Operating Salt Spray (Fog) Apparatus â€“ Testing Equipment

Description

Apparatus

4.1 The apparatus required for salt spray (fog) exposure consists of a fog chamber, a salt solution reservoir, a supply of suitably conditioned compressed air, one or more atomizing nozzles, specimen supports, provision for heating the chamber, and necessary means of control. The size and detailed construction of the apparatus are optional, provided the conditions obtained meet the requirements of this practice.
4.2 Drops of solution which accumulate on the ceiling or cover of the chamber shall not be permitted to fall on the specimens being exposed.
4.3 Drops of solution which fall from the specimens shall not be returned to the solution reservoir for respraying.

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4.4 Material of construction shall be such that it will not affect the corrosiveness of the fog.
4.5 All water used for this practice shall conform to Type IV water in Specification D1193 (except that for this practice limits for chlorides and sodium may be ignored). This does not apply to running tap water. All other water will be referred to as reagent grade.

Test Specimens

5.1 The type and number of test specimens to be used, as well as the criteria for the evaluation of the test results, shall be defined in the specifications covering the material or product being exposed or shall be mutually agreed upon between the purchaser and the seller.

Preparation of Test Specimens

6.1 Specimens shall be suitably cleaned. The cleaning method shall be optional depending on the nature of the surface and the contaminants. Care shall be taken that specimens are not recontaminated after cleaning by excessive or careless handling.
6.2 Specimens for the evaluation of paints and other organic coatings shall be prepared in accordance with applicable specification(s) for the material(s) being exposed, or as agreed upon between the purchaser and the supplier. Otherwise, the test specimens shall consist of steel meeting the requirements of Practice D609 and shall be cleaned and prepared for coating in accordance with the applicable procedure of Practice D609.
6.3 Specimens coated with paints or nonmetallic coatings shall not be cleaned or handled excessively prior to test. 6.4 Whenever it is desired to determine the development of corrosion from an abraded area in the paint or organic coating, a scratch or scribed line shall be made through the coating with a sharp instrument so as to expose the underlying metal before testing. The conditions of making the scratch shall be as defined in Test Method D1654, unless otherwise agreed upon between the purchaser and the seller.
6.5 Unless otherwise specified, the cut edges of plated, coated, or duplex materials and areas containing identification marks or in contact with the racks or supports shall be protected with a suitable coating stable under the conditions of the practice.

Position of Specimens During Exposure

7.1 The position of the specimens in the salt spray chamber during the test shall be such that the following conditions are met:
7.1.1 Unless otherwise specified, the specimens shall be supported or suspended between 15 and 30Â° from the vertical and preferably parallel to the principal direction of flow of fog through the chamber, based upon the dominant surface being tested.
7.1.2 The specimens shall not contact each other or any metallic material or any material capable of acting as a wick.

7.1.3 Each specimen shall be placed to permit unencumbered exposure to the fog.
7.1.4 Salt solution from one specimen shall not drip on any other specimen.

Salt Solution

8.1 The salt solution shall be prepared by dissolving 5 6 1 parts by mass of sodium chloride in 95 parts of water conforming to Type IV water in Specification D1193 (except that for this practice limits for chlorides and sodium may be ignored). Careful attention should be given to the chemical content of the salt. The salt used shall be sodium chloride with not more than 0.3 % by mass of total impurities. Halides (Bromide, Fluoride, and Iodide) other than Chloride shall constitute less than 0.1 % by mass of the salt content. Copper content shall be less than 0.3 ppm by mass. Sodium chloride that has had anti-caking agents added shall not be used because such agents may act as corrosion inhibitors. See Table 1 for a listing of these impurity restrictions. Upon agreement between the purchaser and the seller, analysis may be required and limits established for elements or compounds not specified in the chemical composition given above.
8.2 The pH of the salt solution shall be such that when atomized at 35Â°C (95Â°F) the collected solution will be in the pH range from 6.5 to 7.2 (Note 3). Before the solution is atomized it shall be free of suspended solids (Note 4). The pH measurement shall be made at 23 6 3Â°C (73 6 5Â°F) using a suitable glass pH-sensing electrode, reference electrode, and pH meter system in accordance with Test Method E70. pH measurement shall be recorded once daily (except on weekends, or holidays when the salt spray test is not interrupted for exposing, rearranging, or removing test specimens or to check and replenish the solution in the reservoir. The maximum interval between pH measurements shall not exceed 96 h). Only diluted, reagent grade hydrochloric acid (HCl) or reagent grade sodium hydroxide (NaOH) shall be used to adjust the pH.

