring the weight of the water during the flow rate test. A 5-gal (19-L) carboy water bottle has been found to be suitable (the carboy is the standard water bottle that is used for water coolers).

NOTE 1—The 5-gal (19-L) carboy container is the preferred container. With a narrow opening, the carboy captures all the water during the test at higher water pressure which can result in excess splashing.

6.4 *Force Gauge*—Digital force gauge with a maximum force between 500 and 1000 g-force (1.1 and 2.2 lb-force) and an accuracy of ±2 g-force (±0.071 oz-force).

NOTE 2—When specifying a forge gauge, kilograms and grams are the industry standard unit of measurement and will be used as an exception for this specific test method. For this reason, ounce and pounds equivalents are listed in parentheses.

6.5 *Hot Water Temperature Control Valve,* to maintain and limit mixed hot water to the prerinse spray valve during testing. It shall have a double throttling design to control both the hot and cold water supply to the mixed outlet. The flow characteristics of the valve shall have a resolution temperature control of ±4°F (±2°C) combined with low pressure drop check valves in both the hot and cold water inlets to protect against cross flow.

6.6 *Pressure Gauge,* for measuring pressure of water to the prerinse spray valve. The gauge shall have a resolution of 0.5 psig (3.4 kPa) and a maximum uncertainty of 1 % of the measured value.

6.7 *Spray Disc*—A 10-in. diameter disc made of acrylic or similar material used as a target during the force test. The spray disc will be rigidly attached to the force gauge and be 4.0 ± 0.4 oz (113.44 ± 11.45 g) and at a thickness of 0.08 ± 0.004 in. (2.03 ± 0.1 mm).

6.8 *Spring-Style Prerinse Unit, Deck-Mounted,* with a 36-in. (914.4-mm) flex hose which will have the testing sample prerinse spray valve attach at the end of the flex hose. See Fig. 1.

6.9 *Stopwatch,* with a 0.1-s resolution.

7. Reagents and Materials

7.1 Water used will be from the local municipal water supply.

8. Sampling

8.1 *Prerinse Spray Valve*—Three representative production models shall be selected for performance testing.

9. Preparation of Apparatus

9.1 Attach the prerinse spray valve to a 36-in., spring-style (flex tubing) prerinse spray valve in accordance with the manufacturer's instructions. The minimum flow rate of the flex tubing, with no prerinse spray valve connected, shall be 3.5 gpm (13.25 L/min) at a pressure of 60 ± 2 psi (413.7 ± 13.8 kPa).

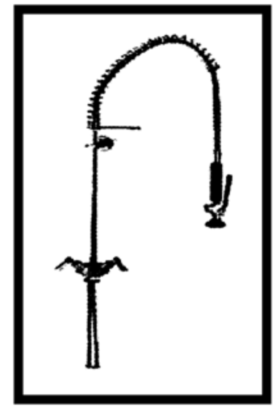

FIG. 1 Illustration of Spring-Style, Deck-Mounted Prerinse Spray Valve

NOTE 3—Specifying a minimum flow rate for the flex tubing ensures that the prerinse spray valve is performing to the manufacturer's specifications and prevents the flex tubing from dictating the flow rate of the prerinse spray valve.

9.2 Connect the mixing valve to the municipal water supply and set the mixing valve to maintain an outlet water temperature of 60.0 ± 10.0°F (15.6 ± 2.6°C). The mixing valve shall be located within 6 ft of the inlet of the flex tubing.

9.3 Install a water line pressure regulator down stream of the mixing valve at the base of the flex tubing. Adjust the pressure regulator so that the water line pressure to the prerinse spray valve can be maintained at 60 ± 2 psi (2.9 ± 0.5 kPa) when water is flowing through the prerinse spray valve.

9.4 Install a temperature sensor in the water line down stream from the mixing valve. The sensors should be installed with the probe immersed in the water. See Fig. 2 for a schematic of the setup for the water supply, mixing valve, pressure regulator, and gauge that are used for testing the prerinse spray valves.

NOTE 4—Install the thermocouple probe described in 9.4 downstream from the temperature mixing valve and upstream from the prerinse spray valve. The thermocouple probe must be installed so that the thermocouple probe is immersed in the incoming water. A compression fitting or equivalent connection should be used to secure the thermocouple without leaks or flow restriction.

9.5 *Force Test Apparatus:*

9.5.1 Rigidly attach a 10 ± 0.25 in. (254 ± 6.4 mm) diameter disc (spray disc) to the force gauge. An example of a suitable rigid connection is illustrated in Fig. 3, where a flat top 'tip' is glued to the center of the spray disc.

9.5.2 Securely mount the force gauge and spray disc apparatus such that the spray disc is positioned in a vertical orientation parallel to the face of the prerinse spray valve. The center of the spray disc and center of the prerinse spray valve faceplate are aligned on the same axis at 8.00 ± 0.25 in. (203.2 ± 6.4 mm) apart. See Fig. 4.

