A STUDY OF THE PERFORMANCE CHARACTERISTICS OF THE VALVE-TYPE PERFORATED TRAY

By

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A STUDY OF THE PERFORMANCE CHARACTERISTICS

OF THE VALVE-TYPE PERFORATED TRAY

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PREFACE

This study was made possible through a grant made by the Dow Chemical Company to the Engineering Experiment Station of the Oklahome Agricultural and Mechanical College. The object of the investigation was to develop a perforated tray which would provide a liquid seal on the tray under low vapor loadings.

The writer is indebted to the late Dr. Luis H. Bartlett for his guidance during the preliminary phases of the work, and to Dr. Charles L. Nickolls for his valuable aid and suggestions through the entire investigation. The author wishes to express his gratitude to Mr. Eugene E. McCroskey for his aid in constructing and maintaining equipment.

In particular, the writer wishes to thank his wife, Paula, for her patience and understanding without which this project could never have been completed.

Stillwater, Oklahoma

September 1, 1954

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INTRODUCTION

The diffusional operations are among the most important of the "unit operations", the application of which make up the science of chemical engineering. In any diffusional operation, one of the principal problems is the attainment of intimate contact between the different phases of material. This contact may be accomplished by one of two general methods:

1. Use of a tray type column in which the phases are alternately mixed and separated, the flow of one phase usually being countercurrent to that of the other.
2. Use of a packed tower filled with one or more of the various types of ceramic or metal packing materials available. This packing provides a surface for contact between the phases with through-put being a function of the difference in density of the two phases.

Though the second of these two methods finds widespread acceptance, the tray-type contactor predominates in industrial usage, and it is with a tray-type contactor that we are concerned. The most commonly used type of tray is a bubble-cap tray, and these bubble-cap trays give satisfactory service when properly designed. However, fabrication costs of bubble-cap trays are high and for this reason there have been various attempts over the years to develop a satisfactory tray which will have a lower fabrication cost with equal or better performance.

Another type of contacting tray which finds some industrial application is the perforated or sieve tray. These find widest application at the present time in service with materials which contain suspended solids which would cause a bubble tray to become fouled with solid material.[10] Perforated trays have two inherent weaknesses which have caused their use in commercial columns to be restricted.[20]

1. Pressure drop across the plate is proportional to the square of the vapor velocity, hence it varies more rapidly with changes of vapor rate than does the pressure drop across a bubble-cap plate.
2. The liquid on the tray can dump or drain through the perforations if the vapor **flow** is momentarily stopped.

Perforated trays have one distinct advantage over bubble-cap trays, that of cost. In trays for industrial columns, the perforations are made by punching rather than by drilling and the cost per tray may be as little as 30% the cost of a bubble-cap tray designed for the same duty.

Another type of tray of interest here is that discussed by Campbell.[7] This tray was fabricated by inserting a rivet in each hole of a standard perforated tray. Vapor flowing upward through the perforations would unseat the rivets and lift them upward to provide passageway through the holes for the vapor. If vapor flow stopped, the rivets would again seat in the holes preventing dumping of the liquid to the tray below. This overcame the principal objection to perforated trays, that of liquid dumping when vapor flow stoppages occurred. However, the pressure drop across the tray was increased to such a degree that this plate never has been widely used.

Nutter[16,17] developed a tray which employs slits rather than holes to permit vapor flow through the plate. These slits are covered by a light metal angle which tilts to one side to provide passageway for vapor. If vapor flow stops, the angles return to a horizontal position effectively shutting off dumping of the liquid to the tray below. Data taken from towers equipped with Nutter trays indicate very favorable performance characteristics when compared with bubble-cap trays. No information is available on costs of these trays.

The author first became interested in the study of perforated trays while employed by a process equipment firm. The high cost of bubble-cap trays caused a search to be made for a cheaper and more economical tray. A search of the literature showed information on the characteristics of perforated trays to be very meager. Fortunately, this situation is improving but there is still a definite need for fundamental work on perforated trays and their performance characteristics.

EXPERIMENTAL BACKGROUND

At the time this investigation was undertaken (summer, 1952) there was very little information available on the performance of perforated trays. For this reason, a model of a perforated tray was constructed to make possible visual observations on the behavior of these trays in operation. This experimental tray verified the objection of liquid dumping to some extent, though the dumping is not extreme unless vapor flow ceases completely, in which case the tray very rapidly loses liquid through the holes in the plate. The dumping tendency increases with increasing hole size and could be a very serious draw-back in plates with hole sizes on the order of 1/4 inch diameter or larger.

Attempts were then made to modify the perforated tray to prevent liquid dumping, without causing any great change in the other operating characteristics of the tray. This was finally accomplished by the addition of a second tray to the column a short distance below the perforated tray. This second tray contained a hole of large diameter in comparison with the holes in the perforated tray, the hole being covered with a circular metal disk which was retained in position over the hole by clips. This metal disk acted as a check valve on the tray, opening when vapor flowed but reseating and sealing the liquid on the tray when vapor flow stopped.

This tray was modified by removing the hold-down clips and attaching a short length of wire to the center of the valve. This kept the valve centered over the hole and would be much easier to fabricate than would the clips. When the wire is used, it is necessary to make the metal disk twice the diameter of the hole in the plate to provide complete coverage of the valve at all times. Figure 3 is a photograph of the tray as finally designed.

Visual observation showed that this tray satisfactorily overcame the dumping of liquid which is a major weakness of a conventional perforated tray. Quantitative results were necessary to make a comparison of other performance characteristics.

APPARATUS

Column

The column used in this investigation was made up of four inch inside diameter glass pipe. This pipe was available in sections six inches long and flanged at each end making it possible to construct a column of any desired length. In this work, a total of four glass sections were used, making the overall length of the column 24 inches. Each joint was equipped with a gasket to prevent leakage. The plate to be investigated was inserted at the middle of the column providing a twelve-inch section above the plate for separating any entrained liquid from the vapor.

The end plates for the column were made of 0.03" galvanized sheet. These end plates were fitted with copper tubing for connecting air, water, manometer, and sampling lines. In an effort to avoid end effects, a 'diffuser' tray made of 0.03" galvanized sheet and containing seventeen 5/32" diameter holes was placed in the column six inches below the plate being tested.

When a valve plate was used in the column, a spacer ring of 1/4" plastic was placed between the valve tray and the perforated tray.

Trays

Both perforated and valve-type trays were used in this investigation, in order to permit comparison of the performance of the two trays. All trays were constructed of 0.030" thick galvanized sheet. All holes were spaced on three-quarter inch triangular spacing, no effect of the variation in hole spacing being included in this work.

Three perforated trays were built containing ten 1/16", 3/32" and 1/8" diameter holes, respectively. The inlet weir for each tray was a $1\frac{1}{2}$" length of $1\frac{1}{2}$" outside diameter thin-walled aluminum tubing. The liquid downcomer in each case was a twelve-inch length of one-half inch standard galvanized pipe which was machined to an outside diameter of 0.75 inch and reamed to an inside diameter of 0.63 inch.

The valve tray was fabricated of 0.030" galvanized sheet as was the valve disk. A one-half inch diameter hole was drilled in the center of the valve tray. The valve disk was cut exactly one inch in diameter and a piece of 0.034 inch diameter steel wire was soldered in the center of the valve. A hole was drilled in the plate to provide passage for the liquid downcomer. A photograph of one of the perforated trays and the valve plate with the valve is shown in Figure 3.

Auxiliaries

i. Two Fischer-Porter model B-4N25A rotameters were used to meter the air flow through the column. These rotameters were installed on the outlet air line to avoid the possibility of variations in pressure of the inlet air line influencing the accuracy of the reading obtained. The calibration curve for these rotameters is shown on page 56.

ii. One Fischer-Porter model B-4N25A rotameter was used to meter the flow of water to the column. This rotameter was installed on the inlet water line to the column.

iii. A Meriam 15" manometer filled with distilled water was used to measure the pressure drop across the tray. This manometer was connected to the column by 1/4" copper tubing with flared connections. The pressure taps were inserted through holes in the end plates of the column and were soldered in place to prevent leakage. The manometer scale was calibrated in inches with the smallest division being 0.1 inch.

iv. An air heater was fabricated from four lengths of one-half inch standard pipe approximately four feet long. These four lengths of pipe were connected in series by suitable pipe connections and were enclosed in a three-foot length of three inch standard pipe. The three-inch pipe was fitted with two 3/4 inch standard pipe nipples, one at either end, to provide for connection of the steam and condensate lines. The heater was insulated with one-inch magnesia pipe insulation to reduce heat losses.

v. Two Precision Scientific Co. wet test meters were used to meter air samples taken from the column in the efficiency runs. These meters were graduated to 0.001 cubic foot with one revolution of the indicator being equivalent to the passage of 0.1 cubic foot of gas through the meter. Each of these meters was checked against a Bureau of Mines standard 0.1 cubic foot gas bottle and found to be accurate within ± 0.2%.

vi. All thermocouples were made of 20 B.W.G. chromel and alumel wire. Thermocouple wells were made of glass tubing to protect the thermocouples from liquids in the column. Each thermocouple was calibrated against a Bureau of Standards thermometer over the temperature range the thermocouple was to be used. The calibration curves are shown in Figures 33 to 36.

vii. A Leeds and Northrup student's potentiometer, No. 7651, was used to measure the emf generated by the thermocouples. This instrument was read to the smallest division, 0.005 millivolt. This corresponds to slightly more than 0.2°F for the chromel-alumel thermocouples.

viii. All drying tubes were of pyrex glass. The large end of the tubes was fitted with a rubber stopper which held a short length of small bore glass tubing. The exposed end of this tubing and the small end of the drying tube were each fitted with a piece of rubber tubing stopped with a cork to prevent air leaks. The tubes were filled with approximately fifteen grams of Davison Chemical Co. PA-100 silica gel to adsorb the water vapor. This silica gel was discarded after use and the tube recharged with silica gel before starting another run.

ix. A Christian Becker Inc. Chainomatic balance was used for all weighing. The weights used with this balance were Sargent stainless steel Class S weights.

x. Water for the tower was drawn from the laboratory mains. Because of fluctuations in pressure, it was necessary to construct a constant head tank to serve as a water supply. This constant head tank was made from a 55-gallon barrel which had one end cut out. Water for the column was removed at the bottom of the tank. An overflow pipe was connected to the drain and the rate of addition of water to the tank was always sufficient to maintain flow through the overflow line. This assured a constant pressure water source so the only cause of variation in water flow was the changing pressure in the column. For this reason, it was necessary to adjust the water flow rate each time the air rate through the column was changed. The constant head tank was erected in the attic above the laboratory and this elevation provided ample fluid head for the requirements of this experiment.

xi. Air for this work was drawn from the laboratory supply tank. This tank was supplied by a single-stage compressor. The pressure in the tank depended on the rate of withdrawal, the upper and lower limits being approximately 120 psig and 60 psig respectively. Air was supplied to the column through a reducing regulator.