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Air Supply

9.1 The compressed air supply to the Air Saturator Tower shall be free of grease, oil, and dirt before use by passing through well-maintained filters. (Note 6) This air should be maintained at a sufficient pressure at the base of the Air Saturator Tower to meet the suggested pressures of Table 2 at the top of the Air Saturator Tower.

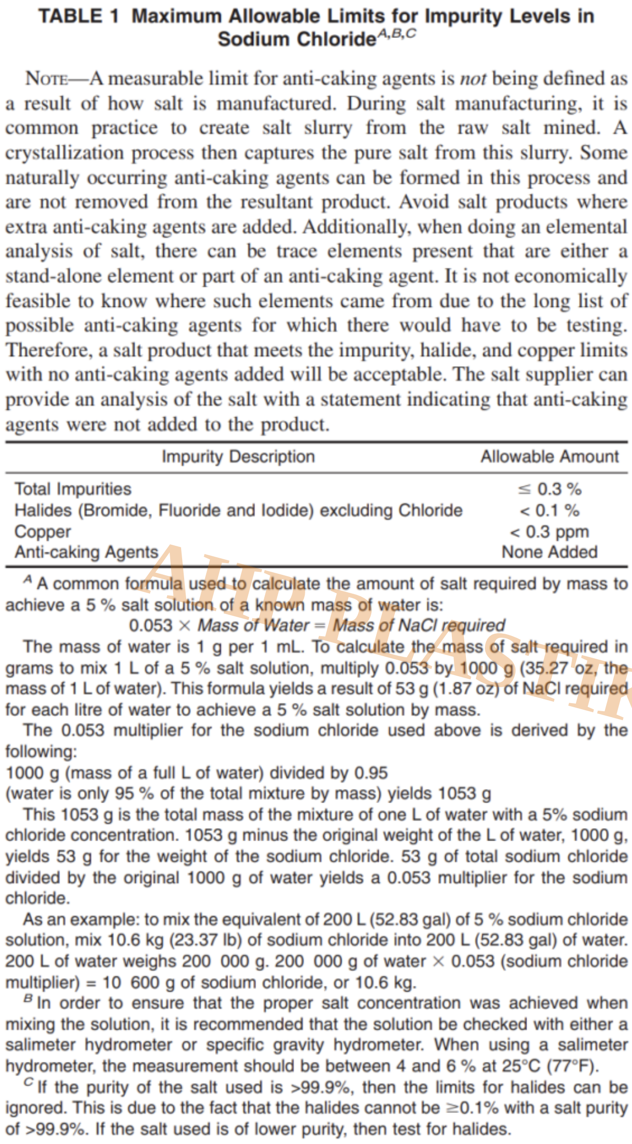

TABLE 1 Maximum Allowable Limits for Impurity Levels in Sodium Chloride[A,B,C]

NOTE—A measurable limit for anti-caking agents is *not* being defined as a result of how salt is manufactured. During salt manufacturing, it is common practice to create salt slurry from the raw salt mined. A crystallization process then captures the pure salt from this slurry. Some naturally occurring anti-caking agents can be formed in this process and are not removed from the resultant product. Avoid salt products where extra anti-caking agents are added. Additionally, when doing an elemental analysis of salt, there can be trace elements present that are either a stand-alone element or part of an anti-caking agent. It is not economically feasible to know where such elements came from due to the long list of possible anti-caking agents for which there would have to be testing. Therefore, a salt product that meets the impurity, halide, and copper limits with no anti-caking agents added will be acceptable. The salt supplier can provide an analysis of the salt with a statement indicating that anti-caking agents were not added to the product.