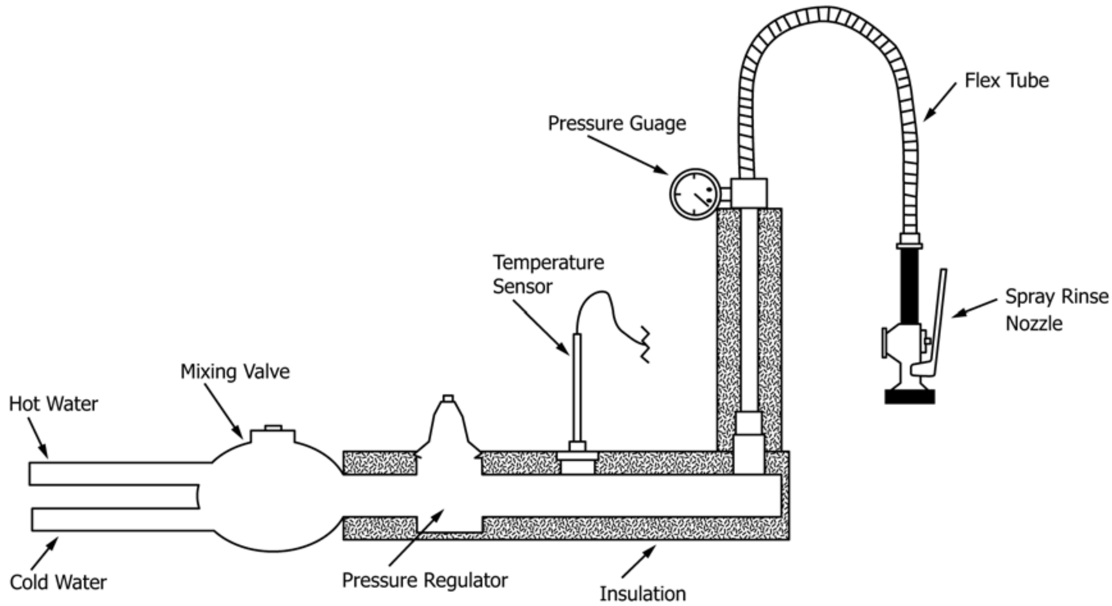

FIG. 2 Sample Schematic of Water Lines and Test Setup

FIG. 3 Attaching the Force Gauge to Spray Disc

9.5.3 The use of a splash guard is not necessary but may be included to help protect the force gauge from splashing water. A splash guard of any design may be used, as long as the guard does not interfere with the operation of the force test rig. An example of a suitable splash guard is as follows:

9.5.3.1 An acrylic sheet 24 by 24 in. (610 by 610 mm) in size with a thickness of 0.08 in. (2.0 mm). The sheet has a 1-in. (25.4 mm) diameter hole in the center of the sheet, and a 0.5 in. (12.7 mm) wide slot cut in the sheet from one edge of the sheet to the center hole. The slot enables proper positioning of the force gauge and 10-in. spray disc without the need to detach the spray disc from the gauge. An example of a splash guard installation is shown in Fig. 5.

9.5.3.2 The splash guard should be installed vertically between the spray disc and the force gauge.

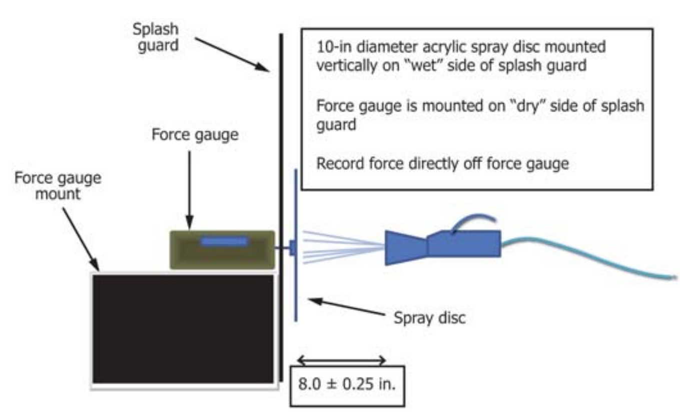

FIG. 4 Force Test Apparatus Diagram (Side View)

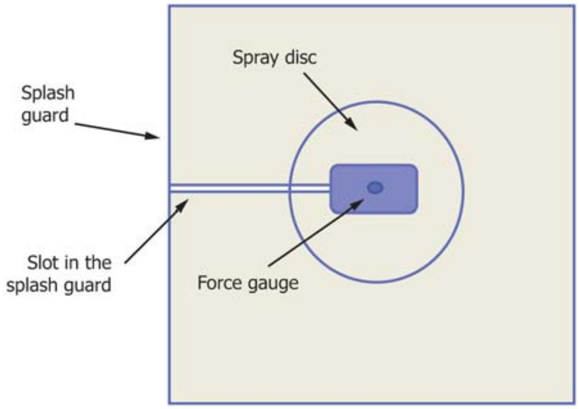

FIG. 5 Force Test Apparatus Diagram (Front View)

10. Procedure

10.1 *General:*

10.1.1 The following shall be obtained and recorded for each run of every test:

10.1.1.1 Water temperature (°F),

10.1.1.2 Dynamic water pressure (psi),

10.1.1.3 Time (min), and

10.1.1.4 Water flow rate (gpm).

10.2 *Prerinse Spray Valve Flow Rate Test:*

10.2.1 This procedure is comprised of a minimum of three separate test runs at the specified water temperature and pressure. Additional test runs may be necessary to obtain the required precision for the reported test results (Annex 1). The reported values of the flow rate test shall be the average of the test runs.

