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ABSORPTION OF SOUND IN AIR BELOW 1000 CPS

by Cyril M. Harris and W. Tempest

Prepared under Contract No. NAS 8-11002 *by*
COLUMBIA UNIVERSITY
New York, N. Y.
for

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24773

ABSORPTION OF SOUND IN AIR BELOW 1000 CPS

SUMMARY

For many acoustic problems associated with the propagation of sound which is generated by launch vehicles, it is important to have accurate data of absorption of sound in air as a function of atmospheric conditions such as temperature, pressure, and humidity. Accurate data of this type have not been available below 2000 cps. Hence the purpose was to extend to lower frequencies the present range of reliable air absorption data. This report presents such information in the frequency range from about 125 cps to 1000 cps at 20° C, 0° C, -20° C, and -40° C.

The data described in this report can be applied to studies of acoustic propagation in the atmosphere in addition to the problem of establishing a theoretical model of sound absorption in air. In this connection measurements were made of the absorption in mixtures of oxygen and water vapor and also in mixtures of oxygen and deuterium oxide.

author

SECTION I. INTRODUCTION

At present it is not possible to make accurate estimates of the attenuation of sound that has propagated through the atmosphere for a considerable distance. Such estimates are of considerable value in many acoustic problems associated with launch vehicles. The total attenuation between two points depends on a number of factors including the absorption of sound in air, refraction, and scattering. It is obvious that reliable data must be available which provide information regarding the absorption of sound in air as a function of atmospheric conditions. Unfortunately, accurate data of this type have not veen available for frequencies below 2000 cps. In general, where such data have been required, they have been estimated by extrapolation from measurements at higher frequencies. The purpose of this study was to extend the range over which reliable air absorption data are available to lower frequencies.

During the past six years in this laboratory, an active program of research has been carried out for investigating the absorption of sound (from 125 cps to 12, 500 cps) in air for different conditions of pressure, temperature, and humidity. The results of the measurements in the range from 2000 to 12, 500 cps were published in a paper last year [1]. The present report on sound absorption in air provides data in the range from approximately 125 cps to 1000 cps.

In addition to the application of the data described in this report to studies of acoustic propagation in the atmosphere, these data can be applied to the problem of establishing a theoretical model of sound absorption in air. In this connection measurements were made of the absorption of sound in mixtures of oxygen and water vapor and also in mixtures of oxygen and deuterium oxide.

SECTION II. MEASUREMENT PROCEDURE

A detailed description of the experimental setup used for obtaining the data presented in this report has been given by Harris [1] in a paper which describes the technique of sound absorption measurement employed here. A complete description of the spherical chamber, the electro-acoustic measurement system, the humidity control, and evaluation of wall losses of the spherical chamber, given in that paper, is reproduced in Appendix A. A summary of this information is abstracted in this section.

The spherical chamber in which the measurements are made has an inner diameter of 1.68 meters. It is fabricated of heavy steel in order to minimize the effects of wall losses, which are quite low. For example, the reverberation time at 1000 cps when the chamber is filled with dry air is 43 seconds. Excellent temperature stability of the sphere is obtained and the temperature can be adjusted by pumping a coolant through coils affixed to the exterior surface of the chamber. The spherical chamber and associated equipment can be evacuated before filling the chamber with air to avoid contamination which can have considerable effect on the measurements.

Sound is introduced from a loudspeaker driving unit through a probe tube into the spherical chamber, thereby producing an acoustic point source within the chamber. This source was very poorly matched to the spherical enclosure so that its contribution to the absorption of the chamber would be negligible. The length of the probe was selected so that the point source is near a pressure maximum for the normal modes of vibration of the enclosure that are used in the low frequency measurements (described below), but of such a length as to discriminate against the excitation of nearby normal modes. After an acoustic steady-state has been established by the sound source, the source is turned off and the rate of decay of sound, in decibels per second, is measured.

The method of establishing a steady-state condition of humidity in the spherical enclosure is to pump the air from the sphere through an auxiliary "saturator" chamber which either adds or substracts moisture--depending on the temperature of the saturator. Air is re-circulated through the saturator until the air contains approximately the amount of water vapor desired. Then the saturator is bypassed, but re-circulated until a steady-state humidity condition has been achieved--during this time, water vapor may be absorbed or given off by the steel walls of the spherical chamber. The humidity in the spherical enclosure is measured by an electric hygrometer which uses lithium chloride sensing elements manufactured by Hygrodynamics, Inc.

Nitrogen has a sound absorption value that is well established. Hence, if the sphere is filled with this gas it is possible to compute the contribution to the measured decay rate R_{N_2} that is due to nitrogen along. If decay rate measurements are made in the sphere when filled with nitrogen, the measured value of the decay rate will be greater than R_{N_2}; the remaining contribution is due to losses at the wall. Now because air and nitrogen are similar in characteristic impedance and in molecular weight, the wall losses are approximately the same for the decay of sound when the sphere is filled with either gas. Thus, decay rate measurements in nitrogen (Tables 5 and 6) provide data for evaluating the wall losses when measurements are made in air. It follows that the decay rate of sound in the sphere, R_{air}, is given by eq. 3 of Appendix A:

$$R_{air} = R_{measured\ (air)} - R_{measured\ (N_2)} + R_{N_2}$$

In this manner the value of the rate of decay for sound in air was evaluated. The attenuation coefficient m per meter (as expressed in the equation $I = I_o e^{-mx}$) is related to the decay rate by the equation:

$$m = R_{air}/(4.34c) \text{ meters}^{-1}$$

where c is the velocity in meters/seconds.

SECTION III. RESULTS OF MEASUREMENTS OF SOUND ABSORPTION IN AIR

In this report the results of measurement of the absorption of sound in air are given as a function of water vapor content at atmospheric pressure for four temperatures, 20°C, 0°C, -20°C, and -40°C. Additional data for air are given at 20°C for pressures of 400 mm and 200 mm. This information is presented in both tabular and graphic form.

The data presented in Reference 1 at higher frequencies were taken by measuring the rate of decay of a large number of modes of vibrations, within a third-octave band, which were excited by a random noise source. Here, in the lower frequency range, the decay rate of individual modes which are excited by a pure tone is measured. Thus, data are given for each of the conditions at the five normal frequencies (eigenfrequencies) of the following normal modes of vibration of the spherical chamber: (1,1), (0,1), (0,2), (0,3), and (0,4). For example, at normal pressure and a temperature of 20°C, the (0,1) normal mode of vibration, which is the first radial mode, has a normal frequency of 293 cps. Since the normal frequencies depend upon the velocity of sound, and since the velocity of sound is a function of temperature, the set of curves presented in Figures 1 through 4 are not at the same set of frequencies for the various temperatures.

The actual data points for the absorption measurements taken at atmospheric pressure are given in Tables 1 through 4 along with other system measurements. For application to practical problems, smoothed curves drawn through the actual data points are more useful. Such smoothed curves are shown in Figures 1 through 4. These data are in good agreement with earlier measurements at higher frequencies [1]. Good accuracy was obtained in all measurements except at -40 °C where the attenuation is exceedingly low. For this reason the data at this temperature may be regarded as a best estimate. The data points corresponding to the smoothed curves are given in Tables 8 through 11. Data for reduced air pressure at 20° C are shown in Figures 10 and 11 and are listed in Table 6.

SECTION IV. COMPARISON WITH THEORY

It is of interest to compare the data presented here with the theoretical studies by Kneser [2] of the absorption of sound in air containing water vapor. The first comparison is shown in Figure 5. This curve of normalized attenuation versus normalized humidity was obtained as follows: The original data points for the attenuation coefficient due to molecular absorption are listed in Tables 1 through 4 under "AIR MOL." The data for each curve has a maximum attenuation value m_{max} at a particular value of water vapor concentration, h_{max}. The data points for each "attenuation versus water vapor" curve were normalized by dividing each value of AIR MOL by m_{max}. According to the theory of Kneser, the normalized data for all frequencies should fall along the dashed curve shown. The solid curve which represents the present results is in close agreement with similar data presented by Harris [1] and with similar data obtained by Delsasso [3].

According to the theory, the maximum value of absorption increases linearly with frequency. This relationship is shown by the solid lines in Figure 6 for 20 °C, 0 °C, and -20° C. Also shown are the values of m_{max} taken from the original data points.

In Figure 7 another comparison with theory is shown in a plot of relaxation frequency, f_{max}, versus the molar concentration of water vapor in the air. The relaxation frequency for a given condition of humidity is the frequency of maximum absorption and is related to the angular relaxation frequency by the equation

$$k = 2\pi f_{max} = \omega_{max}$$

The data obtained in this study are plotted together with similar data from Reference 1 obtained at higher frequencies.

SECTION V. ABSORPTION OF SOUND IN OXYGEN-WATER AND OXYGEN-DEUTERIUM OXIDE MIXTURES

In the past, a number of experiments have been performed to determine the absorption of sound in dry oxygen and in oxygen containing water vapor [4, 11]. It has been shown that there is a peak in the curve of "sound absorption versus moisture content" due to the relaxation of the internal energy of the vibrational mode of the oxygen molecule. In the dry gas, recent work (Parker [7], Holmes, Smith and Tempest [8]) has shown the peak in absorption to occur at about 9 cps at a pressure of 1 atm and at a temperature of 20° C. Other work indicated a higher relaxation frequency (Knotzel and Knotzel [6], 50 cps; and Henderson [9], 60 cps). As is the case with air-water mixtures, measurements in oxygen-water mixtures have shown that small quantities of water significantly affect the relaxation frequency and that this frequency of maximum absorption rises rapidly with increasing moisture content.

Measurements are reported here of the absorption of sound in extremely-dry oxygen of high purity, as a function of water vapor content. Figure 8 shows the results plotted in the form of intensity attenuation coefficient m per meter as a function of moisture content in percent molar concentration of water for the following frequencies (the pairs of numbers in the brackets specify the normal mode of vibration): [(1, 1), 130 cps; (0, 1), 280 cps; (0,2), 482 cps; (0,3), 680 cps; (0,4), 878 cps]. These data are tabulated in Table 12. The moisture content at which the peak in the absorption curve occurs, increases with increasing frequency. The expected values of maximum absorption at the various frequencies were calculated from the Kneser theory [2], and were found to be on average about 5 percent higher than the measured values.

Figure 9 shows a comparison between the experimental data presented here and data of other researchers. Four curves are plotted of relaxation frequency as a function of moisture content as calculated from the following equations which are given in their respective papers:

Knudsen and Obert [5] $f_{max} = 4.96 \times 10^2 h + 6.05 \times 10^3 h^2$

Knotzel and Knotzel [6] $f_{max} = 40 + 1.95 \times 10^3 h + 1.32 \times 10^4 h^2$

Clark and Henderson [10] $f_{max} = 3 + 1.66 \times 10^3 h + 1.45 \times 10^4 h^2$

Harlow and Kitching [11] $f_{max} = 2.10 \times 10^2 h \times 1.20 \times 10^4 h^2$

where f_{max} is the frequency of maximum absorption in cps and h is the percent molar concentration of water. The data of Knudsen and Obert, which differs considerably from the other results shown, is extrapolated from measurements at 3,000 cps and higher; it is probably subject to considerable error at low frequencies. In contrast, the data of

Harlow and Kitching is based on measurements at frequencies as low as 98 cps, which rules out error due to extrapolation. It is possible that the difference between their results and those of others may be due to the method by which they determined the moisture content in their gas. Before the air re-circulation system shown in Figure 14 (Appendix A) was developed for humidity control, some measurements were made in which moisture content was determined from weights of evaporated water in the system. Results so obtained were compared with results in which humidity is measured by the direct technique of circulating the gas over calibrated electrical conductivity elements. It was found that the two methods gave quite different results, in terms of the moisture content required to produce a particular frequency of maximum absorption, with the evaporation technique giving humidity levels as high as three times the direct measurements. It was concluded that a considerable amount of moisture may be taken out of the gas in the chamber by the walls. Such an effect would result in an apparently lower measured value of relaxation frequency for a given moisture content as reported by Harlow and Kitching. The results of the present study shown by the x's in Figure 9 are in good agreement with those of Knotzel and Knotzel; they are in very close agreement with the data of Clark and Henderson, thus supporting the view that the frequency dependence of the absorption peak on moisture content contains a quadratic term.

Data are shown in Figure 12 for the absorption of sound in a mixture of oxygen and deuterium oxide. (These data are tabulated in Table 13.) A comparison of Figures 8 and 12 indicates that for a given frequency, the maximum value of absorption in oxygen-water mixture is approximately the same as the maximum value for water vapor and deuterium oxide mixture. However, the curves for the oxygen-deuterium oxide mixture have their peaks at significantly lower vapor concentrations. At present there is no satisfactory theoretical model to explain these results but these data may prove useful in helping to provide the necessary information required in establishing such a model.

APPENDIX A

I. EXPERIMENTAL SETUP[1]

Spherical Chamber

The spherical chamber used in this study has an inner diameter of 1.68 m (volume=2.48 m^3). It was specially fabricated, in two hemispherical shells, from hot-rolled steel having a thickness of 16 mm. The two halves are fitted with flanges and bolted together with a Teflon gasket, as illustrated in Figure 13. That the acoustic boundary losses are low in this chamber is illustrated by the fact that at 1000 cps its reverberation time is 43 sec when the chamber is filled with dry air. Measurements of the decay of sound in the chamber, when it is filled with nitrogen, show that there are no isolated mechanical resonances of the spherical chamber housing which have significant effect on the rate of decay of sound in the enclosure over the frequency range employed. The entire chamber is packed in glass-fiber blankets to provide thermal insulation. Its temperature is controlled by pumping a methanol coolant through copper tubing fastened to the exterior surface of the sphere (Fig. 13). By this means the air temperature within the chamber can be set at any value between 20° and -60° C and can be held constant to within ± 0.1° C.

A high-capacity vacuum pump connected to the chamber, together with a diffusion pump, can reduce the pressure within the sphere and its associated air lines to 1 micron (mercury column height). This is essential in order to free the entire system from contamination and to rid all parts of the system of water vapor which may be absorbed by the interior walls of the sphere and walls of the air-circulation system. During the actual decay measurements, the air-circulation system is not in operation; then the lines are closed by gate valves to avoid the loss of acoustic energy from the spherical chamber to the lines.

Electro-Acoustic Measurement System

The sound source is a 60-watt loudspeaker unit that is coupled to the spherical chamber by a stainless steel probe tube, 1/4 inch in diameter, as illustrated in Figure 13. This arrangement provides an effective acoustic point source within the chamber at the end of the probe tube. The electrical and acoustical coupling of the acoustic source are purposely mismatched in impedance so that the amount of acoustic energy that

---

[1] The material contained in this Appendix is taken from the reprint "Absorption of Sound in Air in the Audio-Frequency Range," Cyril M. Harris, Journal of the Acoustical Society of America, Vol. 35, No. 1, pp. 11-17, January 1963, Reference 1.

is absorbed by this transducer, while it is inactive during decay measurement, will not be significant. The loudspeaker is driven from a random-noise source. A small dynamic microphone is located in the wall of the spherical chamber. The output of the microphone is amplified, fed through a Bruel and Kjaer third-octave filter (type 2109), and thence to a high-speed level recorder. When the random-noise source is turned off, a curve of the rate of decay of sound in the spherical chamber is obtained with the level recorder. The slope of this decay curve determines the decay rate in db/sec at the center frequency of the band at which the third-octave analyzer is set.

Humidity Control

The problem of accurately controlling and measuring the humidity in a chamber in which air absorption measurements are made has always presented difficulties. In past studies, the accuracy of humidity-measurement techniques at low values of humidity, a range which is often of considerable interest, has been poor. In addition to the question of accuracy, there is the problem of ensuring that the humidity measured actually is representative of conditions within the chamber. Difficulties arise because of the absorption of water by surfaces within the measurement system.

Humidity control and measurement probably account for a major source of discrepancy among published data on the absorption of sound in air. The method used here for establishing controlled conditions of humidity is illustrated in Figure 14. Air is circulated through a closed system by means of a circulation pump which consists of a small high-speed turbofan. Air leaves the spherical chamber through an outlet at the bottom of the sphere. Then it passes through a "saturator" which is a small stainless steel cylinder whose temperature can be controlled from approximately -60 °C to +20°C by means of a coolant in which the saturator is immersed. Distilled water is contained in the bottom of the saturator. Moisture either is taken from the air that passes through the saturator and deposited in the saturator, or is taken from the saturator and added to the air that passes through the saturator -- depending upon the relative temperatures of the spherical chamber and the saturator. Air is recirculated through the system until the air in the spherical chamber contains approximately the amount of water vapor required to achieve the desired equilibrium condition. Then the saturator is bypassed (by a valve system that is not shown in Fig. 14); this causes the air to re-circulate from the sphere, through the pump, and then back to the sphere -- until a steady-state humidity condition is obtained. This usually requires about a half hour.

Two sets of electric hygrometers were employed to measure relative humidity. The operation of the hygrometers is based upon the change in the resistance, with humidity, of lithium chloride sensing elements (class A, type H) which are in a bridge circuit and are manufactured by Hygrodynamics, Inc. Under the conditions employed, these elements have a rapid response time and provide a continuous monitoring of the humidity within the spherical chamber during conditions of re-circulation of air. The individual sensing elements in the two sets covered the following ranges: 1.6 to 5%, 5 to 14%, 12 to 20%, 18 to 30%, 29 to 43%, 41 to 59%, 54 to 72%. The two sets were closely matched against each other. One set was placed at the air inlet near the top of the spherical chamber and the other at the air outlet at the bottom. Observations of the readings of these sets of elements were used to determine when equilibrium was achieved. These humidity-sensing elements were calibrated in the laboratory of the manufacturer immediately before the data contained in this paper were taken--then all units were calibrated once again in a similar manner directly after the experimental data were taken. Essentially, a substitution method of humidity calibration was employed so that the accuracy provided by the sensing elements was greater than that usually quoted for such units which are used under varying field conditions -- here the accuracy was better than ± 1% RH (relative humidity) except in the lowest range where it was about ± 0. 5% RH.

Two calibration techniques are employed by the manufacturer of the humidity-sensing elements that were used. Above 5% RH, elements are calibrated in a controlled-humidity chamber using a high-precision psychrometer employing thermometers calibrated by the National Bureau of Standards. These psychrometric readings are referred to relative-humidity tables based on the barometric pressure corresponding to that in the calibration chamber. In the very low humidity range, elements are calibrated using a two-pressure technique embodying the principles outlined by Weaver and Riley in which a known humidity condition is generated by saturating a gas stream at elevated pressures, and then expanding to atmospheric pressure. Calibrations of the sensing elements used in this study are reproducible within ± 0. 2% RH. The two techniques are compared at the lower-humidity ranges and are in close agreement (within ±0. 5% RH).

Evaluation of Wall Losses of Spherical Chamber

In order to determine the absorption of sound in air from measurements of the rate of decay of sound in the spherical chamber used in this study, it is necessary to know the extent of the contribution to the rate of decay that may be attributed to wall losses. This may be evaluated from measurements of the rate of decay of sound in the chamber when it is filled with nitrogen since nitrogen exhibits no anomalous absorption in the frequency range of measurement. By comparing the measured values of decay rate in nitrogen with the decay rate computed from absorption data for nitrogen, one obtains a small difference which represents the effects of wall losses. This is shown as follows: The decay rate of sound, R_{measured} (air), that one measures in the spherical chamber when it is filled with air is given (in decibels per second) by

$$R_{\text{measured (air)}} = R_{\text{air}} + R_{\text{wall}}, \tag{1}$$

where R_{air} is the decay rate due to absorption in the air, and R_{wall} is the decay rate due to absorption at the walls.

When the chamber is filled with prepurified dry nitrogen,

$$R_{\text{measured }(N_2)} = R_{N_2} + R_{\text{wall}}, \tag{2}$$

where R_{N_2} is the decay rate due to absorption in nitrogen in db/sec.

If it is assumed that the wall losses for N_2 and air are approximately the same, because these gases are closely similar in molecular weight and characteristic impedance, then subtracting eq. 2 from eq. 1:

$$R_{\text{air}} = R_{\text{measured (air)}} - R_{\text{measured }(N_2)} + R_{N_2} \tag{3}$$

The first two terms on the right are obtained from measurements of the rate of decay of sound in the spherical chamber while the third term is calculated from the data for nitrogen by Parbrook and Tempest. Consideration has been given to possible variation in the boundary losses with changes in the humidity within the sphere. As pointed out by Evans and Bazley in discussing this possibility, the work of Knudsen, Wilson and Anderson indicates that such an effect is not significant; their data show that there is no appreciable change in wall absorption even when moisture condenses on the wall surfaces.

The value of R_{air} in db/sec given by eq. 3 is converted to the attenuation coefficient m per meter as expressed in the equation $I = I_0 e^{-mx}$ by the relation

$$m = R_{\text{air}}/(4.34c) \text{ meters}^{-1}$$

where c is the velocity of sound in m/sec.

APPENDIX B

TABULAR DATA *

TABLE NO.	DATA POINTS	GAS	PRESSURE MM	TEMPERATURE DEG. CENT
1	ORIGINAL	AIR + WATER VAPOR	760	20
2	ORIGINAL	AIR + WATER VAPOR	760	0
3	ORIGINAL	AIR + WATER VAPOR	760	-20
4	ORIGINAL	AIR + WATER VAPOR	760	-40
5	ORIGINAL	DRY NITROGEN	760	20
	ORIGINAL	DRY NITROGEN	760	0
	ORIGINAL	DRY NITROGEN	760	-20
	ORIGINAL	DRY NITROGEN	760	-40
6A	ORIGINAL	AIR + WATER VAPOR	400	20
6B	ORIGINAL	AIR + WATER VAPOR	200	20
7	ORIGINAL	DRY NITROGEN VS. PRESSURE		20
8	SMOOTHED	AIR + WATER VAPOR	760	20
9	SMOOTHED	AIR + WATER VAPOR	760	0
10	SMOOTHED	AIR + WATER VAPOR	760	-20
11	SMOOTHED	AIR + WATER VAPOR	760	-40
12	ORIGINAL	OXYGEN + WATER VAPOR	760	20
13	ORIGINAL	OXYGEN + D2O	760	20

* These tabular data, actually computer run sheets, are graphically illustrated in various figures from 1 through 12.

```
                          TABLE NØ. 1
                 TABULATIØN ØF ØRIGINAL DATA PØINTS FØR
                 ABSØRPTIØN ØF SØUND IN AIR VERSUS RELATIVE HUMIDITY
                          AT 20 DEGREES CENTIGRADE

                                                                        3000*
   R.H. TEMP FREQ LAMDA      AIR       AIR  AIR  AIR  AIR  MU          LOG
                              +        ØNLY ØNLY CLAS  MØL              RH
        DEG                  WALL WALL
   PRCT CENT CPS METRS       DB/S DB/S DB/S /M    /M    /M
         1         2         3         4         5         6
12345678901234567890123456789012345678901234567890123456789012345678

     .1  20   136 2.520      2.54 1.99  .55 0037 0007 0037 0093-2999
    1.2  20   136 2.520      3.18 1.99 1.19 0080 0007 0080 0202  238
    1.4  20   136 2.520      3.08 1.99 1.09 0073 0007 0073 0184  438
    1.8  20   136 2.520      2.76 1.99  .77 0052 0007 0052 0131  766
    2.1  20   136 2.520      2.64 1.99  .65 0044 0007 0044 0111  967
    2.7  20   136 2.520      2.50 1.99  .51 0034 0007 0034 0086 1294
    3.8  20   136 2.520      2.36 1.99  .37 0025 0007 0025 0063 1739
    5.1  20   136 2.520      2.30 1.99  .31 0021 0007 0021 0053 2123
    6.1  20   136 2.520      2.26 1.99  .27 0018 0007 0018 0045 2356
    6.2  20   136 2.520      2.36 1.99  .37 0025 0007 0025 0063 2377
    7.2  20   136 2.520      2.32 1.99  .33 0022 0007 0022 0056 2572
    7.4  20   136 2.520      2.26 1.99  .27 0018 0007 0018 0045 2608
    8.2  20   136 2.520      2.35 1.99  .36 0024 0007 0024 0061 2741
    9.0  20   136 2.520      2.22 1.99  .23 0015 0007 0015 0038 2863
   10.1  20   136 2.520      2.26 1.99  .27 0018 0007 0018 0045 3013
   13.3  20   136 2.520      2.38 1.99  .39 0026 0007 0026 0066 3372
   16.3  20   136 2.520      2.35 1.99  .36 0024 0007 0024 0061 3637
   20.0  20   136 2.520      2.36 1.99  .37 0025 0007 0025 0063 3903
   25.4  20   136 2.520      2.23 1.99  .24 0016 0007 0016 0040 4215
   31.0  20   136 2.520      2.22 1.99  .23 0015 0007 0015 0038 4474
   39.0  20   136 2.520      2.22 1.99  .23 0015 0007 0015 0038 4773


     .1  20   293 1.170      1.95 1.36  .59 0040 0032 0040 0047-2999
    1.2  20   293 1.170      4.05 1.36 2.69 0181 0032 0181 0212  238
    1.4  20   293 1.170      4.17 1.36 2.81 0189 0032 0189 0221  438
    1.8  20   293 1.170      4.06 1.36 2.70 0181 0032 0181 0212  766
    2.1  20   293 1.170      3.70 1.36 2.34 0157 0032 0157 0184  967
    2.7  20   293 1.170      3.18 1.36 1.82 0122 0032 0122 0143 1294
    3.8  20   293 1.170      2.86 1.36 1.50 0101 0032 0101 0118 1739
    5.1  20   293 1.170      2.43 1.36 1.07 0072 0032 0072 0084 2123
    6.1  20   293 1.170      2.22 1.36  .86 0058 0032 0058 0068 2356
    6.2  20   293 1.170      2.22 1.36  .86 0058 0032 0058 0068 2377
    7.2  20   293 1.170      2.12 1.36  .76 0051 0032 0051 0060 2572
    7.4  20   293 1.170      2.09 1.36  .73 0049 0032 0049 0057 2608
    8.2  20   293 1.170      2.07 1.36  .71 0048 0032 0048 0056 2741
    9.0  20   293 1.170      2.01 1.36  .65 0044 0032 0044 0052 2863
   10.1  20   293 1.170      2.03 1.36  .67 0045 0032 0045 0053 3013
   13.3  20   293 1.170      1.99 1.36  .63 0042 0032 0042 0049 3372
   16.3  20   293 1.170      1.98 1.36  .62 0042 0032 0042 0049 3637
   20.0  20   293 1.170      1.98 1.36  .62 0042 0032 0042 0049 3903
   25.4  20   293 1.170      1.97 1.36  .61 0041 0032 0041 0048 4215
   31.0  20   293 1.170      1.98 1.36  .62 0042 0032 0042 0049 4474
   39.0  20   293 1.170      1.96 1.36  .60 0040 0032 0040 0047 4773
```

* last column employed in computer plotting only.