Impurity Description	Allowable Amount
Total Impurities	≤ 0.3 %
Halides (Bromide, Fluoride and Iodide) excluding Chloride	< 0.1 %
Copper	< 0.3 ppm
Anti-caking Agents	None Added

[A] A common formula used to calculate the amount of salt required by mass to achieve a 5 % salt solution of a known mass of water is:

$$0.053 \times \textit{Mass of Water} = \textit{Mass of NaCl required}$$

The mass of water is 1 g per 1 mL. To calculate the mass of salt required in grams to mix 1 L of a 5 % salt solution, multiply 0.053 by 1000 g (35.27 oz, the mass of 1 L of water). This formula yields a result of 53 g (1.87 oz) of NaCl required for each litre of water to achieve a 5 % salt solution by mass.

The 0.053 multiplier for the sodium chloride used above is derived by the following:

1000 g (mass of a full L of water) divided by 0.95
(water is only 95 % of the total mixture by mass) yields 1053 g

This 1053 g is the total mass of the mixture of one L of water with a 5% sodium chloride concentration. 1053 g minus the original weight of the L of water, 1000 g, yields 53 g for the weight of the sodium chloride. 53 g of total sodium chloride divided by the original 1000 g of water yields a 0.053 multiplier for the sodium chloride.

As an example: to mix the equivalent of 200 L (52.83 gal) of 5 % sodium chloride solution, mix 10.6 kg (23.37 lb) of sodium chloride into 200 L (52.83 gal) of water. 200 L of water weighs 200 000 g. 200 000 g of water × 0.053 (sodium chloride multiplier) = 10 600 g of sodium chloride, or 10.6 kg.

[B] In order to ensure that the proper salt concentration was achieved when mixing the solution, it is recommended that the solution be checked with either a salimeter hydrometer or specific gravity hydrometer. When using a salimeter hydrometer, the measurement should be between 4 and 6 % at 25°C (77°F).

[C] If the purity of the salt used is >99.9%, then the limits for halides can be ignored. This is due to the fact that the halides cannot be ≥0.1% with a salt purity of >99.9%. If the salt used is of lower purity, then test for halides.

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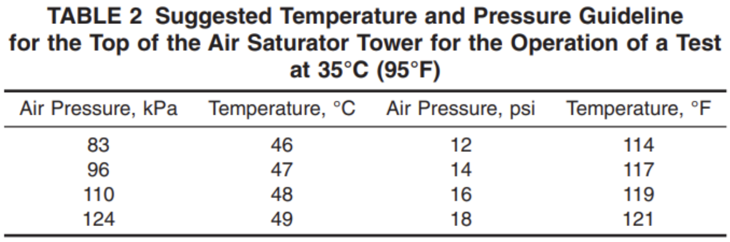

TABLE 2 Suggested Temperature and Pressure Guideline for the Top of the Air Saturator Tower for the Operation of a Test at 35°C (95°F)

Air Pressure, kPa	Temperature, °C	Air Pressure, psi	Temperature, °F
83	46	12	114
96	47	14	117
110	48	16	119
124	49	18	121

9.2 The compressed air supply to the atomizer nozzle or nozzles shall be conditioned by introducing it into the bottom of a tower filled with water. A common method of introducing the air is through an air dispersion device (X1.4.1). The level of the water must be maintained automatically to ensure adequate humidification. It is common practice to maintain the temperature in this tower between 46 and 49Â°C (114â€“121Â°F) to offset the cooling effect of expansion to atmospheric pressure during the atomization process. Table 2 shows the temperature, at different pressures, that are commonly used to offset the cooling effect of expansion to atmospheric pressure.

9.3 Careful attention should be given to the relationship of tower temperature to pressure since this relationship can have a direct impact to maintaining proper collection rates (Note 7). It is preferable to saturate the air at temperatures well above the chamber temperature as insurance of a wet fog as listed in Table 2.