10.2.2 Ensure water is supplied at a flowing water pressure of 60 ± 2 psi (413.7 ± 13.8 kPa) and at a temperature of 60.0 ± 10.0°F (15.6 ± 2.6°C).

10.2.3 Weigh and record the weight of the empty carboy prior to testing (or equivalent 5-gal (19-L) container).

10.2.4 Hold the prerinse spray valve over the opening of the carboy container. Squeeze the prerinse spray valve handle to allow maximum flow and begin recording the time elapsed. At the end of 1 min, stop the water flow and record the weight of the water and container and subtract the weight of the container. Use the weight of water to calculate the flow rate based on the formula provided in 11.3.1.

NOTE 5—Maximum flow may not occur when the handle is fully depressed.

10.2.5 Repeat 10.2.2 – 10.2.4 two additional times. Additional tests may be needed to obtain an uncertainty less than 10 % by following the calculations in Annex A1.

10.2.6 Report the average flow rate measured and confirm that it is within 5 % of the manufacturers rated flow rate. If the difference is greater than 5 %, all further testing ceases and the manufacturer shall be contacted. The manufacturer may make appropriate changes or adjustments to the prerinse spray valve.

10.3 *Spray Force Test:*

10.3.1 This procedure is comprised of a minimum of three separate test runs at the specified water temperature and pressure. Additional test runs may be necessary to obtain the required precision for the reported test results (Annex A1). The reported values of the force test shall be the average of the test runs.

10.3.2 Test the prerinse spray valve for force at a flowing water pressure of 60.0 ± 2.0 psi (413.7 ± 13.8 kPa) while the prerinse spray valve is at its maximum flow rate and an average water temperature of 60.0 ± 10.0°F (15.6 ± 2.6°C).

10.3.3 Prior to testing, calibrate the force gauge using the gauge manufacturer's recommendations. The margin of error in compression mode should not exceed ±2 g-force (0.071 oz-force). If the unit is out of calibration, make the necessary adjustments to the force gauge.

10.3.4 To begin the force test, initiate the flow of water from the prerinse spray valve toward the center of the test disc.

10.3.5 Maintain water flow from the prerinse spray valve for at least 5 s or until force readings stabilize.

10.3.6 After the prerinse spray valve has flowed for at least 5 s, record the average force gauge measurement over the next 15 s to the nearest 0.025 oz-force (0.7 g-force).

10.3.7 If the prerinse spray valve has multiple modes, force shall be tested in accordance with this test procedure for each mode.

10.3.8 Repeat 10.3.2 – 10.3.6 an additional two times. Additional tests may be needed to obtain an uncertainty less than 10 % by following the calculations in Annex A1.

10.3.9 The average force shall be determined from the test data collected from the required sample size.

11. Calculation and Report

11.1 *Test Prerinse Spray Valve*—Summarize the physical and operating characteristic of the prerinse spray valve.

11.2 *Apparatus and Procedure*—Confirm that the testing apparatus conformed to all of the specifications in Section 9. Describe any deviations from those specifications.

11.3 *Flow Rate Test:*

11.3.1 Calculate and report the nozzle flow rate based on:

$$Q_{nozzle} = \frac{W_{water}}{8.337\frac{\text{lb}}{\text{gal}}\left(1.000\frac{\text{kg}}{\text{L}}\right)} \quad (1)$$

where:

Q_{nozzle} = nozzle flow rate, gpm (L/min), and
W_{water} = weight of the water collected in 1 min, lb (kg).

11.3.2 Report the water temperature and water line pressure.

11.4 *Force Test:*

11.4.1 Report the force obtained from the digital force gauge in ounces for each replicate of the prerinse spray valves tested.

11.4.2 Calculate and report the average force of the nozzles tested in ounces (oz) to the nearest 0.1 oz-force (2.83 g-force).

12. Precision and Bias

12.1 *Precision:*

12.1.1 *Repeatability* (within laboratory, same operator and equipment)—The percent uncertainty in each result has been specified to be no greater than ±5 %, based on at least three test runs.

12.1.2 *Reproducibility* (multiple laboratories)—The interlaboratory precision of the procedure in this test method for measuring each reported parameter is being determined.

12.2 *Bias*—No statement can be made concerning the bias of the procedures in this test method because there are no accepted reference values for the parameters reported.

13. Keywords

13.1 gallons per minute; force; force gauge; force test; prerinse spray valve; pre-rinse spray valve; prerinse; pre-rinse; spray force; spray valve; test method

ANNEX

(Mandatory Information)

A1. PROCEDURE FOR DETERMINING THE UNCERTAINTY IN REPORTED TEST RESULTS

NOTE A1.1—This procedure is based on the ASHRAE method for determining the confidence interval for the average of several test results (ASHRAE Guideline 2-1986(RA90)). It should only be applied to test results that have been obtained within the tolerances prescribed in this method (for example, thermocouples calibrated, appliance operating within 5 % of rated input during the test run).

A1.1 For the flow rate test results, the uncertainty in the averages of at least three test runs is reported. For each test run, the uncertainty of the flow rate test must be no greater than ±5 % before any of the parameters for that flow rate test run can be reported.