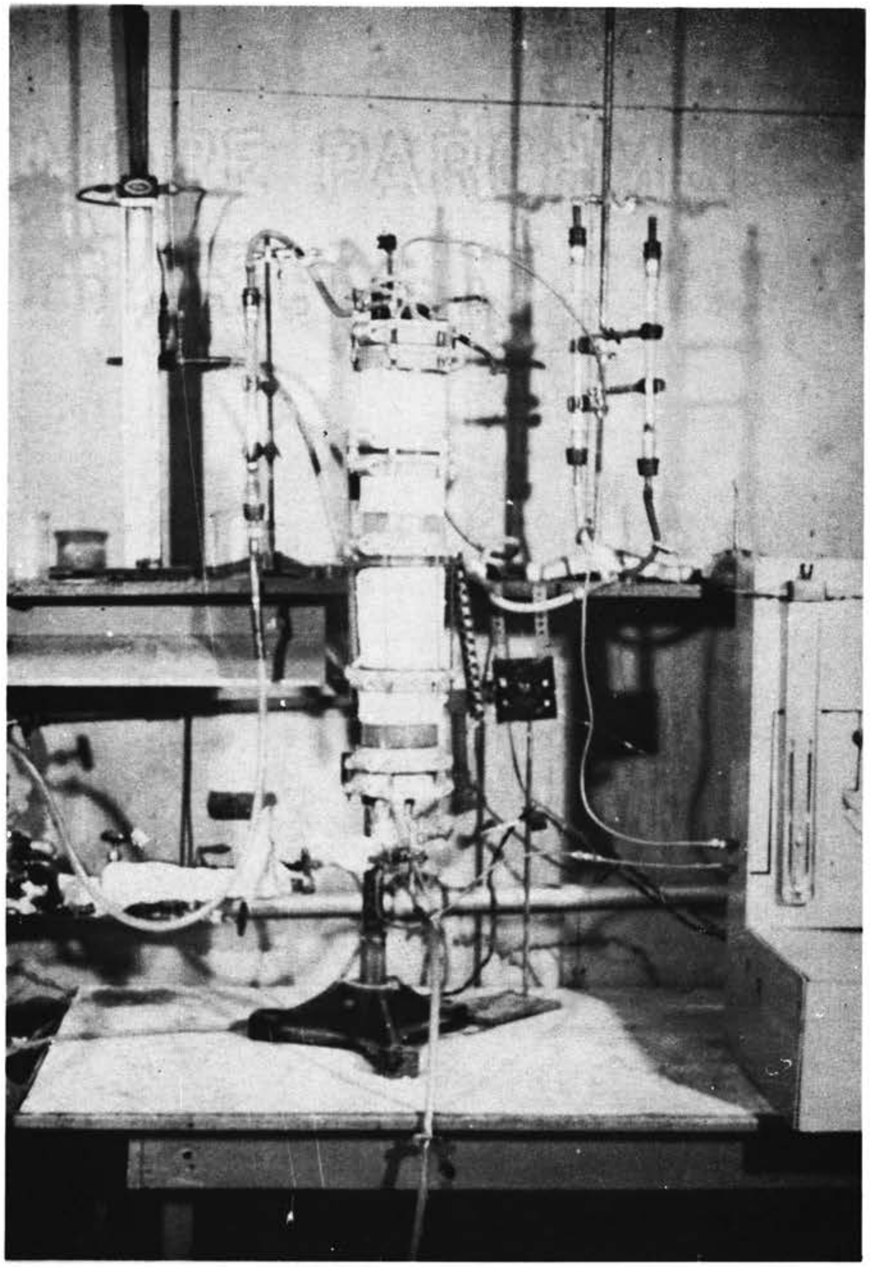


Figure 1

PHOTOGRAPH OF COLUMN

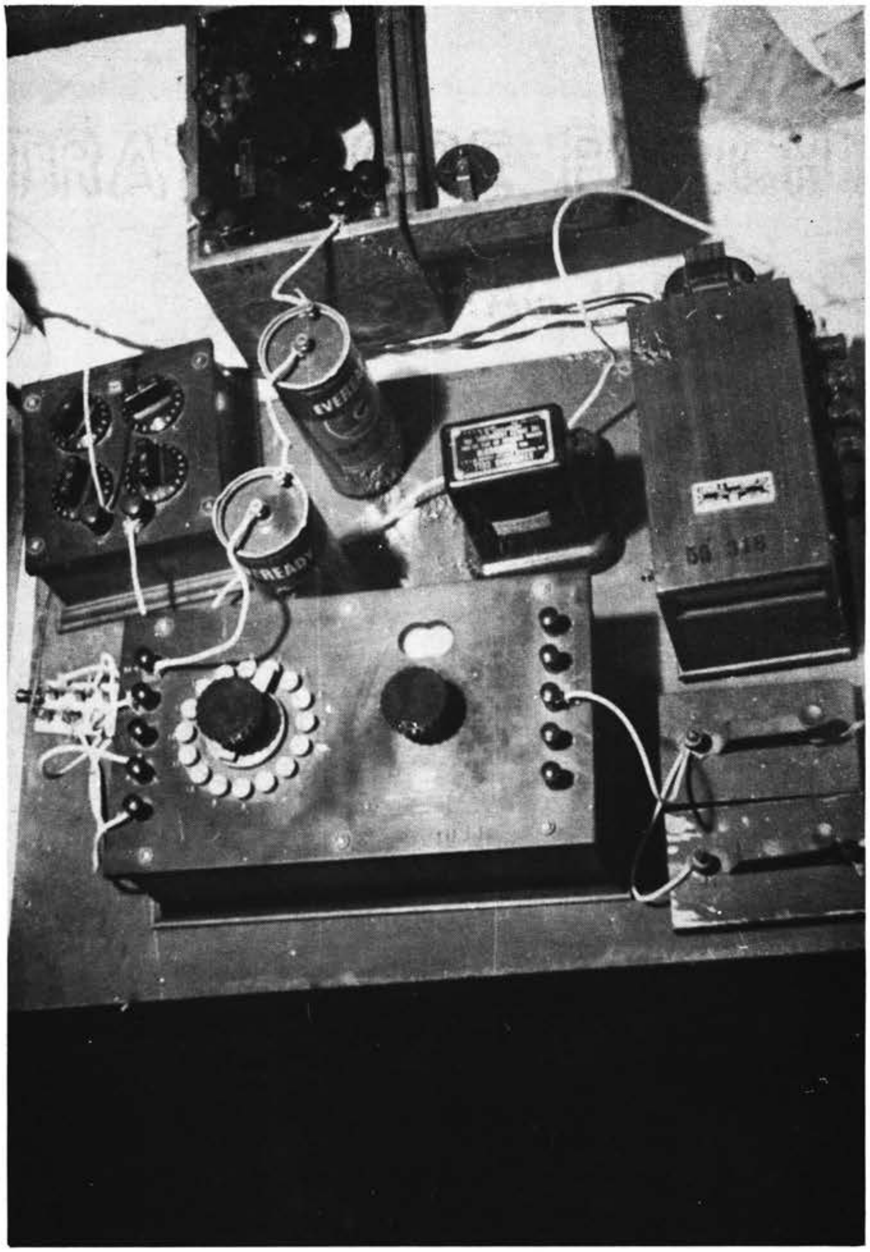


Figure 2

PHOTOGRAPH OF POTENTIOMETER

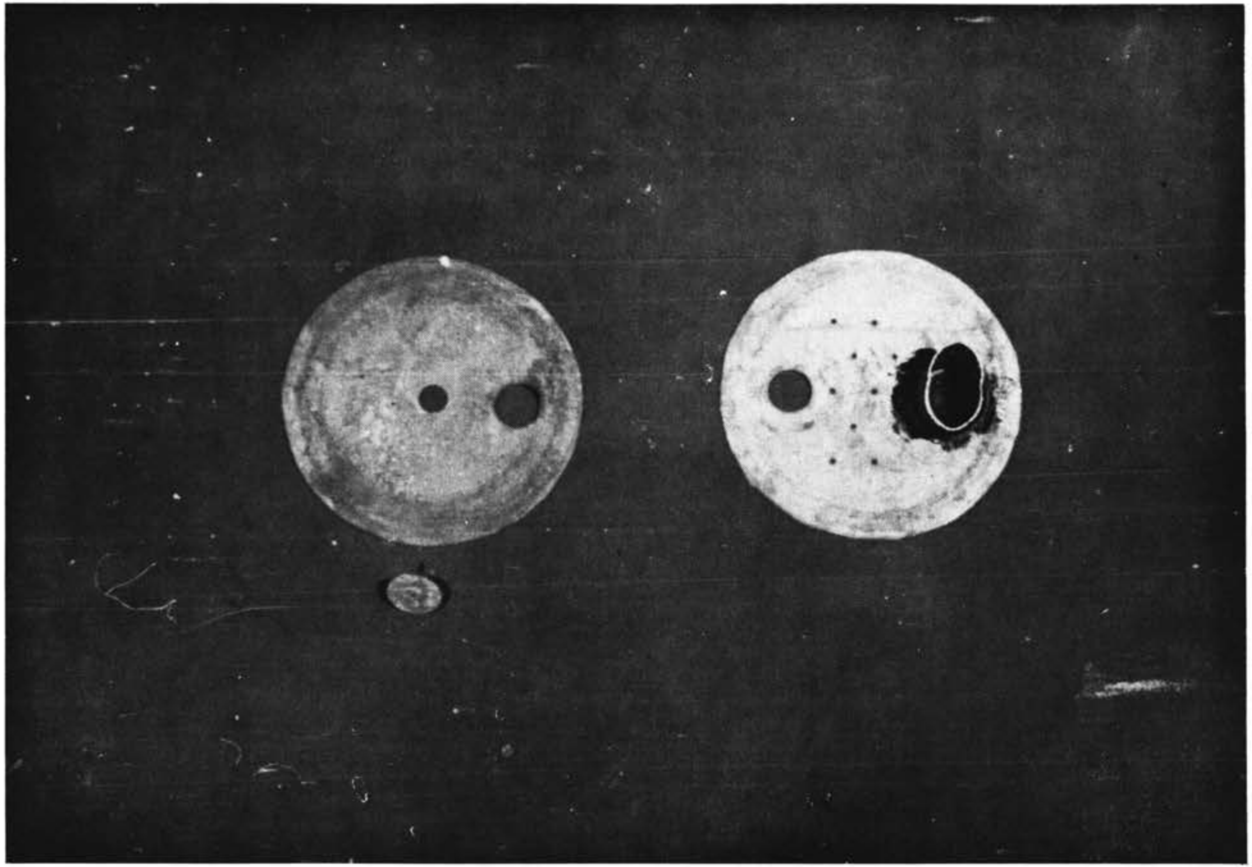


Figure 3

PHOTOGRAPH OF SIEVE AND VALVE TRAYS

PROCEDURE

Dry Runs

The column was assembled with the proper plate, the outlet weir being plugged with a cork. The air was then turned on and adjusted to the approximate maximum air rate. After the supply tank reached a constant pressure, the flow through the column was adjusted to the desired rate and the column permitted to operate under these conditions until all readings were constant. After constancy was maintained, readings of pressure drop across the plate, air flow rate and barometric pressure were recorded.

After one set of readings were taken, the air rate would be adjusted to a different value and the tower permitted to stabilize under the new conditions before readings were taken under the new operating conditions.

Wet Runs

The column was assembled with the proper plate and weir. The air was then turned on and adjusted to the approximate air rate. After the supply tank reached a constant pressure, the flow through the column was adjusted to the desired flow rate. The water was then turned on and the flow adjusted to the desired value. The column was allowed to operate under these conditions until all readings were constant. After the column had stabilized, readings of pressure drop across the plate, air rate, water rate and barometric pressure were recorded.

After one set of readings were taken, the air rate would be adjusted to a different value, the water rate checked, and the tower permitted to stabilize under the new conditions before readings were taken.

Efficiency Runs

Before starting an efficiency run, the drying tubes to be used in that run were filled with fresh silica gel and weighed, the weight being recorded. The column was then assembled with the proper plate and weir, and the air flow adjusted to the desired rate as in the wet pressure drop runs. Steam was then turned into the air heater and the air flow through the heater adjusted by means of the bypass valves to give an air temperature at the entrance to the column of approximately 110°F. The water was then turned on and adjusted to the desired rate of flow. The air temperature would then be adjusted to 110°F by controlling the amount of the air stream passing through the air heater. The sampling lines were connected to the wet test meters and flow through the lines adjusted to the desired rate to purge the lines before taking the samples. In all cases, this rate of flow was less than 0.05 cubic feet of air per minute through each sampling line. The column was permitted to operate until steady conditions prevailed. After operating under steady conditions for at least fifteen minutes, the flow through the sampling lines would be shut off momentarily by use of pinch-cocks while initial readings of the wet test meters were taken and the drying tubes connected to the sampling lines and the wet test meters. The pinch-cocks were then removed from the sampling lines and samples of the inlet air to the column and the wet air leaving the column were taken. While these samples were being taken, readings of the pressure drop across the plate, the air flow rate, the water flow rate, the inlet air temperature, the outlet air temperature, the inlet water temperature, the outlet water temperature and the barometric pressure were made and recorded. When a sufficient volume of each air stream had been removed, the pinch-clamps were replaced on the sampling lines and the wet test meters read. The drying tubes were then removed to the balance room for weighing. The air flow rate would then be adjusted to another value and the above procedure repeated.

RESULTS

On the following pages, the data obtained during the course of this investigation are presented in graphical form. These data are also presented in tabular form in the appendix. The first data shown are for pressure drops across the dry plates, then pressure drops across plates carrying a fixed height of liquid, and finally efficiencies of the two types of trays when used in humidification of air with water.