Conditions in the Salt Spray Chamber

10.1 Temperatureâ€”The exposure zone of the salt spray chamber shall be maintained at 35 6 2Â°C (95 6 3Â°F). Each set point and its tolerance represents an operational control point for equilibrium conditions at a single location in the cabinet which may not necessarily represent the uniformity of conditions throughout the cabinet. The temperature within the exposure zone of the closed cabinet shall be recorded (Note 8) at least once daily (except on Saturdays, Sundays, and holidays when the salt spray test is not interrupted for exposing, rearranging, or removing test specimens or to check and replenish the solution in the reservoir)

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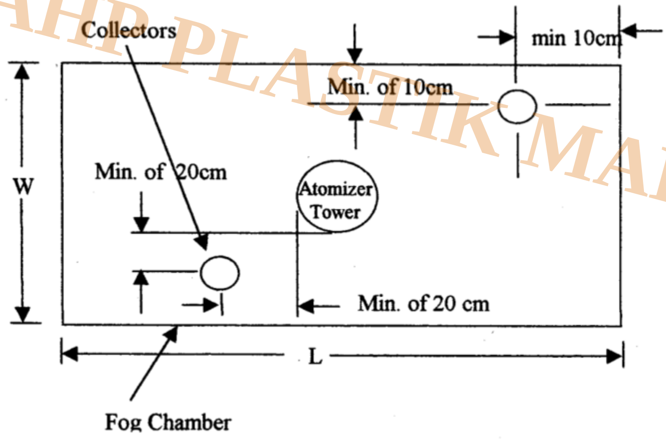


NOTE—This figure shows a typical fog collector arrangement for a single atomizer tower cabinet. The same fog collector arrangement is also applicable for multiple atomizer tower and horizontal ("T" type) atomizer tower cabinet constructions as well.

FIG. 1 Arrangement of Fog Collectors

10.2 Atomization and Quantity of Fogâ€”Place at least two clean fog collectors per atomizer tower within the exposure zone so that no drops of solution will be collected from the test specimens or any other source. Position the collectors in the proximity of the test specimens, one nearest to any nozzle and the other farthest from all nozzles. A typical arrangement is shown in Fig. 1. The fog shall be such that for each 80 cm2 (12.4 in.2) of horizontal collecting area, there will be collected from 1.0 to 2.0 mL of solution per hour based on an average run of at least 16 h (Note 9). The sodium chloride concentration of the collected solution shall be 5 6 1 mass % (Notes 9-11). The pH of the collected solution shall be 6.5 to

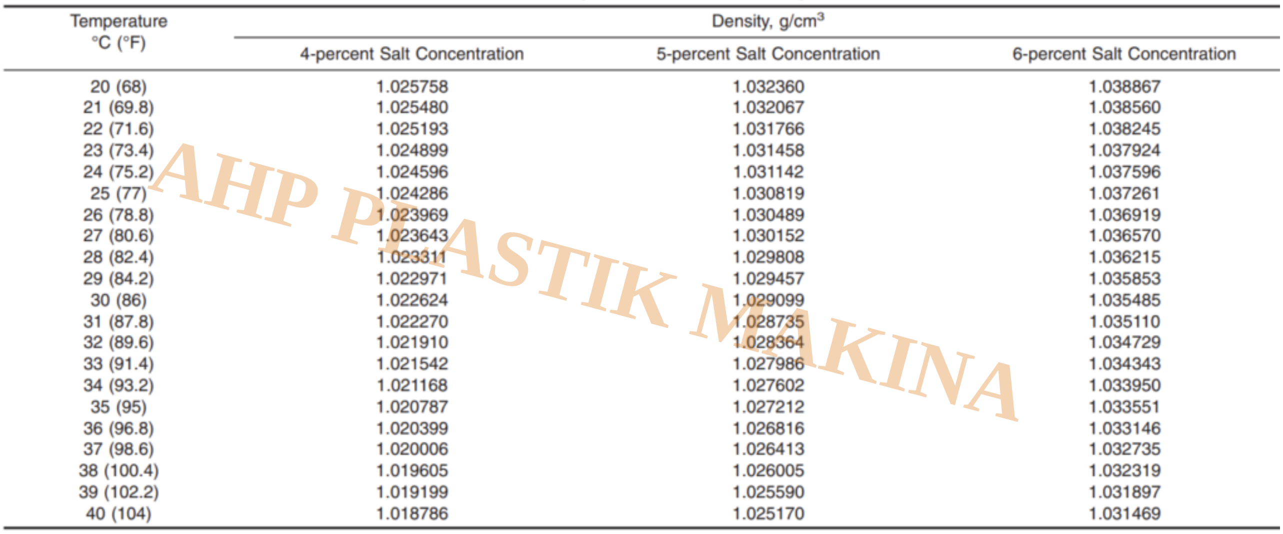
7.2. The pH measurement shall be made as described in 8.2 (Note 3). Both sodium chloride concentration (measured as specific gravity) and volume of condensate collected (measured in mL) shall be recorded once daily (except on weekends, or holidays when the salt spray test is not interrupted for exposing, rearranging, or removing test specimens or to check and replenish the solution in the reservoir. The maximum interval between these data collection measurements shall not exceed 96 h).