A1.2 The uncertainty in a reported result is a measure of its precision. If, for example, the gpm flow rate for the prerinse spray valve is 1.6 gpm at 60 psi, the uncertainty must not be greater than ±0.08 gpm. Thus, the true gpm flow rate is between 1.52 and 1.68 gpm. Therefore, interval is determined at the 95 % confidence level, which means that there is only a 1 in 20 chance that the true gpm flow rate could be outside of this interval.

A1.3 Calculating the uncertainty not only guarantees the maximum uncertainty in the reported results, but is also used to determine how many test runs are needed to satisfy this requirement. The uncertainty is calculated from the standard deviation of three or more test results and a factor from Table A1.1, which lists the number of test results used to calculate the average. The percent uncertainty is the ratio of the uncertainty to the average expressed as a percent.

A1.4 For the force test results, the uncertainty in the averages of at least three test runs is reported using the same formulas in A1.5.1 – A1.5.10. For each test run, the uncertainty of the flow rate test must be no greater than ±5 % before any of the parameters for that flow rate test run can be reported.

TABLE A1.1 Uncertainty Factors

Test Results, *n*	Uncertainty Factor, *Cn*
3	2.48
4	1.59
5	1.24
6	1.05
7	0.92
8	0.84
9	0.77
10	0.72

A1.5 *Procedure* :

A1.5.1 *Step 1*—Calculate the average and the standard deviation for the test results (gpm flow rate or force) using the results of the first three test runs, as follows:

A1.5.1.1 The formula for the average (three test runs) is as follows:

$$Xa_3 = (1/3) \times (X_1 + X_2 + X_3) \quad \text{(A1.1)}$$

where:

Xa_3 = average of results for three test runs, and
X_1, X_2, X_3 = results for each test run.

A1.5.1.2 The formula for the sample standard deviation (three test runs) is as follows:

$$S_3 = \left(1/\sqrt{2}\right) \times \sqrt{(A_3 - B_3)} \quad \text{(A1.2)}$$

where:

S_3 = standard deviation of results for three test runs,
A_3 = $(X_1)^2 + (X_2)^2 + (X_3)^2$, and
B_3 = $(1/3) \times (X_1 + X_2 + X_3)^2$.

NOTE A1.2—The formulas may be used to calculate the average and sample standard deviation. However, a calculator with statistical function is recommended, in which case be sure to use the sample standard deviation function. The population standard deviation function will result in an error in the uncertainty.

NOTE A1.3—The "*A*" quantity is the sum of the squares of each test result, and the " *B*" quantity is the square of the sum of all test results multiplied by a constant (⅓ in this case).

A1.5.2 *Step 2*—Calculate the absolute uncertainty in the average for each parameter listed in Step 1. Multiply the standard deviation calculated in Step 1 by the uncertainty factor corresponding to three test results from Table A1.1.

A1.5.2.1 The formula for the absolute uncertainty (three test runs) is as follows:

$$U_3 = C_3 \times S_3 \quad \text{(A1.3)}$$

$$U_3 = 2.48 \times S_3$$

where:

U_3 = absolute uncertainty in average for three test runs, and
C_3 = uncertainty factor for three test runs (Table A1.1).

A1.5.3 *Step 3*—Calculate the percent uncertainty in each parameter average using the averages from Step 1 and the absolute uncertainties from Step 2.

A1.5.3.1 The formula for the percent uncertainty (three test runs) is as follows:

$$\%U_3 = (U_3/Xa_3) \times 100\,\% \quad (A1.4)$$

where:

$\%U_3$ = percent uncertainty in average for three test runs,
U_3 = absolute uncertainty in average for three test runs, and
Xa_3 = average of three test runs.

A1.5.4 *Step 4*—If the percent uncertainty, $\%U_3$, is not greater than ±5 % for the gpm flow rate or ±10 % for force, report the average for these parameters along with their corresponding absolute uncertainty, U_3, in the results reporting page in the following format:

$$Xa_3 \pm U_3$$

If the percent uncertainty is greater than required precision, proceed to Step 5.

A1.5.5 *Step 5*—Run a fourth test for the gpm flow rate or force test if the percent uncertainty was greater than ±5 % for the gpm flow rate or ±10 % for force.

A1.5.6 *Step 6*—When a fourth test is run, calculate the average and standard deviation for test results using a calculator or the following formulas:

A1.5.6.1 The formula for the average (four test runs) is as follows:

$$Xa_4 = (1/4) \times (X_1 + X_2 + X_3 + X_4) \quad (A1.5)$$

where:

Xa_4 = average of results for four test runs, and
X_1, X_2, X_3, X_4 = results for each test run.

A1.5.6.2 The formula for the standard deviation (four test runs) is as follows:

$$S_4 = \left(1/\sqrt{3}\right) \times \sqrt{(A_4 - B_4)} \quad (A1.6)$$

where:

S_4 = standard deviation of results for four test runs,
A_4 = $(X_1)^2 + (X_2)^2 + (X_3)^2 + (X_4)^2$, and
B_4 = $(1/4) \times (X_1 + X_2 + X_3 + X_4)^2$.

A1.5.7 *Step 7*—Calculate the absolute uncertainty in the average for each parameter listed in Step 1. Multiply the standard deviation calculated in Step 6 by the uncertainty factor for four test results from Table A1.1.

