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An American National Standard

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 cleanability of prerinse spray valves (here after referred to as spray valves). The food service operator can use this evaluation to select a spray valve and understand its water consumption and cleaning effectiveness.

1.2 The following procedures are included in this test method:

1.2.1 Water consumption (see 10.2).

1.2.2 Cleanability (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

3. Terminology

3.1 *Definitions:*

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

3.1.2 *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.

3.1.3 *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 spray valve is determined at the manufacturer's specified water pressure to verify that the spray valve is operating at the manufacturer's rated flow rate. If the measured 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 spray valve.

4.2 The spray valve's water flow rate is measured at 60 ± 1 psi (2.9 ± 0.5 kPa) settings at a temperature of 120 ± 4°F (49 ± 2°C).

4.3 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).

5. Significance and Use

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

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

6. Apparatus

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

6.2 *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

[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.

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 for 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 *Hot Water Temperature Control Valve,* to maintain and limit mixed hot water to the 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.

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

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

6.7 *Spring-Style Pre-Rinse Unit, Deck-Mounted,* with a 36-in. (915-mm) flex hose which will have the testing sample spray valve attach at the end of the flex hose. See Fig. 1.

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

6.9 *Temperature Sensor,* for measuring water temperature in the range from 50 to 200°F (10 to 93°C), with a resolution of 0.5°F (0.3°C) and an uncertainty of ±1°F (0.5°C).

7. Reagents and Materials

7.1 *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)).

7.2 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.

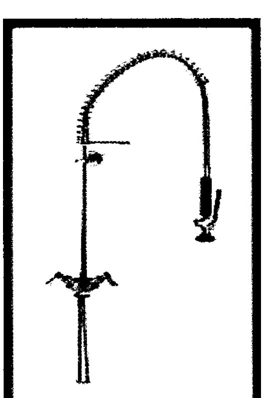

FIG. 1 Illustration of Spring-Style, Deck-Mounted Prerinse Unit

7.3 *Tomato Sauce,* shall be comprised of tomato paste and water. Mix 6 oz (175 mL) tomato paste (see 7.1) with 10 oz (295 mL) of 75 ± 5°F (24 ± 3°C) water to form the tomato sauce. Stir until mixture becomes consistent.

NOTE 2—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. 2 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 (nationals brand) are the tomato skin flecks, which are more difficult to remove.

7.4 *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.

7.5 *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).[3]

8. Sampling

8.1 *Prerinse Spray Valve*—A representative production model shall be selected for performance testing.

9. Preparation of Apparatus

9.1 Attach the spray valve to a 36-in., spring-style (flex tubing) prerinse unit in accordance with the manufacturer's instructions. The minimum flow rate of the flex tubing, with no spray valve connected, shall be 7 gpm (26 L/min) at a pressure of 60 ± 2 psi (2.9 ± 0.5 kPa).

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

9.2 Insulate the entire length of the water pipe from the mixing valve to the inlet of the flex tubing with one-half inch 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).

9.3 Connect the mixing valve to the municipal water supply and set the mixing valve to maintain an outlet water temperature of 120 ± 4°F (49 ± 2°C). The mixing valve shall be located within six feet of the inlet of the flex tubing.

9.4 Install a water line pressure regulator down stream of the mixing valve. Install a pressure gage at the base of the flex

[3] Inter-American® mdl #132 is within the specified weight range and is inexpensive.

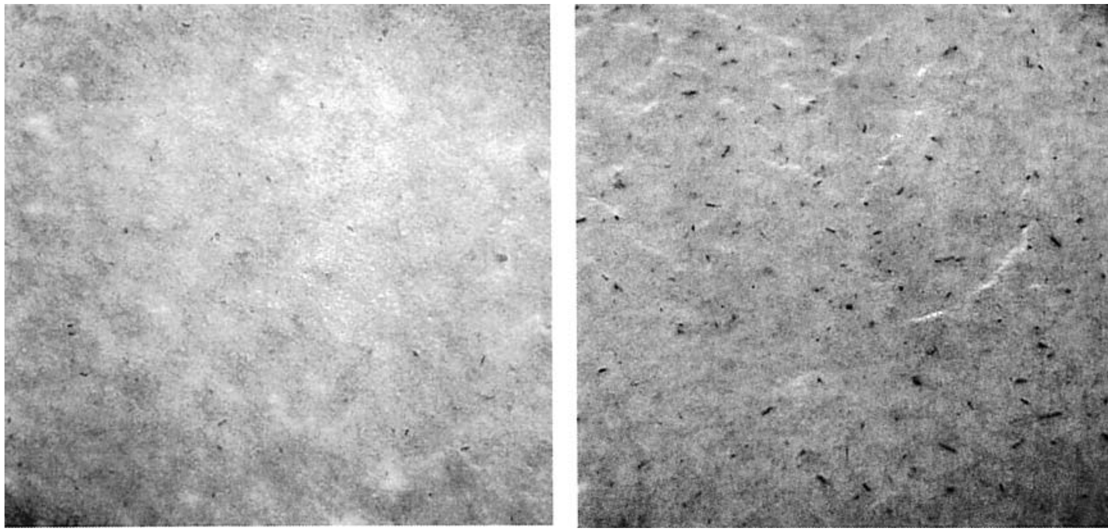

FIG. 2 Generic Brand on the Left and the National Brand on the Right

tubing. Adjust the pressure regulator so that the water line pressure to the prerinse valve can be maintained at 60 ± 2 psi (2.9 ± 0.5 kPa) when the water is flowing to the spray valve, as the lever is fully pressed.