10.3 The nozzle or nozzles shall be so directed or baffled that none of the spray can impinge directly on the test specimens.

Continuity of Exposure

11.1 Unless otherwise specified in the specifications covering the material or product being tested, the test shall be continuous for the duration of the entire test period. Continuous operation implies that the chamber be closed and the spray operating continuously except for the short daily interruptions necessary to inspect, rearrange, or remove test specimens, to check and replenish the solution in the reservoir, and to make necessary recordings as described in Section 10.

TABLE 3 Temperature versus Density Data



Temperature °C (°F)	Density, g/cm³		
	4-percent Salt Concentration	5-percent Salt Concentration	6-percent Salt Concentration
20 (68)	1.025758	1.032360	1.038867
21 (69.8)	1.025480	1.032067	1.038560
22 (71.6)	1.025193	1.031766	1.038245
23 (73.4)	1.024899	1.031458	1.037924
24 (75.2)	1.024596	1.031142	1.037596
25 (77)	1.024286	1.030819	1.037261
26 (78.8)	1.023969	1.030489	1.036919
27 (80.6)	1.023643	1.030152	1.036570
28 (82.4)	1.023311	1.029808	1.036215
29 (84.2)	1.022971	1.029457	1.035853
30 (86)	1.022624	1.029099	1.035485
31 (87.8)	1.022270	1.028735	1.035110
32 (89.6)	1.021910	1.028364	1.034729
33 (91.4)	1.021542	1.027986	1.034343
34 (93.2)	1.021168	1.027602	1.033950
35 (95)	1.020787	1.027212	1.033551
36 (96.8)	1.020399	1.026816	1.033146
37 (98.6)	1.020006	1.026413	1.032735
38 (100.4)	1.019605	1.026005	1.032319
39 (102.2)	1.019199	1.025590	1.031897
40 (104)	1.018786	1.025170	1.031469

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Period of Exposure

12.1 The period of exposure shall be as designated by the specifications covering the material or product being tested or as mutually agreed upon between the purchaser and the seller. NOTE 13â€”Recommended exposure periods are to be as agreed upon between the purchaser and the seller, but exposure periods of multiples of 24 h are suggested.

Cleaning of Tested Specimens

13.1 Unless otherwise specified in the specifications covering the material or product being tested, specimens shall be treated as follows at the end of the test:
13.1.1 The specimens shall be carefully removed.
13.2 Specimens may be gently washed or dipped in clean running water not warmer than 38Â°C (100Â°F) to remove salt deposits from their surface, and then immediately dried.

Evaluation of Results

14.1 A careful and immediate examination shall be made as required by the specifications covering the material or product being tested or by agreement between the purchaser and the seller.

Salt Spray Tester

Salt Spray Tester is used to test the anti-erosion quality of the surface of all materials after the rust-proof painting, coating, electroplating, anodizing, and rust-proof greasing .anti corrosion treatment for a variety of materials, corrosion resistance of their products.

Salt Spray Tester is an accelerated corrosion test that produces a corrosive attack to the coated samples in order to predict its suitability in use as a protective finish. The appearance of corrosion products (oxides) is evaluated after a period of time. Test duration depends on the corrosion resistance of the coating; the more corrosion resistant the coating is, the longer the period in testing without showing signs of corrosion. Different coatings have different behavior in salt spray test and consequently, test duration will differ from one type of coating to another.