A1.5.7.1 The formula for the absolute uncertainty (four test runs) is as follows:

$$U_4 = C_4 \times S_4 \quad (A1.7)$$

$$U_4 = 1.59 \times S_4$$

where:

U_4 = absolute uncertainty in average for four test runs, and
C_4 = uncertainty factor for four test runs (Table A1.1).

A1.5.8 *Step 8*—Calculate the percent uncertainty in the parameter averages using the averages from Step 6 and the absolute uncertainties from Step 7.

A1.5.8.1 The formula for the percent uncertainty (four test runs) is as follows:

$$\%U_4 = (U_4/Xa_4) \times 100\,\% \quad (A1.8)$$

where:

$\%U_4$ = percent uncertainty in average for four test runs,
U_4 = absolute uncertainty in average for four test runs, and
Xa_4 = average of four test runs.

A1.5.9 *Step 9*—If the percent uncertainty, $\%U_4$, is not greater than ±5 % for the gpm flow rate or ±10 % for force, report the average for these parameters along with their corresponding absolute uncertainty, U_4, in the results reporting page in the following format:

$$Xa_4 \pm U_4$$

If the percent uncertainty is greater than ±5 % for the gpm flow rate or ±10 % for force, proceed to Step 10.

A1.5.10 *Step 10*—The steps required for five or more test runs are the same as those previously described. More general formulas are listed as follows for calculating the average, standard deviation, absolute uncertainty, and percent uncertainty.

A1.5.10.1 The formula for the average (*n* test runs) is as follows:

$$Xa_n = (1/n) \times (X_1 + X_2 + X_3 + X_4 + \ldots + X_n) \quad (A1.9)$$

where:

n = number of test runs,
Xa_n = average of results of n test runs, and
X_1, X_2, X_3, X_4 ... X_n = results for each test run.

A1.5.10.2 The formula for the standard deviation (*n* test runs) is as follows:

$$S_n = \left(1/\sqrt{(n-1)}\right) \times \left(\sqrt{A_n - B_n}\right) \quad (A1.10)$$

where:

S_n = standard deviation of results for n test runs,
A_n = $(X_1)^2 + (X_2)^2 + (X_3)^2 + (X_4)^2 + \ldots + (X_n)^2$, and
B_n = $(1/n) \times (X_1 + X_2 + X_3 + X_4 + \ldots + X_n)^2$.

A1.5.10.3 The formula for the absolute uncertainty (*n* test runs) is as follows:

$$U_n = C_n \times S_n \quad (A1.11)$$

where:

U_n = absolute uncertainty in average for n test runs, and
C_n = uncertainty factor for n test runs (Table A1.1).

A1.5.10.4 The formula for the percent uncertainty (*n* test runs) is as follows:

$$\%U_n = (U_n/Xa_n) \times 100\,\% \quad (A1.12)$$

where:

$\%U_n$ = percent uncertainty in average for n test runs,
U_n = absolute uncertainty in average for n test runs, and

Xa_n = average of n test runs.

A1.5.10.5 When the percent uncertainty, $\%U_n$, is less than or equal to ±5 % for the gpm flow rate or ±10 % for force, report the average for these parameters along with their corresponding absolute uncertainty, U_n, in the results reporting page in the following format:

$$Xa_n \pm U_n$$

NOTE A1.4—The researcher may compute a test result that deviates significantly from the other test results. Such a result should be discarded only if there is some physical evidence that the test run was not performed according to the conditions specified in this method. For example, the water psi was out of calibration, the water temperature was not in the accepted range, or the plates with the dried tomato sauce had not dry long enough. To ensure all results are obtained under approximately the same conditions, it is good practice to monitor those test conditions specified in this method.

APPENDIX

(Nonmandatory Information)

X1. CLEANABILITY TEST

INTRODUCTION

This cleanability test procedure has been removed from the main body of the test method to Appendix X1 and has been replaced by 10.3 (spray force test).

The following procedure evaluates the time to clean dried tomato sauce from dinner plates. The intent of the test was to evaluate the prerinse spray valves cleanability (effectiveness) when removing a standardized soil from dinner plates and has served as a metric for evaluating prerinse spray valve efficacy in the absence of other performance ratings.

Subsequent research sponsored by WaterSense has shown that the tomato sauce cleaning times have little relation to user satisfaction or prerinse spray valve usage time. The tomato sauce test procedure is presented below for reference purposes only.

X1.1 Scope

X1.1.1 This test method covers the cleanability of prerinse spray valves. The food service operator can use this evaluation to select a prerinse spray valve and understand its cleaning effectiveness.

X1.2 Terminology

X1.2.1 *cleanability*—the effectiveness of the prerinse prerinse spray valve to remove soil from the plate before it is placed in a dishwashing machine.

X1.3 Summary of Test Method

X1.3.1 The spray valve's cleanability (effectiveness) is determined at 60 ± 1 psi (2.9 ± 0.5 kPa), with a water temperature of 120 ± 4°F (49 ± 2°C).

X1.4 Significance and Use

X1.4.1 The cleanability test is used to verify the prerinse spray valve's effectiveness at cleaning the plates before they are sent into the dishwashing machine.