9.5 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. 3 for a schematic of the setup for the water supply, mixing valve, pressure regulator, and gage that are used for testing the spray valves.

NOTE 4—Install the thermocouple probes described in 9.5 into water outlets for the prerinse. The thermocouple probe must be installed so that the thermocouple probe is immersed in the incoming water. A compression fitting should be first installed into the plumbing inlets. A junction fitting may need to be installed in the plumbing line that would be compatible with the compression fitting.

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,

10.1.1.2 Water pressure,

10.1.1.3 Time, and

10.1.1.4 Water flow rate.

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. The reported values of the flow rate test shall be the average of the three test runs.

10.2.2 Ensure water is supplied at 60 ± 2 psi (2.9 ± 0.5 kPa) and 120 ± 4°F (49 ± 2°C).

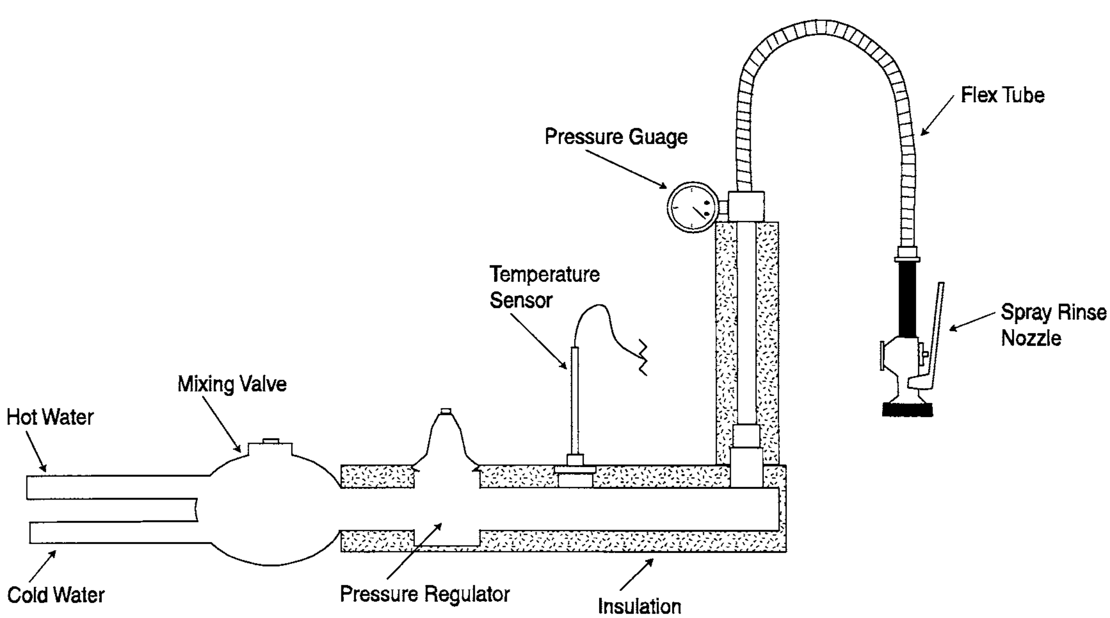

FIG. 3 Schematic of Water Lines and Testing Setup

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

10.2.4 Hold the spray valve over the opening of the carboy container. Squeeze the spray valve handle to allow maximum flow and begin recording the time elapsed. At the end of one minute, record the weight of the water and container and subtract the weight of the container.

10.2.5 Repeat 10.2.2-10.2.4 for the remaining test runs.

10.3 *Preparation of the Plates for the Cleanability Test:*

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

10.3.2 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.

10.3.3 Apply one level tablespoon (15 mL) of tomato sauce as described in 7.3 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. 4 for an illustration of the preparation of the plates.

10.3.4 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. 5.

NOTE 5—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.

10.3.5 Repeat 10.3.2-10.3.4 until all 20 plates are prepared. Allow plates to dry for 24 h before testing.

10.4 *Cleanability Performance Test:*

10.4.1 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 (s/plate).

NOTE 6—The test can be divided into 3 groups of 20-plate racks if sixty plates are not available.

10.4.2 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.

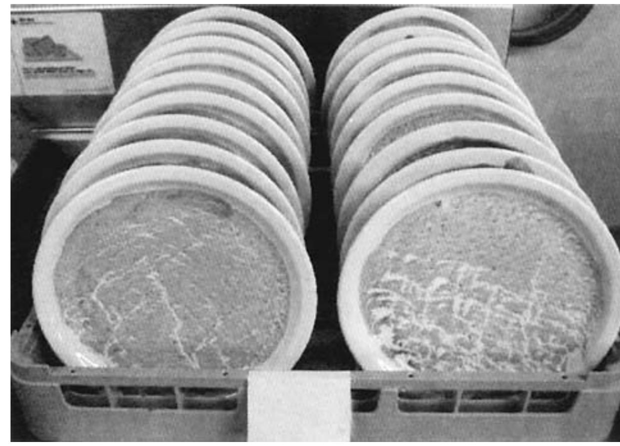

FIG. 5 A Rack of Plates Drying

10.4.3 Place an empty dishrack under the prerinse valve in the sink.

10.4.4 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 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. 6 shows a drawing plate in the dishrack with the cleaning distances.