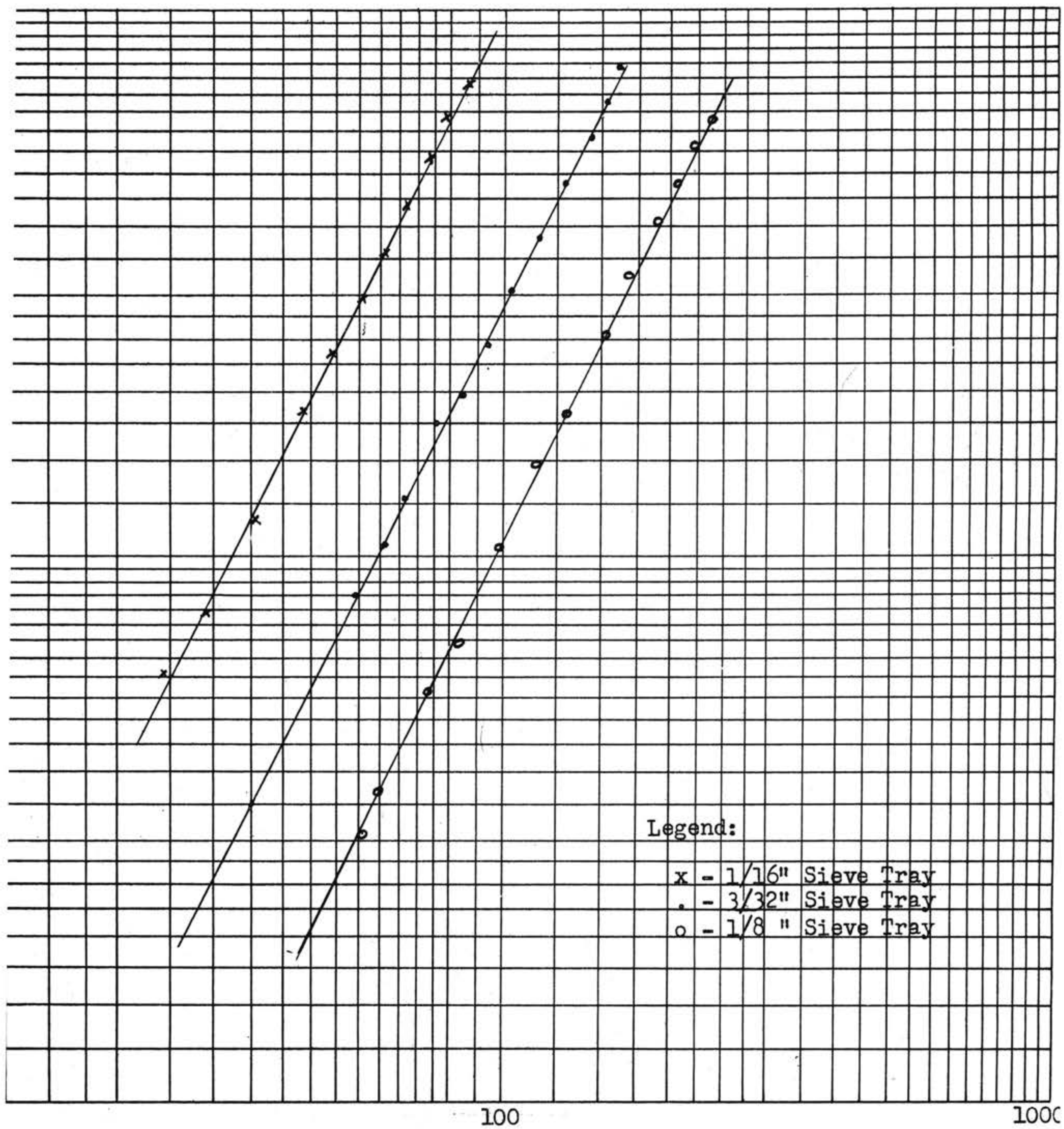


FIGURE 4

DRY TRAY PRESSURE DROP
SIEVE TRAY

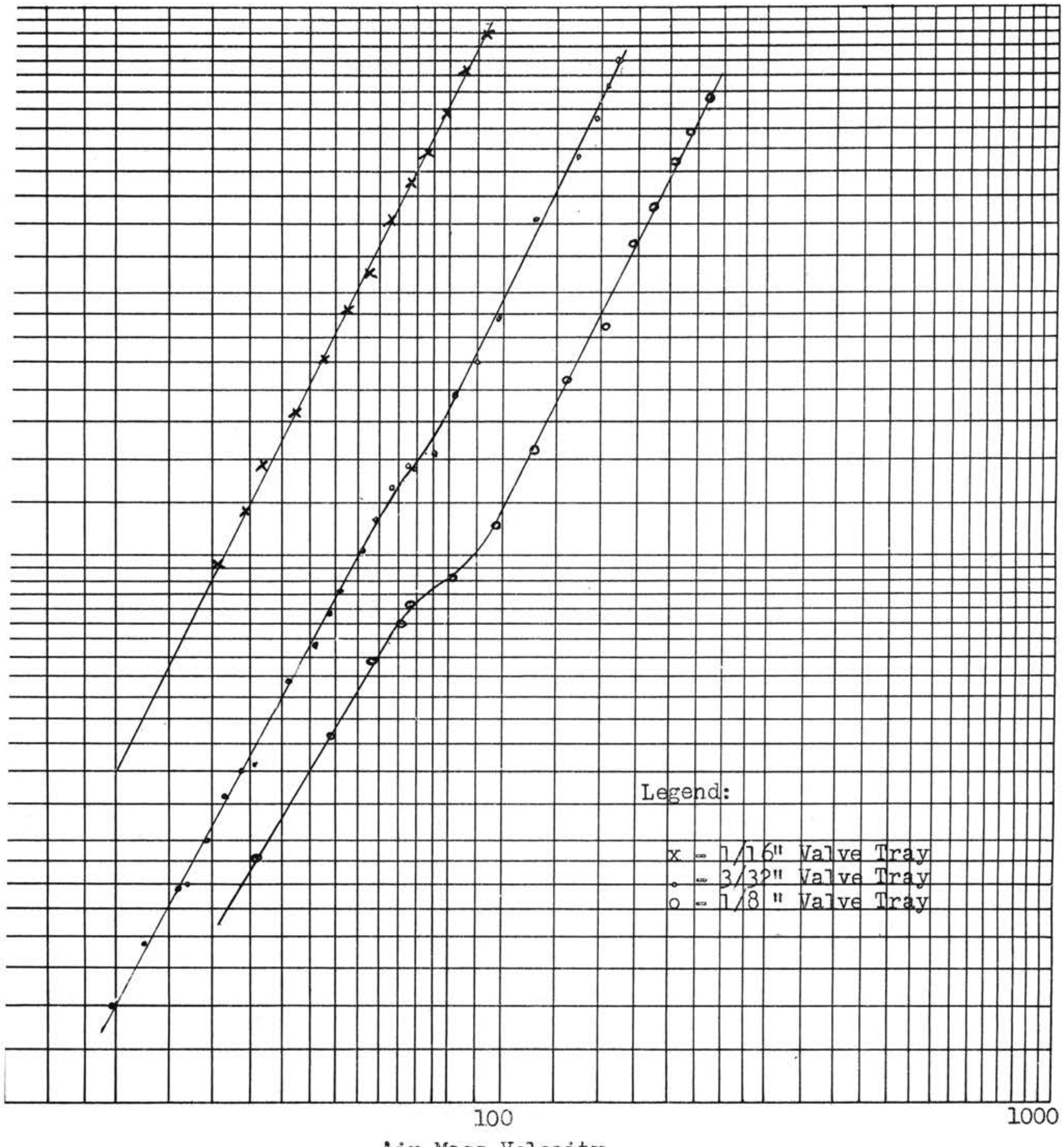


FIGURE 5

DRY TRAY PRESSURE DROP

VALVE TRAY

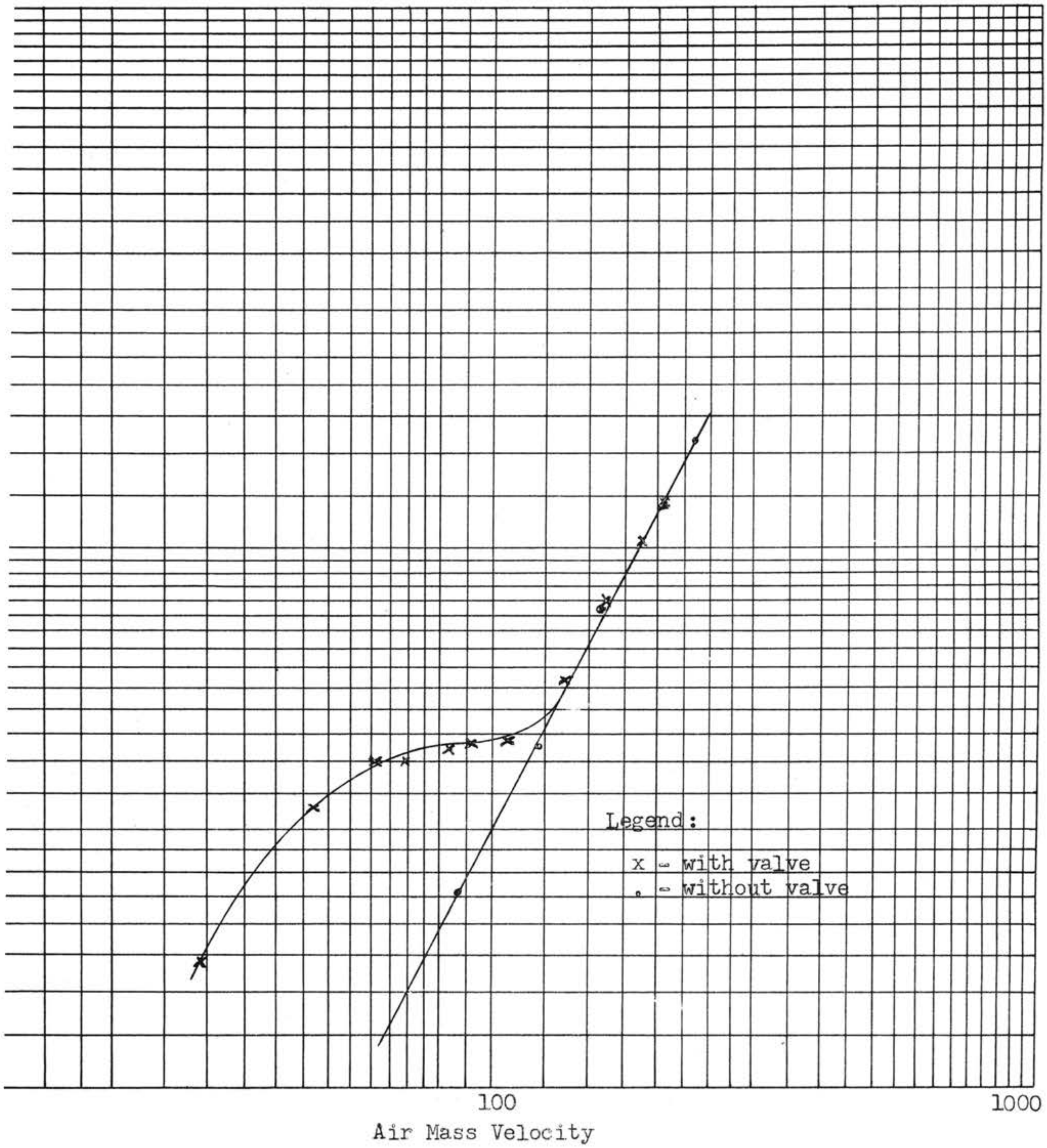


FIGURE 6

DRY TRAY PRESSURE DROP
VALVE TRAY

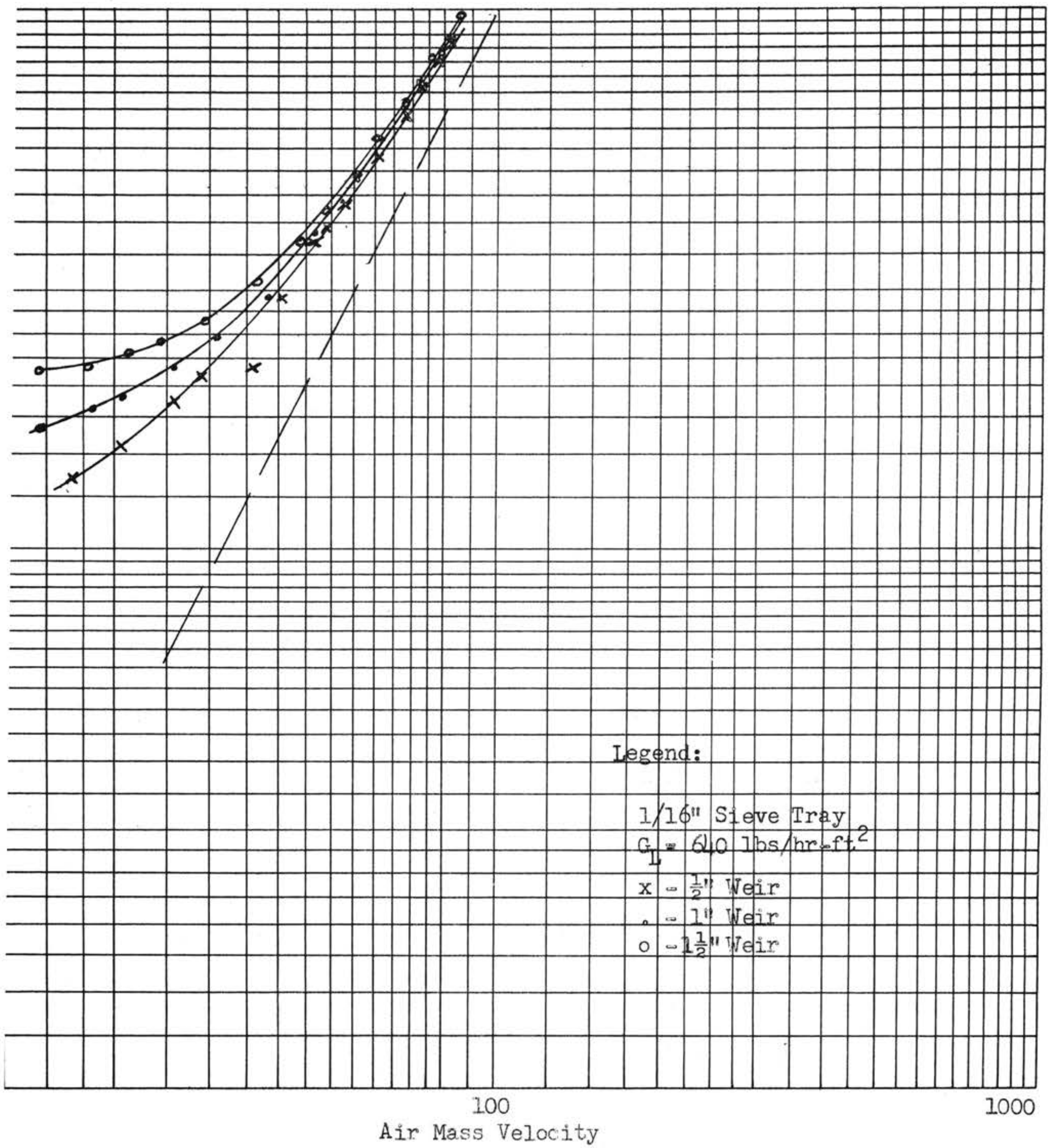