X1.5 Apparatus

X1.5.1 *Calibrated Exposed Junction Thermocouple Probes,* with a range from 50 to 200°F (10 to 93°C), with a resolution of 0.2°F (0.1°C) and an uncertainty of 1.0°F (0.5°C), for measuring water line temperatures. Calibrated K-type 24-GA thermocouple wire with stainless steel sheath and ceramic insulation is the recommended choice for measuring the water line temperatures. The thermocouple probe can be fed through a compression fitting so as to submerse exposed junction in the water lines.

X1.5.2 *Measuring Spoons,* used to portion out one level tablespoon of tomato sauce on each plate for the cleanability test.

X1.5.3 *Pressure Gauge,* for measuring pressure of water to the prerinse spray valve. The gauge shall have a resolution of 0.5 psig (3.4 kPa) and a maximum uncertainty of 1 % of the measured value.

X1.5.4 *Spring-Style Prerinse Unit, Deck-Mounted,* with a 36-in. (915-mm) flex hose which will have the test prerinse spray valve attach at the end of the flex hose. See Fig. 1.

X1.5.5 *Stopwatch,* with a 0.1-s resolution.

X1.6 Reagents and Materials

X1.6.1 *Tomato Paste,* shall be 100 % pure and shall have a moisture content of 70 ± 2.5 %. Stabilize paste at room temperature (75 ± 5°F (24 ± 3°C)).

X1.6.1.1 Gravimetric moisture analysis shall be performed as follows: To determine moisture content, place a 1-lb sample of the test food on a dry, aluminum sheet pan and place the pan in a convection drying oven at a temperature of 220 ± 5°F for a period of 24 h. Weigh the sample before it is placed in the oven and after it is removed and determine the percent moisture content based on the percent weight loss of the sample. The sample must be spread evenly over the surface of the sheet pan in order for all of the moisture to evaporate during drying and it is permissible to spread the sample on top of baking paper in order to protect the sheet pan and simplify cleanup.

X1.6.2 *Tomato Sauce,* shall be comprised of tomato paste and water. Mix 6 oz (175 mL) tomato paste (see X1.6.1) with 10 oz (295 mL) of 75 ± 5°F (24 ± 3°C) water to form the tomato sauce. Stir until mixture becomes consistent.

NOTE X1.1—Testing at the Food Service Technology Center has found that a generic store brand such as "Safeway®" brand or "Albertson's®" brand tomato paste is the preferred test product. National brands tend to have excess tomato skins in the tomato paste, which makes repeatability difficult. Shown in Fig. X1.1 are the two types of tomato paste. The "generic" store brand is on the left, and the "national" brand on the right. The dark spots in the photo on the right (national brand) are the tomato skin flecks, which are more difficult to remove.

X1.6.3 *Plates,* shall be 9-in. (229-mm), white ceramic glazed, with an inside flat diameter of 7-in. (178-mm), weighing an average of 1.3 ± 0.05 lb (590 ± 23 g) each. Sixty plates are required.

X1.6.4 *Dishracks,* to hold the plates with the dried tomato sauce for the cleanability test and in the preparation of the plates to dry the tomato sauce so that the plates can be dried vertically, or acceptable equivalent. Four Metro Mdl P2MO, 20 by 20-in. (508 by 508-mm), peg-type, commercial dishracks, each weighing 4.6 ± 0.1 lb (2.09 ± 0.04 kg).

X1.7 Sampling

X1.7.1 *Prerinse Spray Valve*—Three representative production models shall be selected for performance testing.

X1.8 Preparation of Apparatus

X1.8.1 Install the test prerinse spray valve in accordance with 9.1 – 9.4, and

X1.8.2 Insulate the entire length of the water pipe from the mixing valve to the inlet of the flex tubing with ½-in. foam insulation. The insulation material shall have a thermal resistance (R) value of not less than 4°F × ft^2 × h/Btu (0.7°K × m^2/W).

X1.8.3 *Preparation of the Plates for the Cleanability Test:*

X1.8.3.1 Prepare 60 plates with one leveled tablespoon of tomato sauce on each plate.

X1.8.3.2 The plates are to be dry and stabilized at a room temperature of 75 ± 5°F (24 ± 3°C) before the tomato sauce is portioned onto the plate.

X1.8.3.3 Apply one level tablespoon (15 mL) of tomato sauce as described in X1.6.2 to a plate, and evenly distribute the tomato sauce around the plate by shaking and turning the plate. Portion out the tomato sauce one plate at a time. Make sure that the tomato sauce is not distributed onto the rim/lip of the plate. In addition, do not use a spoon or other utensil to spread the tomato sauce, as this will leave ridges in the sauce on the plate, altering test times. Using a utensil will also pickup some of the sauce and make the amount of sauce on each plate different. See Fig. X1.2 for an illustration of the preparation of the plates.

X1.8.3.4 Place the plates with the tomato sauce in a dish rack to let the tomato sauce dry on the plates at room temperature (75 ± 5°F (24 ± 3°C)). See Fig. X1.3.

NOTE X1.2—This can be accomplished by storing the dish loads in a room with an ambient temperature of 75 ± 5°F (24 ± 3°C). Avoid any circumstances that would result in some dishes being at different temperatures from others, such as being stored in the air path of an HVAC supply register.

X1.8.3.5 Repeat X1.8.3.1 – X1.8.3.4 until all 60 plates are prepared. Allow plates to dry for 24 h before testing.