TABLE NO. 1
TABULATION OF ORIGINAL DATA POINTS FOR ABSORPTION OF SOUND IN AIR VERSUS RELATIVE HUMIDITY AT 20 DEGREES CENTIGRADE

```
     R.H. TEMP FREQ LAMDA      AIR        AIR  AIR  AIR  AIR  MU     3000*
                                +         ONLY ONLY CLAS  MOL         LOG
          DEG                  WALL WALL                              RH
     PRCT CENT CPS METRS       DB/S DB/S DB/S /M    /M   /M
          1         2          3         4         5         6
1234567890123456789012345678901234567890123456789012345678901234567890123456789
       .1  20  504  .681       1.81 1.17  .64 0043 0094 0042 0029-2999
      1.2  20  504  .681       4.76 1.17 3.59 0241 0094 0240 0163  238
      1.4  20  504  .681       5.30 1.17 4.13 0277 0094 0276 0188  438
      1.8  20  504  .681       5.97 1.17 4.80 0322 0094 0321 0219  766
      2.1  20  504  .681       6.12 1.17 4.95 0332 0094 0331 0225  967
      2.7  20  504  .681       5.56 1.17 4.39 0295 0094 0294 0200 1294
      3.8  20  504  .681       4.95 1.17 3.78 0254 0094 0253 0172 1739
      5.1  20  504  .681       3.92 1.17 2.75 0185 0094 0184 0125 2123
      6.1  20  504  .681       3.29 1.17 2.12 0142 0094 0141 0096 2356
      6.2  20  504  .681       3.26 1.17 2.09 0140 0094 0139 0095 2377
      7.2  20  504  .681       2.93 1.17 1.76 0118 0094 0117 0080 2572
      7.4  20  504  .681       2.87 1.17 1.70 0114 0094 0113 0077 2608
      8.2  20  504  .681       2.76 1.17 1.59 0107 0094 0106 0072 2741
      9.0  20  504  .681       2.57 1.17 1.40 0094 0094 0093 0063 2863
     10.1  20  504  .681       2.52 1.17 1.35 0091 0094 0090 0061 3013
     13.3  20  504  .681       2.29 1.17 1.12 0075 0094 0074 0050 3372
     16.3  20  504  .681       2.19 1.17 1.02 0068 0094 0067 0046 3637
     20.0  20  504  .681       2.14 1.17  .97 0065 0094 0064 0044 3903
     25.4  20  504  .681       2.12 1.17  .95 0064 0094 0063 0043 4215
     31.0  20  504  .681       2.15 1.17  .98 0066 0094 0065 0044 4474
     39.0  20  504  .681       2.19 1.17 1.02 0068 0094 0067 0046 4773


       .1  20  712  .482       2.77 2.07  .70 0047 0187 0045 0022-2999
      1.2  20  712  .482       6.22 2.07 4.15 0279 0187 0277 0134  238
      1.4  20  712  .482       6.97 2.07 4.90 0329 0187 0327 0158  438
      1.8  20  712  .482       8.30 2.07 6.23 0418 0187 0416 0201  766
      2.1  20  712  .482       9.13 2.07 7.06 0474 0187 0472 0228  967
      2.7  20  712  .482       9.26 2.07 7.19 0483 0187 0481 0232 1294
      3.8  20  712  .482       8.73 2.07 6.66 0447 0187 0445 0215 1739
      5.1  20  712  .482       7.30 2.07 5.23 0351 0187 0349 0168 2123
      6.1  20  712  .482       6.21 2.07 4.14 0278 0187 0276 0133 2356
      6.2  20  712  .482       6.19 2.07 4.12 0277 0187 0275 0133 2377
      7.2  20  712  .482       5.54 2.07 3.47 0233 0187 0231 0111 2572
      7.4  20  712  .482       5.41 2.07 3.34 0224 0187 0222 0107 2608
      8.2  20  712  .482       5.13 2.07 3.06 0205 0187 0203 0098 2741
      9.0  20  712  .482       4.79 2.07 2.72 0183 0187 0181 0087 2863
     10.1  20  712  .482       4.74 2.07 2.67 0179 0187 0177 0085 3013
     13.3  20  712  .482       4.15 2.07 2.08 0140 0187 0138 0067 3372
     16.3  20  712  .482       3.89 2.07 1.82 0122 0187 0120 0058 3637
     20.0  20  712  .482       3.72 2.07 1.65 0111 0187 0109 0053 3903
     25.4  20  712  .482       3.62 2.07 1.55 0104 0187 0102 0049 4215
     31.0  20  712  .482       3.61 2.07 1.54 0103 0187 0101 0049 4474
     39.0  20  712  .482       3.65 2.07 1.58 0106 0187 0104 0050 4773
```

* last column employed in computer plotting only.

```
                              TABLE NO. 1
                  TABULATION OF ORIGINAL DATA POINTS FOR
                  ABSORPTION OF SOUND IN AIR VERSUS RELATIVE HUMIDITY
                              AT 20 DEGREES CENTIGRADE

                                                                           3000*
    R.H. TEMP FREQ LAMDA      AIR        AIR  AIR  AIR  AIR  MU            LOG
                               +         ONLY ONLY CLAS  MOL                RH
         DEG                  WALL WALL
    PRCT CENT CPS  METRS      DB/S DB/S DB/S /M        /M   /M
           1          2          3          4         5         6
123456789012345678901234567890123456789012345678901234567890123456789
      .1  20   918  .374      5.22 4.50  .72 0048 0312 0045 0017-2999
     1.2  20   918  .374      8.55 4.50 4.05 0272 0312 0269 0101  233
     1.4  20   918  .374      9.26 4.50 4.76 0320 0312 0317 0119  438
     1.8  20   918  .374     11.00 4.50 6.50 0436 0312 0433 0162  766
     2.1  20   918  .374     12.40 4.50 7.90 0530 0312 0527 0197  967
     2.7  20   918  .374     13.35 4.50 8.85 0594 0312 0591 0221 1294
     3.8  20   918  .374     13.20 4.50 8.70 0584 0312 0581 0217 1739
     5.1  20   918  .374     11.70 4.50 7.20 0483 0312 0480 0179 2123
     6.1  20   918  .374     10.35 4.50 5.85 0393 0312 0390 0146 2356
     6.2  20   918  .374     10.30 4.50 5.80 0389 0312 0386 0144 2377
     7.2  20   918  .374      9.48 4.50 4.98 0334 0312 0331 0124 2572
     7.4  20   918  .374      9.26 4.50 4.76 0320 0312 0317 0119 2608
     8.2  20   918  .374      8.85 4.50 4.35 0292 0312 0289 0108 2741
     9.0  20   918  .374      8.33 4.50 3.83 0257 0312 0254 0095 2863
    10.1  20   918  .374      8.25 4.50 3.75 0252 0312 0249 0093 3013
    13.3  20   918  .374      7.25 4.50 2.75 0185 0312 0182 0068 3372
    16.3  20   918  .374      6.90 4.50 2.40 0161 0312 0158 0059 3637
    20.0  20   918  .374      6.50 4.50 2.00 0134 0312 0131 0049 3903
    25.4  20   918  .374      6.28 4.50 1.78 0119 0312 0116 0043 4215
    31.0  20   918  .374      6.23 4.50 1.73 0116 0312 0113 0042 4474
    39.0  20   918  .374      6.28 4.50 1.78 0119 0312 0116 0043 4773
    39.5  20   918  .374      6.03 4.50 1.53 0103 0312 0100 0037 4790
```

* last column employed in computer plotting only.

TABLE NO.2
TABULATION OF ORIGINAL DATA POINTS FOR
ABSORPTION OF SOUND IN AIR VERSUS RELATIVE HUMIDITY
AT 0 DEGREES CENTIGRADE

```
      R.H. TEMP FREQ LAMDA      AIR       AIR  AIR  AIR  AIR  MU     3000*
                                 +        ONLY ONLY CLAS  MOL        LOG
           DEG                  WALL WALL                            RH
      PRCT CENT CPS  METRS      DB/S DB/S DB/S /M    /M   /M
            1         2         3         4          5         6
123456789012345678901234567890123456789012345678901234567890123456789012345678
        .1   0  132 2.520       2.10 1.88  .22 0015 0007 0015 0038-2999
       3.1   0  132 2.520       2.60 1.88  .72 0050 0007 0050 0126 1474
       4.1   0  132 2.520       2.67 1.88  .79 0055 0007 0055 0138 1838
       4.4   0  132 2.520       2.67 1.88  .79 0055 0007 0055 0138 1930
       5.4   0  132 2.520       2.64 1.88  .76 0053 0007 0053 0133 2197
       6.2   0  132 2.520       2.53 1.88  .65 0045 0007 0045 0113 2377
       7.3   0  132 2.520       2.55 1.88  .67 0047 0007 0047 0118 2590
       8.9   0  132 2.520       2.34 1.88  .46 0032 0007 0032 0080 2848
      11.1   0  132 2.520       2.37 1.88  .49 0034 0007 0034 0085 3136
      11.9   0  132 2.520       2.26 1.88  .38 0026 0007 0026 0065 3227
      12.4   0  132 2.520       2.17 1.88  .29 0020 0007 0020 0050 3280
      13.0   0  132 2.520       2.10 1.88  .22 0015 0007 0015 0038 3342
      15.4   0  132 2.520       2.10 1.88  .22 0015 0007 0015 0038 3563
      17.5   0  132 2.520       2.07 1.88  .19 0013 0007 0013 0033 3729
      25.1   0  132 2.520       2.04 1.88  .16 0011 0007 0011 0028 4199
      27.4   0  132 2.520       2.02 1.88  .14 0010 0007 0010 0025 4313
      33.6   0  132 2.520       2.02 1.88  .14 0010 0007 0010 0025 4579
      38.4   0  132 2.520       1.97 1.88  .09 0006 0007 0006 0015 4753
      44.6   0  132 2.520       2.02 1.88  .14 0010 0007 0010 0025 4948
      54.0   0  132 2.520       1.99 1.88  .11 0008 0007 0008 0020 5197
      64.0   0  132 2.520       2.03 1.88  .15 0010 0007 0010 0025 5419
      84.0   0  132 2.520       1.99 1.88  .11 0008 0007 0008 0020 5773
      91.0   0  132 2.520       2.00 1.88  .12 0008 0007 0008 0020 5877


        .1   0  282 1.170       1.63 1.34  .29 0020 0031 0020 0024-2999
       3.1   0  282 1.170       2.49 1.34 1.15 0080 0031 0080 0094 1474
       4.1   0  282 1.170       2.75 1.34 1.41 0098 0031 0098 0115 1838
       4.4   0  282 1.170       2.92 1.34 1.58 0110 0031 0110 0129 1930
       5.4   0  282 1.170       3.05 1.34 1.71 0119 0031 0119 0140 2197
       6.2   0  282 1.170       3.08 1.34 1.74 0121 0031 0121 0142 2377
       7.3   0  282 1.170       3.14 1.34 1.80 0125 0031 0125 0147 2590
       8.9   0  282 1.170       3.07 1.34 1.73 0120 0031 0120 0141 2848
      11.1   0  282 1.170       2.95 1.34 1.61 0112 0031 0112 0132 3136
      11.9   0  282 1.170       2.75 1.34 1.41 0098 0031 0098 0115 3227
      12.4   0  282 1.170       2.58 1.34 1.24 0086 0031 0086 0101 3280
      13.0   0  282 1.170       2.39 1.34 1.05 0073 0031 0073 0086 3342
      15.4   0  282 1.170       2.22 1.34  .88 0061 0031 0061 0072 3563
      17.5   0  282 1.170       2.06 1.34  .72 0050 0031 0050 0059 3729
      25.1   0  282 1.170       1.88 1.34  .54 0038 0031 0038 0045 4199
      27.4   0  282 1.170       1.87 1.34  .53 0037 0031 0037 0043 4313
      33.6   0  282 1.170       1.74 1.34  .40 0028 0031 0028 0033 4579
      38.4   0  282 1.170       1.69 1.34  .35 0024 0031 0024 0028 4753
      44.6   0  282 1.170       1.65 1.34  .31 0022 0031 0022 0026 4948
      54.0   0  282 1.170       1.64 1.34  .30 0021 0031 0021 0025 5197
      64.0   0  282 1.170       1.59 1.34  .25 0017 0031 0017 0020 5419
      84.0   0  282 1.170       1.59 1.34  .25 0017 0031 0017 0020 5773
      91.0   0  282 1.170       1.59 1.34  .25 0017 0031 0017 0020 5877
```

* last column employed in computer plotting only.

```
                          TABLE NO. 2
               TABULATION OF ORIGINAL DATA POINTS FOR
               ABSORPTION OF SOUND IN AIR VERSUS RELATIVE HUMIDITY
                          AT  0 DEGREES CENTIGRADE

    R.H. TEMP FREQ LAMDA      AIR       AIR  AIR  AIR  AIR  MU  3000*
                               +        ONLY ONLY CLAS  MOL      LOG
         DEG                  WALL WALL                          RH
    PRCT CENT CPS METRS       DB/S DB/S DB/S /M    /M   /M
             1         2         3         4         5         6
12345678901234567890123456789012345678901234567890123456789012345678
      .1   0  486  .681      1.43 1.10  .33 0023 0090 0022 0015-2999
     3.1   0  486  .681      2.40 1.10 1.30 0090 0090 0089 0061 1474
     4.1   0  486  .681      2.76 1.10 1.66 0115 0090 0114 0078 1838
     4.4   0  486  .681      2.98 1.10 1.88 0131 0090 0130 0089 1930
     5.4   0  486  .681      3.32 1.10 2.22 0154 0090 0153 0104 2197
     6.2   0  486  .681      3.54 1.10 2.44 0170 0090 0169 0115 2377
     7.3   0  486  .681      3.78 1.10 2.68 0186 0090 0185 0126 2590
     8.9   0  486  .681      4.03 1.10 2.93 0204 0090 0203 0138 2848
    11.1   0  486  .681      4.13 1.10 3.03 0211 0090 0210 0143 3136
    11.9   0  486  .681      4.12 1.10 3.02 0210 0090 0209 0143 3227
    12.4   0  486  .681      3.97 1.10 2.87 0200 0090 0199 0136 3280
    13.0   0  486  .681      3.71 1.10 2.61 0181 0090 0180 0123 3342
    15.4   0  486  .681      3.37 1.10 2.27 0158 0090 0157 0107 3563
    17.5   0  486  .681      3.05 1.10 1.95 0136 0090 0135 0092 3729
    25.1   0  486  .681      2.58 1.10 1.48 0103 0090 0102 0070 4199
    27.4   0  486  .681      2.57 1.10 1.47 0102 0090 0101 0069 4313
    33.6   0  486  .681      2.16 1.10 1.06 0074 0090 0073 0050 4579
    38.4   0  486  .681      2.00 1.10  .90 0063 0090 0062 0042 4753
    44.6   0  486  .681      1.88 1.10  .78 0054 0090 0053 0036 4948
    54.0   0  486  .681      1.81 1.10  .71 0049 0090 0048 0033 5197
    64.0   0  486  .681      1.67 1.10  .57 0040 0090 0039 0027 5419
    84.0   0  486  .681      1.61 1.10  .51 0035 0090 0034 0023 5773
    91.0   0  486  .681      1.59 1.10  .49 0034 0090 0033 0023 5877


      .1   0  686  .482      2.70 2.62  .08 0006 0179 0004 0002-2999
     3.1   0  686  .482      3.77 2.62 1.15 0080 0179 0078 0038 1474
     4.1   0  686  .482      4.03 2.62 1.41 0098 0179 0096 0046 1838
     4.4   0  686  .482      4.38 2.62 1.76 0122 0179 0120 0058 1930
     5.4   0  686  .482      4.79 2.62 2.17 0151 0179 0149 0072 2197
     6.2   0  686  .482      5.14 2.62 2.52 0175 0179 0173 0084 2377
     7.3   0  686  .482      5.49 2.62 2.87 0200 0179 0198 0096 2590
     8.9   0  686  .482      5.97 2.62 3.35 0233 0179 0231 0112 2848
    11.1   0  686  .482      6.28 2.62 3.66 0254 0179 0252 0122 3136
    11.9   0  686  .482      6.58 2.62 3.96 0275 0179 0273 0132 3227
    12.4   0  686  .482      6.70 2.62 4.08 0284 0179 0282 0136 3280
    13.0   0  686  .482      6.63 2.62 4.01 0279 0179 0277 0134 3342
    15.4   0  686  .482      6.28 2.62 3.66 0254 0179 0252 0122 3563
    17.5   0  686  .482      5.80 2.62 3.18 0221 0179 0219 0106 3729
    25.1   0  686  .482      5.03 2.62 2.41 0168 0179 0166 0080 4199
    27.4   0  686  .482      5.16 2.62 2.54 0177 0179 0175 0085 4313
    33.6   0  686  .482      4.33 2.62 1.71 0119 0179 0117 0057 4579
    38.4   0  686  .482      4.03 2.62 1.41 0098 0179 0096 0046 4753
    44.6   0  686  .482      3.77 2.62 1.15 0080 0179 0078 0038 4948
    54.0   0  686  .482      3.62 2.62 1.00 0070 0179 0068 0033 5197
    64.0   0  686  .482      3.37 2.62  .75 0052 0179 0050 0024 5419
    84.0   0  686  .482      3.26 2.62  .64 0044 0179 0042 0020 5773
    91.0   0  686  .482      3.13 2.62  .51 0035 0179 0033 0016 5877
```

* last column employed in computer plotting only.

```
                        TABLE NO. 2
               TABULATION OF ORIGINAL DATA POINTS FOR
               ABSORPTION OF SOUND IN AIR VERSUS RELATIVE HUMIDITY
                        AT  0 DEGREES CENTIGRADE

   R.H. TEMP FREQ LAMDA      AIR        AIR  AIR  AIR  AIR  MU   3000*
                              +         ONLY ONLY CLAS  MOL      LOG
        DEG                  WALL WALL                           RH
   PRCT CENT CPS METRS       DB/S DB/S DB/S /M     /M   /M
         1         2          3         4         5         6
12345678901234567890123456789012345678901234567890123456789012345678
     .1   0  886   .374      4.57 4.00  .57 0040 0299 0037 0014-2999
    3.1   0  886   .374      5.58 4.00 1.58 0110 0299 0107 0040 1474
    4.1   0  886   .374      6.08 4.00 2.08 0145 0299 0142 0053 1838
    4.4   0  886   .374      6.13 4.00 2.13 0148 0299 0145 0054 1930
    5.4   0  886   .374      6.65 4.00 2.65 0184 0299 0181 0068 2197
    6.2   0  886   .374      7.10 4.00 3.10 0216 0299 0213 0080 2377
    7.3   0  886   .374      7.43 4.00 3.43 0238 0299 0235 0088 2590
    8.9   0  886   .374      8.29 4.00 4.29 0298 0299 0295 0110 2848
   11.1   0  886   .374      8.68 4.00 4.68 0325 0299 0322 0120 3136
   11.9   0  886   .374      9.40 4.00 5.40 0375 0299 0372 0139 3227
   12.4   0  886   .374      9.78 4.00 5.78 0402 0299 0399 0149 3280
   13.0   0  886   .374     10.00 4.00 6.00 0417 0299 0414 0155 3342
   15.4   0  886   .374      9.67 4.00 5.67 0394 0299 0391 0146 3563
   17.5   0  886   .374      9.45 4.00 5.45 0379 0299 0376 0141 3729
   25.1   0  886   .374      6.67 4.00 2.67 0186 0299 0183 0068 4199
   27.4   0  886   .374      8.36 4.00 4.36 0303 0299 0300 0112 4313
   33.6   0  886   .374      7.40 4.00 3.40 0236 0299 0233 0087 4579
   38.4   0  886   .374      6.96 4.00 2.96 0206 0299 0203 0076 4753
   44.6   0  886   .374      6.52 4.00 2.52 0175 0299 0172 0064 4948
   54.0   0  886   .374      6.28 4.00 2.28 0158 0299 0155 0058 5197
   64.0   0  886   .374      5.77 4.00 1.77 0123 0299 0120 0045 5419
   84.0   0  886   .374      5.42 4.00 1.42 0099 0299 0096 0036 5773
```

* last column employed in computer plotting only.