FIGURE 7

SIEVE TRAY PRESSURE DROP

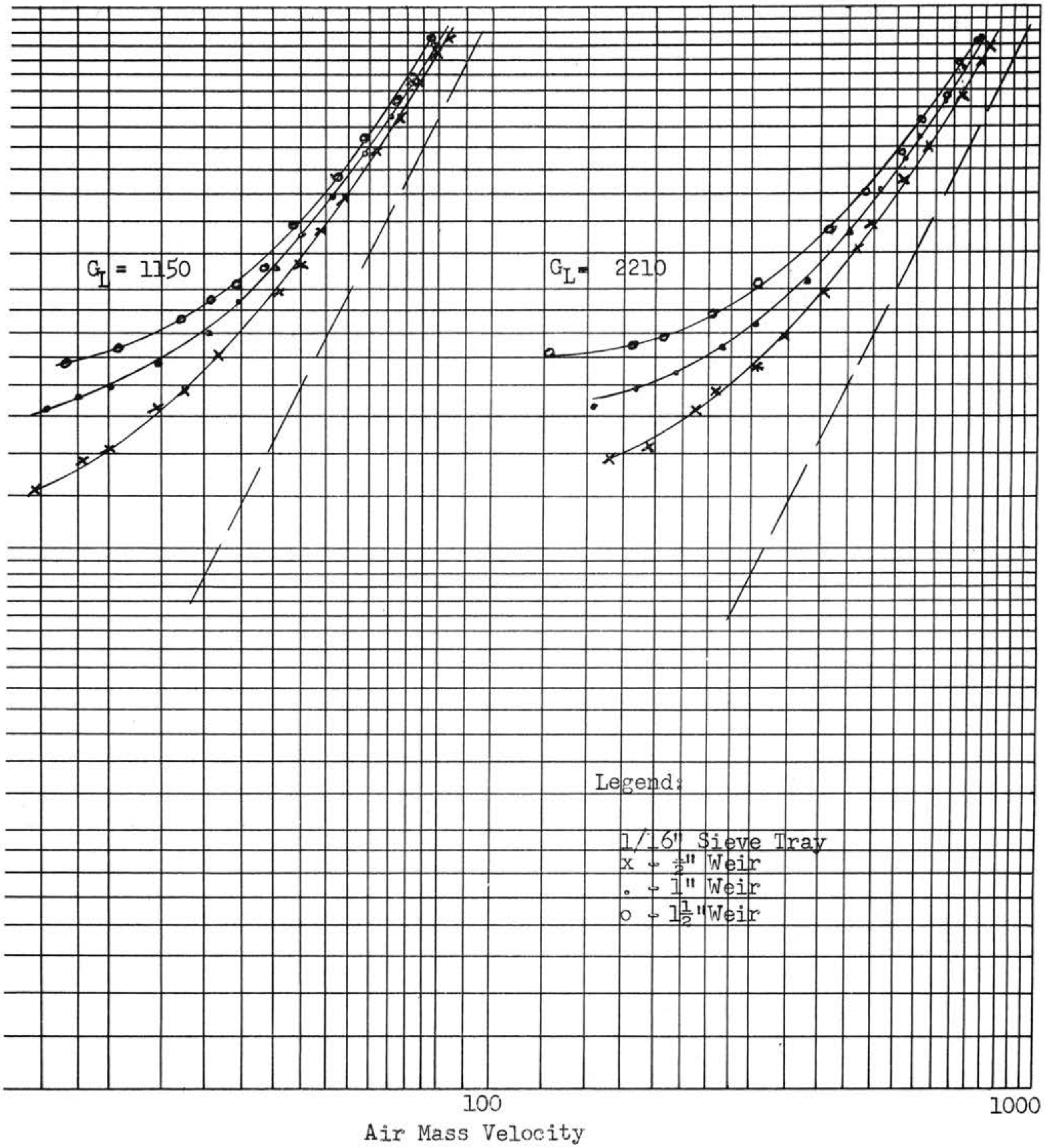


FIGURE 8

SIEVE TRAY PRESSURE DROP

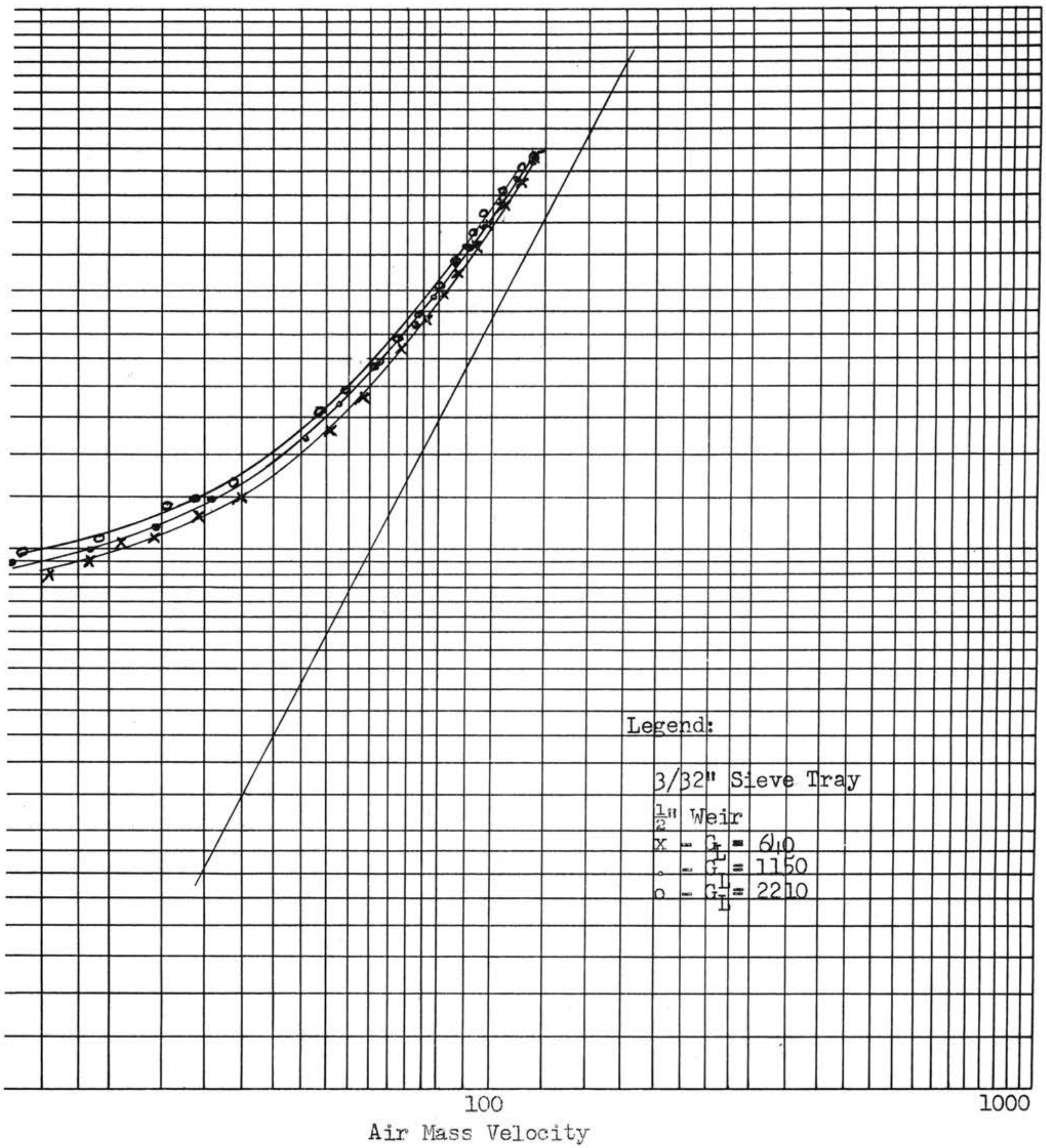


FIGURE 9

SIEVE TRAY PRESSURE DROP

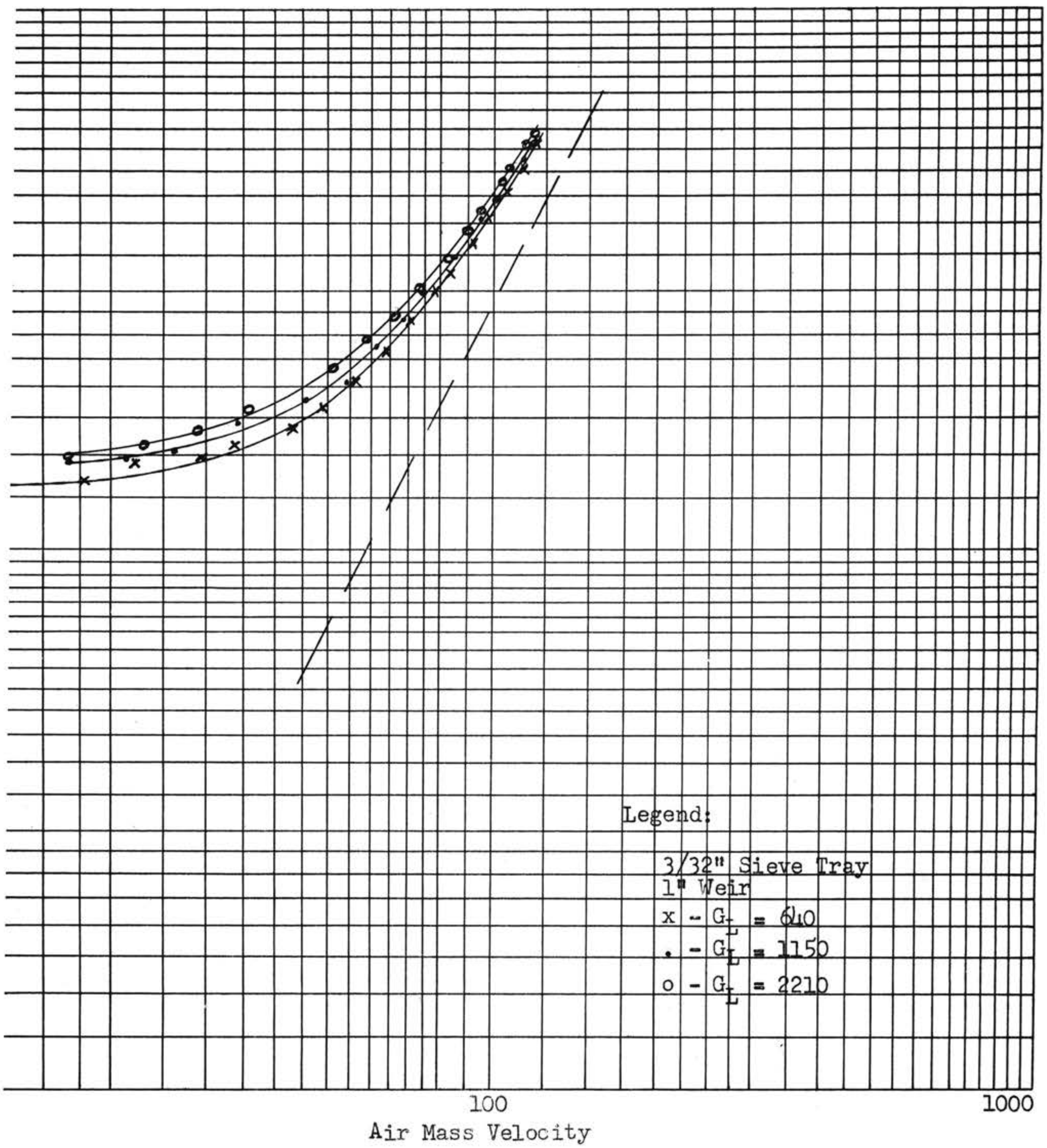
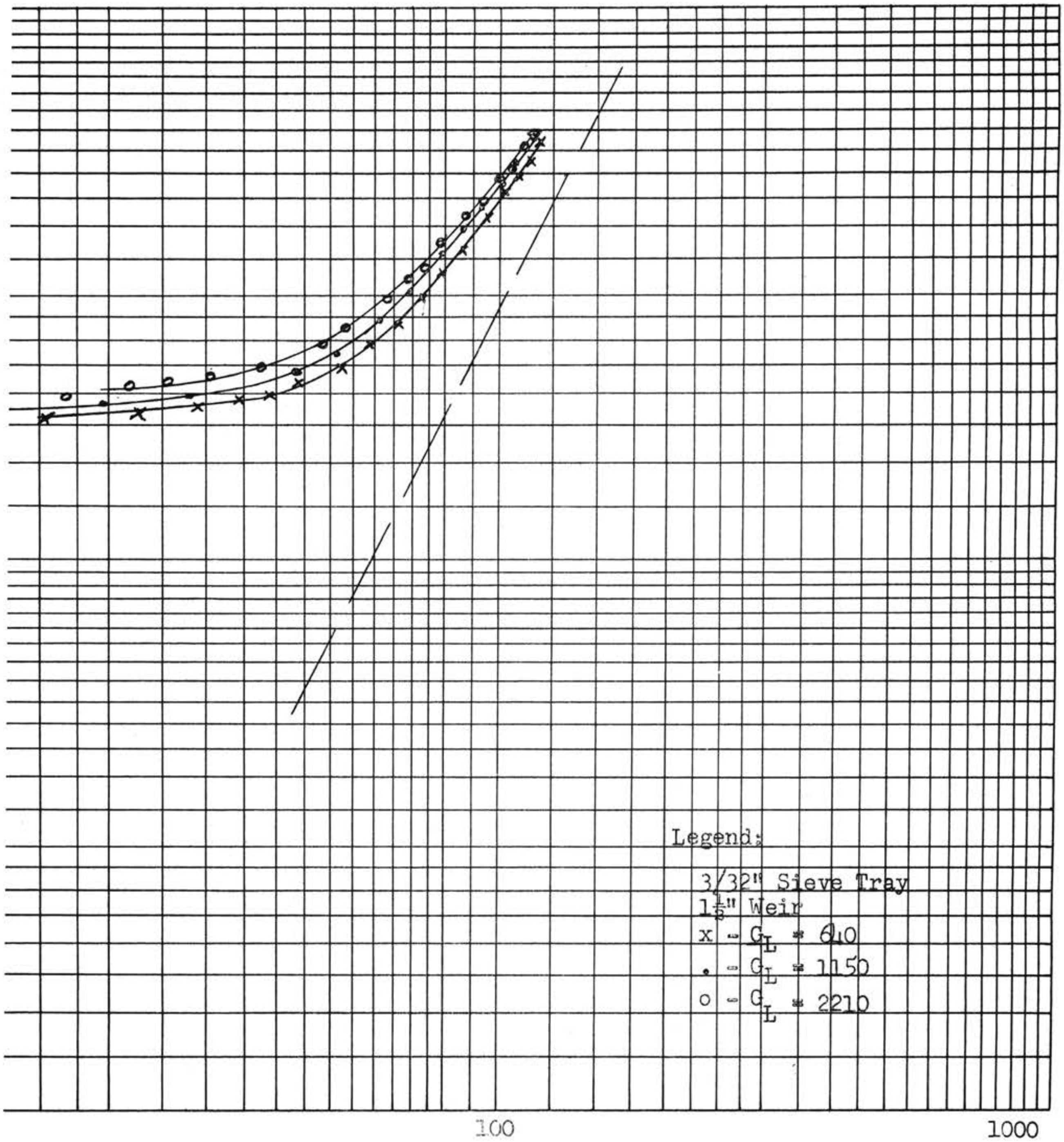