X1.9 Procedure

X1.9.1 *General:*

X1.9.1.1 The following shall be obtained and recorded for each run of every test:

(1) Water temperature (°F),

(2) Water pressure (psi),

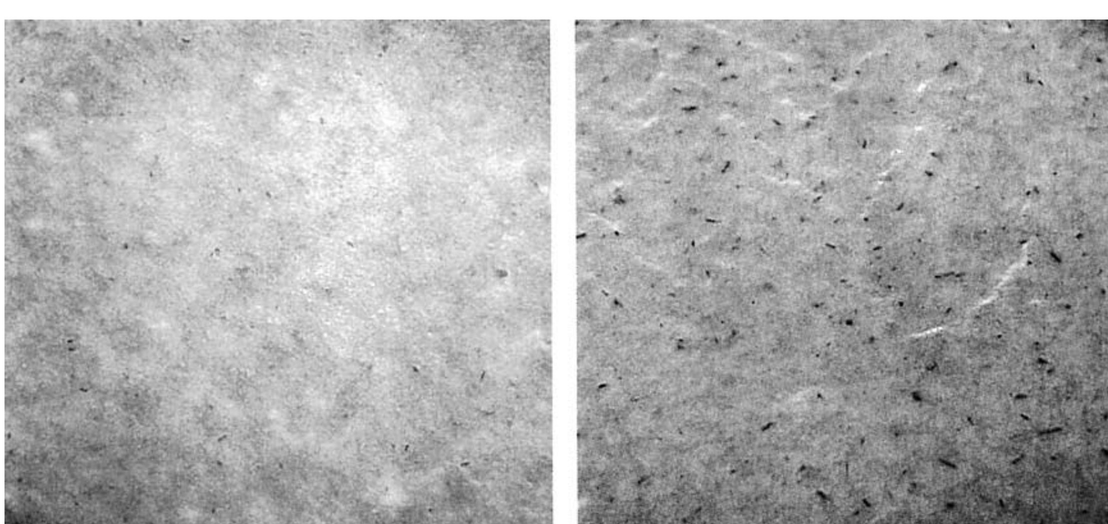

FIG. X1.1 Generic Brand on the Left and the National Brand on the Right

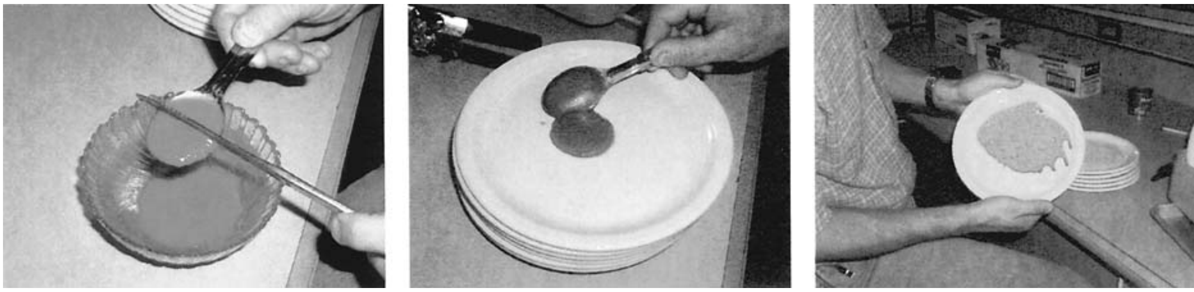

FIG. X1.2 Plate Preparation

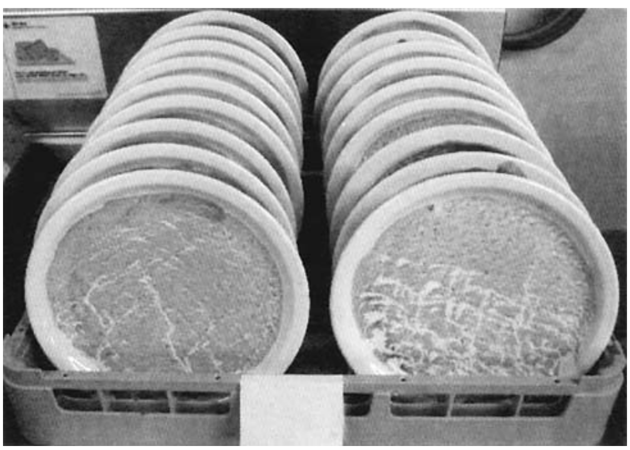

FIG. X1.3 A Rack of Plates Drying

(3) Duration (seconds), and
(4) Water flow rate (gpm).

X1.9.2 *Cleanability Performance Test:*

X1.9.2.1 This procedure shall be performed at the specified water temperature and pressure. The reported values of the cleanability procedure shall be the average of the sixty plates measured in seconds per plate (seconds/plate).

NOTE X1.3—The test can be divided into 3 groups of 20-plate racks if 60 plates are not available.

X1.9.2.2 Ensure that the water supply is at 60 ± 2 psi (2.9 ± 0.5 kPa) and 120 ± 4°F (49 ± 2°C) with the nozzle operating at maximum flow.

X1.9.2.3 Place an empty dishrack under the prerinse spray valve in the sink.