TABLE 3
TABULATION OF ORIGINAL DATA POINTS FOR ABSORPTION OF SOUND IN AIR VERSUS RELATIVE HUMIDITY AT -20 DEGREES CENTIGRADE

```
    R.H. TEMP FREQ LAMDA      AIR        AIR  AIR  AIR  AIR  MU    3000*
                               +         ONLY ONLY CLAS  MOL       LOG
         DEG                  WALL WALL                            RH
    PRCT CENT CPS  METRS      DB/S DB/S DB/S /M      /M    /M
            1          2         3         4          5          6
12345678901234567890123456789012345678901234567890123456789012345678


     1.0 -20   272 1.170      1.40 1.21  .19 0014 0029 0014 0016    0
    17.7 -20   272 1.170      1.65 1.21  .44 0032 0029 0032 0038 3744
    22.2 -20   272 1.170      1.90 1.21  .69 0050 0029 0050 0059 4039
    29.3 -20   272 1.170      2.10 1.21  .89 0064 0029 0064 0075 4401
    31.1 -20   272 1.170      2.16 1.21  .95 0069 0029 0069 0081 4478
    37.0 -20   272 1.170      2.16 1.21  .95 0069 0029 0069 0081 4705
    42.8 -20   272 1.170      2.12 1.21  .91 0066 0029 0066 0077 4894
    46.7 -20   272 1.170      2.05 1.21  .84 0061 0029 0061 0072 5008
    58.0 -20   272 1.170      1.95 1.21  .74 0053 0029 0053 0062 5290
    66.5 -20   272 1.170      1.86 1.21  .65 0047 0029 0047 0055 5468
    72.0 -20   272 1.170      1.79 1.21  .58 0042 0029 0042 0049 5572
    78.0 -20   272 1.170      1.73 1.21  .52 0038 0029 0038 0045 5676
    80.0 -20   272 1.170      1.71 1.21  .50 0036 0029 0036 0042 5709
    98.0 -20   272 1.170      1.68 1.21  .47 0034 0029 0034 0040 5974

     1.0 -20   468  .680      1.19  .99  .20 0014 0086 0013 0009    0
    17.7 -20   468  .680      1.45  .99  .46 0033 0086 0032 0022 3744
    22.2 -20   468  .680      1.78  .99  .79 0057 0086 0056 0038 4039
    29.3 -20   468  .680      2.04  .99 1.05 0076 0086 0075 0051 4401
    31.1 -20   468  .680      2.34  .99 1.35 0098 0086 0097 0066 4478
    37.0 -20   468  .680      2.55  .99 1.56 0113 0086 0112 0076 4705
    42.8 -20   468  .680      2.63  .99 1.64 0118 0086 0117 0080 4894
    46.7 -20   468  .680      2.64  .99 1.65 0119 0086 0118 0080 5008
    58.0 -20   468  .680      2.62  .99 1.63 0118 0086 0117 0080 5290
    66.5 -20   468  .680      2.53  .99 1.54 0111 0086 0110 0075 5468
    72.0 -20   468  .680      2.42  .99 1.43 0103 0086 0102 0070 5572
    78.0 -20   468  .680      2.31  .99 1.32 0095 0086 0094 0064 5676
    80.0 -20   468  .680      2.25  .99 1.26 0091 0086 0090 0061 5709
    98.0 -20   468  .680      2.10  .99 1.11 0080 0086 0079 0054 5974
```

* last column employed in computer plotting only.

```
                                 TABLE 3
                  TABULATION OF ORIGINAL DATA POINTS FOR
                  ABSORPTION OF SOUND IN AIR VERSUS RELATIVE HUMIDITY
                                 AT -20 DEGREES CENTIGRADE

     R.H. TEMP FREQ LAMDA       AIR        AIR  AIR  AIR  AIR  MU    3000*
                                 +         ONLY ONLY CLAS  MOL
          DEG                   WALL WALL                             LOG
     PRCT CENT CPS METRS        DB/S DB/S DB/S /M    /M   /M          RH
             1         2         3         4         5         6
1234567890123456789012345678901234567890123456789012345678901234567890123456778


      1.0 -20  660   .482       2.00 1.86  .14 0010 0170 0008 0004    0
     17.7 -20  660   .482       2.32 1.86  .46 0033 0170 0031 0015 3744
     22.2 -20  660   .482       2.66 1.86  .80 0058 0170 0056 0027 4039
     29.3 -20  660   .482       2.98 1.86 1.12 0081 0170 0079 0038 4401
     31.1 -20  660   .482       3.40 1.86 1.54 0111 0170 0109 0053 4478
     37.0 -20  660   .482       3.73 1.86 1.87 0135 0170 0133 0064 4705
     42.8 -20  660   .482       3.99 1.86 2.13 0154 0170 0152 0073 4894
     46.7 -20  660   .482       4.14 1.86 2.28 0165 0170 0163 0079 5008
     58.0 -20  660   .482       4.25 1.86 2.39 0173 0170 0171 0083 5290
     66.5 -20  660   .482       4.23 1.86 2.37 0171 0170 0169 0082 5468
     72.0 -20  660   .482       4.20 1.86 2.34 0169 0170 0167 0081 5572
     78.0 -20  660   .482       4.08 1.86 2.22 0160 0170 0158 0076 5676
     80.0 -20  660   .482       4.04 1.86 2.18 0157 0170 0155 0075 5709
     98.0 -20  660   .482       3.96 1.86 2.10 0152 0170 0150 0072 5974

      1.0 -20  853   .373       3.62 3.58  .04 0003 0288 0000 0000    0
     17.7 -20  853   .373       3.82 3.58  .24 0017 0288 0014 0005 3744
     22.2 -20  853   .373       4.05 3.58  .47 0034 0288 0031 0012 4039
     29.3 -20  853   .373       4.38 3.58  .80 0058 0288 0055 0021 4401
     31.1 -20  853   .373       4.83 3.58 1.25 0090 0288 0087 0033 4478
     37.0 -20  853   .373       5.27 3.58 1.69 0122 0288 0119 0045 4705
     42.8 -20  853   .373       5.67 3.58 2.09 0151 0288 0148 0055 4894
     46.7 -20  853   .373       5.92 3.58 2.34 0169 0288 0166 0062 5008
     58.0 -20  853   .373       6.20 3.58 2.62 0189 0288 0186 0070 5290
     66.5 -20  853   .373       6.20 3.58 2.62 0189 0288 0186 0070 5468
     72.0 -20  853   .373       6.35 3.58 2.77 0200 0288 0197 0074 5572
     78.0 -20  853   .373       6.29 3.58 2.71 0196 0288 0193 0072 5676
     80.0 -20  853   .373       6.21 3.58 2.63 0190 0288 0187 0070 5709
     98.0 -20  853   .373       6.25 3.58 2.67 0193 0288 0190 0071 5974
```

* last column employed in computer plotting only.

TABLE 4

TABULATION OF ORIGINAL DATA POINTS FOR
ABSORPTION OF SOUND IN AIR VERSUS RELATIVE HUMIDITY
AT -40 DEGREES CENTIGRADE

```
R.H. TEMP FREQ LAMDA      AIR         AIR  AIR  AIR  AIR   MU   3000*
                           +          ONLY ONLY CLAS  MOL       LOG
                                                                RH
     DEG                  WALL WALL

PRCT CENT CPS METRS       DB/S DB/S DB/S /M    /M    /M

     1         2          3         4         5         6

12345678901234567890123456789012345678901234567890123456789012345678

 9.0  40  260 1.170       1.34 1.31  .13 0010 0083 0009 0007 2680
32.0  40  260 1.170       1.33 1.31  .12 0009 0083 0008 0006 4510
43.0  40  260 1.170       1.37 1.31  .16 0012 0083 0011 0008 4910
74.0  40  260 1.170       1.39 1.31  .18 0013 0083 0012 0009 5610
88.0  40  260 1.170       1.38 1.31  .17 0013 0083 0012 0009 5830
97.0  40  260 1.170       1.40 1.31  .19 0014 0083 0013 0010 5970
 9.0  40  447  .680       1.15  .95  .20 0015 0164 0013 0010 2860
32.0  40  447  .680       1.12  .95  .17 0013 0164 0011 0009 4510
43.0  40  447  .680       1.14  .95  .19 0014 0164 0013 0010 4910
74.0  40  447  .680       1.17  .95  .22 0016 0164 0014 0011 5610
88.0  40  447  .680       1.17  .95  .23 0016 0164 0014 0011 5830
97.0  40  447  .680       1.18  .95  .24 0017 0164 0015 0012 5970
 9.0  40  631  .482       1.82 1.71  .11 0008 0277 0005 0004 2860
32.0  40  631  .482       1.82 1.71  .11 0008 0277 0005 0004 4510
43.0  40  631  .482       1.83 1.71  .12 0009 0277 0006 0004 4910
74.0  40  631  .482       1.87 1.71  .16 0012 0277 0009 0006 5610
88.0  40  631  .482       1.87 1.71  .16 0012 0277 0009 0006 5830
97.0  40  631  .482       1.87 1.71  .16 0012 0277 0009 0006 5970
```

* last column employed in computer plotting only.

TABLE NO. 5

TABULATION OF DATA POINTS FOR
ABSORPTION OF SOUND IN DRY NITROGEN
AT 20 DEGREES CENTIGRADE
FOR THE COMPUTATION OF WALL LOSSES

MICROPHN	111111111111111		2222222222222222		2222222222222222		1111111111	
TEMP	+20C		0C		-20C		-40C	
MODE	F	R	F	R	F	R	F	R
11	139	2.14	134	1.88	129	1.92	----	-----
01	298	1.39	288	1.34	277	1.28	265	1.21
02	512	1.20	495	1.10	475	1.02	456	0.95
03	724	2.06	698	2.62	673	1.93	644	1.71
04	933	4.31	900	4.00	867	3.49	830	3.13

TABLE 6A-----400 MM PRESSURE
TABULATION OF ORIGINAL DATA POINTS FOR ABSORPTION OF SOUND IN AIR VERSUS RELATIVE HUMIDITY AT 20 DEGREES CENTIGRADE

1 2 3 4 5 6

123456789012345678901234567890123456789012345678901234567890123456789012345678

R.H. PRCT	TEMP DEG CENT	FREQ CPS	LAMDA METRS		AIR + WALL DB/S	WALL DB/S	AIR ONLY DB/S	AIR ONLY /M	AIR CLAS /M	AIR MOL /M	MU	3000* LOG RH
1.5	20	136	2.520	400	3.42	2.42	1.00	0067	0013	0067	0169	528
1.8	20	136	2.520	400	3.20	2.42	.78	0052	0013	0052	0131	766
1.9	20	136	2.520	400	3.11	2.42	.69	0046	0013	0046	0116	836
2.0	20	136	2.520	400	2.96	2.42	.54	0036	0013	0036	0091	903
2.2	20	136	2.520	400	2.80	2.42	.38	0026	0013	0026	0066	1027
2.8	20	136	2.520	400	2.75	2.42	.33	0022	0013	0022	0056	1341
4.8	20	136	2.520	400	2.72	2.42	.30	0020	0013	0020	0050	2044
5.2	20	136	2.520	400	2.73	2.42	.31	0021	0013	0021	0053	2148
5.8	20	136	2.520	400	2.66	2.42	.24	0016	0013	0016	0040	2290
6.7	20	136	2.520	400	2.65	2.42	.23	0015	0013	0015	0038	2478
8.0	20	136	2.520	400	2.69	2.42	.27	0018	0013	0018	0045	2709
10.0	20	136	2.520	400	2.62	2.42	.20	0013	0013	0013	0033	3000
12.2	20	136	2.520	400	2.64	2.42	.22	0015	0013	0015	0038	3259
13.7	20	136	2.520	400	2.60	2.42	.18	0012	0013	0012	0030	3410
18.5	20	136	2.520	400	2.68	2.42	.26	0017	0013	0017	0043	3802
23.1	20	136	2.520	400	2.63	2.42	.21	0014	0013	0014	0035	4091
26.8	20	136	2.520	400	2.64	2.42	.22	0015	0013	0015	0038	4284
33.0	20	136	2.520	400	2.60	2.42	.18	0012	0013	0012	0030	4556
37.0	20	136	2.520	400	2.60	2.42	.18	0012	0013	0012	0030	4705
1.5	20	293	1.170	400	4.48	1.75	2.73	0183	0061	0182	0213	528
1.8	20	293	1.170	400	4.29	1.75	2.54	0171	0061	0170	0199	766
1.9	20	293	1.170	400	4.13	1.75	2.38	0160	0061	0159	0186	836
2.0	20	293	1.170	400	3.74	1.75	1.99	0134	0061	0133	0156	903
2.2	20	293	1.170	400	3.40	1.75	1.65	0111	0061	0110	0129	1027
2.8	20	293	1.170	400	3.07	1.75	1.32	0089	0061	0088	0103	1341
4.8	20	293	1.170	400	2.86	1.75	1.11	0075	0061	0074	0087	2044
5.2	20	293	1.170	400	2.65	1.75	.90	0060	0061	0059	0069	2148
5.8	20	293	1.170	400	2.50	1.75	.75	0050	0061	0049	0057	2290
6.7	20	293	1.170	400	2.37	1.75	.62	0042	0061	0041	0048	2478
8.0	20	293	1.170	400	2.29	1.75	.54	0036	0061	0035	0041	2709
10.0	20	293	1.170	400	2.22	1.75	.47	0032	0061	0031	0036	3000
12.2	20	293	1.170	400	2.19	1.75	.44	0030	0061	0029	0034	3259
13.7	20	293	1.170	400	2.20	1.75	.45	0030	0061	0029	0034	3410
18.5	20	293	1.170	400	2.24	1.75	.49	0033	0061	0032	0037	3802
23.1	20	293	1.170	400	2.24	1.75	.49	0033	0061	0032	0037	4091
26.8	20	293	1.170	400	2.26	1.75	.51	0034	0061	0033	0039	4284
33.0	20	293	1.170	400	2.26	1.75	.51	0034	0061	0033	0039	4556
37.0	20	293	1.170	400	2.23	1.75	.48	0032	0061	0031	0036	4705

* last column employed in computer plotting only.

```
                          TABLE 6A-----400 MM PRESSURE
                TABULATION OF ORIGINAL DATA POINTS FOR
                ABSORPTION OF SOUND IN AIR VERSUS RELATIVE HUMIDITY
                          AT 20 DEGREES CENTIGRADE

    R.H. TEMP FREQ LAMDA      AIR        AIR  AIR  AIR  AIR  MU    3000*
                               +         ONLY ONLY CLAS  MOL       LOG
         DEG                  WALL WALL                             RH
    PRCT CENT CPS METRS       DB/S DB/S DB/S /M    /M    /M
              1         2         3         4         5         6
12345678901234567890123456789012345678901234567890123456789012345678

     1.5  20  504  .681 400   5.52 1.68 3.84 0258 0180 0256 0174  528
     1.8  20  504  .681 400   6.33 1.68 4.65 0312 0180 0310 0211  766
     1.9  20  504  .681 400   6.42 1.68 4.74 0318 0180 0316 0215  836
     2.0  20  504  .681 400   6.23 1.68 4.55 0305 0180 0303 0206  903
     2.2  20  504  .681 400   5.76 1.68 4.08 0274 0180 0272 0185 1027
     2.8  20  504  .681 400   5.17 1.68 3.49 0234 0180 0232 0158 1341
     4.8  20  504  .681 400   4.65 1.68 2.97 0199 0180 0197 0134 2044
     5.2  20  504  .681 400   4.13 1.68 2.45 0164 0180 0162 0110 2148
     5.8  20  504  .681 400   3.66 1.68 1.98 0133 0180 0131 0089 2290
     6.7  20  504  .681 400   3.28 1.68 1.60 0107 0180 0105 0072 2478
     8.0  20  504  .681 400   2.94 1.68 1.26 0085 0180 0083 0057 2709
    10.0  20  504  .681 400   2.68 1.68 1.00 0067 0180 0065 0044 3000
    12.2  20  504  .681 400   2.55 1.68  .87 0058 0180 0056 0038 3259
    13.7  20  504  .681 400   2.51 1.68  .83 0056 0180 0054 0037 3410
    18.5  20  504  .681 400   2.48 1.68  .80 0054 0180 0052 0035 3802
    23.1  20  504  .681 400   2.45 1.68  .77 0052 0180 0050 0034 4091
    26.8  20  504  .681 400   2.47 1.68  .79 0053 0180 0051 0035 4284
    33.0  20  504  .681 400   2.50 1.68  .82 0055 0180 0053 0036 4556
    37.0  20  504  .681 400   2.51 1.68  .83 0056 0180 0054 0037 4705

     1.5  20  712  .482 400   7.30 2.92 4.38 0294 0368 0290 0140  528
     1.8  20  712  .482 400   8.90 2.92 5.98 0401 0368 0397 0191  766
     1.9  20  712  .482 400   9.38 2.92 6.46 0434 0368 0430 0207  836
     2.0  20  712  .482 400   9.70 2.92 6.78 0455 0368 0451 0217  903
     2.2  20  712  .482 400   9.48 2.92 6.56 0440 0368 0436 0210 1027
     2.8  20  712  .482 400   9.00 2.92 6.08 0408 0368 0404 0195 1341
     4.8  20  712  .482 400   8.32 2.92 5.40 0362 0368 0358 0173 2044
     5.2  20  712  .482 400   7.51 2.92 4.59 0308 0368 0304 0147 2148
     5.8  20  712  .482 400   6.75 2.92 3.83 0257 0368 0253 0122 2290
     6.7  20  712  .482 400   6.00 2.92 3.08 0207 0368 0203 0098 2478
     8.0  20  712  .482 400   5.33 2.92 2.41 0162 0368 0158 0076 2709
    10.0  20  712  .482 400   4.80 2.92 1.88 0126 0368 0122 0059 3000
    12.2  20  712  .482 400   4.52 2.92 1.60 0107 0368 0103 0050 3259
    13.7  20  712  .482 400   4.38 2.92 1.46 0098 0368 0094 0045 3410
    18.5  20  712  .482 400   4.21 2.92 1.29 0087 0368 0083 0040 3802
    23.1  20  712  .482 400   4.08 2.92 1.16 0078 0368 0074 0036 4091
    26.8  20  712  .482 400   4.07 2.92 1.15 0077 0368 0073 0035 4284
    33.0  20  712  .482 400   4.04 2.92 1.12 0075 0368 0071 0034 4556
    37.0  20  712  .482 400   4.07 2.92 1.15 0077 0368 0073 0035 4705
```

* last column employed in computer plotting only.

```
                             TABLE 6A-----400 MM PRESSURE
                  TABULATION OF ORIGINAL DATA POINTS FOR
                  ABSORPTION OF SOUND IN AIR VERSUS RELATIVE HUMIDITY
                             AT 20 DEGREES CENTIGRADE

    R.H. TEMP FREQ LAMDA      AIR        AIR  AIR  AIR  AIR  MU     3000*
                               +         ONLY ONLY CLAS  MOL        LOG
         DEG                  WALL WALL                             RH
    PRCT CENT CPS METRS       DB/S DB/S DB/S /M     /M   /M
           1         2         3         4         5         6
12345678901234567890123456789012345678901234567890123456789012345678


     1.5  20  918  .374 400 11.00 6.98 4.02 0270 0618 0264 0099  528
     1.8  20  918  .374 400 13.00 6.98 6.02 0404 0618 0398 0149  766
     1.9  20  918  .374 400 13.60 6.98 6.62 0444 0618 0438 0164  836
     2.0  20  918  .374 400 14.70 6.98 7.72 0518 0618 0512 0191  903
     2.2  20  918  .374 400 14.70 6.98 7.72 0518 0618 0512 0191 1027
     2.8  20  918  .374 400 14.70 6.98 7.72 0518 0618 0512 0191 1341
     4.8  20  918  .374 400 14.10 6.98 7.12 0478 0618 0472 0176 2044
     5.2  20  918  .374 400 13.30 6.98 6.32 0424 0618 0418 0156 2148
     5.8  20  918  .374 400 12.10 6.98 5.12 0344 0618 0338 0126 2290
     6.7  20  918  .374 400 11.20 6.98 4.22 0283 0618 0277 0104 2478
     8.0  20  918  .374 400 10.20 6.98 3.22 0216 0618 0210 0079 2709
    10.0  20  918  .374 400  9.20 6.98 2.22 0149 0618 0143 0053 3000
    12.2  20  918  .374 400  8.79 6.98 1.81 0122 0618 0116 0043 3259
    13.7  20  918  .374 400  8.79 6.98 1.81 0122 0618 0116 0043 3410
    18.5  20  918  .374 400  8.53 6.98 1.55 0104 0618 0098 0037 3802
    23.1  20  918  .374 400  8.30 6.98 1.32 0089 0618 0083 0031 4091
    26.8  20  918  .374 400  8.03 6.98 1.05 0070 0618 0064 0024 4284
    33.0  20  918  .374 400  8.11 6.98 1.13 0076 0618 0070 0026 4556
    37.0  20  918  .374 400  8.11 6.98 1.13 0076 0618 0070 0026 4705
```

* last column employed in computer plotting only.

```
                    TABLE 6B----200 MM PRESSURE
           TABULATIØN ØF ØRIGINAL DATA PØINTS FØR
           ABSØRPTIØN ØF SØUND IN AIR VERSUS RELATIVE HUMIDITY
                       AT 20 DEGREES CENTIGRADE

   R•H• TEMP FREQ LAMDA      AIR         AIR  AIR  AIR  AIR   MU     3000*
                              +          ØNLY ØNLY CLAS  MØL
         DEG                 WALL WALL                               LOG
   PRCT CENT CPS METRS       DB/S DB/S DB/S /M    /M    /M           RH
         1         2         3         4         5         6
1234567890123456789012345678901234567890123456789012345678901234567 8


   1•4   20  136 2•520 200  3•52 3•05  •47 0032 0027 0032 0081   438
   1•5   20  136 2•520 200  3•59 3•05  •54 0036 0027 0036 0091   528
   1•7   20  136 2•520 200  3•36 3•05  •31 0021 0027 0021 0053   691
   1•8   20  136 2•520 200  3•30 3•05  •25 0017 0027 0017 0043   766
   1•9   20  136 2•520 200  3•33 3•05  •28 0019 0027 0019 0048   836
   2•1   20  136 2•520 200  3•30 3•05  •25 0017 0027 0017 0043   967
   2•4   20  136 2•520 200  3•20 3•05  •15 0010 0027 0010 0025  1141
   3•1   20  136 2•520 200  3•10 3•05  •05 0003 0027 0003 0008  1474
   4•7   20  136 2•520 200  3•13 3•05  •08 0005 0027 0005 0013  2016
   6•4   20  136 2•520 200  3•05 3•05  •00 0000 0027 0000 0000  2419
   8•3   20  136 2•520 200  3•11 3•05  •06 0004 0027 0004 0010  2757
  16•7   20  136 2•520 200  3•22 3•05  •17 0011 0027 0011 0028  3668
  22•0   20  136 2•520 200  3•23 3•05  •18 0012 0027 0012 0030  4027
  26•3   20  136 2•520 200  3•26 3•05  •21 0014 0027 0014 0035  4260

   1•4   20  293 1•170 200  4•58 2•38 2•20 0148 0122 0147 0172   438
   1•5   20  293 1•170 200  4•28 2•38 1•90 0128 0122 0127 0149   528
   1•7   20  293 1•170 200  3•78 2•38 1•40 0094 0122 0093 0109   691
   1•8   20  293 1•170 200  3•63 2•38 1•25 0084 0122 0083 0097   766
   1•9   20  293 1•170 200  3•48 2•38 1•10 0074 0122 0073 0086   836
   2•1   20  293 1•170 200  3•31 2•38  •93 0062 0122 0061 0071   967
   2•4   20  293 1•170 200  3•23 2•38  •85 0057 0122 0056 0066  1141
   3•1   20  293 1•170 200  3•10 2•38  •72 0048 0122 0047 0055  1474
   4•7   20  293 1•170 200  2•95 2•38  •57 0038 0122 0037 0043  2016
   6•4   20  293 1•170 200  2•81 2•38  •43 0029 0122 0028 0033  2419
   8•3   20  293 1•170 200  2•72 2•38  •34 0023 0122 0022 0026  2757
  16•7   20  293 1•170 200  2•74 2•38  •36 0024 0122 0023 0027  3668
  22•0   20  293 1•170 200  2•77 2•38  •39 0026 0122 0025 0029  4027
  26•3   20  293 1•170 200  2•83 2•38  •45 0030 0122 0029 0034  4260
```