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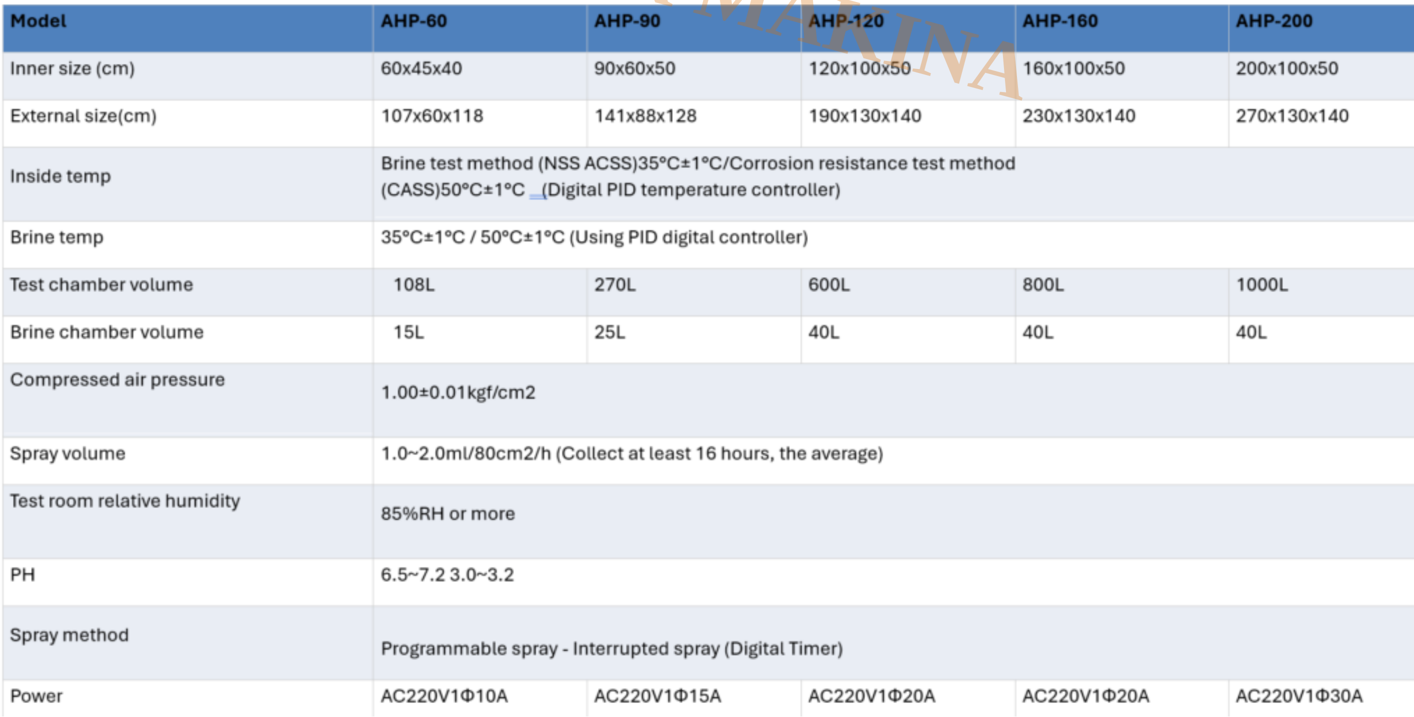

Model	AHP-60	AHP-90	AHP-120	AHP-160	AHP-200
Inner size (cm)	60x45x40	90x60x50	120x100x50	160x100x50	200x100x50
External size(cm)	107x60x118	141x88x128	190x130x140	230x130x140	270x130x140
Inside temp	Brine test method (NSS ACSS)35°C±1°C/Corrosion resistance test method (CASS)50°C±1°C (Digital PID temperature controller)				
Brine temp	35°C±1°C / 50°C±1°C (Using PID digital controller)				
Test chamber volume	108L	270L	600L	800L	1000L
Brine chamber volume	15L	25L	40L	40L	40L
Compressed air pressure	1.00±0.01kgf/cm2				
Spray volume	1.0~2.0ml/80cm2/h (Collect at least 16 hours, the average)				
Test room relative humidity	85%RH or more				
PH	6.5~7.2 3.0~3.2				
Spray method	Programmable spray - Interrupted spray (Digital Timer)				
Power	AC220V1Φ10A	AC220V1Φ15A	AC220V1Φ20A	AC220V1Φ20A	AC220V1Φ30A

Category

1. Equipment for Standards
2. Standards