FIGURE 10

SIEVE TRAY PRESSURE DROP



Air Mass Velocity

FIGURE 11

SIEVE TRAY PRESSURE DROP

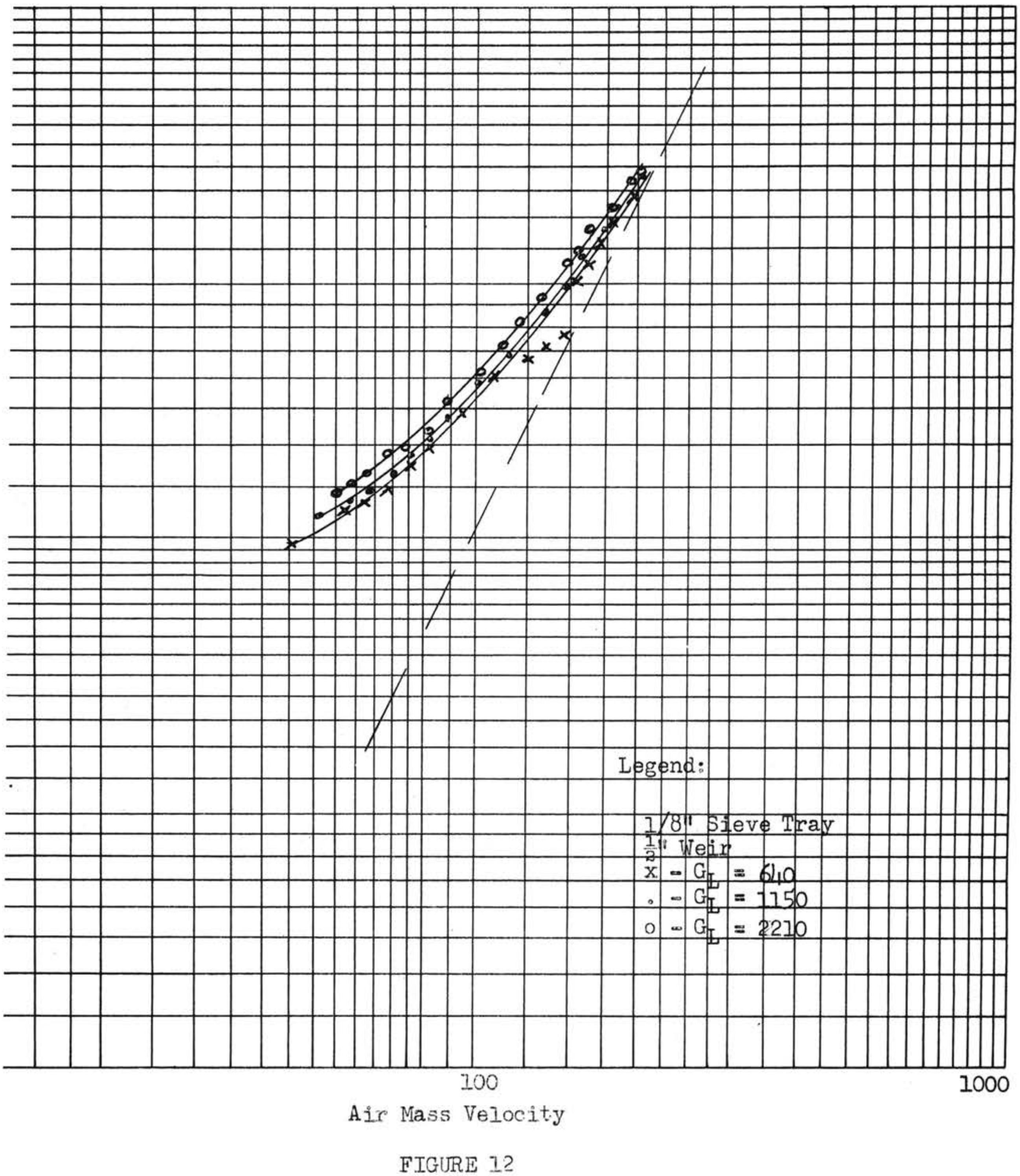


FIGURE 12

SIEVE TRAY PRESSURE DROP

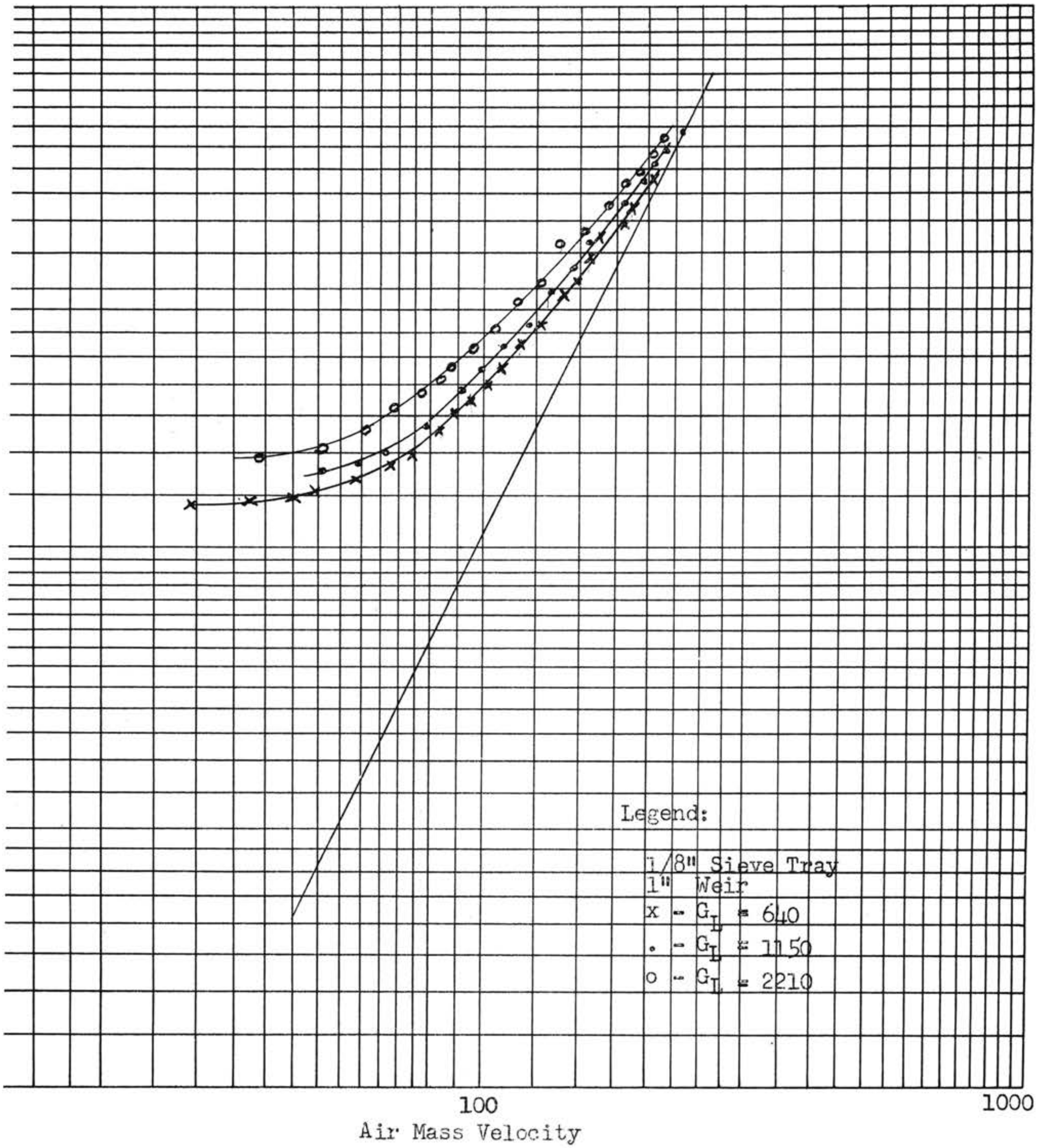
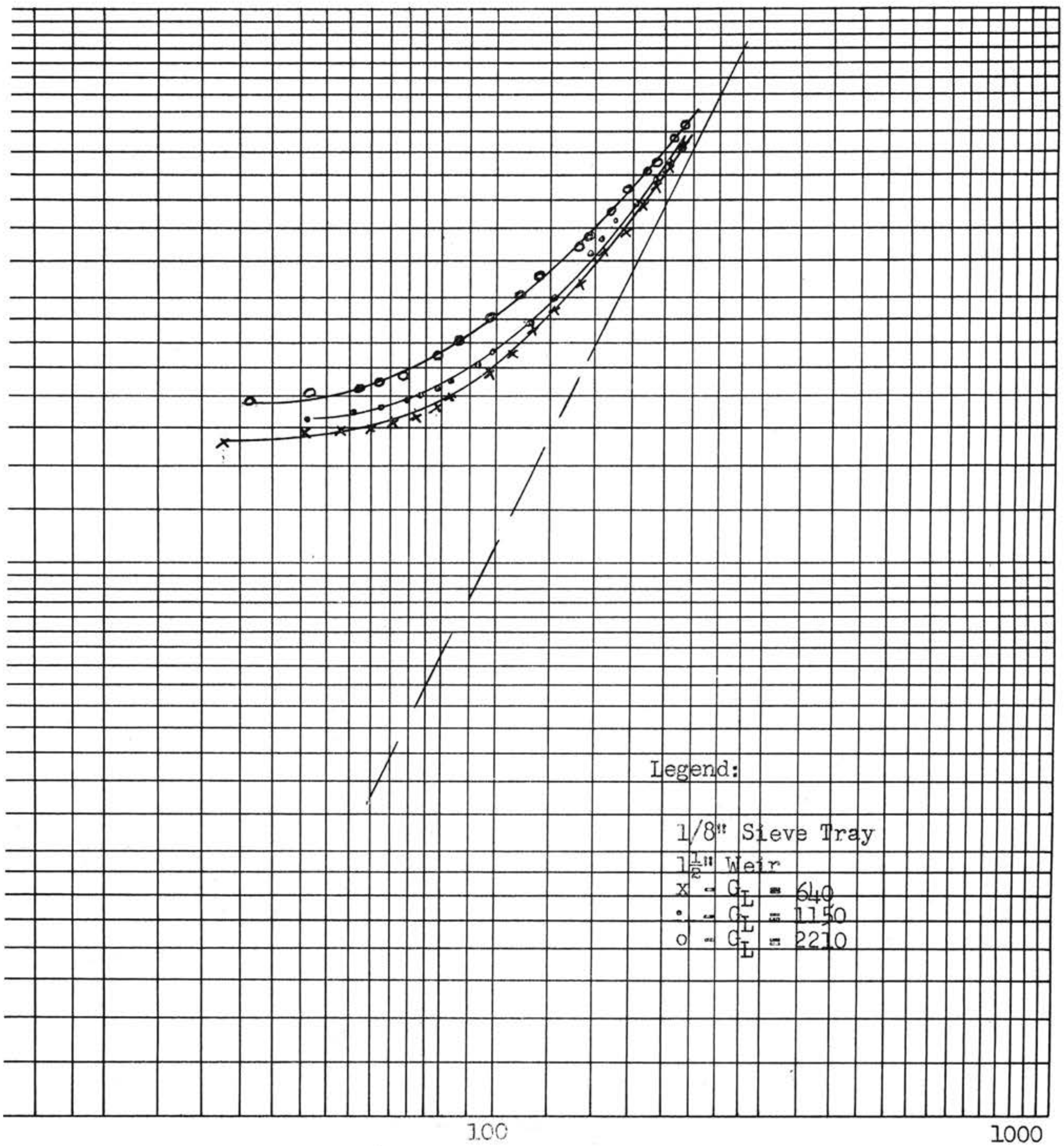