* last column employed in computer plotting only.

```
                          TABLE 6B----200 MM PRESSURE
                TABULATION OF ORIGINAL DATA POINTS FOR
                ABSORPTION OF SOUND IN AIR VERSUS RELATIVE HUMIDITY
                          AT 20 DEGREES CENTIGRADE

   R.H. TEMP FREQ LAMDA      AIR       AIR  AIR  AIR  AIR  MU     3000*
                              +        ONLY ONLY CLAS  MOL        LOG
        DEG                  WALL WALL                            RH
   PRCT CENT CPS  METRS      DB/S DB/S DB/S /M    /M   /M
          1         2         3         4         5         6
12345678901234567890123456789012345678901234567890123456789012345678


    1.4  20  504  .681 200  7.12 2.40 4.72 0317 0360 0313 0213  438
    1.5  20  504  .681 200  6.84 2.40 4.44 0298 0360 0294 0200  528
    1.7  20  504  .681 200  6.08 2.40 3.68 0247 0360 0243 0165  691
    1.8  20  504  .681 200  5.80 2.40 3.40 0228 0360 0224 0153  766
    1.9  20  504  .681 200  5.50 2.40 3.10 0208 0360 0204 0139  836
    2.1  20  504  .681 200  5.10 2.40 2.70 0181 0360 0177 0121  967
    2.4  20  504  .681 200  4.81 2.40 2.41 0162 0360 0158 0108 1141
    3.1  20  504  .681 200  4.42 2.40 2.02 0136 0360 0132 0090 1474
    4.7  20  504  .681 200  4.00 2.40 1.60 0107 0360 0103 0070 2016
    6.4  20  504  .681 200  3.49 2.40 1.09 0073 0360 0069 0047 2419
    8.3  20  504  .681 200  3.18 2.40  .78 0052 0360 0048 0033 2757
   16.7  20  504  .681 200  3.02 2.40  .62 0042 0360 0038 0026 3668
   22.0  20  504  .681 200  3.03 2.40  .63 0042 0360 0038 0026 4027
   26.3  20  504  .681 200  3.11 2.40  .71 0048 0360 0044 0030 4260

    1.4  20  712  .482 200 10.60 4.14 6.46 0434 0736 0427 0206  438
    1.5  20  712  .482 200 10.70 4.14 6.56 0440 0736 0433 0209  528
    1.7  20  712  .482 200 10.20 4.14 6.06 0407 0736 0400 0193  691
    1.8  20  712  .482 200 10.00 4.14 5.86 0393 0736 0386 0186  766
    1.9  20  712  .482 200  9.59 4.14 5.45 0366 0736 0359 0173  836
    2.1  20  712  .482 200  9.04 4.14 4.90 0329 0736 0322 0155  967
    2.4  20  712  .482 200  8.63 4.14 4.49 0301 0736 0294 0142 1141
    3.1  20  712  .482 200  7.97 4.14 3.83 0257 0736 0250 0121 1474
    4.7  20  712  .482 200  7.23 4.14 3.09 0207 0736 0200 0096 2016
    6.4  20  712  .482 200  6.20 4.14 2.06 0138 0736 0131 0063 2419
    8.3  20  712  .482 200  5.58 4.14 1.44 0097 0736 0090 0043 2757
   16.7  20  712  .482 200  5.08 4.14  .94 0063 0736 0056 0027 3668
   22.0  20  712  .482 200  5.02 4.14  .88 0059 0736 0052 0025 4027
   26.3  20  712  .482 200  5.09 4.14  .95 0064 0736 0057 0027 4260
```

* last column employed in computer plotting only.

```
                             TABLE 6B----200 MM PRESSURE
              TABULATION OF ORIGINAL DATA POINTS FOR
              ABSORPTION OF SOUND IN AIR VERSUS RELATIVE HUMIDITY
                             AT 20 DEGREES CENTIGRADE

    R.H. TEMP FREQ LAMDA     AIR       AIR  AIR  AIR  AIR  MU     3000*
                              +        ONLY ONLY CLAS  MOL       LOG
         DEG                 WALL WALL                           RH
    PRCT CENT CPS METRS      DB/S DB/S DB/S /M    /M   /M
         1         2         3         4         5         6
12345678901234567890123456789012345678901234567890123456789012345678


     1.4  20  918  .374 200 15.20 8.02 7.18 0482 1236 0470 0176  438
     1.5  20  918  .374 200 15.80 8.02 7.78 0522 1236 0510 0191  528
     1.7  20  918  .374 200 15.70 8.02 7.68 0516 1236 0504 0188  691
     1.8  20  918  .374 200 16.00 8.02 7.98 0536 1236 0524 0196  766
     1.9  20  918  .374 200 15.50 8.02 7.48 0502 1236 0490 0183  836
     2.1  20  918  .374 200 14.70 8.02 6.68 0448 1236 0436 0163  967
     2.4  20  918  .374 200 14.40 8.02 6.38 0428 1236 0416 0156 1141
     3.1  20  918  .374 200 13.40 8.02 5.38 0361 1236 0349 0130 1474
     4.7  20  918  .374 200 12.60 8.02 4.58 0307 1236 0295 0110 2016
     6.4  20  918  .374 200 11.00 8.02 2.98 0200 1236 0188 0070 2419
     8.3  20  918  .374 200 10.00 8.02 1.98 0133 1236 0121 0045 2757
    16.7  20  918  .374 200  9.20 8.02 1.18 0079 1236 0067 0025 3668
    22.0  20  918  .374 200  9.04 8.02 1.02 0068 1236 0056 0021 4027
    26.3  20  918  .374 200  9.00 8.02  .98 0066 1236 0054 0020 4260
```

* last column employed in computer plotting only.

TABLE NO. 7

TABULATION OF ORIGINAL DATA POINTS FOR ABSORPTION OF SOUND IN DRY NITROGEN AT 20 DEGREES CENTIGRADE

SPHERE CONTAINS TWO MICROPHONES++++NOMINAL VALUES OF FREQUENCY ARE LISTED

FREQUENCY	139 CPS	298 CPS	512 CPS	724 CPS	933 CPS
PRESSURE	R IN DB/S	R IN DB/S	R IN DB/S	R IN DB/S	R/IN DB/S
765 MM	2.14	1.39	1.20	2.06	4.31
493 MM	2.31	1.61	1.50	2.66	6.23
399 MM	2.42	1.75	1.68	2.92	6.98
298 MM	2.68	1.99	1.94	3.36	7.60
193 MM	3.08	2.41	2.44	4.20	8.05
148 MM	3.55	2.77	2.82	4.78	7.98

TABLE NO. 8

TABULATION OF SMOOTHED DATA POINTS FOR ABSORPTION OF SOUND IN AIR VERSUS RELATIVE HUMIDITY AT 20 DEGREES CENTIGRADE

```
R.H.  TEMP FREQ LAMDA     AIR       AIR  AIR  AIR  AIR  MU   3000*
                           +        ONLY ONLY CLAS MOL       LOG
      DEG                 WALL WALL                          RH
PRCT  CENT CPS METRS      DB/S DB/S DB/S /M    /M   /M
      1          2        3         4          5        6
123456789012345678901234567890123456789012345678901234567890123456789012345678

   .1  20  136 2.520      2.54 1.99  .55 0009 0007 0009 0093 0000
  1.2  20  136 2.520      3.18 1.99 1.19 0085 0007 0085 0202  238
  1.4  20  136 2.520      3.08 1.99 1.09 0083 0007 0083 0184  438
  1.8  20  136 2.520      2.76 1.99  .77 0074 0007 0074 0131  766
  2.1  20  136 2.520      2.64 1.99  .65 0065 0007 0065 0111  967
  2.7  20  136 2.520      2.50 1.99  .51 0048 0007 0048 0086 1294
  3.8  20  136 2.520      2.36 1.99  .37 0032 0007 0032 0063 1739
  5.1  20  136 2.520      2.30 1.99  .31 0023 0007 0023 0053 2123
  6.1  20  136 2.520      2.26 1.99  .27 0020 0007 0020 0045 2356
  6.2  20  136 2.520      2.36 1.99  .37 0019 0007 0019 0063 2377
  7.2  20  136 2.520      2.32 1.99  .33 0017 0007 0017 0056 2572
  7.4  20  136 2.520      2.26 1.99  .27 0017 0007 0017 0045 2608
  8.2  20  136 2.520      2.35 1.99  .36 0017 0007 0017 0061 2741
  9.0  20  136 2.520      2.22 1.99  .23 0017 0007 0017 0038 2863
 10.1  20  136 2.520      2.26 1.99  .27 0017 0007 0017 0045 3013
 13.3  20  136 2.520      2.38 1.99  .39 0017 0007 0017 0066 3372
 16.3  20  136 2.520      2.35 1.99  .36 0017 0007 0017 0061 3637
 20.0  20  136 2.520      2.36 1.99  .37 0017 0007 0017 0063 3903
 25.4  20  136 2.520      2.23 1.99  .24 0017 0007 0017 0040 4215
 31.0  20  136 2.520      2.22 1.99  .23 0017 0007 0017 0038 4474
 39.0  20  136 2.520      2.22 1.99  .23 0017 0007 0017 0038 4773

  1.2  20  293 1.170      4.05 1.36 2.69 0174 0032 0174 0212  238
  1.4  20  293 1.170      4.17 1.36 2.81 0185 0032 0185 0221  438
  1.8  20  293 1.170      4.06 1.36 2.70 0183 0032 0183 0212  766
  2.1  20  293 1.170      3.70 1.36 2.34 0170 0032 0170 0184  967
  2.7  20  293 1.170      3.18 1.36 1.82 0137 0032 0137 0143 1294
  3.8  20  293 1.170      2.86 1.36 1.50 0092 0032 0092 0118 1739
  5.1  20  293 1.170      2.43 1.36 1.07 0065 0032 0065 0084 2123
  6.1  20  293 1.170      2.22 1.36  .86 0054 0032 0054 0068 2356
  6.2  20  293 1.170      2.22 1.36  .86 0052 0032 0052 0068 2377
  7.2  20  293 1.170      2.12 1.36  .76 0045 0032 0045 0060 2572
  7.4  20  293 1.170      2.09 1.36  .73 0043 0032 0043 0057 2608
  8.2  20  293 1.170      2.07 1.36  .71 0039 0032 0039 0056 2741
  9.0  20  293 1.170      2.01 1.36  .65 0037 0032 0037 0052 2863
 10.1  20  293 1.170      2.03 1.36  .67 0037 0032 0037 0053 3013
 13.3  20  293 1.170      1.99 1.36  .63 0037 0032 0037 0049 3372
 16.3  20  293 1.170      1.98 1.36  .62 0037 0032 0037 0049 3637
 20.0  20  293 1.170      1.98 1.36  .62 0037 0032 0037 0049 3903
 25.4  20  293 1.170      1.97 1.36  .61 0037 0032 0037 0048 4215
 31.0  20  293 1.170      1.98 1.36  .62 0037 0032 0037 0049 4474
 39.0  20  293 1.170      1.96 1.36  .60 0037 0032 0037 0047 4773
```

* last column employed in computer plotting only.

TABLE NO. 8

TABULATION OF SMOOTHED DATA POINTS FOR ABSORPTION OF SOUND IN AIR VERSUS RELATIVE HUMIDITY AT 20 DEGREES CENTIGRADE

```
R.H. TEMP FREQ LAMDA     AIR       AIR  AIR  AIR  AIR  MU   3000*
                          +        ONLY ONLY CLAS  MOL       LOG
     DEG                 WALL WALL                           RH
PRCT CENT CPS  METRS     DB/S DB/S DB/S /M   /M    /M
         1         2         3         4         5         6
123456789012345678901234567890123456789012345678901234567890123456789012345678

  .1  20  504  .681      1.81 1.17  .64 0020 0094 0020 0029 0000
 1.2  20  504  .681      4.76 1.17 3.59 0232 0094 0232 0163  238
 1.4  20  504  .681      5.30 1.17 4.13 0274 0094 0274 0188  438
 1.8  20  504  .681      5.97 1.17 4.80 0320 0094 0320 0219  766
 2.1  20  504  .681      6.12 1.17 4.95 0323 0094 0323 0225  967
 2.7  20  504  .681      5.56 1.17 4.39 0304 0094 0304 0200 1294
 3.8  20  504  .681      4.95 1.17 3.78 0229 0094 0229 0172 1739
 5.1  20  504  .681      3.92 1.17 2.75 0160 0094 0160 0125 2123
 6.1  20  504  .681      3.29 1.17 2.12 0131 0094 0131 0096 2356
 6.2  20  504  .681      3.26 1.17 2.09 0127 0094 0127 0095 2377
 7.2  20  504  .681      2.93 1.17 1.76 0108 0094 0108 0080 2572
 7.4  20  504  .681      2.87 1.17 1.70 0104 0094 0104 0077 2608
 8.2  20  504  .681      2.76 1.17 1.59 0091 0094 0091 0072 2741
 9.0  20  504  .681      2.57 1.17 1.40 0085 0094 0085 0063 2863
10.1  20  504  .681      2.52 1.17 1.35 0075 0094 0075 0061 3013
13.3  20  504  .681      2.29 1.17 1.12 0065 0094 0065 0050 3372
16.3  20  504  .681      2.19 1.17 1.02 0065 0094 0065 0046 3637
20.0  20  504  .681      2.14 1.17  .97 0065 0094 0065 0044 3903
25.4  20  504  .681      2.12 1.17  .95 0065 0094 0065 0043 4215
31.0  20  504  .681      2.15 1.17  .98 0065 0094 0065 0044 4474
39.0  20  504  .681      2.19 1.17 1.02 0065 0094 0065 0046 4773

  .1  20  712  .482      2.77 2.07  .70 0024 0187 0023 0022 0000
 1.2  20  712  .482      6.22 2.07 4.15 0259 0187 0258 0134  238
 1.4  20  712  .482      6.97 2.07 4.90 0301 0187 0300 0158  438
 1.8  20  712  .482      8.30 2.07 6.23 0379 0187 0378 0201  766
 2.1  20  712  .482      9.13 2.07 7.06 0429 0187 0428 0228  967
 2.7  20  712  .482      9.26 2.07 7.19 0458 0187 0457 0232 1294
 3.8  20  712  .482      8.73 2.07 6.66 0411 0187 0410 0215 1739
 5.1  20  712  .482      7.30 2.07 5.23 0315 0187 0314 0168 2123
 6.1  20  712  .482      6.21 2.07 4.14 0250 0187 0249 0133 2356
 6.2  20  712  .482      6.19 2.07 4.12 0245 0187 0244 0133 2377
 7.2  20  712  .482      5.54 2.07 3.47 0204 0187 0203 0111 2572
 7.4  20  712  .482      5.41 2.07 3.34 0199 0187 0198 0107 2608
 8.2  20  712  .482      5.13 2.07 3.06 0176 0187 0175 0098 2741
 9.0  20  712  .482      4.79 2.07 2.72 0158 0187 0157 0087 2863
10.1  20  712  .482      4.74 2.07 2.67 0139 0187 0138 0085 3013
13.3  20  712  .482      4.15 2.07 2.08 0102 0187 0101 0067 3372
16.3  20  712  .482      3.89 2.07 1.82 0093 0187 0092 0058 3637
20.0  20  712  .482      3.72 2.07 1.65 0093 0187 0092 0053 3903
25.4  20  712  .482      3.62 2.07 1.55 0093 0187 0092 0049 4215
31.0  20  712  .482      3.61 2.07 1.54 0093 0187 0092 0049 4474
39.0  20  712  .482      3.65 2.07 1.58 0093 0187 0092 0050 4773
```

* last column employed in computer plotting only.

```
                            TABLE NO. 8
              TABULATION OF SMOOTHED DATA POINTS FOR
              ABSORPTION OF SOUND IN AIR VERSUS RELATIVE HUMIDITY
                            AT 20 DEGREES CENTIGRADE

    R.H. TEMP FREQ LAMDA      AIR       AIR  AIR  AIR  AIR  MU     3000*
                               +        ONLY ONLY CLAS  MOL        LOG
         DEG                  WALL WALL                            RH
    PRCT CENT CPS METRS       DB/S DB/S DB/S /M    /M    /M
         1        2           3         4         5         6
1234567890123456789012345678901234567890123456789012345678901234567

      .1  20  918  .374       5.22 4.50  .72 0027 0312 0024 0017 0000
     1.2  20  918  .374       8.55 4.50 4.05 0291 0312 0288 0101  238
     1.4  20  918  .374       9.26 4.50 4.76 0333 0312 0330 0119  438
     1.8  20  918  .374      11.00 4.50 6.50 0417 0312 0414 0162  766
     2.1  20  918  .374      12.40 4.50 7.90 0489 0312 0486 0197  967
     2.7  20  918  .374      13.35 4.50 8.85 0585 0312 0582 0221 1294
     3.8  20  918  .374      13.20 4.50 8.70 0591 0312 0588 0217 1739
     5.1  20  918  .374      11.70 4.50 7.20 0483 0312 0480 0179 2123
     6.1  20  918  .374      10.35 4.50 5.85 0405 0312 0402 0146 2356
     6.2  20  918  .374      10.30 4.50 5.80 0389 0312 0386 0144 2377
     7.2  20  918  .374       9.48 4.50 4.98 0327 0312 0324 0124 2572
     7.4  20  918  .374       9.26 4.50 4.76 0315 0312 0312 0119 2608
     8.2  20  918  .374       8.85 4.50 4.35 0285 0312 0282 0108 2741
     9.0  20  918  .374       8.33 4.50 3.83 0255 0312 0252 0095 2863
    10.1  20  918  .374       8.25 4.50 3.75 0225 0312 0222 0093 3013
    13.3  20  918  .374       7.25 4.50 2.75 0165 0312 0162 0068 3372
    16.3  20  918  .374       6.90 4.50 2.40 0135 0312 0132 0059 3637
    20.0  20  918  .374       6.50 4.50 2.00 0123 0312 0120 0049 3903
    25.4  20  918  .374       6.28 4.50 1.78 0123 0312 0120 0043 4215
    31.0  20  918  .374       6.23 4.50 1.73 0123 0312 0120 0042 4474
    39.0  20  918  .374       6.28 4.50 1.78 0123 0312 0120 0043 4773
    39.5  20  918  .374       6.03 4.50 1.53 0123 0312 0120 0037 4790
```

* last column employed in computer plotting only.

TABLE NO. 9

TABULATION OF SMOOTHED DATA POINTS FOR
ABSORPTION OF SOUND IN AIR VERSUS RELATIVE HUMIDITY
AT 0 DEGREES CENTIGRADE

```
  R.H. TEMP FREQ LAMDA      AIR       AIR  AIR  AIR  AIR  MU   3000*
                             +        ONLY ONLY CLAS  MOL      LOG
       DEG                  WALL WALL                          RH
  PRCT CENT CPS  METRS      DB/S DB/S DB/S /M    /M   /M
          1         2         3         4         5         6
12345678901234567890123456789012345678901234567890123456789012345678
   3.1   0  132 2.520       2.60 1.88  .72 0053 0007 0053 0126 1474
   4.1   0  132 2.520       2.67 1.88  .79 0060 0007 0060 0138 1838
   4.4   0  132 2.520       2.67 1.88  .79 0060 0007 0060 0138 1930
   5.4   0  132 2.520       2.64 1.88  .76 0058 0007 0058 0133 2197
   6.2   0  132 2.520       2.53 1.88  .65 0053 0007 0053 0113 2377
   7.3   0  132 2.520       2.55 1.88  .67 0046 0007 0046 0118 2590
   8.9   0  132 2.520       2.34 1.88  .46 0037 0007 0037 0080 2848
  11.1   0  132 2.520       2.37 1.88  .49 0028 0007 0028 0085 3136
  11.9   0  132 2.520       2.26 1.88  .38 0026 0007 0026 0065 3227
  12.4   0  132 2.520       2.17 1.88  .29 0025 0007 0025 0050 3280
  13.0   0  132 2.520       2.10 1.88  .22 0023 0007 0023 0038 3342
  15.4   0  132 2.520       2.10 1.88  .22 0019 0007 0019 0038 3563
  17.5   0  132 2.520       2.07 1.88  .19 0017 0007 0017 0033 3729
  25.1   0  132 2.520       2.04 1.88  .16 0012 0007 0012 0028 4199
  27.4   0  132 2.520       2.02 1.88  .14 0012 0007 0012 0025 4313
  33.6   0  132 2.520       2.02 1.88  .14 0012 0007 0012 0025 4579
  38.4   0  132 2.520       1.97 1.88  .09 0012 0007 0012 0015 4753
  44.6   0  132 2.520       2.02 1.88  .14 0012 0007 0012 0025 4948
  54.0   0  132 2.520       1.99 1.88  .11 0012 0007 0012 0020 5197
  64.0   0  132 2.520       2.03 1.88  .15 0012 0007 0012 0025 5419
  84.0   0  132 2.520       1.99 1.88  .11 0012 0007 0012 0020 5773
  91.0   0  132 2.520       2.00 1.88  .12 0012 0007 0012 0020 5877

    .1   0  282 1.170       1.63 1.34  .29 0001 0031 0001 0024 0000
   3.1   0  282 1.170       2.49 1.34 1.15 0070 0031 0070 0094 1474
   4.1   0  282 1.170       2.75 1.34 1.41 0089 0031 0089 0115 1838
   4.4   0  282 1.170       2.92 1.34 1.58 0096 0031 0096 0129 1930
   5.4   0  282 1.170       3.05 1.34 1.71 0106 0031 0106 0140 2197
   6.2   0  282 1.170       3.08 1.34 1.74 0123 0031 0123 0142 2377
   7.3   0  282 1.170       3.14 1.34 1.80 0123 0031 0123 0147 2590
   8.9   0  282 1.170       3.07 1.34 1.73 0119 0031 0119 0141 2848
  11.1   0  282 1.170       2.95 1.34 1.61 0101 0031 0101 0132 3136
  11.9   0  282 1.170       2.75 1.34 1.41 0095 0031 0095 0115 3227
  12.4   0  282 1.170       2.58 1.34 1.24 0091 0031 0091 0101 3280
  13.0   0  282 1.170       2.39 1.34 1.05 0087 0031 0087 0086 3342
  15.4   0  282 1.170       2.22 1.34  .88 0070 0031 0070 0072 3563
  17.5   0  282 1.170       2.06 1.34  .72 0060 0031 0060 0059 3729
  25.1   0  282 1.170       1.88 1.34  .54 0040 0031 0040 0045 4199
  27.4   0  282 1.170       1.87 1.34  .53 0036 0031 0036 0043 4313
  33.6   0  282 1.170       1.74 1.34  .40 0029 0031 0029 0033 4579
  38.4   0  282 1.170       1.69 1.34  .35 0026 0031 0026 0028 4753
  44.6   0  282 1.170       1.65 1.34  .31 0025 0031 0025 0026 4948
  54.0   0  282 1.170       1.64 1.34  .30 0025 0031 0025 0025 5197
  64.0   0  282 1.170       1.59 1.34  .25 0025 0031 0025 0020 5419
  84.0   0  282 1.170       1.59 1.34  .25 0025 0031 0025 0020 5773
  91.0   0  282 1.170       1.59 1.34  .25 0025 0031 0025 0020 5877
```

* last column employed in computer plotting only.