10.4.5 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. 7 demonstrates a cleanability test.

10.4.6 Repeat 10.4.5 for the 59 remaining test plates.

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:

FIG. 4 Plate Preparation

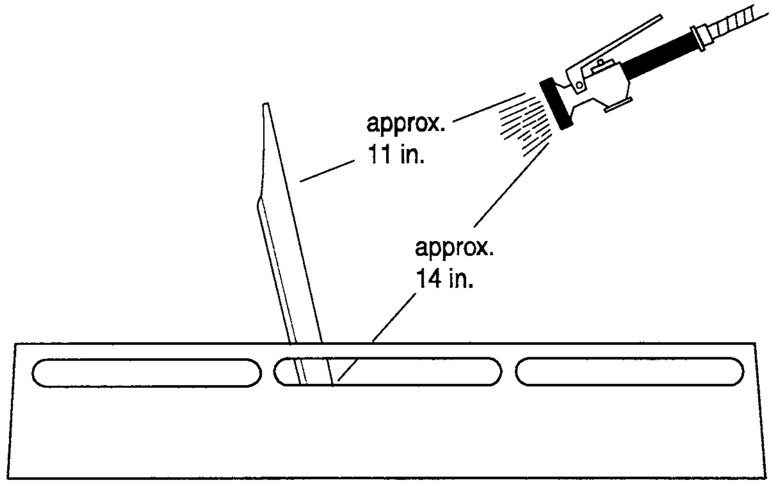

FIG. 6 Plate and Sprayer Distance

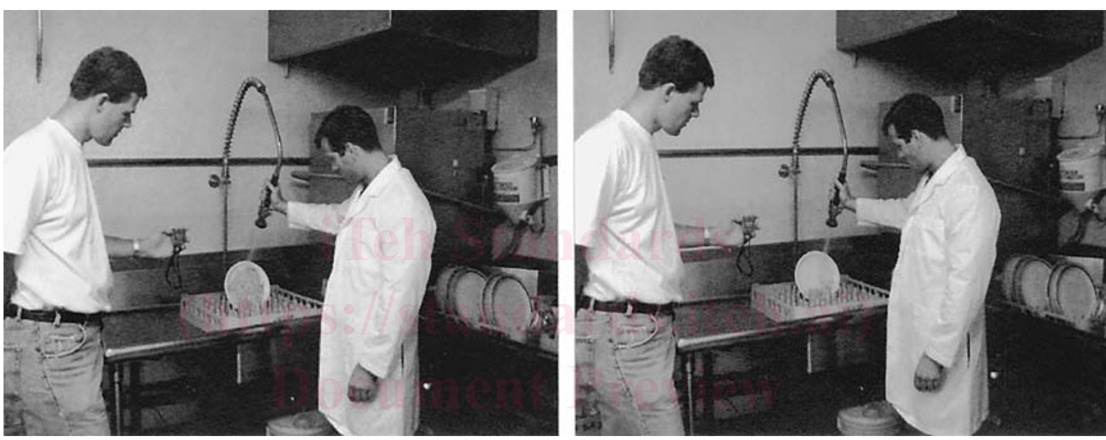

FIG. 7 Cleanability Test

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

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 *Cleanability (Effectiveness) Test:*

11.4.1 Report the average cleaning time in seconds per plate.

11.4.2 Report the water temperature and water line pressure.

12. Precision and Bias

12.1 *Precision:*

12.1.1 *Repeatability* (within laboratory, same operator and equipment)—The repeatability of each reported parameter is being determined.

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 cleanability (effectiveness) dishrack; gallons per minute; prerinse 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 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 *Procedure* :

NOTE A1.2—Section A1.5 shows how to apply this procedure.

A1.4.1 *Step 1*—Calculate the average and the standard deviation for the test results (gpm flow rate) using the results of the first three test runs, as follows:

A1.4.1.1 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.

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

A1.4.1.2 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 A1.3—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 A1.4—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).

A1.4.2 *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.

A1.4.2.1 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).

A1.4.3 *Step 3*—Calculate the percent uncertainty in each parameter average using the averages from Step 1 and the absolute uncertainties from Step 2.

A1.4.3.1 The formula for the percent uncertainty (three test runs) is as follows:

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

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.

A1.4.4 *Step 4*—If the percent uncertainty, $\%U_3$, is not greater than ±10 % for the gpm flow rate, report the average for these parameters along with their corresponding absolute uncertainty, U_3, in the following format:

$$Xa_3 \pm U_3$$

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

A1.4.5 *Step 5*—Run a fourth test for the gpm flow rate if the percent uncertainty was greater than ±10 %.