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An American National Standard

Standard Practice for Maintaining Constant Relative Humidity by Means of Aqueous Glycerin Solutions[1]

This standard is issued under the fixed designation D5032; 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 practice describes a method for obtaining constant relative humidity ranging from 30 to 98 % at temperatures ranging from 0 to 70°C in relatively small containers by means of an aqueous glycerin solution.

1.2 This practice is applicable for closed systems such as environmental conditioning containers.

1.3 This practice is not recommended for the generation of continuous (flowing) streams of constant humidity unless precautionary criteria are followed to ensure source stability.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D618 Practice for Conditioning Plastics for Testing

D4023 Terminology Relating to Humidity Measurements

D6054 Practice for Conditioning Electrical Insulating Materials for Testing

E104 Practice for Maintaining Constant Relative Humidity by Means of Aqueous Solutions

2.2 *Other Documents:*

DIN50008 Constant Climates ~~Over~~over Aqueous Solutions[3]

Part 1: Saturated Salt and Glycerol Solutions

Part 2: Sulfuric Acid Solutions (1981)

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3. Summary of Practice

3.1 Controlled relative humidity environments are generated using mixtures of glycerin and water.

3.2 Practice E104 contains methods for maintaining constant relative humidity environments using aqueous saturated salt solutions or various strength sulfuric acid-water systems.

4. Significance and Use

4.1 Controlled relative humidity environments are important for conditioning materials for shelf-life studies or for investigating the change in physical or dielectric properties after exposure.

4.2 The use of aqueous-glycerin solutions reduces the possibility of contamination of the materials or corrosion of electrode systems which would be more likely to result from saturated salt or acid water solutions.

4.3 Applicable material specifications should state the exposure conditions, including time, temperature and relative ~~humidity,~~humidity that a material should be subjected to before subsequent testing. Typical conditions are given in Practice D618 or D6054.

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[1] This practice is under the jurisdiction of ASTM Committee D09 on Electrical and Electronic Insulating Materials and is the direct responsibility of Subcommittee D09.12 on Electrical Tests.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from *Deutsches Institut fur Normung*, 4-10 *Burggrenzenstrasse Postfach* 1107, D-1000 Berlin, Germany. Also available from American National Standards Institute, 25 W. 43rd St., 4th Floor, New York, NY 10036..

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5. Apparatus

5.1 *Container*, airtight, of a material not acted upon by copper sulfate (or with the glycerin solution contained in a tray made of a material not acted upon by copper sulfate).

5.2 ~~*Refractometer*~~Refract meter, covering the range of 1.33 to 1.47 (sodium) with an accuracy of 0.0003.

6. Glycerin Solution

6.1 Use a good industrial grade of glycerin ("high gravity" and "dynamite" grades ~~are~~have been found to be satisfactory) in distilled water. Calculate the concentration in terms of the refractive index, (R), at 25°C for the desired relative humidity at any temperature between 0 and 70°C as follows:

$$R = (\sqrt{(100 + A)^2 + A^2 - (H + A)^2} - A)\frac{1}{715.3} + 1.3333 \quad (1)$$

where:

T = temperature of the solution, °C,
A = $25.60 - 0.1950T + 0.0008T^2$, and
H = relative humidity, percent.

6.1.1 This will give the desired relative humidity with an accuracy of ±0.2 % at a constant temperature of 25°C. At other constant temperatures, the error, if any, may increase with the deviation of the temperature from 25°C. The relative humidity values at 0, 25, 50 and 70°C for a number of refractive index values are given in Table 1. Obtain the refractive index for intermediate values of relative humidity and temperature by plotting curves from the values in the table or by calculating from the above formula.

6.2 To prevent fungus growth in the solution, add about 0.1 % by weight of copper sulfate to the glycerin solution. The most convenient way of measuring the copper sulfate is to prepare a saturated solution in water and add four drops of the saturated solution per 100 mL of the glycerin solution. Use a container, or tray holding the glycerin solution, made of a material that will not react with the copper in the copper sulfate. If the copper is removed, fungus growth can occur, which will cause lowering of the humidity value of the glycerin solution.

6.3 Loss of water through evaporation when the container is ~~open, or by absorption by the material being conditioned, will~~ opened can reduce the humidity value of the solution. The rate of loss with the container open is quite low and is negligible for the normal time the container would be opened for loading and unloading (Note 1~~). A material being conditioned that will absorb a large amount of water may seriously reduce the humidity unless proper precautions are taken. For example, a loss of 0.26 mL water/cubic in.^{3} of a glycerin-water solution adjusted to produce a 96 % relative humidity at 25°C will reduce the humidity by 0.5 % relative humidity. If it is estimated that the reduction in humidity will be greater than desired, one or both of the following may be done: the loading may re reduced below that suggested in 7.5 or the depth of the solution may be increased.~~).

NOTE 1—A solution adjusted to produce a 96 % relative humidity atmosphere at 25°C in an open container, in a still atmosphere of 50 % relative humidity at 25°C, will lose water at the rate of approximately 0.01 mL/h/in.^{2} ~~of solution surface area. This rate will reduce the relative humidity value of a 96 % solution having a depth of 1 in. by 0.5 % relative humidity in 26 h.~~ of solution surface area. This rate will reduce the relative humidity value of a 96 % solution having a depth of 1 in. by 0.5 % relative humidity in 26 h.

6.4 Loss of water by absorption by the material being conditioned, can reduce the humidity value of the solution. Proper precaution must be taken to prevent the reduction of humidity by a material being conditioned that will absorb a large amount of water. If it is estimated that the reduction in humidity will be greater than desired, one or both of the following options must be done: Reduce the loading below that suggested in 7.5 or increase the depth of the solution.

NOTE 2—For example, a loss of 0.26 mL water/in.^{3} of a glycerin-water solution adjusted to produce a 96 % relative humidity at 25°C will reduce the humidity by 0.5 % relative humidity.

TABLE 1 Relative Humidity Over Glycerin Solutions

Refractive Index at 25°C	Relative Humidity, %			
	0°C	25°C	50°C	70°C
1.3463	97.7	98.0	98.2	98.4
1.3560	95.6	96.0	96.4	96.7
1.3602	94.5	95.0	95.5	95.8
1.3773	89.2	90.0	90.7	91.2
1.3905	84.0	85.0	85.9	86.6
1.4015	78.8	80.0	81.1	81.8
1.4109	73.7	75.0	76.2	77.0
1.4191	68.6	70.0	71.3	72.2
1.4264	63.4	65.0	66.4	67.3
1.4329	58.4	60.0	61.4	62.5
1.4387	53.3	55.0	56.5	57.6
1.4440	48.3	50.0	51.5	52.6
1.4486	43.3	45.0	46.6	47.7
1.4529	38.3	40.0	41.6	42.7

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