TABLE NO. 9
TABULATION OF SMOOTHED DATA POINTS FOR
ABSORPTION OF SOUND IN AIR VERSUS RELATIVE HUMIDITY
AT 0 DEGREES CENTIGRADE

```
    R.H. TEMP FREQ LAMDA       AIR        AIR  AIR  AIR  AIR  MU    3000*
                                +         ONLY ONLY CLAS  MOL.      LOG
         DEG                   WALL WALL                            RH
    PRCT CENT CPS  METRS       DB/S DB/S DB/S /M    /M   /M
           1         2          3         4         5         6
1234567890123456789012345678901234567890123456789012345678901234567890123456789012345678
      .1   0  486  .681        1.43 1.10  .33 0002 0090 0002 0015-2999
     3.1   0  486  .681        2.40 1.10 1.30 0083 0090 0083 0061 1474
     4.1   0  486  .681        2.76 1.10 1.66 0109 0090 0109 0078 1838
     4.4   0  486  .681        2.98 1.10 1.88 0117 0090 0117 0089 1930
     5.4   0  486  .681        3.32 1.10 2.22 0143 0090 0143 0104 2197
     6.2   0  486  .681        3.54 1.10 2.44 0160 0090 0160 0115 2377
     7.3   0  486  .681        3.78 1.10 2.68 0192 0090 0192 0126 2590
     8.9   0  486  .681        4.03 1.10 2.93 0209 0090 0209 0138 2848
    11.1   0  486  .681        4.13 1.10 3.03 0209 0090 0209 0143 3136
    11.9   0  486  .681        4.12 1.10 3.02 0207 0090 0207 0143 3227
    12.4   0  486  .681        3.97 1.10 2.87 0204 0090 0204 0136 3280
    13.0   0  486  .681        3.71 1.10 2.61 0200 0090 0200 0123 3342
    15.4   0  486  .681        3.37 1.10 2.27 0177 0090 0177 0107 3563
    17.5   0  486  .681        3.05 1.10 1.95 0158 0090 0158 0092 3729
    25.1   0  486  .681        2.58 1.10 1.48 0102 0090 0102 0070 4199
    27.4   0  486  .681        2.57 1.10 1.47 0092 0090 0092 0069 4313
    33.6   0  486  .681        2.16 1.10 1.06 0072 0090 0072 0050 4579
    38.4   0  486  .681        2.00 1.10  .90 0062 0090 0062 0042 4753
    44.6   0  486  .681        1.88 1.10  .78 0053 0090 0053 0036 4948
    54.0   0  486  .681        1.81 1.10  .71 0045 0090 0045 0033 5197
    64.0   0  486  .681        1.67 1.10  .57 0042 0090 0042 0027 5419
    84.0   0  486  .681        1.61 1.10  .51 0042 0090 0042 0023 5773
    91.0   0  486  .681        1.59 1.10  .49 0042 0090 0042 0023 5877

      .1   0  686  .482        2.70 2.62  .08 0004 0179 0003 0002 0000
     3.1   0  686  .482        3.77 2.62 1.15 0094 0179 0093 0038 1474
     4.1   0  686  .482        4.03 2.62 1.41 0125 0179 0124 0046 1838
     4.4   0  686  .482        4.38 2.62 1.76 0131 0179 0130 0058 1930
     5.4   0  686  .482        4.79 2.62 2.17 0158 0179 0157 0072 2197
     6.2   0  686  .482        5.14 2.62 2.52 0182 0179 0181 0084 2377
     7.3   0  686  .482        5.49 2.62 2.87 0209 0179 0208 0096 2590
     8.9   0  686  .482        5.97 2.62 3.35 0255 0179 0254 0112 2848
    11.1   0  686  .482        6.28 2.62 3.66 0294 0179 0293 0122 3136
    11.9   0  686  .482        6.58 2.62 3.96 0300 0179 0299 0132 3227
    12.4   0  686  .482        6.70 2.62 4.08 0303 0179 0302 0136 3280
    13.0   0  686  .482        6.63 2.62 4.01 0308 0179 0307 0134 3342
    15.4   0  686  .482        6.28 2.62 3.66 0295 0179 0296 0122 3563
    17.5   0  686  .482        5.80 2.62 3.18 0275 0179 0274 0106 3729
    25.1   0  686  .482        5.03 2.62 2.41 0200 0179 0199 0080 4199
    27.4   0  686  .482        5.16 2.62 2.54 0176 0179 0175 0085 4313
    33.6   0  686  .482        4.33 2.62 1.71 0140 0179 0139 0057 4579
    38.4   0  686  .482        4.03 2.62 1.41 0122 0179 0121 0046 4753
    44.6   0  686  .482        3.77 2.62 1.15 0101 0179 0100 0038 4948
    54.0   0  686  .482        3.62 2.62 1.00 0083 0179 0082 0033 5197
    64.0   0  686  .482        3.37 2.62  .75 0070 0179 0069 0024 5419
    84.0   0  686  .482        3.26 2.62  .64 0061 0179 0060 0020 5773
    91.0   0  686  .482        3.13 2.62  .51 0061 0179 0060 0016 5877
```

* last column employed in computer plotting only.

```
                               TABLE NO. 9
                    TABULATION OF SMOOTHED DATA POINTS FOR
                    ABSORPTION OF SOUND IN AIR VERSUS RELATIVE HUMIDITY
                               AT  0 DEGREES CENTIGRADE

     R.H. TEMP FREQ LAMDA       AIR         AIR  AIR  AIR  AIR  MU    3000*
                                 +          ONLY ONLY CLAS  MOL       LOG
          DEG                   WALL WALL                             RH
     PRCT CENT CPS METRS        DB/S DB/S DB/S /M    /M   /M
           1        2           3          4         5         6
1234567890123456789012345678901234567890123456789012345678901234567890123345678
       .1   0  886  .374        4.57 4.00  .57 0006 0299 0004 0014 0000
      3.1   0  886  .374        5.58 4.00 1.58 0115 0299 0113 0040 1474
      4.1   0  886  .374        6.08 4.00 2.08 0146 0299 0144 0053 1838
      4.4   0  886  .374        6.13 4.00 2.13 0158 0299 0156 0054 1930
      5.4   0  886  .374        6.65 4.00 2.65 0193 0299 0191 0068 2197
      6.2   0  886  .374        7.10 4.00 3.10 0221 0299 0219 0080 2377
      7.3   0  886  .374        7.43 4.00 3.43 0252 0299 0250 0088 2590
      8.9   0  886  .374        8.29 4.00 4.29 0306 0299 0304 0110 2848
     11.1   0  886  .374        8.68 4.00 4.68 0372 0299 0370 0120 3136
     11.9   0  886  .374        9.40 4.00 5.40 0378 0299 0378 0139 3227
     12.4   0. 886  .374        9.78 4.00 5.78 0388 0299 0386 0149 3280
     13.0   0  886  .374       10.00 4.00 6.00 0392 0299 0390 0155 3342
     15.4   0  886  .374        9.67 4.00 5.67 0388 0299 0386 0146 3563
     17.5   0  886  .374        9.45 4.00 5.45 0372 0299 0370 0141 3729
     27.4   0  886  .374        8.36 4.00 4.36 0256 0299 0254 0112 4313
     33.6   0  886  .374        7.40 4.00 3.40 0197 0299 0195 0087 4579
     38.4   0  886  .374        6.96 4.00 2.95 0170 0299 0168 0076 4753
     44.6   0  886  .374        6.52 4.00 2.52 0143 0299 0141 0064 4948
     54.0   0  886  .374        6.28 4.00 2.28 0115 0299 0113 0058 5197
     64.0   0  886  .374        5.77 4.00 1.77 0099 0299 0097 0045 5419
     84.0   0  886  .374        5.42 4.00 1.42 0080 0299 0078 0036 5780
     91.0   0  886  .374        5.36 4.00 1.36 0080 0299 0078 0034 5870
```

* last column employed in computer plotting only.

```
                                           TABLF NO. 10


                      TABULATION OF SMOOTHED DATA POINTS FOR
                      ABSORPTION OF SOUND IN AIR VERSUS RELATIVE HUMIDITY
                                       AT -20 DEGREES CENTIGRADE .

    R.H.  TEMP  FREQ LAMDA       AIR         AIR  AIR   AIR   AIR   MU    3000*
                                   +         ONLY ONLY  CLAS   MOL        LOG
          DEG                   WALL  WALL                               RH
    PRCT  CENT  CPS  METRS       DB/S  DB/S  DB/S /M     /M    /M
           1          2           3          4           5          6
123456789012345678901234567890123456789012345678901234567890123456789012345678

    17.7  -20   272  1.170       1.65  1.21   .44 0044  0029  0044  0038  3744
    22.2  -20   272  1.170       1.90  1.21   .69 0058  0029  0058  0059  4039
    29.3  -20   272  1.170       2.10  1.21   .89 0066  0029  0066  0075  4401
    31.1  -20   272  1.170       2.16  1.21   .95 0067  0029  0067  0081  4478
    37.0  -20   272  1.170       2.16  1.21   .95 0067  0029  0067  0081  4705
    42.8  -20   272  1.170       2.12  1.21   .91 0062  0029  0062  0077  4894
    46.7  -20   272  1.170       2.05  1.21   .84 0058  0029  0058  0072  5008
    58.0  -20   272  1.170       1.95  1.21   .74 0049  0029  0049  0062  5290
    66.5  -20   272  1.170       1.86  1.21   .65 0044  0029  0044  0055  5468
    72.0  -20   272  1.170       1.79  1.21   .58 0042  0029  0042  0049  5572
    78.0  -20   272  1.170       1.73  1.21   .52 0039  0029  0039  0045  5676
    80.0  -20   272  1.170       1.71  1.21   .50 0038  0029  0038  0042  5709
    98.0  -20   272  1.170       1.68  1.21   .47 0032  0029  0032  0040  5974


    17.7  -20   468   .680       1.45   .99   .46 0037  0086. 0036  0022  3744
    22.2  -20   468   .680       1.78   .99   .79 0056  0086  0055  0038  4039
    29.3  -20   468   .680       2.04   .99  1.05 0090  0086  0089  0051  4401
    31.1  -20   468   .680       2.34   .99  1.35 0098  0086  0097  0066  4478
    37.0  -20   468   .680       2.55   .99  1.56 0113  0086  0112  0076  4705
    42.8  -20   468   .680       2.63   .99  1.64 0119  0086  0118  0080  4894
    46.7  -20   468   .680       2.64   .99  1.65 0121  0086  0120  0080  5008
    58.0  -20   468   .680       2.62   .99  1.63 0118  0086  0117  0080  5290
    66.5  -20   468   .680       2.53   .99  1.54 0110  0086  0109  0075  5468
    72.0  -20   468   .680       2.42   .99  1.43 0103  0086  0102  0070  5572
    78.0  -20   468   .680       2.31   .99  1.32 0098  0086  0097  0064  5676
    80.0  -20   468   .680       2.25   .99  1.26 0095  0086  0094  0061  5709
    98.0  -20   468   .680       2.10   .99  1.11 0082  0086  0081  0054  5974
```

* last column employed in computer plotting only.

```
                              TABLE NO. 10


                TABULATION OF SMOOTHED DATA POINTS FOR -
                ABSORPTION OF SOUND IN AIR VERSUS RELATIVE HUMIDITY
                               AT -20 DEGREES CENTIGRADE

     R.H. TEMP FREQ LAMDA      AIR        AIR  AIR  AIR  AIR  MU    3000*
                                +         ONLY ONLY CLAS  MOL       LOG
          DEG                  WALL WALL                            RH
     PRCT CENT CPS METRS       DB/S DB/S DB/S /M    /M   /M
             1         2          3         4         5         6
12345678901234567890123456789012345678901234567890123456789012345678

     17.7 -20  660  .482       2.32 1.86  .46 0033 0170 0031 0015 3744
     22.2 -20  660  .482       2.66 1.86  .80 0052 0170 0050 0027 4039
     29.3 -20  660  .482       2.98 1.86 1.12 0096 0170 0094 0038 4401
     31.1 -20  660  .482       3.40 1.86 1.54 0110 0170 0108 0053 4478
     37.0 -20  660  .482       3.73 1.86 1.87 0139 0170 0137 0064 4705
     42.8 -20  660  .482       3.99 1.86 2.13 0159 0170 0157 0073 4894
     46.7 -20  660  .482       4.14 1.86 2.28 0166 0170 0164 0079 5008
     58.0 -20  660  .482       4.25 1.86 2.39 0174 0170 0172 0083 5290
     66.5 -20  660  .482       4.23 1.86 2.37 0172 0170 0170 0082 5468
     72.0 -20  660  .482       4.20 1.86 2.34 0167 0170 0165 0081 5572
     78.0 -20  660  .482       4.08 1.86 2.22 0159 0170 0157 0076 5676
     80.0 -20  660  .482       4.04 1.86 2.18 0157 0170 0155 0075 5709
     98.0 -20  660  .482       3.96 1.86 2.10 0135 0170 0133 0072 5974

     17.7 -20  853  .373       3.82 3.58  .24 0021 0288 0018 0005 3744
     22.2 -20  853  .373       4.05 3.58  .47 0045 0288 0042 0012 4039
     29.3 -20  853  .373       4.38 3.58  .80 0080 0288 0077 0021 4401
     31.1 -20  853  .373       4.83 3.58 1.25 0089 0288 0086 0033 4478
     37.0 -20  853  .373       5.27 3.58 1.69 0123 0288 0120 0045 4705
     42.8 -20  853  .373       5.67 3.58 2.09 0152 0288 0149 0055 4894
     46.7 -20  853  .373       5.92 3.58 2.34 0170 0288 0167 0062 5008
     58.0 -20  853  .373       6.20 3.58 2.62 0194 0288 0191 0070 5290
     66.5 -20  853  .373       6.20 3.58 2.62 0199 0288 0196 0070 5468
     72.0 -20  853  .373       6.35 3.58 2.77 0201 0288 0198 0074 5572
     78.0 -20  853  .373       6.29 3.58 2.71 0199 0288 0196 0072 5676
     80.0 -20  853  .373       6.21 3.58 2.63 0197 0288 0194 0070 5709
     98.0 -20  853  .373       6.25 3.58 2.67 0179 0288 0176 0071 5974
```

* last column employed in computer plotting only.

```
                                TABLE NO. 11

              TABULATION OF SMOOTHED DATA POINTS FOR
              ABSORPTION OF SOUND IN AIR VERSUS RELATIVE HUMIDITY
                             AT -40 DEGREES CENTIGRADE

    R.H. TEMP FREQ LAMDA     AIR       AIR  AIR  AIR  AIR  MU    3000*
                              +        ONLY ONLY CLAS VOL        LOG
          DEG                WALL WALL                           RH
    PRCT CENT CPS  METRS     DB/S DB/S DB/S /M    /M   /M
         1         2         3         4         5         6
123456789012345678901234567890123456789012345678901234567890123456789012345678

     4.0 -40  121 2.520                     0000
     8.0 -40  121 2.520                     0001
    16.0 -40  121 2.520                     0002
    39.0 -40  121 2.520                     0004
    79.0 -40  121 2.520                     0008

     4.0 -40  260 1.170                     0001
     8.0 -40  260 1.170                     0001
    16.0 -40  260 1.170                     0002
    39.0 -40  260 1.170                     0006
    79.0 -40  260 1.170                     0012

     4.0 -40  447  .680                     0001
     8.0 -40  447  .680                     0002
    16.0 -40  447  .680                     0003
    39.0 -40  447  .680                     0007
    79.0 -40  447  .680                     0014

     4.0 -40  631  .482                     0002
     8.0 -40  631  .482                     0003
    16.0 -40  631  .482                     0004
    39.0 -40  631  .482                     0009
    79.0 -40  631  .482                     0017

     4.0 -40  815  .373                     0003
     8.0 -40  815  .373                     0004
    16.0 -40  815  .373                     0006
    39.0 -40  815  .373                     0012
    79.0 -40  815  .373                     0022
```

* last column employed in computer plotting only.

```
                             TABLE NO. 12
              TABULATION OF ORIGINAL DATA POINTS FOR
              ABSORPTION OF SOUND IN OXYGEN VERSUS RELATIVE HUMIDITY
                             AT 20 DEGREES CENTIGRADE
    R.H. TEMP FREQ LAMDA     02        02   02   02   02   MU    3000*
                              +        ONLY ONLY CLAS  MOL       LOG
         DEG                 WALL WALL                           RH
    PRCT CENT CPS METRS      DB/S DB/S DB/S /M    /M   /M
         1         2         3         4         5         6
12345678901234567890123456789012345678901234567890123456789012345678

     1.3  20  130 2.510      4.08 2.05 2.03 0143 0007 0143 0361  342
     1.4  20  130 2.510      6.60 2.05 4.55 0320 0007 0320 0807  438
     1.9  20  130 2.510      7.41 2.05 5.36 0376 0007 0376 0949  836
     2.3  20  130 2.510      7.59 2.05 5.54 0389 0007 0389 0982 1085
     2.8  20  130 2.510      6.96 2.05 4.91 0345 0007 0345 0871 1341
     4.2  20  130 2.510      6.42 2.05 4.37 0307 0007 0307 0775 1870
     5.1  20  130 2.510      5.58 2.05 3.53 0248 0007 0248 0626 2123
     5.9  20  130 2.510      4.70 2.05 2.65 0186 0007 0186 0469 2313
     6.4  20  130 2.510      4.16 2.05 2.11 0148 0007 0148 0373 2419
     8.3  20  130 2.510      3.62 2.05 1.57 0110 0007 0110 0278 2757
     8.9  20  130 2.510      3.43 2.05 1.38 0097 0007 0097 0245 2848
     9.9  20  130 2.510      3.13 2.05 1.08 0076 0007 0076 0192 2987
    10.8  20  130 2.510      2.93 2.05  .88 0062 0007 0062 0156 3100
    12.8  20  130 2.510      2.61 2.05  .56 0039 0007 0039 0098 3322
    14.9  20  130 2.510      2.46 2.05  .41 0029 0007 0029 0073 3520
    17.3  20  130 2.510      2.35 2.05  .30 0021 0007 0021 0053 3714
    20.3  20  130 2.510      2.26 2.05  .21 0015 0007 0015 0038 3922
    24.0  20  130 2.510      2.17 2.05  .12 0008 0007 0008 0020 4141
    29.0  20  130 2.510      2.11 2.05  .06 0004 0007 0004 0010 4387
    32.5  20  130 2.510      2.06 2.05  .01 0001 0007 0001 0003 4536
    44.0  20  130 2.510      2.05 2.05  .00 0000 0007 0000 0000 4930
    50.0  20  130 2.510      2.05 2.05  .00 0000 0007 0000 0000 5097
    54.0  20  130 2.510      2.05 2.05  .00 0000 0007 0000 0000 5197

      .0  20  279 1.170      2.21 1.35  .86 0060 0031 0060 0071    0
     1.3  20  279 1.170      3.82 1.35 2.47 0173 0031 0173 0203  342
     1.4  20  279 1.170      6.90 1.35 5.55 0390 0031 0390 0459  438
     1.9  20  279 1.170      8.82 1.35 7.47 0525 0031 0525 0617  836
     2.3  20  279 1.170     11.90 1.3510.55 0741 0031 0741 0871 1085
     2.8  20  279 1.170     12.70 1.3511.35 0797 0031 0797 0937 1341
     4.2  20  279 1.170     13.20 1.3511.85 0832 0031 0832 0978 1870
     5.1  20  279 1.170     12.70 1.3511.35 0797 0031 0797 0937 2123
     5.9  20  279 1.170     11.25 1.35 9.90 0695 0031 0695 0817 2313
     6.4  20  279 1.170     10.25 1.35 8.90 0625 0031 0625 0735 2419
     8.3  20  279 1.170      8.32 1.35 6.97 0490 0031 0490 0576 2757
     8.9  20  279 1.170      7.48 1.35 6.13 0431 0031 0431 0507 2848
     9.9  20  279 1.170      6.30 1.35 4.95 0348 0031 0348 0409 2987
    10.8  20  279 1.170      5.60 1.35 4.25 0299 0031 0299 0352 3100
    12.8  20  279 1.170      4.52 1.35 3.17 0223 0031 0223 0262 3322
    14.9  20  279 1.170      3.55 1.35 2.20 0155 0031 0155 0182 3520
    17.3  20  279 1.170      3.04 1.35 1.69 0119 0031 0119 0140 3714
    20.3  20  279 1.170      2.64 1.35 1.29 0091 0031 0091 0107 3922
    24.0  20  279 1.170      2.22 1.35  .87 0061 0031 0061 0072 4141
    29.0  20  279 1.170      1.97 1.35  .62 0044 0031 0044 0052 4387
    32.5  20  279 1.170      1.83 1.35  .48 0034 0031 0034 0040 4536
    44.0  20  279 1.170      1.64 1.35  .29 0020 0031 0020 0024 4930
    50.0  20  279 1.170      1.53 1.35  .18 0013 0031 0013 0015 5097
    54.0  20  279 1.170      1.46 1.35  .11 0008 0031 0008 0009 5197
```

* last column employed in computer plotting only.

```
                                 TABLE NO. 12
                TABULATION OF ORIGINAL DATA POINTS FOR
                ABSORPTION OF SOUND IN OXYGEN VERSUS RELATIVE HUMIDITY
                                 AT 20 DEGREES CENTIGRADE
    R.H. TEMP  FREQ LAMDA        O2        O2     O2    O2    O2    MU   3000*
                                  +        ONLY   ONLY  CLAS  MOL        LOG
         DEG                     WALL WALL                               RH
    PRCT CENT  CPS  METRS        DB/S DB/S DB/S   /M     /M    /M
          1          2           3          4           5           6
123456789012345678901234567890123456789012345678901234567890123456789012345678
      .0  20   479   .680         1.94 1.07  .87  0061  0092  0060  0041     0
     1.3  20   479   .680         3.52 1.07 2.45  0172  0092  0171  0117   342
     1.4  20   479   .680         7.28 1.07 6.21  0436  0092  0435  0298   438
     1.9  20   479   .680         9.45 1.07 8.38  0589  0092  0588  0403   836
     2.3  20   479   .680        12.40 1.0711.33  0796  0092  0795  0544  1085
     2.8  20   479   .680        15.70 1.0714.63  1028  0092  1027  0703  1341
     4.2  20   479   .680        17.90 1.0716.83  1182  0092  1181  0809  1870
     5.1  20   479   .680        20.60 1.0719.53  1372  0092  1371  0939  2123
     5.9  20   479   .680        21.40 1.0720.33  1428  0092  1427  0977  2313
     6.4  20   479   .680        20.60 1.0719.53  1372  0092  1371  0939  2419
     8.3  20   479   .680        18.40 1.0717.33  1217  0092  1216  0833  2757
     8.9  20   479   .680        16.75 1.0715.68  1101  0092  1100  0753  2848
     9.9  20   479   .680        14.45 1.0713.38  0940  0092  0939  0643  2987
    10.8  20   479   .680        12.80 1.0711.73  0824  0092  0823  0564  3100
    12.8  20   479   .680        10.30 1.07 9.23  0648  0092  0647  0443  3322
    14.9  20   479   .680         7.70 1.07 6.63  0466  0092  0465  0318  3520
    17.3  20   479   .680         6.28 1.07 5.21  0366  0092  0365  0250  3714
    20.3  20   479   .680         5.12 1.07 4.05  0284  0092  0283  0194  3922
    24.0  20   479   .680         3.88 1.07 2.81  0197  0092  0196  0134  4141
    29.0  20   479   .680         3.14 1.07 2.07  0145  0092  0144  0099  4387
    32.5  20   479   .680         2.72 1.07 1.65  0116  0092  0115  0079  4536
    44.0  20   479   .680         2.22 1.07 1.15  0081  0092  0080  0055  4930
    50.0  20   479   .680         1.89 1.07  .82  0058  0092  0057  0039  5097
    54.0  20   479   .680         1.78 1.07  .71  0050  0092  0049  0034  5197

      .0  20   677   .482         3.16 1.93 1.23  0086  0183  0084  0041     0
     1.3  20   677   .482         4.73 1.93 2.80  0197  0183  0195  0094   342
     1.4  20   677   .482         8.72 1.93 6.79  0477  0183  0475  0230   438
     1.9  20   677   .482        11.00 1.93 9.07  0637  0183  0635  0308   836
     2.3  20   677   .482        14.10 1.9312.17  0855  0183  0853  0413  1085
     2.8  20   677   .482        18.50 1.9316.57  1164  0183  1162  0563  1341
     4.2  20   677   .482        21.60 1.9319.67  1382  0183  1380  0669  1870
     5.1  20   677   .482        27.20 1.9325.27  1775  0183  1773  0859  2123
     5.9  20   677   .482        30.40 1.9328.47  2000  0183  1998  0968  2313
     6.4  20   677   .482        31.60 1.9329.67  2084  0183  2082  1009  2419
     8.3  20   677   .482        30.20 1.9328.27  1986  0183  1984  0961  2757
     8.9  20   677   .482        28.60 1.9326.67  1873  0183  1871  0907  2848
     9.9  20   677   .482        26.10 1.9324.17  1698  0183  1696  0822  2987
    10.8  20   677   .482        23.30 1.9321.37  1501  0183  1499  0726  3100
    12.8  20   677   .482        19.55 1.9317.62  1238  0183  1236  0599  3322
    14.9  20   677   .482        15.10 1.9313.17  0925  0183  0923  0447  3520
    17.3  20   677   .482        12.30 1.9310.37  0728  0183  0726  0352  3714
    20.3  20   677   .482        10.20 1.93 8.27  0581  0183  0579  0281  3922
    24.0  20   677   .482         7.77 1.93 5.84  0410  0183  0408  0198  4141
    29.0  20   677   .482         6.30 1.93 4.37  0307  0183  0305  0148  4387
    32.5  20   677   .482         5.45 1.93 3.52  0247  0183  0245  0119  4536
    44.0  20   677   .482         4.48 1.93 2.55  0179  0183  0177  0086  4930
    50.0  20   677   .482         3.84 1.93 1.91  0134  0183  0132  0064  5097
    54.0  20   677   .482         3.57 1.93 1.64  0115  0183  0113  0055  5197
```

