Designation: F2324 – 13 (Reapproved 2019)

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 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, health, and environmental practices and determine the applicability of regulatory limitations prior to its use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

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.

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[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. 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).

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.

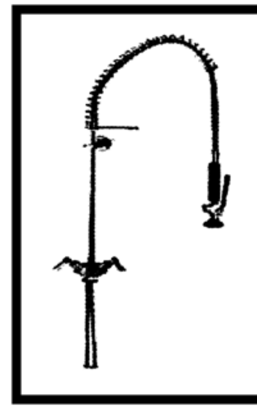

FIG. 1 Illustration of Spring-Style, Deck-Mounted Prerinse Spray Valve

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).

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

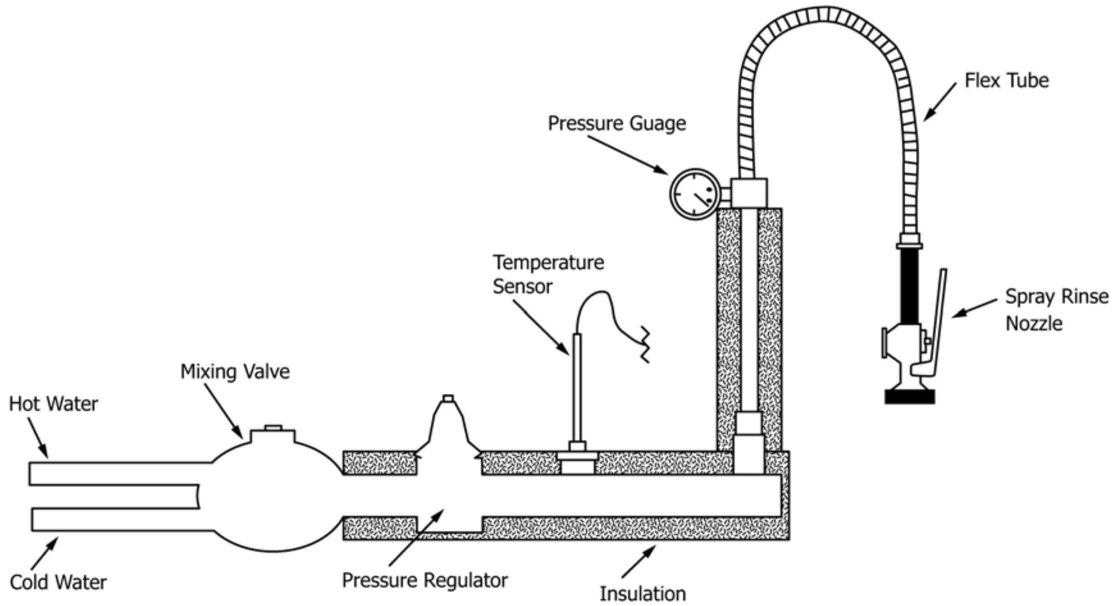

FIG. 2 Sample Schematic of Water Lines and Test Setup

FIG. 3 Attaching the Force Gauge to Spray Disc

faceplate are aligned on the same axis at 8.00 ± 0.25 in. (203.2 ± 6.4 mm) apart. See Fig. 4.

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.

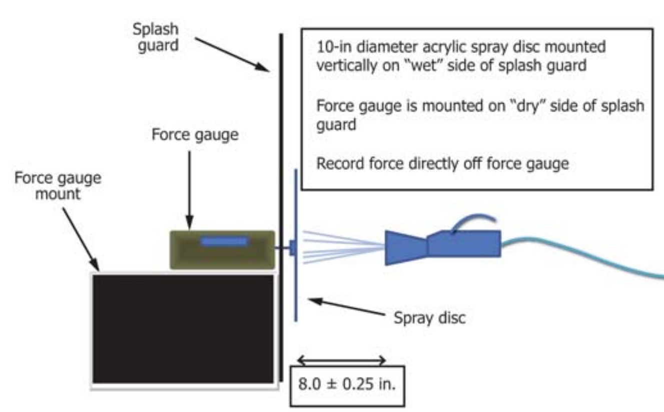

FIG. 4 Force Test Apparatus Diagram (Side View)

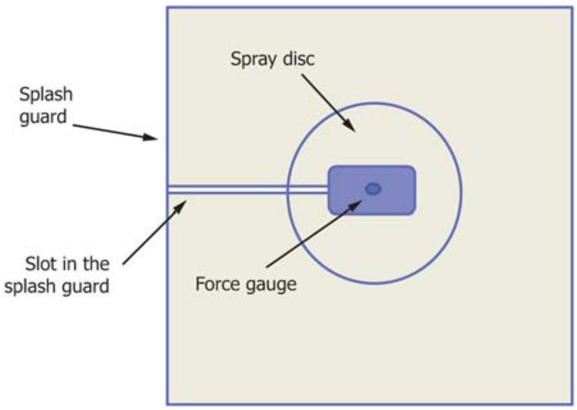

FIG. 5 Force Test Apparatus Diagram (Front View)

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

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.

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 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.

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:

$$U_3 = C_3 \times S_3 \tag{A1.3}$$

$$U_3 = 2.48 \times S_3$$

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:

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

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:

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

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:

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

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:

$$U_4 = C_4 \times S_4 \tag{A1.7}$$

$$U_4 = 1.59 \times S_4$$

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:

$$\%U_4 = (U_4/Xa_4) \times 100\,\% \tag{A1.8}$$

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:

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

where:

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

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

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

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:

$$U_n = C_n \times S_n \tag{A1.11}$$

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:

$$\%U_n = (U_n/Xa_n) \times 100\,\% \tag{A1.12}$$