FIGURE 13

SIEVE TRAY PRESSURE DROP



Air Mass Velocity

FIGURE 14

SIEVE TRAY PRESSURE DROP

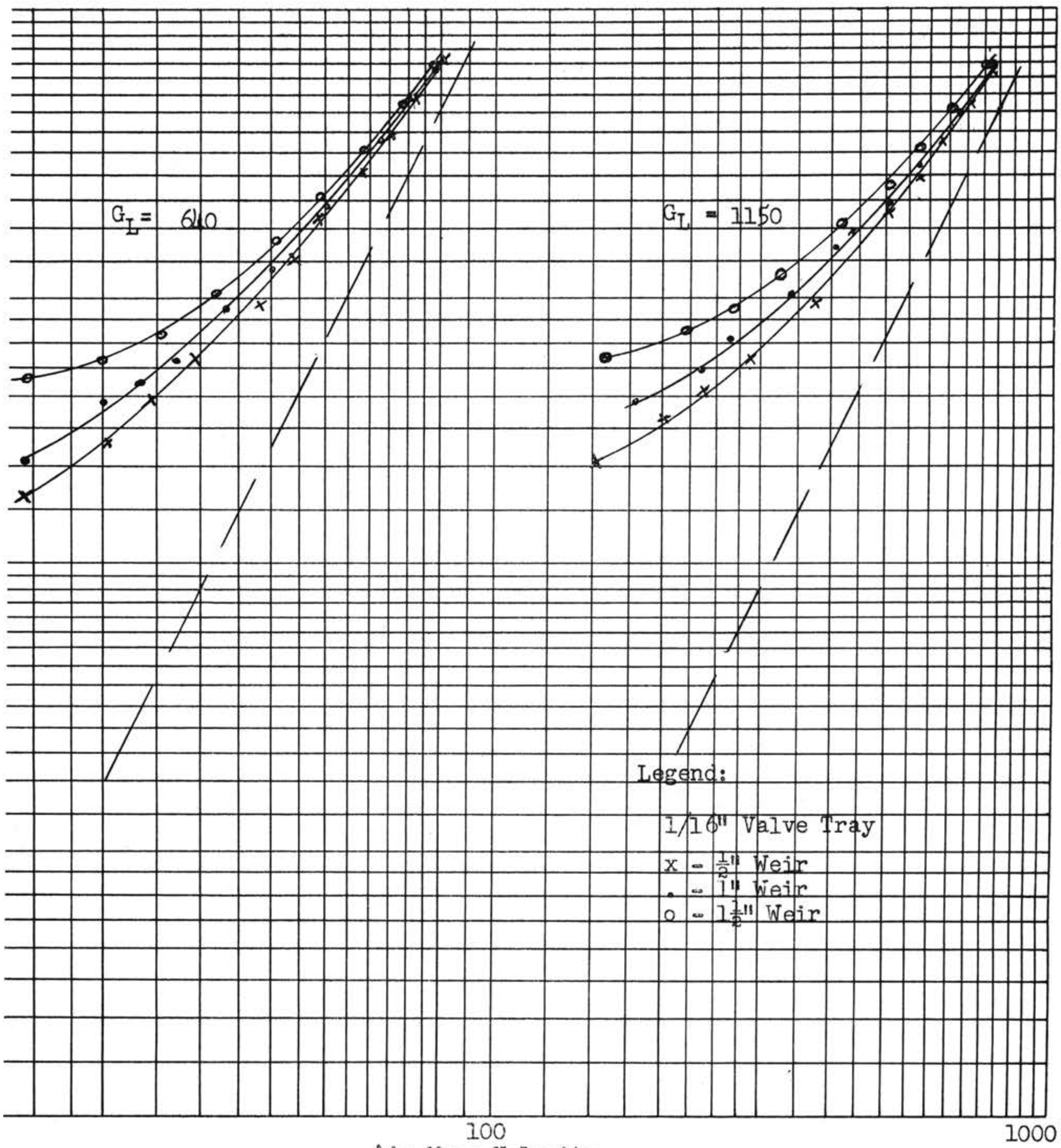


FIGURE 15

VALVE TRAY PRESSURE DROP

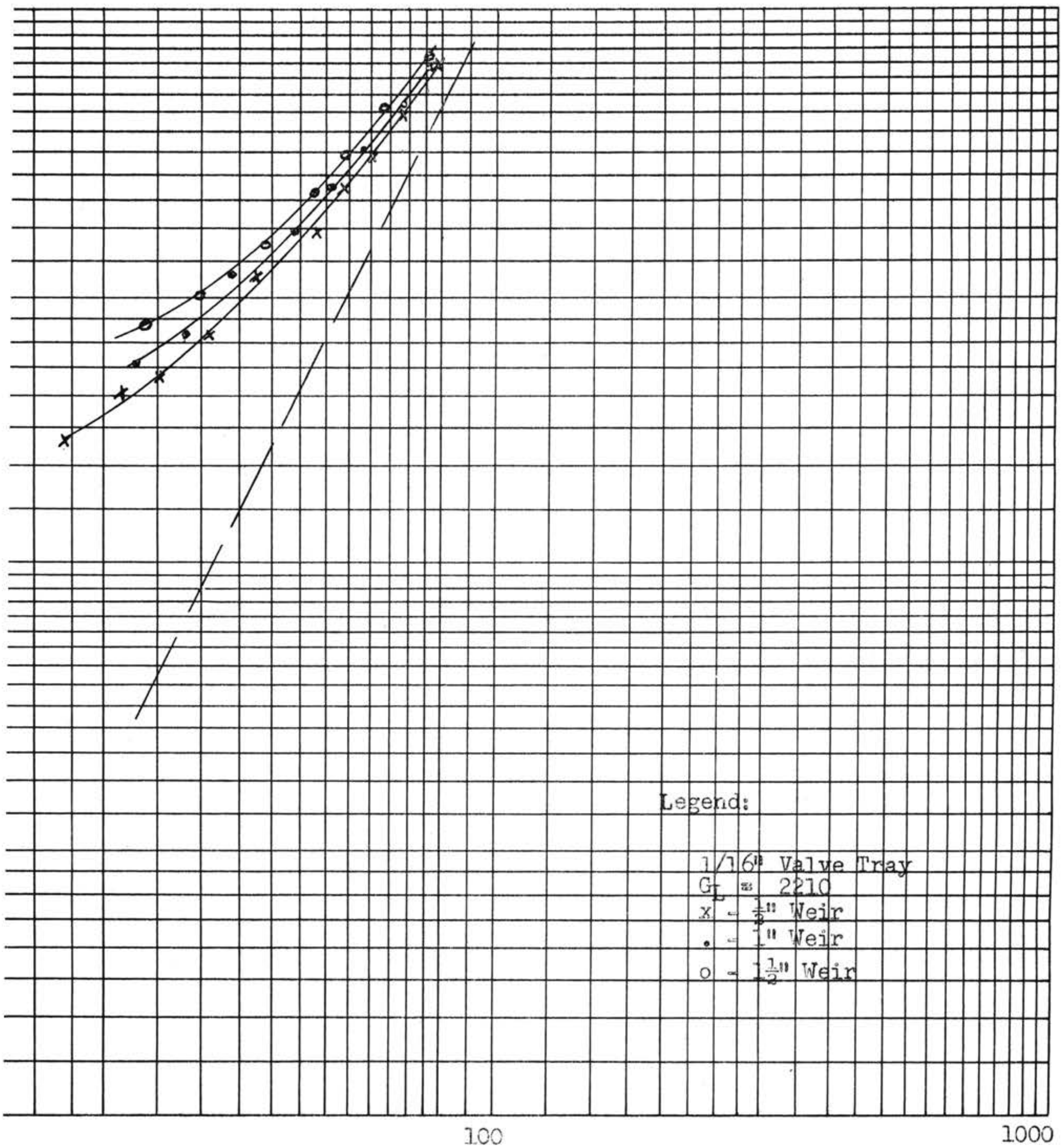


FIGURE 16

VALVE TRAY PRESSURE DROP

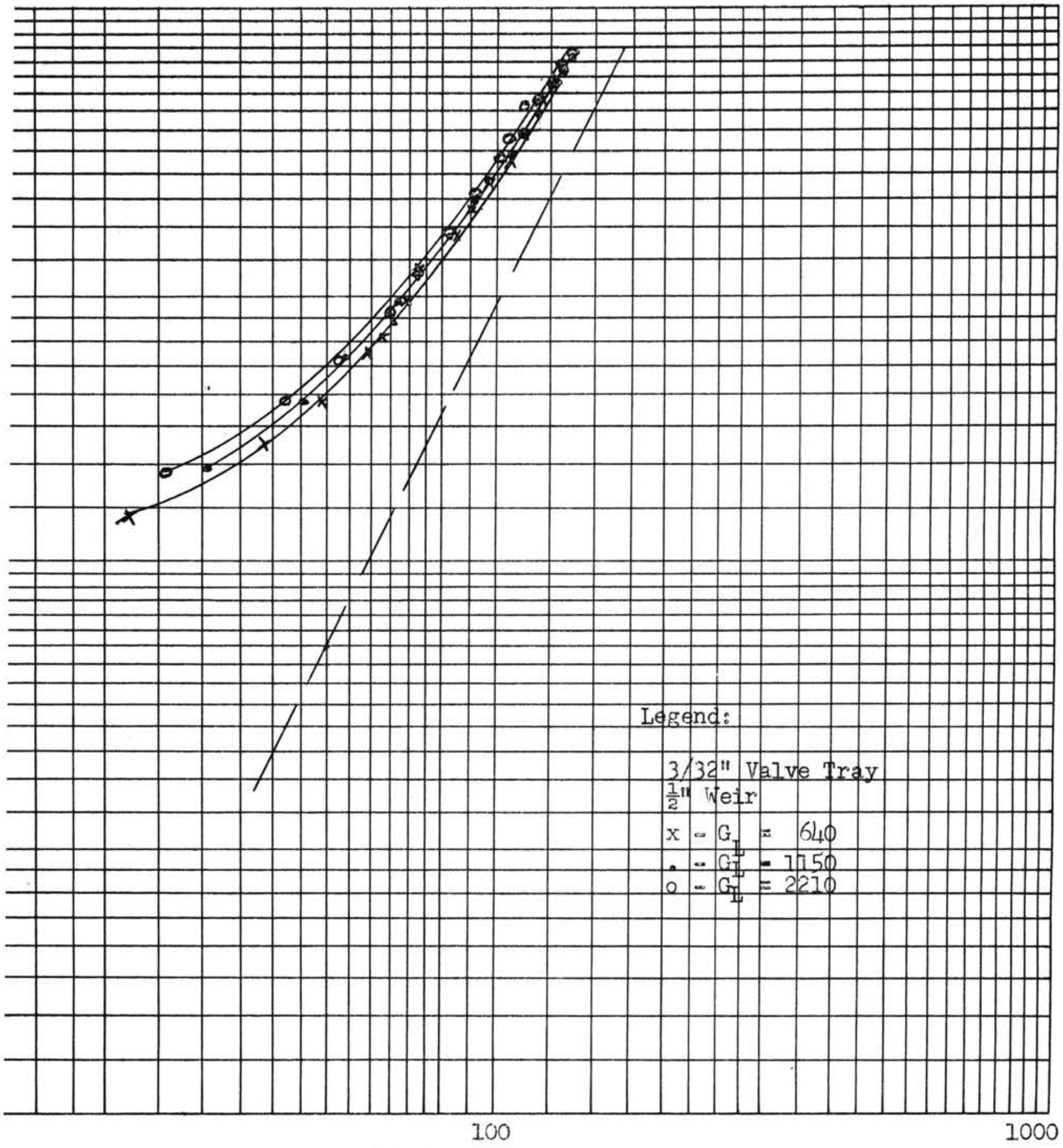