* last column employed in computer plotting only.

```
                             TABLE NØ. 12
              TABULATIØN ØF ØRIGINAL DATA PØINTS FØR
              ABSØRPTIØN ØF SØUND IN ØXYGEN VERSUS RELATIVE HUMIDITY
                             AT 20 DEGREES CENTIGRADE
    R.H. TEMP FREQ LAMDA     02        02   02   02   02   MU    3000*
                              +        ØNLY ØNLY CLAS  MØL
         DEG                 WALL WALL                           LOG
    PRCT CENT CPS METRS      DB/S DB/S DB/S /M    /M   /M        RH
         1         2         3         4         5         6
12345678901234567890123456789012345678901234567890123456789012345678

      .0  20  874  .373      5.32 4.00 1.32 0093 0310 0090 0034    0
     1.3  20  874  .373      6.86 4.00 2.86 0201 0310 0198 0074  342
     1.4  20  874  .373     10.70 4.00 6.70 0471 0310 0468 0176  438
     1.9  20  874  .373     13.00 4.00 9.00 0632 0310 0629 0236  836
     2.3  20  874  .373     16.30 4.0012.30 0864 0310 0861 0323 1085
     2.8  20  874  .373     21.00 4.0017.00 1194 0310 1191 0447 1341
     4.2  20  874  .373     24.60 4.0020.60 1447 0310 1444 0542 1870
     5.1  20  874  .373     32.70 4.0028.70 2016 0310 2013 0756 2123
     5.9  20  874  .373     37.10 4.0033.10 2325 0310 2322 0872 2313
     6.4  20  874  .373     39.60 4.0035.60 2501 0310 2498 0938 2419
     8.3  20  874  .373     40.30 4.0036.30 2550 0310 2547 0956 2757
     8.9  20  874  .373     41.40 4.0037.40 2627 0310 2624 0985 2848
     9.9  20  874  .373     36.80 4.0032.80 2304 0310 2301 0864 2987
    10.8  20  874  .373     34.60 4.0030.60 2149 0310 2146 0805 3100
    12.8  20  874  .373     31.20 4.0027.20 1911 0310 1908 0716 3322
    14.9  20  874  .373     25.00 4.0021.00 1475 0310 1472 0552 3520
    17.3  20  874  .373     20.80 4.0016.80 1180 0310 1177 0442 3714
    20.3  20  874  .373     17.20 4.0013.20 0927 0310 0924 0347 3922
    24.0  20  874  .373     13.60 4.00 9.60 0674 0310 0671 0252 4141
    29.0  20  874  .373     11.10 4.00 7.10 0499 0310 0496 0186 4387
    32.5  20  874  .373      9.76 4.00 5.76 0405 0310 0402 0151 4536
    44.0  20  874  .373      7.85 4.00 3.85 0270 0310 0267 0100 4930
    50.0  20  874  .373      7.05 4.00 3.05 0214 0310 0211 0079 5097
    54.0  20  874  .373      6.69 4.00 2.69 0189 0310 0186 0070 5197
```

* last column employed in computer plotting only.

```
                                  TABLE NO. 13
                   TABULATION OF ORIGINAL DATA POINTS FOR
  ABSORPTION OF SOUND IN OXYGEN VS CONCENTRATION OF DEUTERIUM OXIDE
    R.H.  TEMP FREQ LAMDA         O2         O2    O2    O2    O2    MU     3000*
                                   +        ONLY  ONLY  CLAS   MOL          LOG
          DEG                     WALL WALL
    PRCT CENT  CPS METRS          DB/S DB/S DB/S  /M     /M    /M           RH
123456789012345678901234567890123456789012345678901234567890123456789012345678
       .1  20    130  2.510        3.19 2.05 1.14  0080  0007  0080  0201-2999
      1.2  20    130  2.510        6.73 2.05 4.68  0330  0007  0330  0830   238
      1.3  20    130  2.510        6.88 2.05 4.83  0340  0007  0340  0855   342
      1.4  20    130  2.510        7.08 2.05 5.03  0354  0007  0354  0890   438
      1.5  20    130  2.510        6.89 2.05 4.84  0341  0007  0341  0858   528
      1.6  20    130  2.510        6.63 2.05 4.58  0323  0007  0323  0812   612
      1.7  20    130  2.510        6.36 2.05 4.31  0304  0007  0304  0765   691
      1.8  20    130  2.510        6.09 2.05 4.04  0285  0007  0285  0717   766
      1.9  20    130  2.510        6.40 2.05 4.35  0307  0007  0307  0772   836
      2.2  20    130  2.510        6.08 2.05 4.03  0284  0007  0284  0714  1027
      2.5  20    130  2.510        5.63 2.05 3.58  0252  0007  0252  0634  1194
      4.1  20    130  2.510        5.08 2.05 3.03  0214  0007  0214  0538  1838
      4.3  20    130  2.510        4.89 2.05 2.84  0200  0007  0200  0503  1900
      4.8  20    130  2.510        4.43 2.05 2.38  0168  0007  0168  0423  2044
      5.8  20    130  2.510        4.02 2.05 1.97  0139  0007  0139  0350  2290
      7.1  20    130  2.510        3.31 2.05 1.26  0089  0007  0089  0224  2554
      8.2  20    130  2.510        2.95 2.05  .90  0063  0007  0063  0158  2741
     10.9  20    130  2.510        2.78 2.05  .73  0051  0007  0051  0128  3112
     14.0  20    130  2.510        2.49 2.05  .44  0031  0007  0031  0078  3438
     18.0  20    130  2.510        2.34 2.05  .29  0020  0007  0020  0050  3766
     22.4  20    130  2.510        2.24 2.05  .19  0013  0007  0013  0033  4051
     28.8  20    130  2.510        2.19 2.05  .14  0010  0007  0010  0025  4378
     32.0  20    130  2.510        2.17 2.05  .12  0008  0007  0008  0020  4515
     37.0  20    130  2.510        2.11 2.05  .06  0004  0007  0004  0010  4705
     43.0  20    130  2.510        2.10 2.05  .05  0004  0007  0004  0010  4900
     47.0  20    130  2.510        2.09 2.05  .04  0003  0007  0003  0008  5016
       .1  20    279  1.170        2.42 1.35 1.07  0075  0031  0075  0088-2999
      1.2  20    279  1.170        7.43 1.35 6.08  0428  0031  0428  0502   238
      1.3  20    279  1.170        8.40 1.35 7.05  0497  0031  0497  0583   342
      1.4  20    279  1.170        9.01 1.35 7.66  0540  0031  0540  0633   438
      1.5  20    279  1.170        9.43 1.35 8.08  0569  0031  0569  0667   528
      1.6  20    279  1.170       11.35 1.3510.00  0705  0031  0705  0826   612
      1.7  20    279  1.170       11.28 1.35 9.93  0700  0031  0700  0820   691
      1.8  20    279  1.170       13.10 1.3511.75  0828  0031  0828  0970   766
      1.9  20    279  1.170       13.60 1.3512.25  0863  0031  0863  1011   836
      2.2  20    279  1.170       13.80 1.3512.45  0877  0031  0877  1028  1027
      2.5  20    279  1.170       13.50 1.3512.15  0856  0031  0856  1003  1194
      4.1  20    279  1.170       12.70 1.3511.35  0800  0031  0800  0938  1838
      4.3  20    279  1.170       12.40 1.3511.05  0779  0031  0779  0913  1900
      4.8  20    279  1.170       10.15 1.35 8.80  0620  0031  0620  0727  2044
      5.8  20    279  1.170        8.23 1.35 6.88  0485  0031  0485  0568  2290
      7.1  20    279  1.170        6.90 1.35 5.55  0391  0031  0391  0458  2554
      8.2  20    279  1.170        5.51 1.35 4.16  0293  0031  0293  0343  2741
     10.9  20    279  1.170        4.48 1.35 3.13  0221  0031  0221  0259  3112
     14.0  20    279  1.170        3.54 1.35 2.19  0154  0031  0154  0180  3438
     18.0  20    279  1.170        3.01 1.35 1.66  0117  0031  0117  0137  3766
     22.4  20    279  1.170        2.45 1.35 1.10  0078  0031  0078  0091  4051
     28.8  20    279  1.170        2.15 1.35  .80  0056  0031  0056  0066  4378
     32.0  20    279  1.170        2.02 1.35  .67  0047  0031  0047  0055  4515
     37.0  20    279  1.170        1.91 1.35  .56  0039  0031  0039  0046  4705
     47.0  20    279  1.170        1.80 1.35  .45  0032  0031  0032  0038  5016
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* last column employed in computer plotting only.

TABLE NO. 13

TABULATION OF ORIGINAL DATA POINTS FOR ABSORPTION OF SOUND IN OXYGEN VS CONCENTRATION OF DEUTERIUM OXIDE

R.H. PRCT	TEMP DEG CENT	FREQ CPS	LAMDA METRS	02 + WALL DB/S	WALL DB/S	02 ONLY DB/S	02 ONLY /M	02 CLAS /M	02 MOL /M	MU	3000* LOG RH.
.1	20	479	.680	2.37	1.35	1.02	0072	0092	0071	0048	-2999
1.2	20	479	.680	7.60	1.35	6.25	0440	0092	0439	0300	238
1.3	20	479	.680	9.23	1.35	7.88	0555	0092	0554	0378	342
1.4	20	479	.680	10.20	1.35	8.85	0624	0092	0623	0425	438
1.5	20	479	.680	11.20	1.35	9.85	0694	0092	0693	0473	528
1.6	20	479	.680	12.70	1.35	11.35	0800	0092	0799	0545	612
1.7	20	479	.680	14.00	1.35	12.65	0891	0092	0890	0608	691
1.8	20	479	.680	15.45	1.35	14.10	0994	0092	0993	0678	766
1.9	20	479	.680	17.30	1.35	15.95	1124	0092	1123	0767	836
2.2	20	479	.680	19.20	1.35	17.85	1258	0092	1257	0858	1027
2.5	20	479	.680	20.80	1.35	19.45	1371	0092	1370	0935	1194
4.1	20	479	.680	21.20	1.35	19.85	1399	0092	1398	0954	1838
4.3	20	479	.680	21.50	1.35	20.15	1420	0092	1419	0969	1900
4.8	20	479	.680	20.80	1.35	19.45	1371	0092	1370	0935	2044
5.8	20	479	.680	18.70	1.35	17.35	1223	0092	1222	0834	2290
7.1	20	479	.680	15.60	1.35	14.25	1004	0092	1003	0685	2554
8.2	20	479	.680	13.25	1.35	11.90	0839	0092	0838	0572	2741
10.9	20	479	.680	10.70	1.35	9.35	0659	0092	0658	0449	3112
14.0	20	479	.680	8.07	1.35	6.72	0474	0092	0473	0323	3438
18.0	20	479	.680	6.52	1.35	5.17	0364	0092	0363	0248	3766
22.4	20	479	.680	4.85	1.35	3.50	0247	0092	0246	0168	4051
28.8	20	479	.680	3.98	1.35	2.63	0185	0092	0184	0126	4378
32.0	20	479	.680	3.60	1.35	2.25	0159	0092	0158	0108	4515
37.0	20	479	.680	3.24	1.35	1.89	0133	0092	0132	0090	4705
43.0	20	479	.680	3.08	1.35	1.73	0122	0092	0121	0083	4900
47.0	20	479	.680	2.92	1.35	1.57	0111	0092	0110	0075	5016
.1	20	677	.482	3.69	1.93	1.76	0124	0183	0122	0059	-2999
1.2	20	677	.482	9.08	1.93	7.15	0504	0183	0502	0242	238
1.3	20	677	.482	10.80	1.93	8.87	0625	0183	0623	0301	342
1.4	20	677	.482	11.85	1.93	9.92	0699	0183	0697	0337	438
1.5	20	677	.482	13.10	1.93	11.17	0787	0183	0785	0379	528
1.6	20	677	.482	14.70	1.93	12.77	0900	0183	0898	0434	612
1.7	20	677	.482	16.40	1.93	14.47	1020	0183	1018	0492	691
1.8	20	677	.482	18.20	1.93	16.27	1146	0183	1144	0553	766
1.9	20	677	.482	20.70	1.93	18.77	1323	0183	1321	0638	836
2.2	20	677	.482	23.70	1.93	21.77	1534	0183	1532	0740	1027
2.5	20	677	.482	27.10	1.93	25.17	1774	0183	1772	0856	1194
4.1	20	677	.482	28.90	1.93	26.97	1900	0183	1898	0917	1838
4.3	20	677	.482	29.80	1.93	27.87	1964	0183	1962	0948	1900
4.8	20	677	.482	31.70	1.93	29.77	2098	0183	2096	1012	2044
5.8	20	677	.482	31.30	1.93	29.37	2070	0183	2068	0999	2290
7.1	20	677	.482	27.90	1.93	25.97	1830	0183	1828	0883	2554
8.2	20	677	.482	24.40	1.93	22.47	1583	0183	1581	0764	2741
10.9	20	677	.482	20.40	1.93	18.47	1301	0183	1299	0627	3112
14.0	20	677	.482	16.10	1.93	14.17	0998	0183	0996	0481	3438
18.0	20	677	.482	12.90	1.93	10.97	0773	0183	0771	0372	3766
22.4	20	677	.482	9.85	1.93	7.92	0558	0183	0556	0269	4051
28.8	20	677	.482	8.15	1.93	6.22	0438	0183	0436	0211	4378
32.2	20	677	.482	7.43	1.93	5.50	0388	0183	0386	0186	4524
37.0	20	677	.482	6.64	1.93	4.71	0332	0183	0330	0159	4705
43.0	20	677	.482	6.38	1.93	4.45	0314	0183	0312	0151	4900
47.0	20	677	.482	6.05	1.93	4.12	0290	0183	0288	0139	5016

* last column employed in computer plotting only.

```
                             TABLE NO. 13

              TABULATION OF ORIGINAL DATA POINTS FOR
  ABSORPTION OF SOUND IN OXYGEN VS CONCENTRATION OF DEUTERIUM OXIDE
                             AT 20 DEGREES CENTIGRADE

    R.H. TEMP FREQ LAMDA     02        02   02   02   02   MU    3000*
                              +        ONLY ONLY CLAS  MOL       LOG
         DEG                 WALL WALL
    PRCT CENT CPS  METRS     DB/S DB/S DB/S /M    /M   /M        RH
         1         2         3         4         5         6
12345678901234567890123456789012345678901234567890123456789012345678