X1.9.2.4 Place a single plate with dried tomato sauce upright in the dishrack. The plate is to be placed in the dishrack at a distance from the tip of the prerinse spray valves to the top of the plate of 11 ± 1 in. (279 ± 25 mm) and 14 ± 1 in. (356 ± 25 mm) from the bottom of the plate. Mark the location of the plate in the dishrack, as this will be where all the testing plates will be placed. Fig. X1.4 shows a drawing plate in the dishrack with the cleaning distances.

X1.9.2.5 Begin spraying the plate as time is recorded on the stopwatch. The plate is to be sprayed in a side to side motion from the top to the bottom of the plate. Repeat this spray pattern until all the tomato sauce has been rinsed from the plate. Record the amount of time required to clear the plate. Fig. X1.5 demonstrates a cleanability test.

X1.9.2.6 Repeat X1.9.2.5 for the 59 remaining test plates.

X1.10 Calculation and Report

X1.10.1 Report the average cleaning time in seconds per plate.

X1.10.2 Report the water temperature and water line pressure.

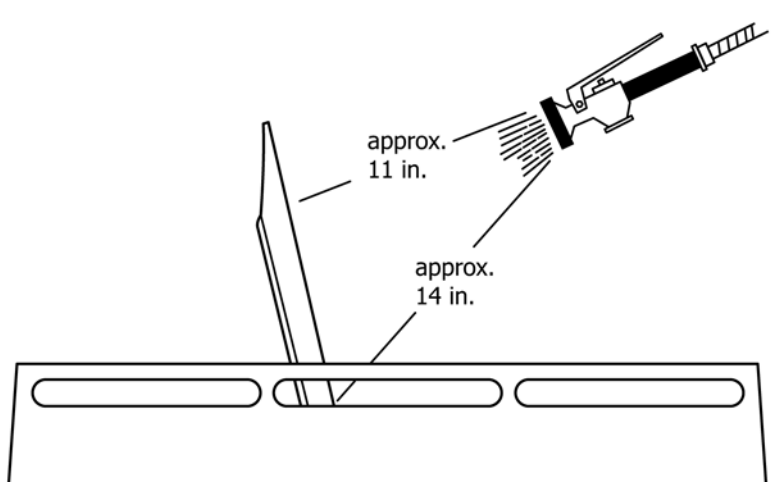

FIG. X1.4 Plate and Sprayer Distance

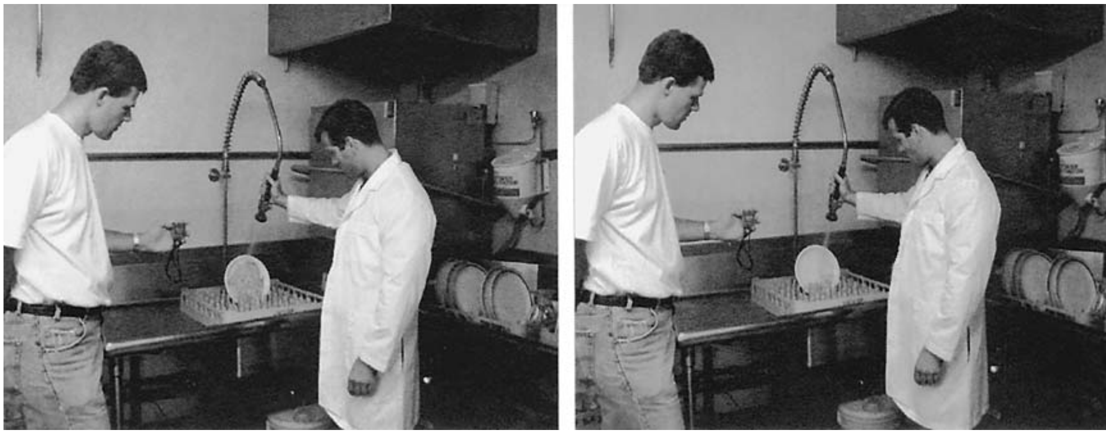

FIG. X1.5 Cleanability Test

TABLE X1.1 Results Reporting Sheets

Manufacturer:		____________			
Manufacturers rated flow rate, gpm (L/min):		____________			
Spray pattern (for example, blade or circular):		____________			
Carboy weight, lb (kg):		____________			
Tomato paste brand:		____________			
Date:		____________			
Test reference number (optional):		____________			
Flow Rate Test Nozzle 1					
Test		Water Weight, lb (kg)		Flow Rate, gpm (L/min)	
Test # 1					
Test # 2					
Test # 3					
Flow Rate Test Nozzle 2					
Test		Water Weight, lb (kg)		Flow Rate, gpm (L/min)	
Test # 1					
Test # 2					
Test # 3					
Flow Rate Test Nozzle 3					
Test		Water Weight, lb (kg)		Flow Rate, gpm (L/min)	
Test # 1					
Test # 2					
Test # 3					
Average Flow Rate (gpm):					
Prerinse Spray Force					
Prerinse Spray Valve 1		Prerinse Spray Valve 2		Prerinse Spray Valve 3	
Replicate #	Force (oz)	Replicate #	Force (oz)	Replicate #	Force (oz)
1		1		1	
2		2		2	
3		3		3	
4		4		4	
5		5		5	
6		6		6	
Average Force (oz):					