FIGURE 17

VALVE TRAY PRESSURE DROP

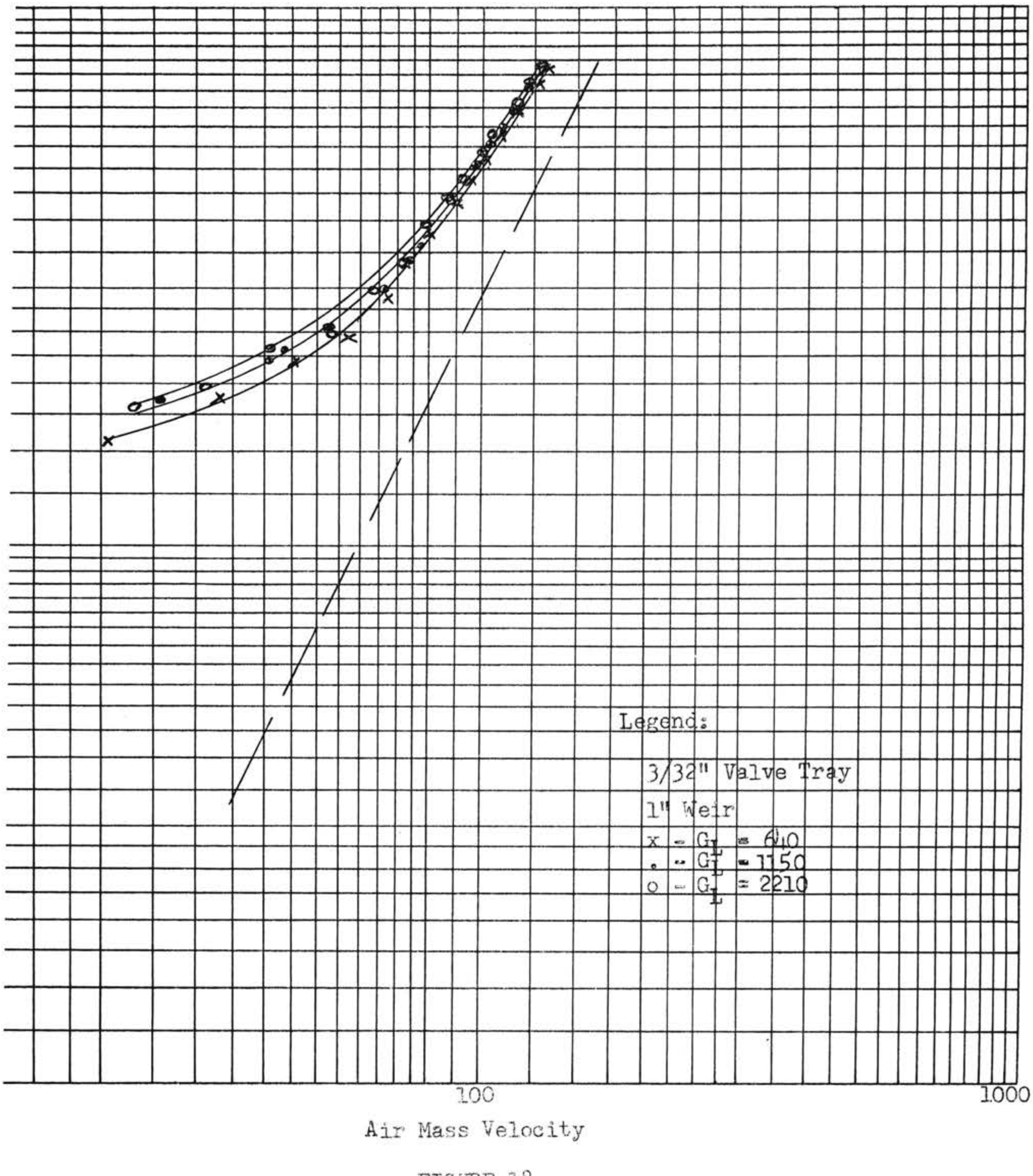


FIGURE 18

VALVE TRAY PRESSURE DROP

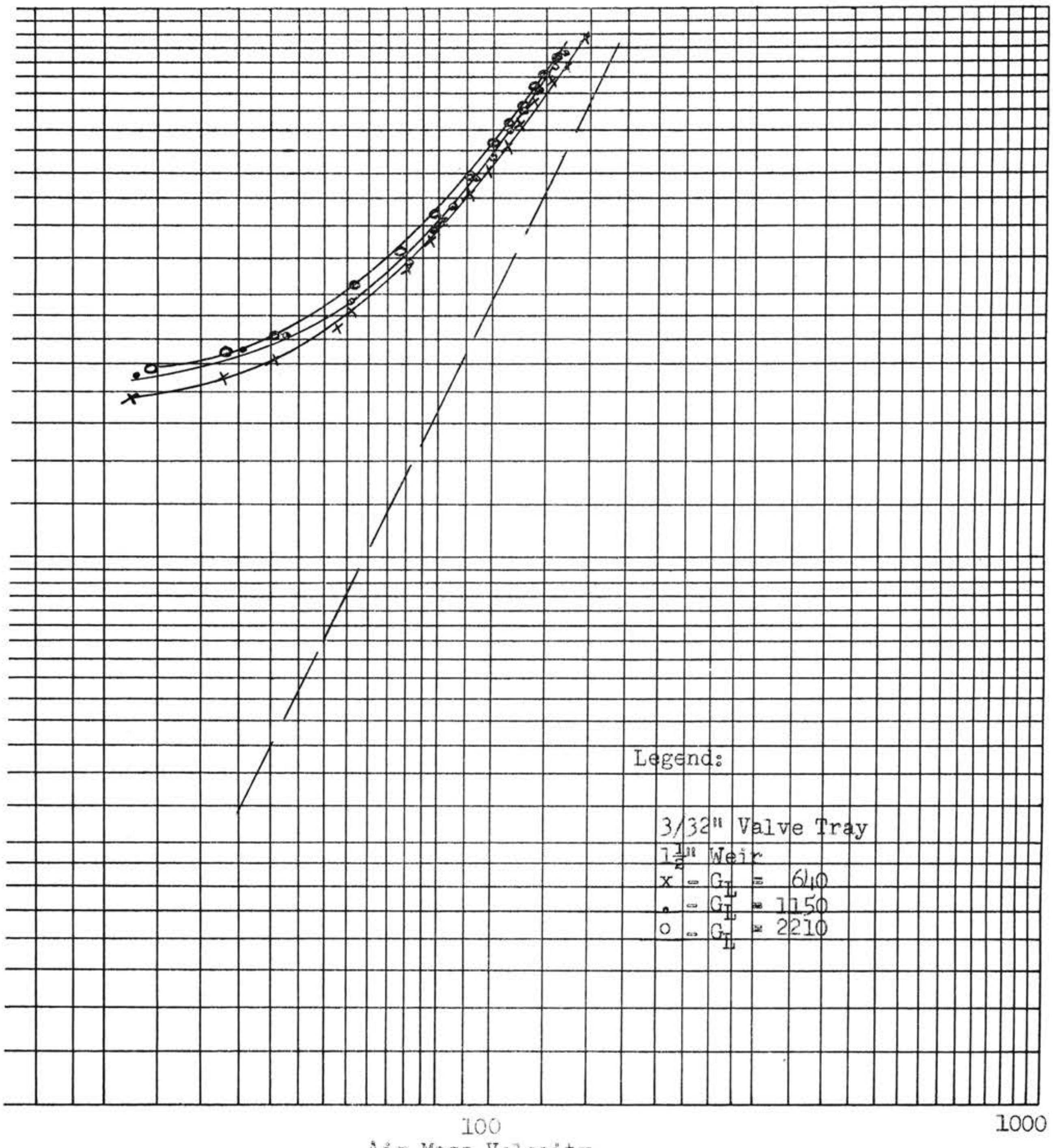


FIGURE 19

VALVE TRAY PRESSURE DROP

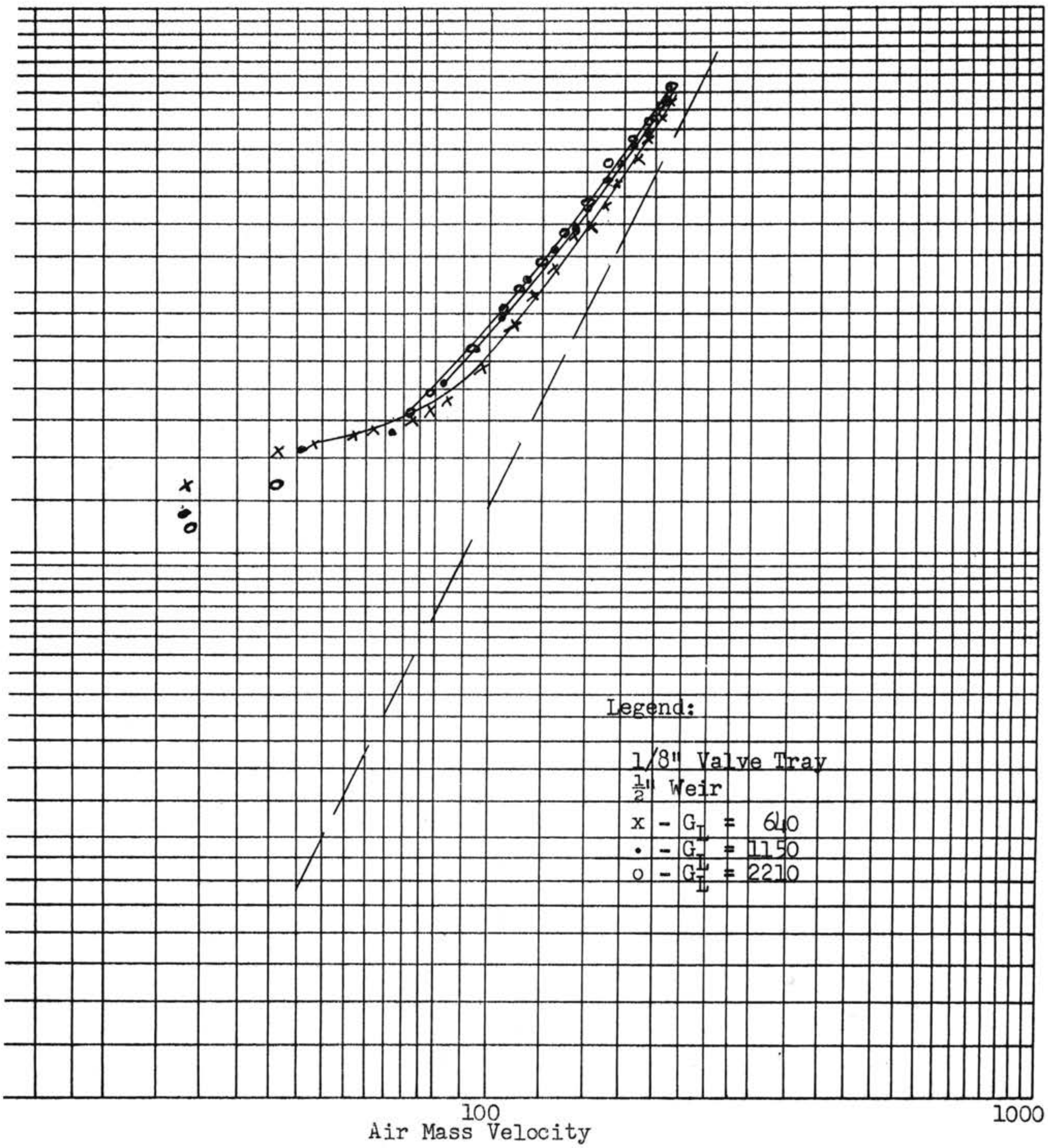


FIGURE 20

VALVE TRAY PRESSURE DROP