     .1   20  874  .373      5.63 4.00 1.63 0115 0310 0112 0042-2999
    1.2   20  874  .373     10.90 4.00 6.90 0486 0310 0483 0181  238
    1.3   20  874  .373     12.60 4.00 8.60 0606 0310 0603 0226  342
    1.4   20  874  .373     13.50 4.00 9.50 0669 0310 0666 0249  438
    1.5   20  874  .373     14.85 4.0010.85 0765 0310 0762 0285  528
    1.6   20  874  .373     16.60 4.0012.60 0888 0310 0885 0331  612
    1.7   20  874  .373     18.30 4.0014.30 1008 0310 1005 0376  691
    1.8   20  874  .373     19.90 4.0015.90 1120 0310 1117 0418  766
    1.9   20  874  .373     23.00 4.0019.00 1339 0310 1336 0500  836
    2.2   20  874  .373     26.00 4.0022.00 1550 0310 1547 0579 1027
    2.5   20  874  .373     30.00 4.0026.00 1832 0310 1829 0684 1194
    4.1   20  874  .373     32.20 4.0028.20 1987 0310 1984 0742 1838
    4.3   20  874  .373     36.40 4.0032.40 2283 0310 2280 0853 1900
    4.8   20  874  .373     38.90 4.0034.90 2459 0310 2456 0919 2044
    5.8   20  874  .373     40.70 4.0036.70 2586 0310 2583 0966 2290
    7.1   20  874  .373     37.40 4.0033.40 2353 0310 2350 0879 2554
    8.2   20  874  .373     34.70 4.0030.70 2163 0310 2160 0808 2741
   10.9   20  874  .373     30.50 4.0026.50 1867 0310 1864 0697 3112
   14.0   20  874  .373     25.50 4.0021.50 1515 0310 1512 0566 3438
   18.0   20  874  .373     20.70 4.0016.70 1177 0310 1174 0439 3766
   22.4   20  874  .373     16.00 4.0012.00 0846 0310 0843 0315 4051
   28.8   20  874  .373     13.50 4.00 9.50 0669 0310 0666 0249 4378
   32.0   20  874  .373     12.40 4.00 8.40 0592 0310 0589 0220 4515
   37.0   20  874  .373     11.20 4.00 7.20 0507 0310 0504 0189 4705
   43.0   20  874  .373     10.80 4.00 6.80 0479 0310 0476 0178 4900
   47.0   20  874  .373     10.40 4.00 6.40 0451 0310 0448 0168 5016
```

* last column employed in computer plotting only.

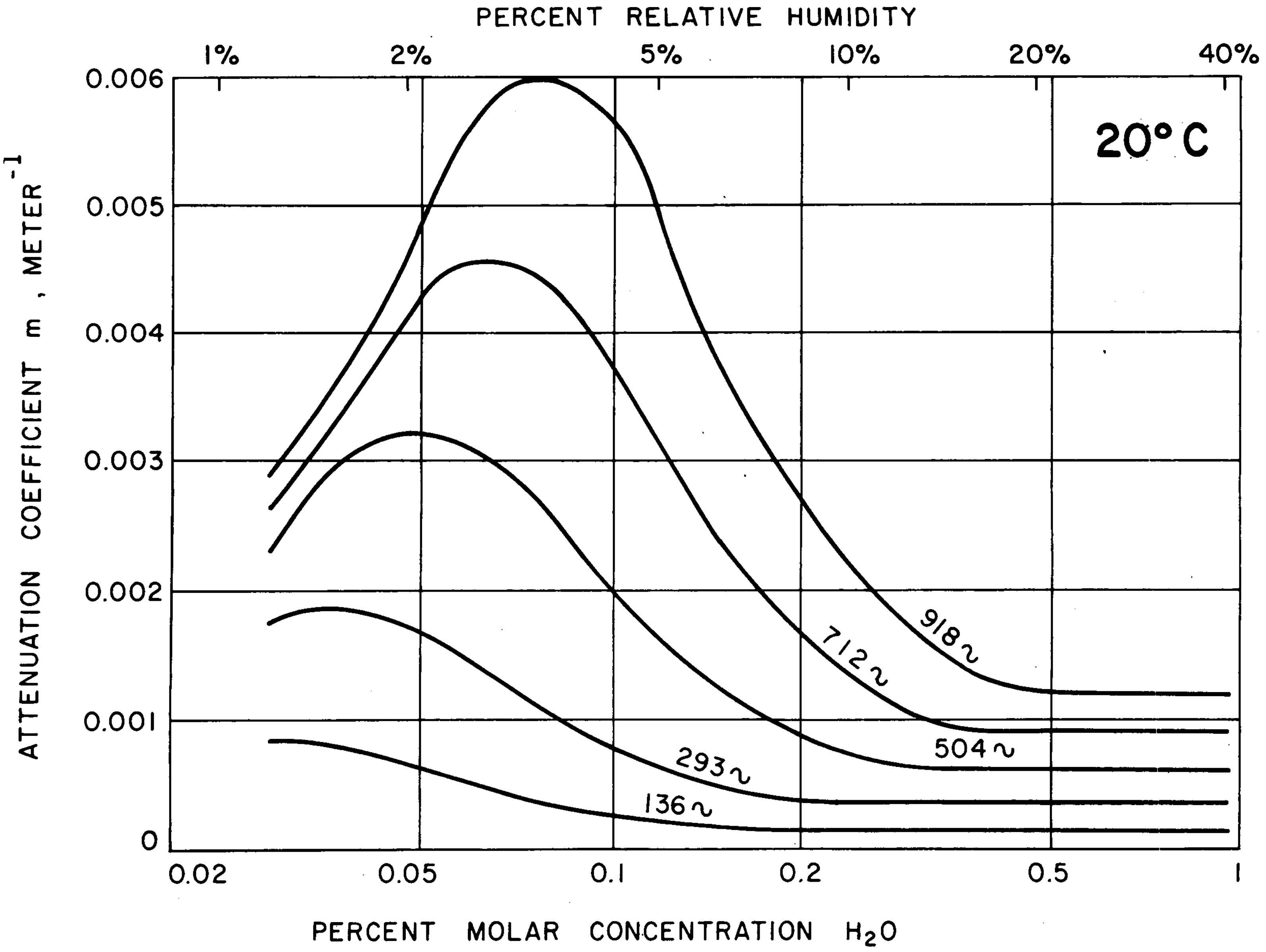

FIGURE 1. ATTENUATION COEFFICIENT m VERSUS PERCENT RELATIVE HUMIDITY FOR AIR AT 20° C AND NORMAL ATMOSPHERIC PRESSURE

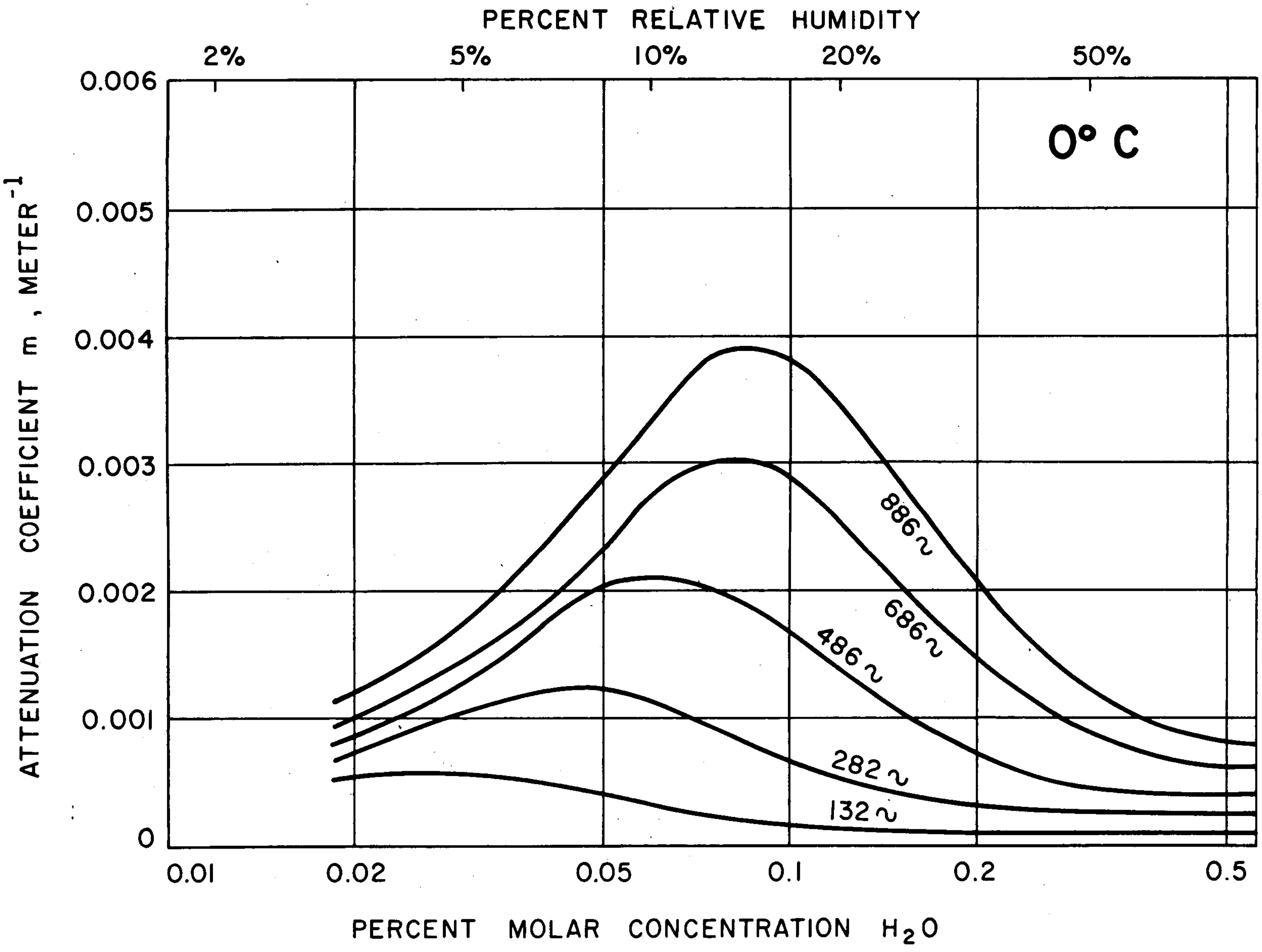

FIGURE 2. ATTENUATION COEFFICIENT m VERSUS PERCENT RELATIVE HUMIDITY FOR AIR AT 0° C AND NORMAL ATMOSPHERIC PRESSURE

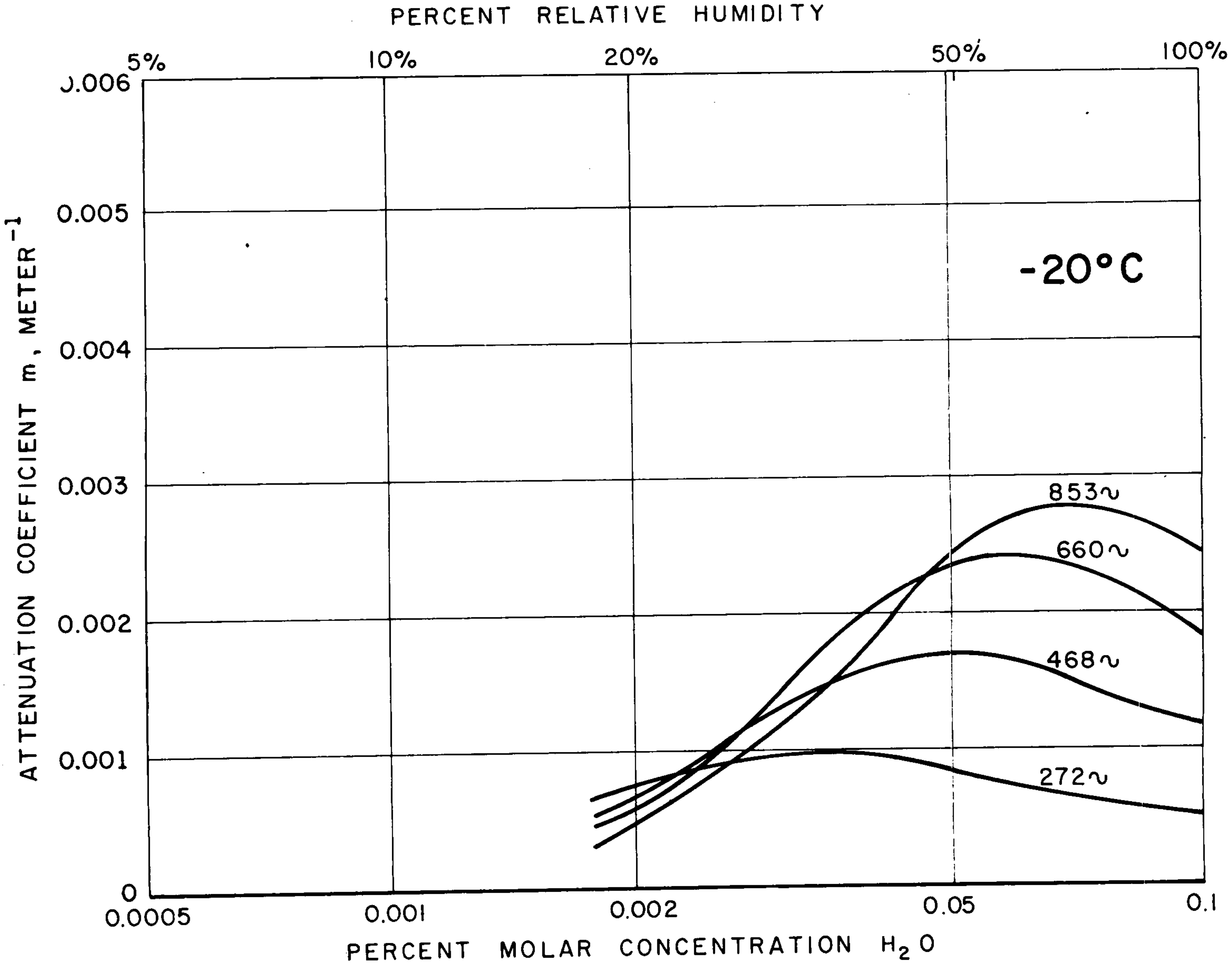

FIGURE 3. ATTENUATION COEFFICIENT m VERSUS PERCENT RELATIVE HUMIDITY FOR AIR AT -20°C AND NORMAL ATMOSPHERIC PRESSURE

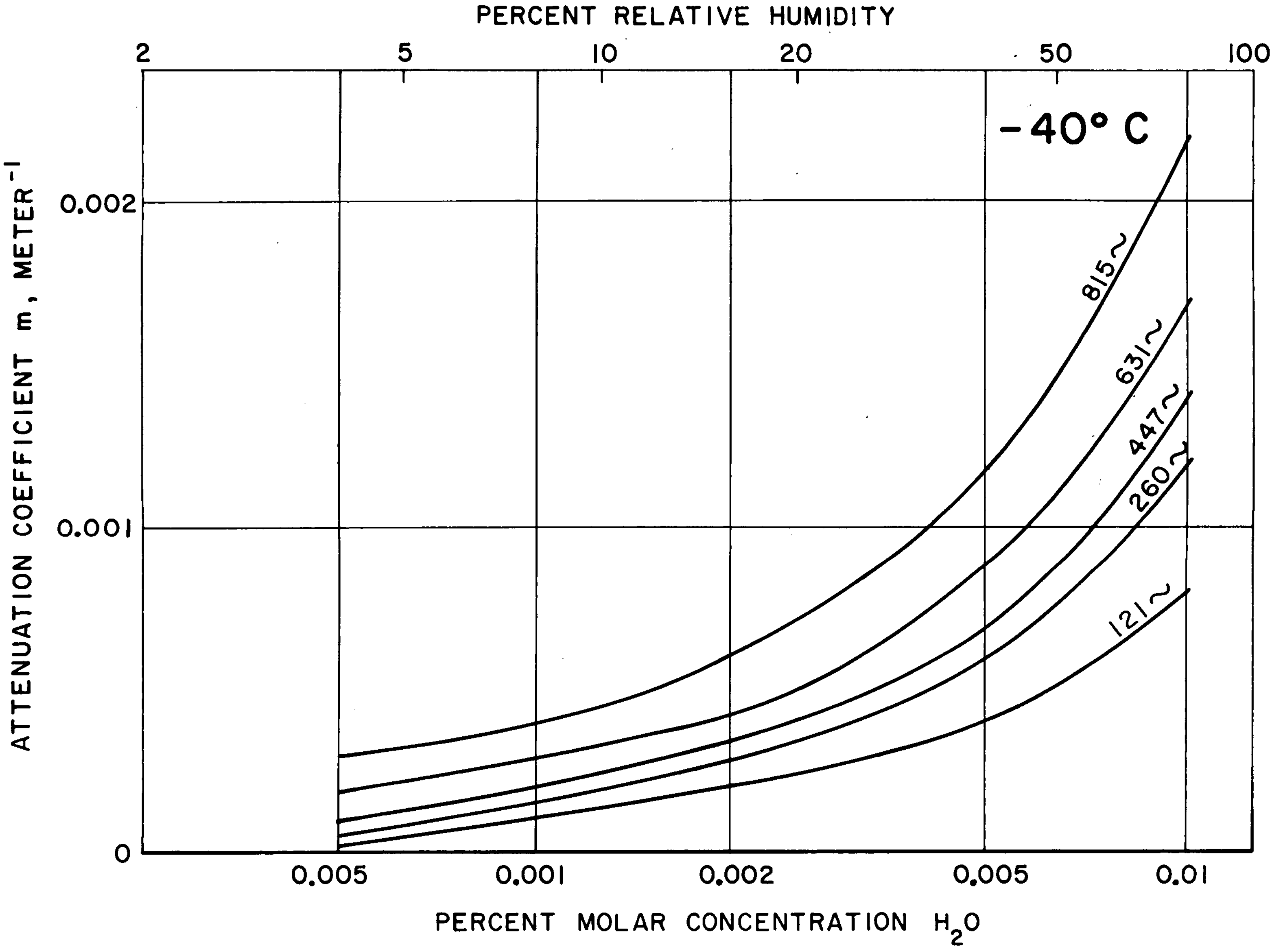

FIGURE 4. ATTENUATION COEFFICIENT m VERSUS PERCENT RELATIVE HUMIDITY FOR AIR AT -40° C AND NORMAL ATMOSPHERIC PRESSURE

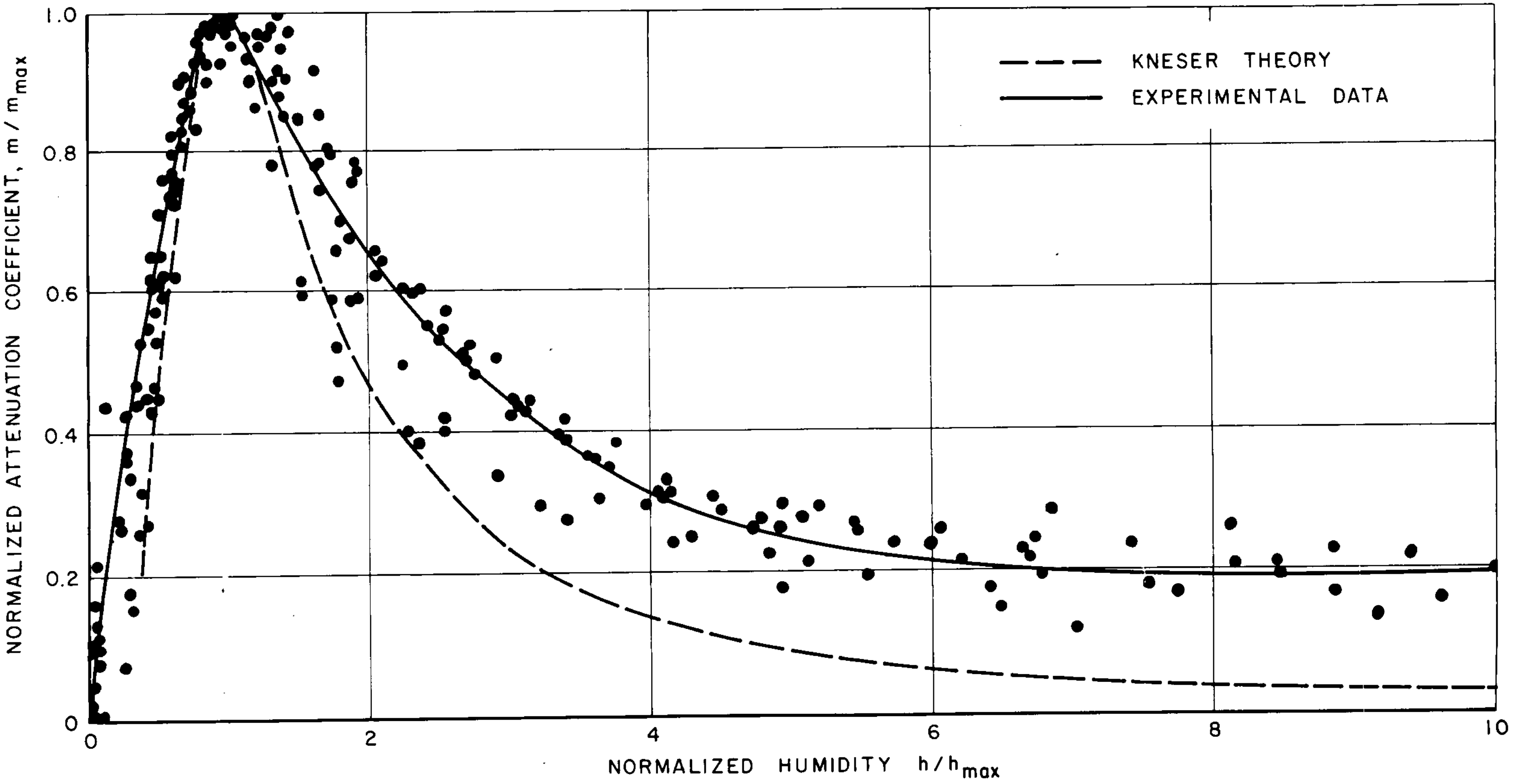

FIGURE 5. PLOT OF EXPERIMENTAL DATA AT 20° C, 0° C and -20° C OF ATTENUATION IN AIR VERSUS HUMIDITY. THESE DATA ARE PRESENTED IN NORMALIZED FORM M/m_{max} VERSUS h/h_{max}

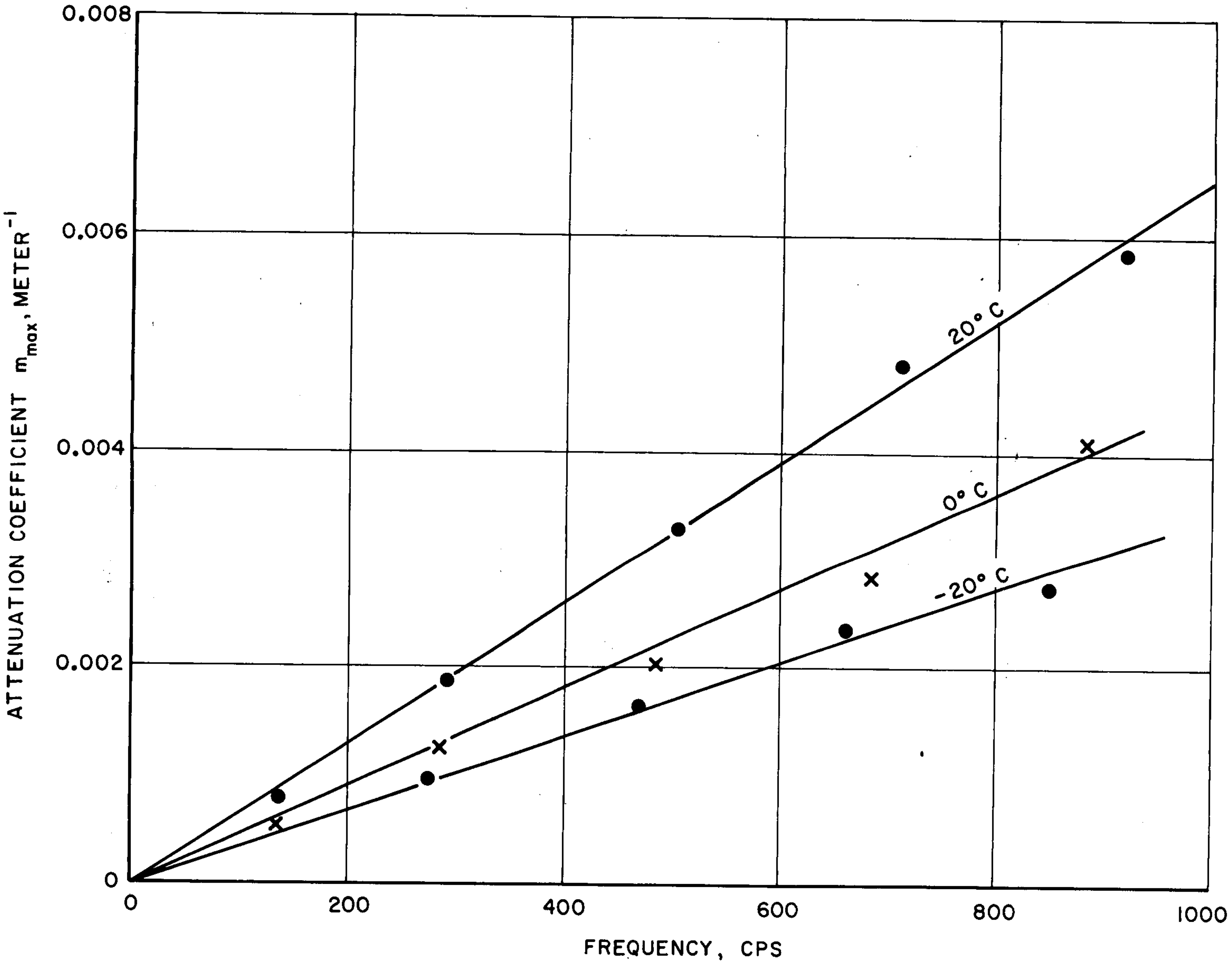

FIGURE 6. MAXIMUM ATTENUATION COEFFICIENT m_{max} VERSUS FREQUENCY

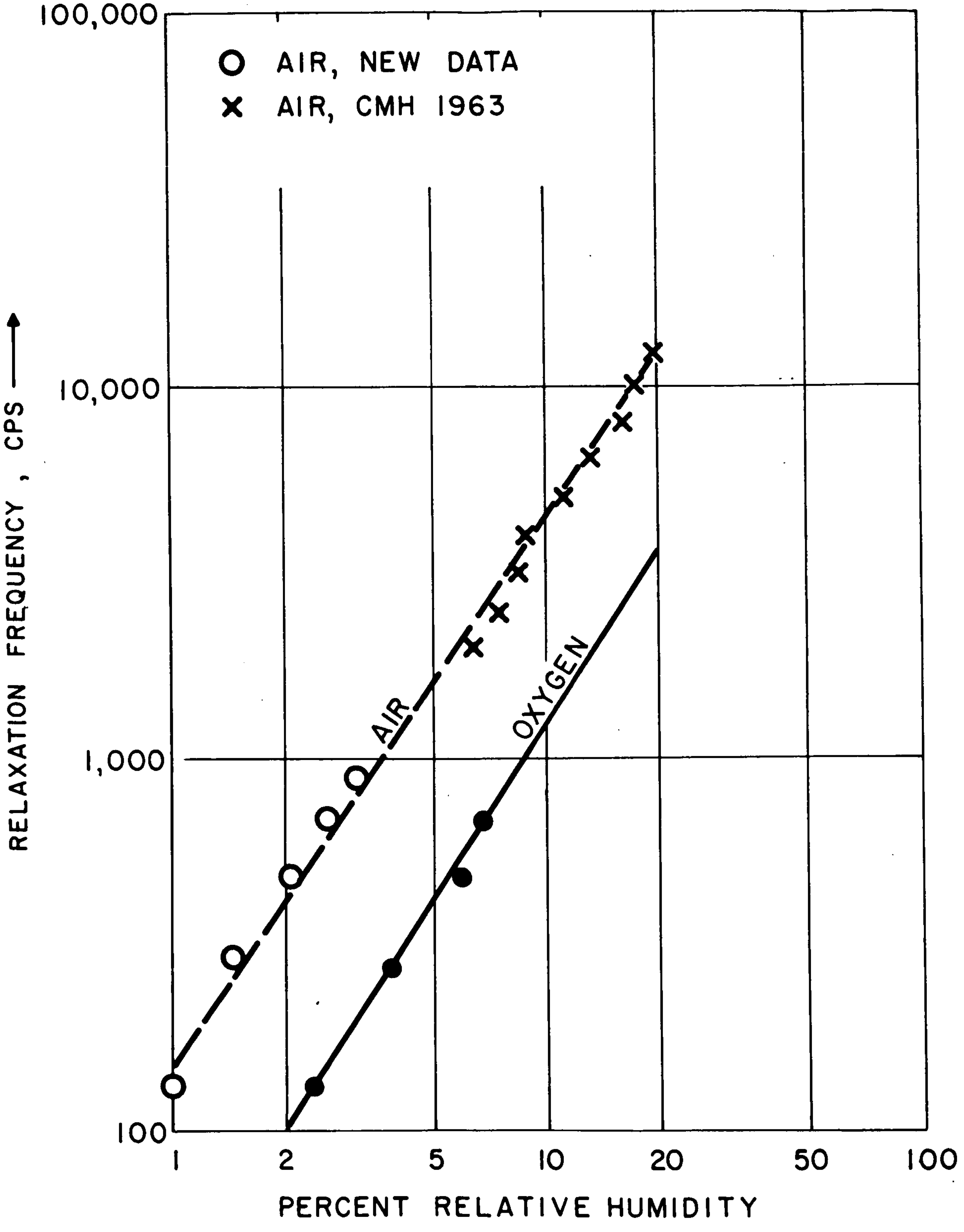

FIGURE 7. RELAXATION FREQUENCY PLOTTED AS A FUNCTION OF h, THE PERCENT MOLAR CONCENTRATION OF WATER VAPOR IN AIR

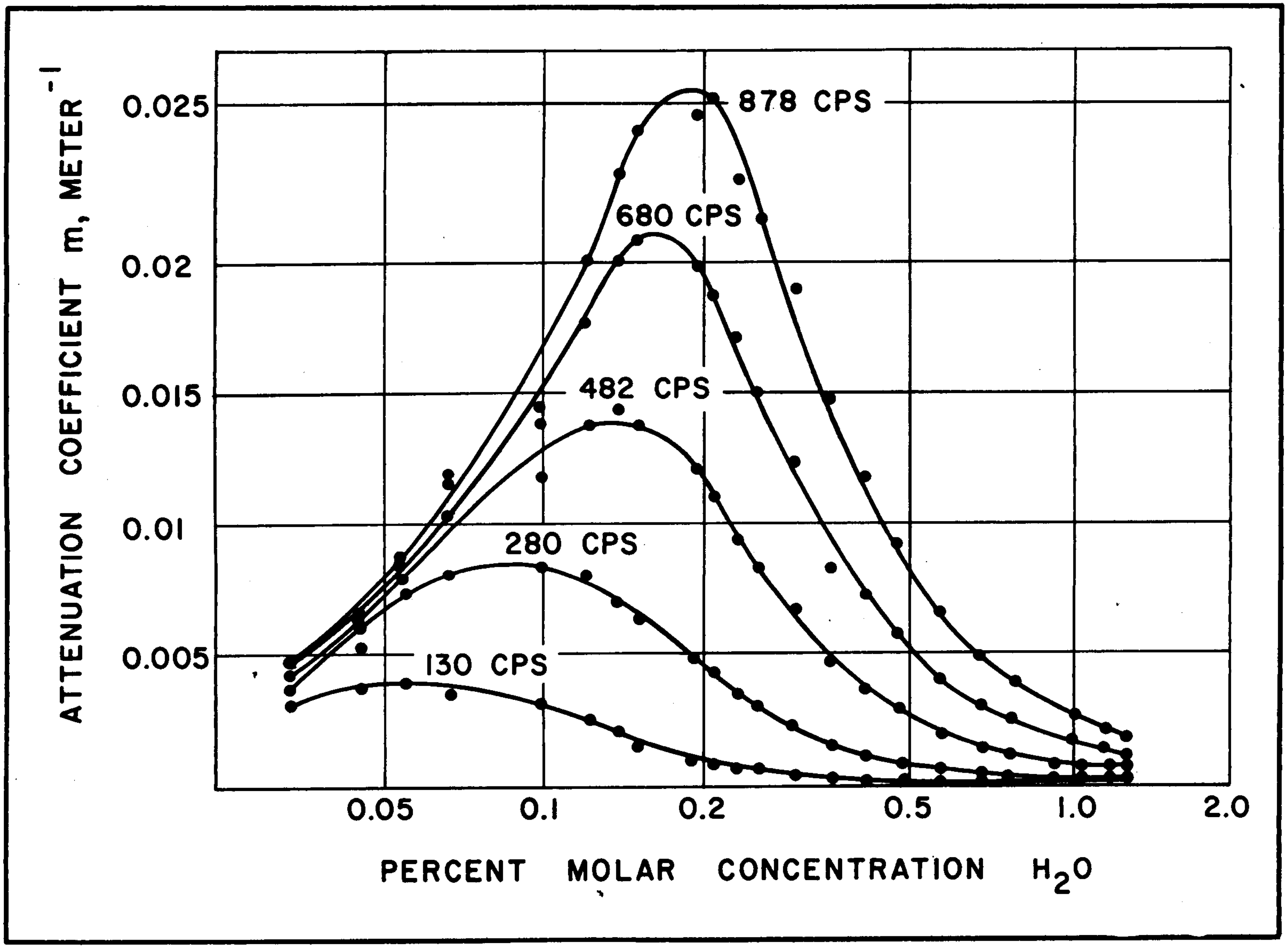

FIGURE 8. ATTENUATION COEFFICIENT m VERSUS PERCENT MOLAR CONCENTRATION OF WATER VAPOR FOR OXYGEN AT 20° C AND NORMAL PRESSURE

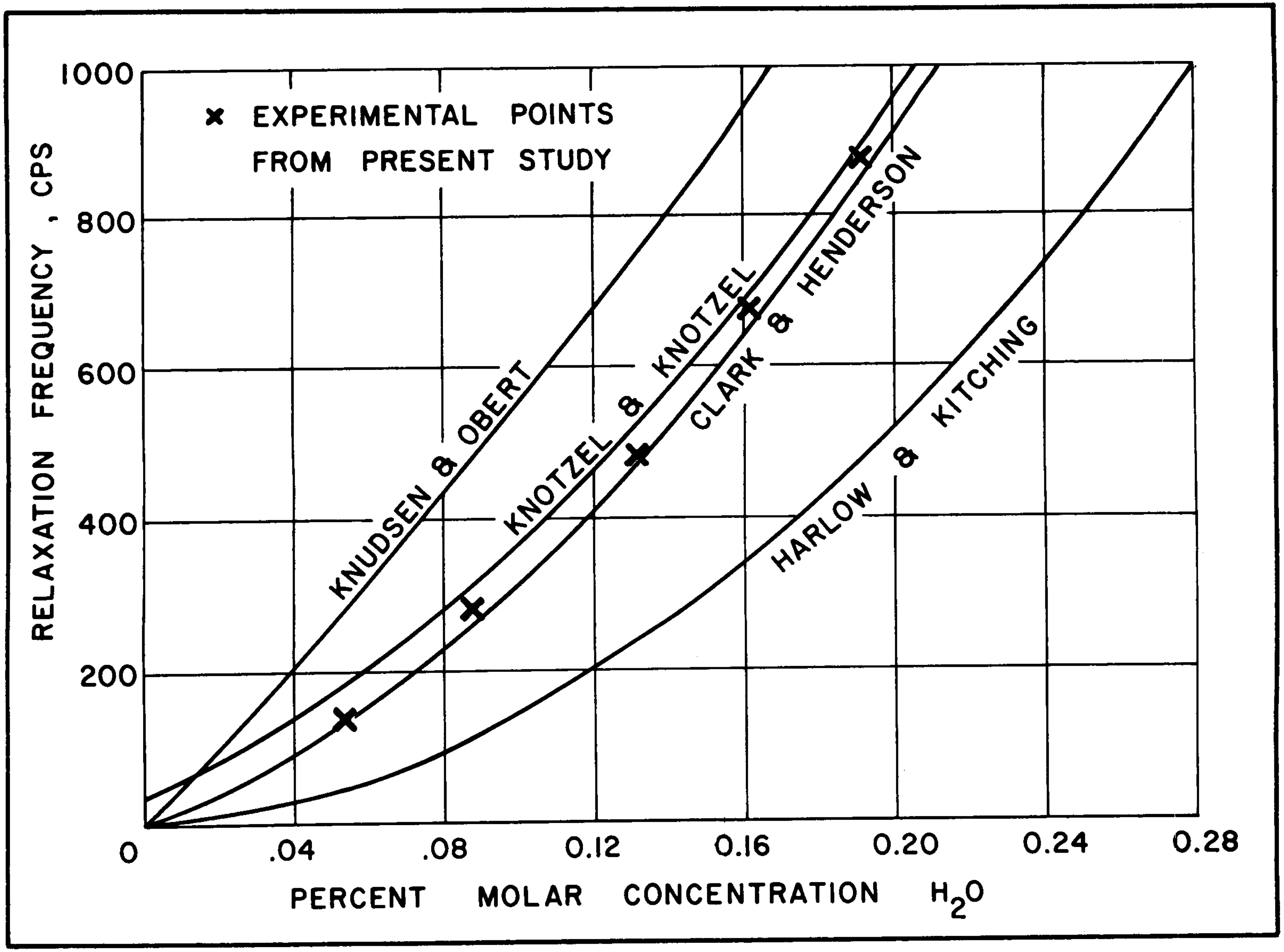

FIGURE 9. RELAXATION FREQUENCY, f_{max}, PLOTTED AS A FUNCTION OF $\underline{h}$, THE PERCENT MOLAR CONCENTRATION OF WATER VAPOR IN OXYGEN

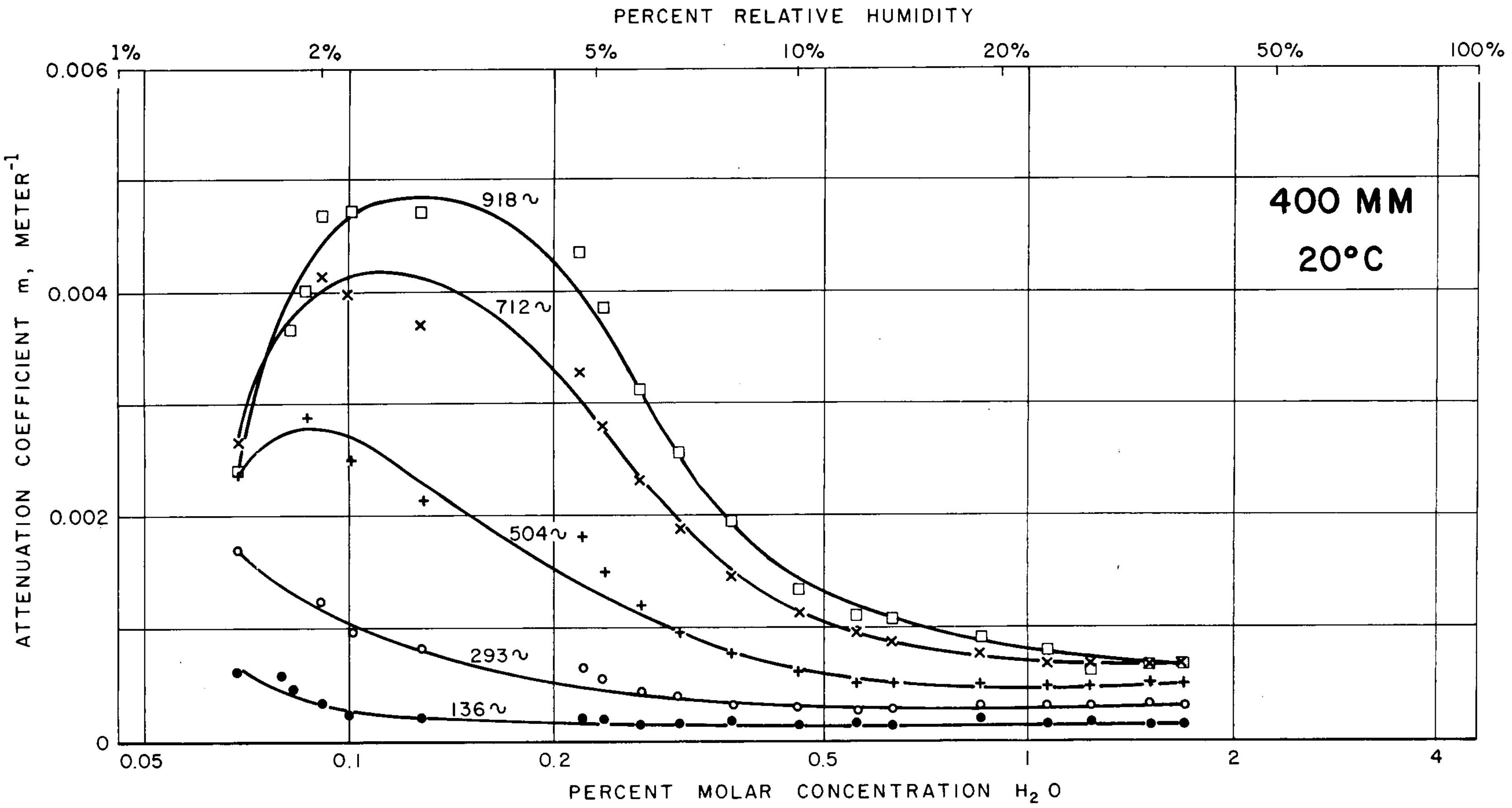

FIGURE 10. ATTENUATION COEFFICIENT m VERSUS PERCENT RELATIVE HUMIDITY FOR AIR AT 20°C AND PRESSURE OF 400 mm

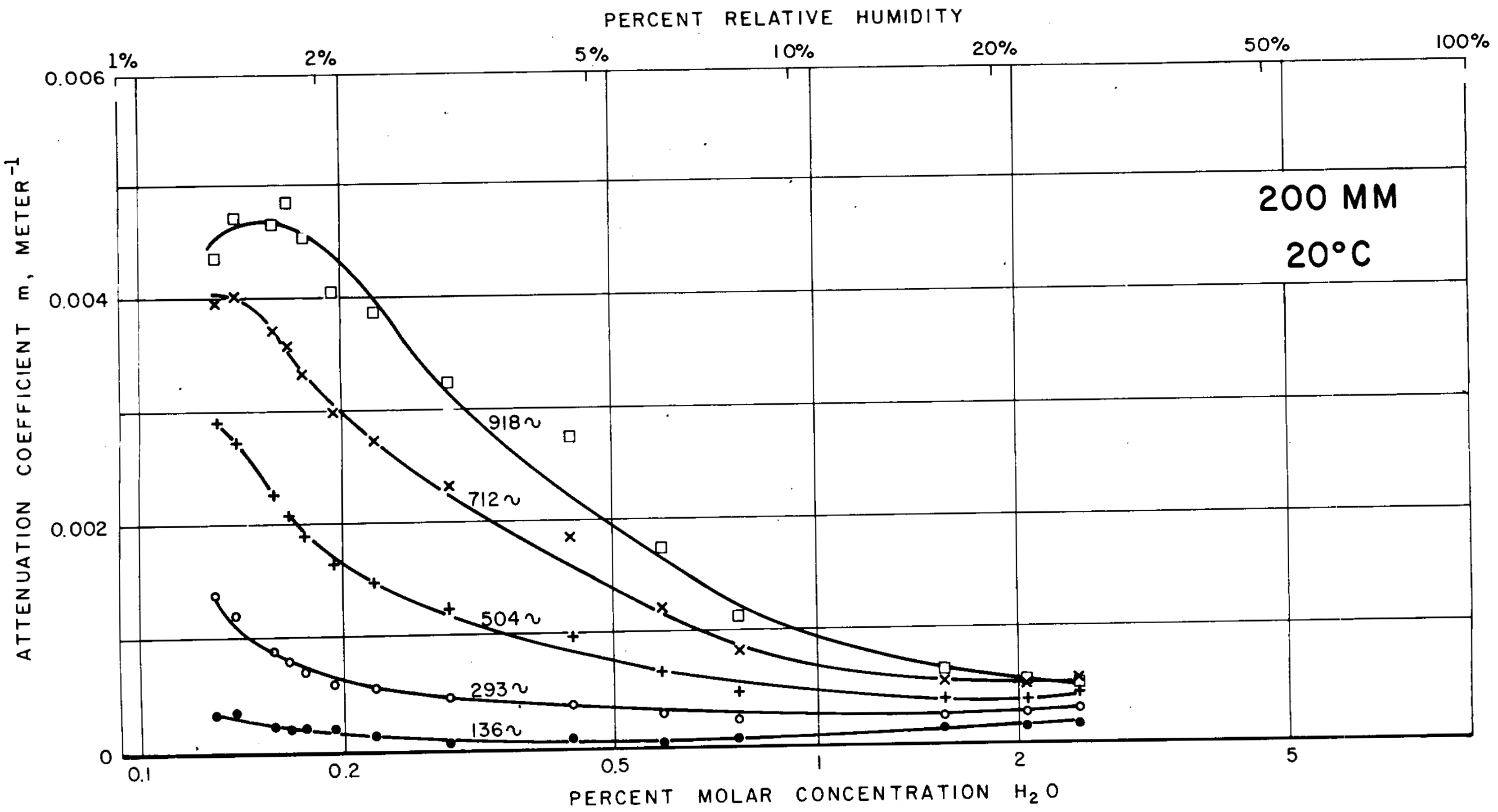

FIGURE 11. ATTENUATION COEFFICIENT m VERSUS PERCENT RELATIVE HUMIDITY FOR AIR at 20°C AND PRESSURE OF 200 mm

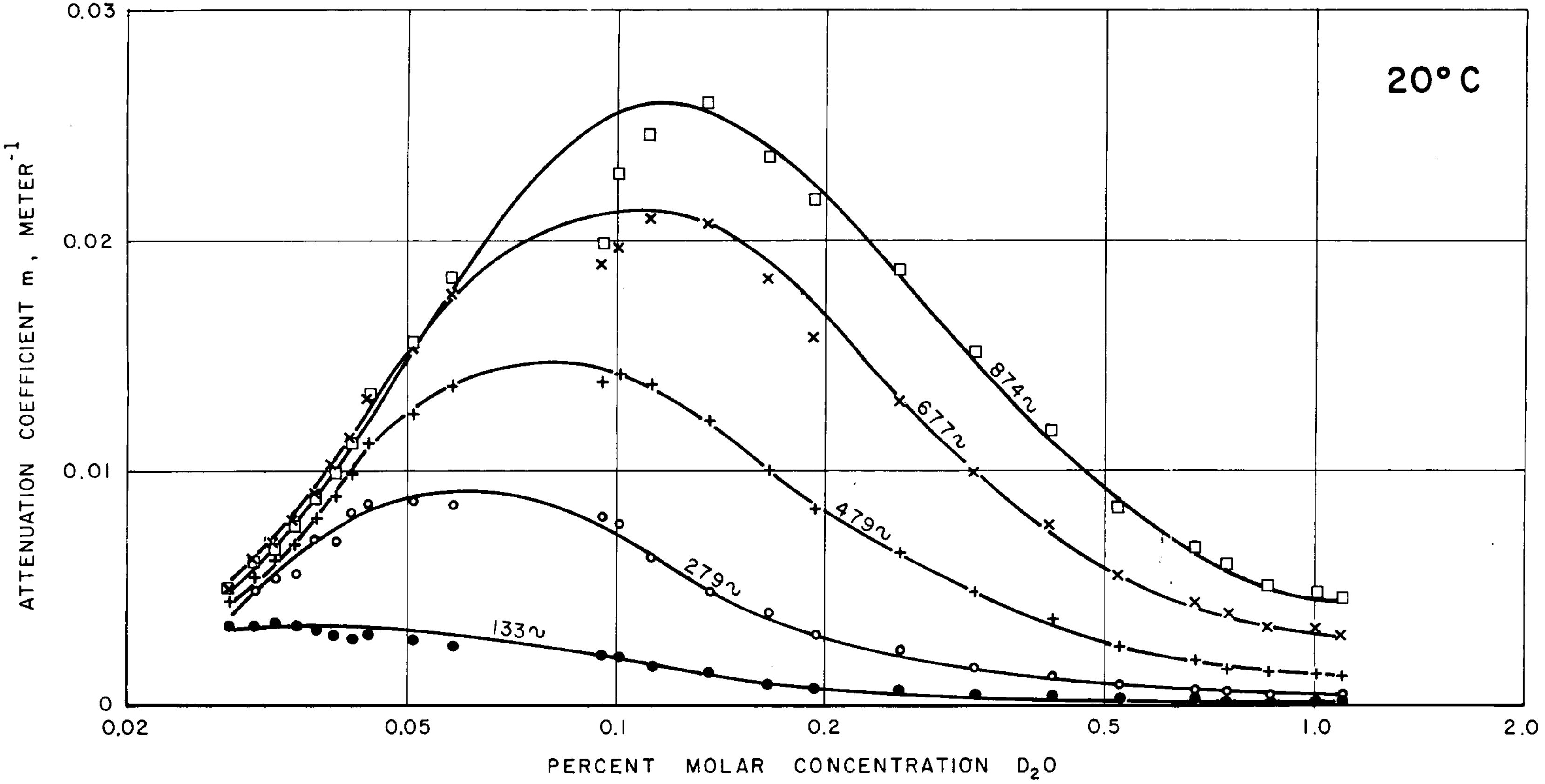

FIGURE 12. ATTENUATION COEFFICIENT m VERSUS PERCENT MOLAR CONCENTRATION OF DEUTERIUM OXIDE VAPOR FOR OXYGEN AT 20°C AND NORMAL PRESSURE

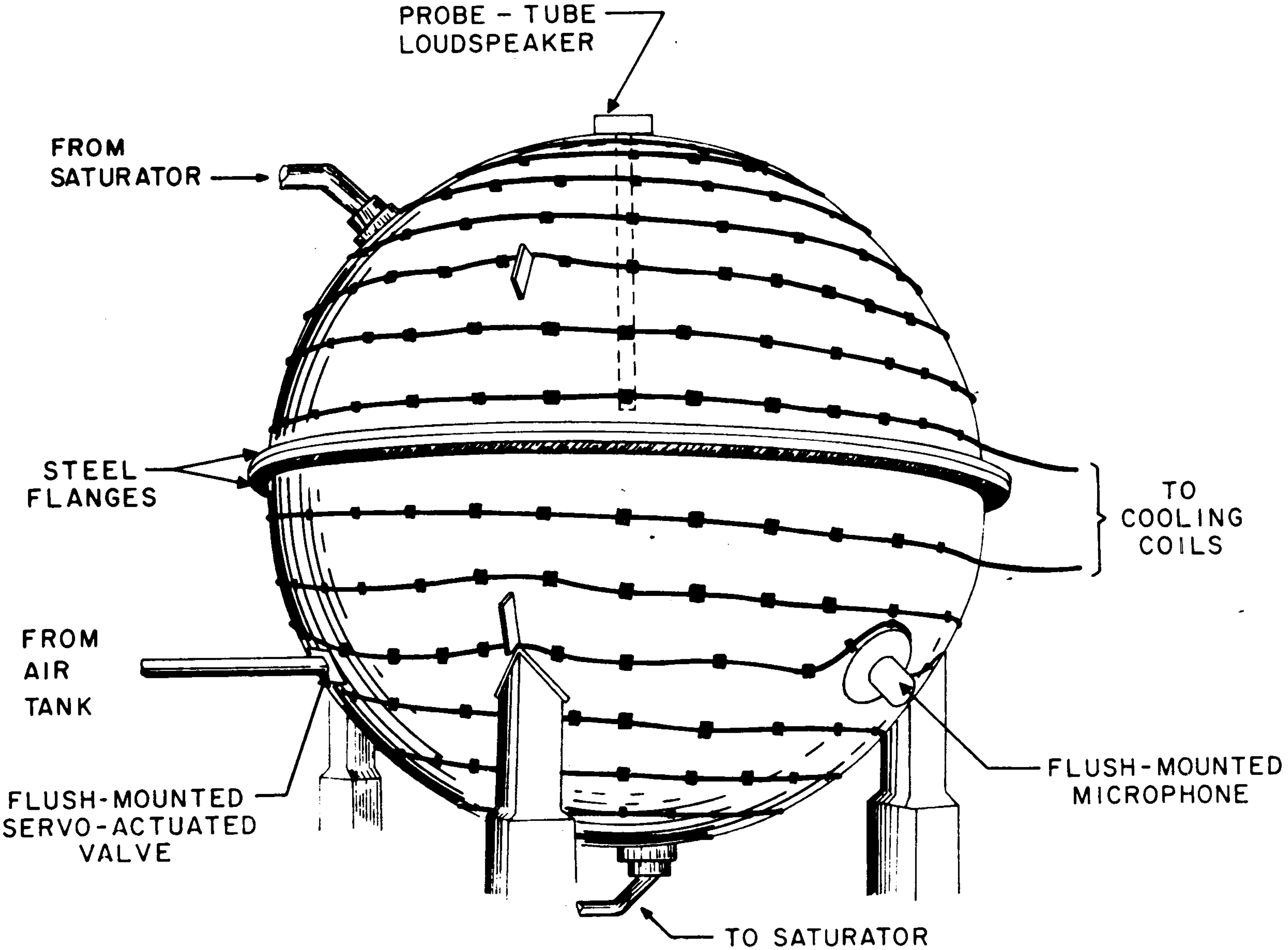

FIGURE 13. DRAWING SHOWING THE SPHERICAL CHAMBER USED IN MEASUREMENTS. COPPER TUBING ATTACHED TO EXTERIOR SURFACE IS PART OF THE TEMPERATURE-CONTROL SYSTEM

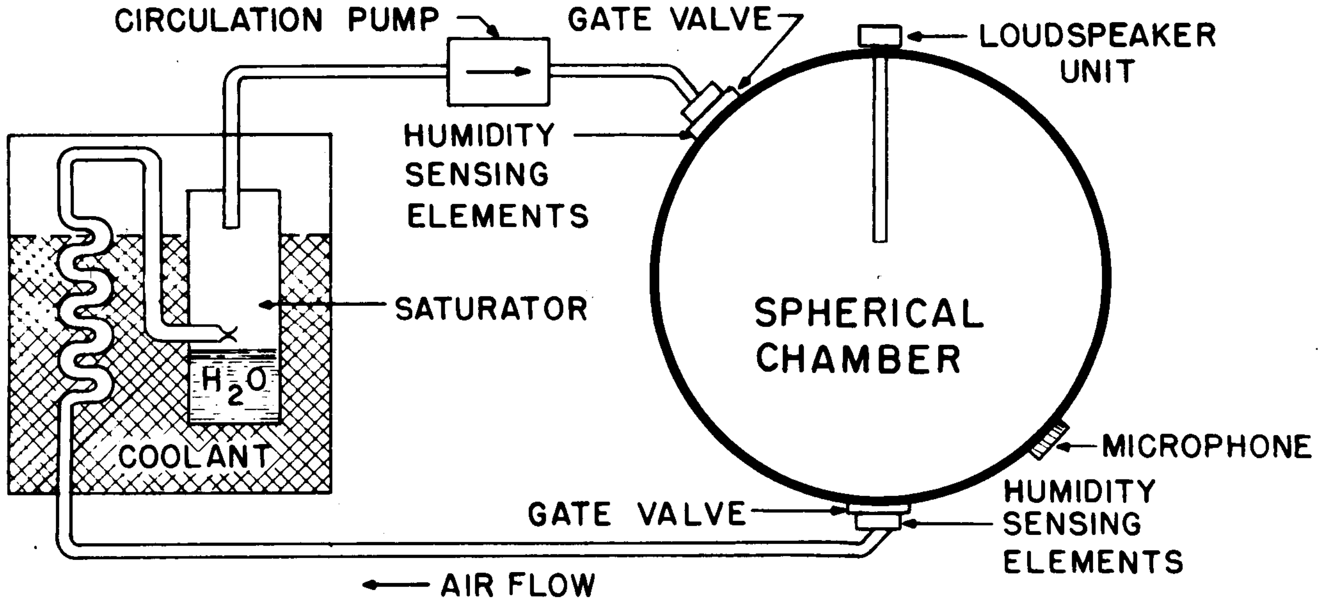

FIGURE 14. SIMPLIFIED SCHEMATIC DIAGRAM OF THE AIR-CIRCULATION SYSTEM. AIR IS RECIRCULATED CONTINUOUSLY THROUGH THE SPHERICAL CHAMBER. THE SATURATOR EITHER TAKES AWAY MOISTURE FROM THE AIR OR ADDS MOISTURE TO IT--DEPENDING ON THE RELATIVE TEMPERATURES OF THE SPHERICAL CHAMBER AND THE SATURATOR

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