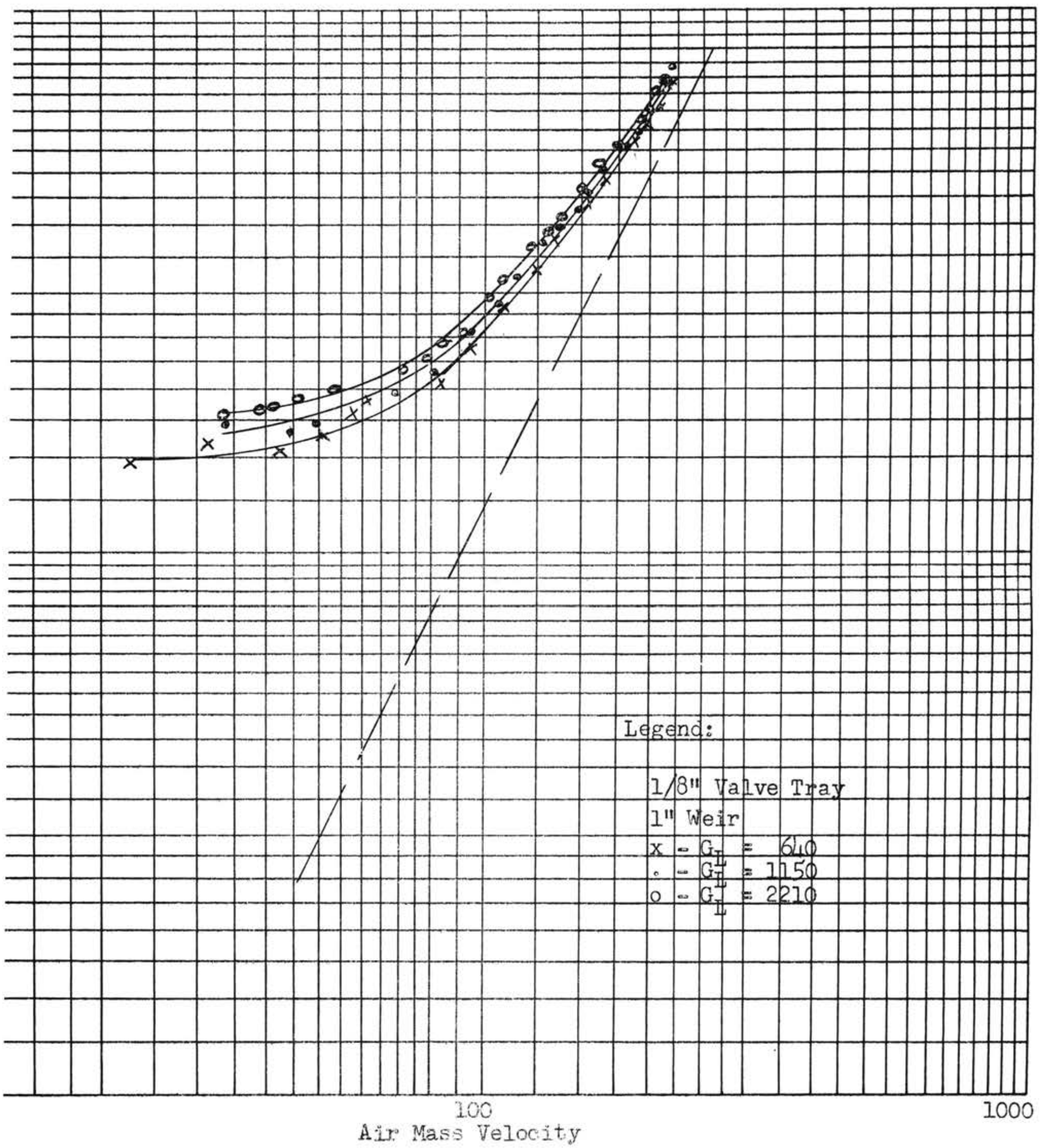
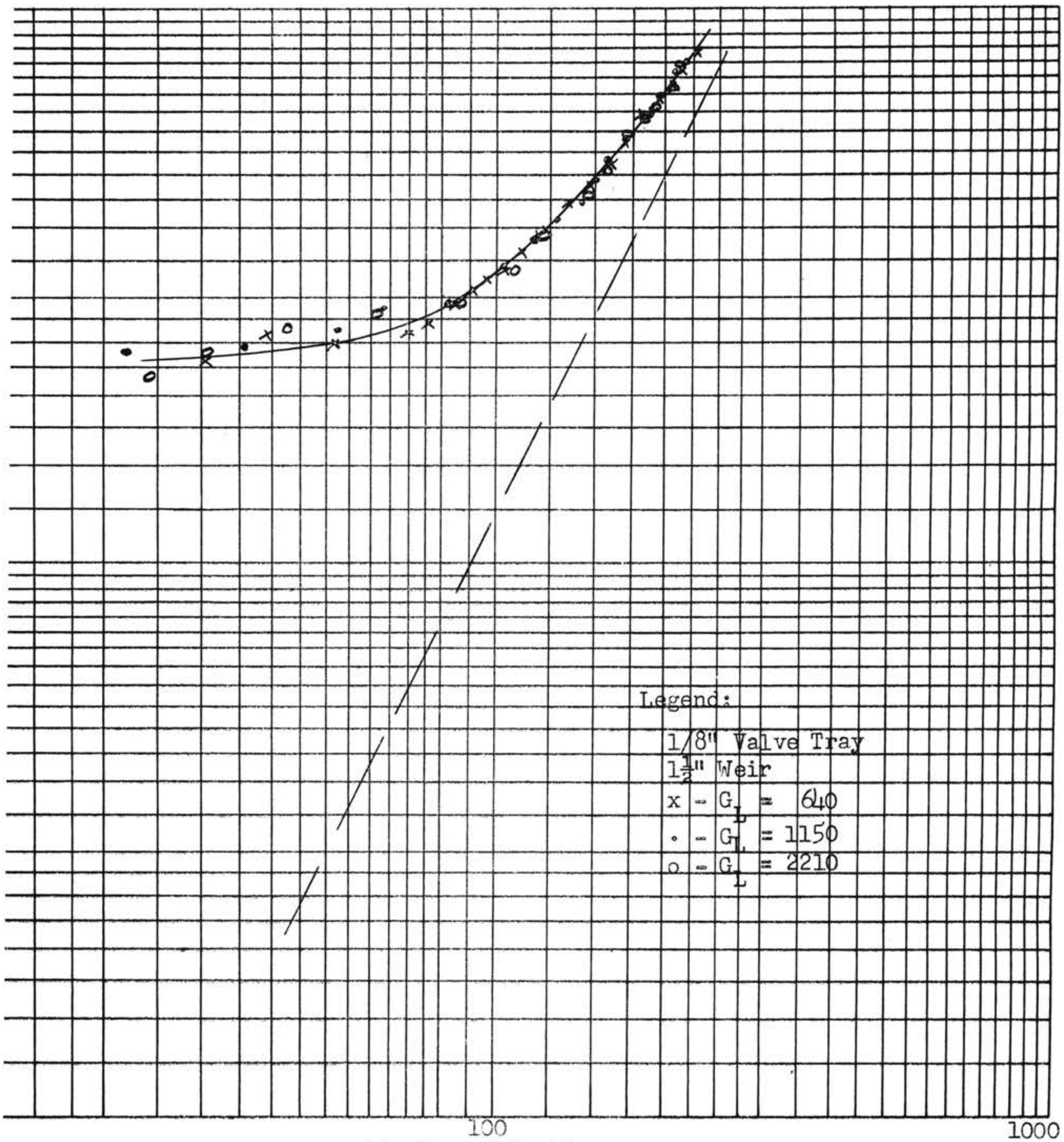


FIGURE 21

VALVE TRAY PRESSURE DROP



Air Mass Velocity

FIGURE 22

VALVE TRAY PRESSURE DROP

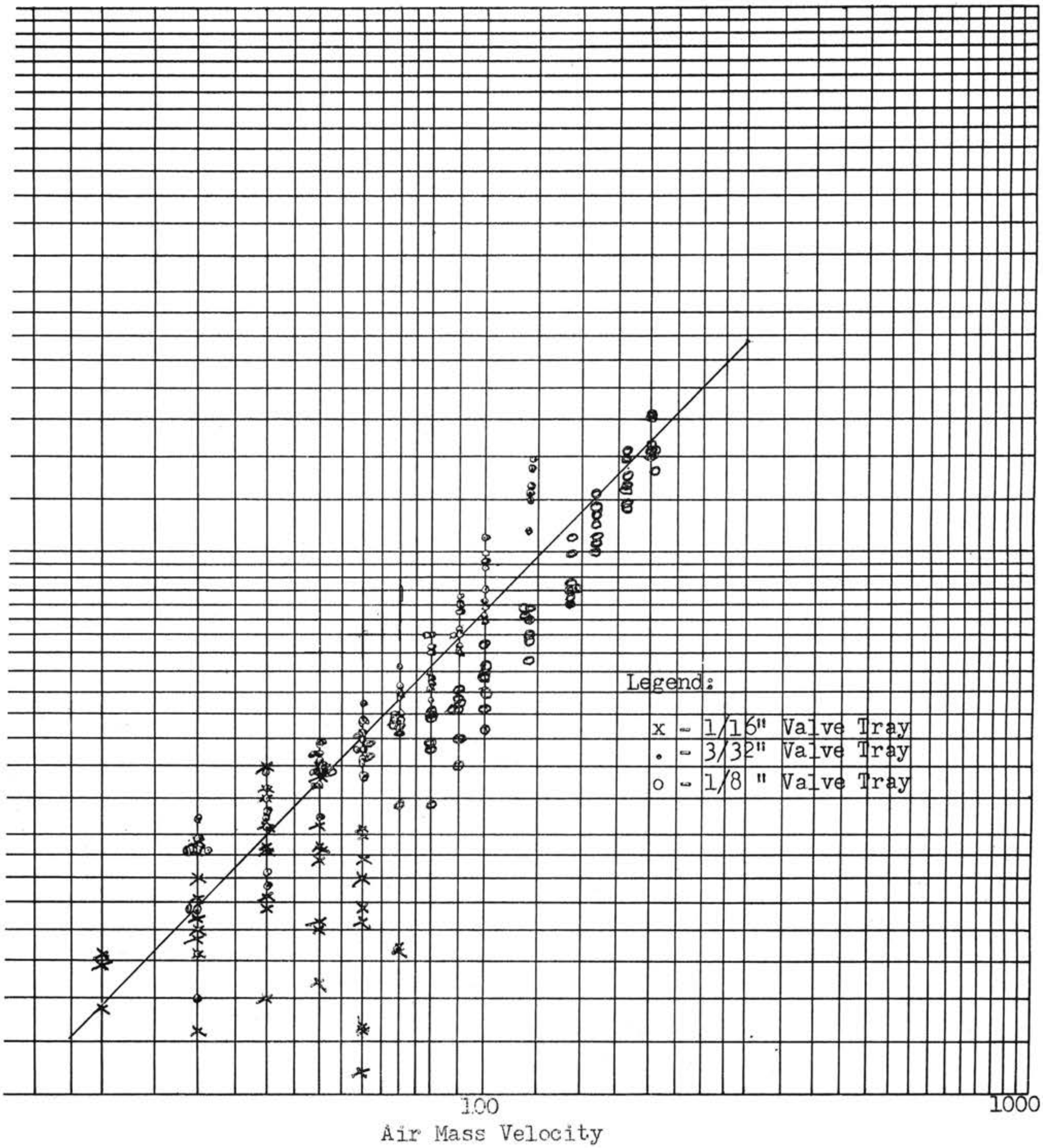


FIGURE 23

PRESSURE DROP ACROSS VALVE

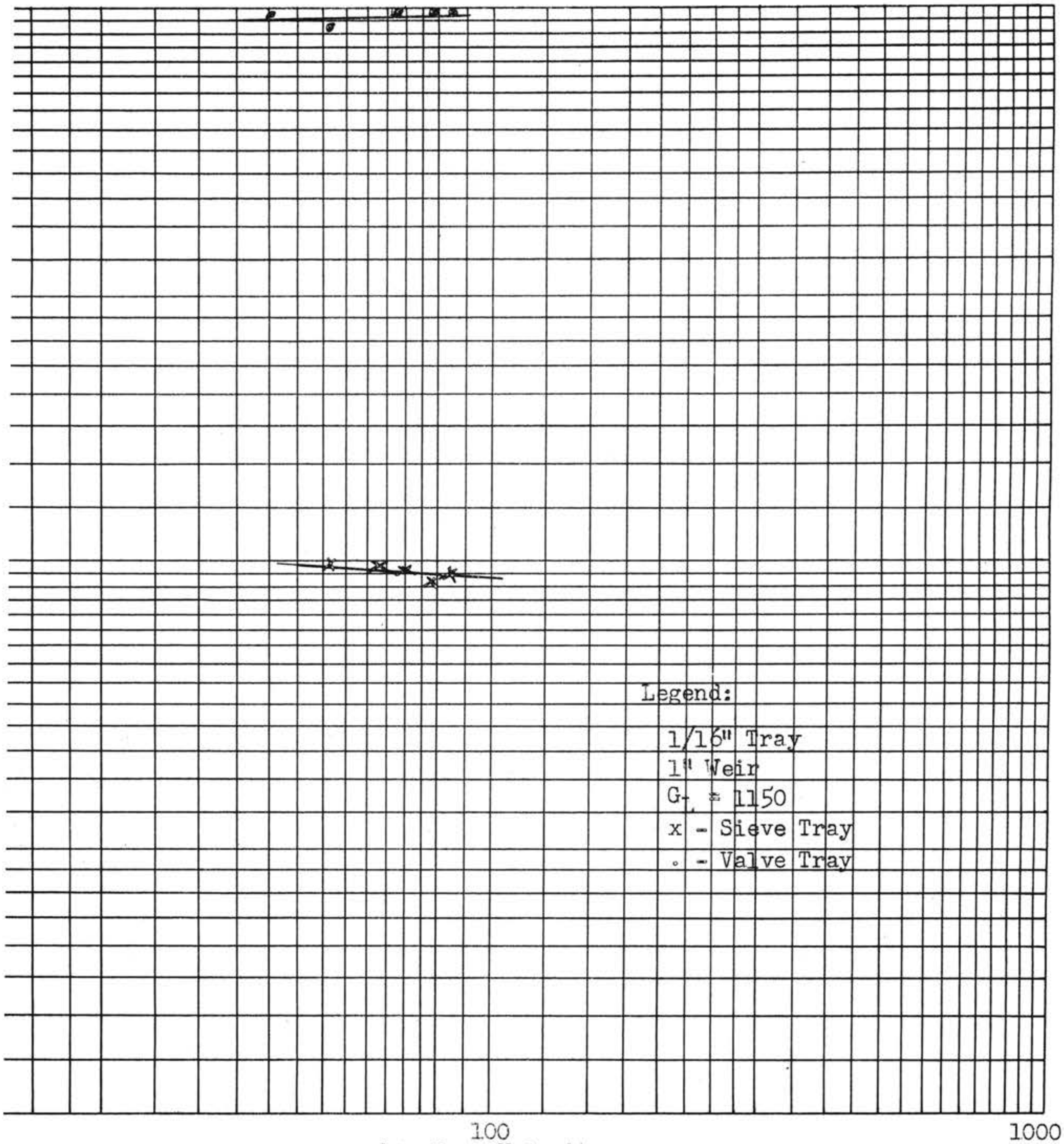
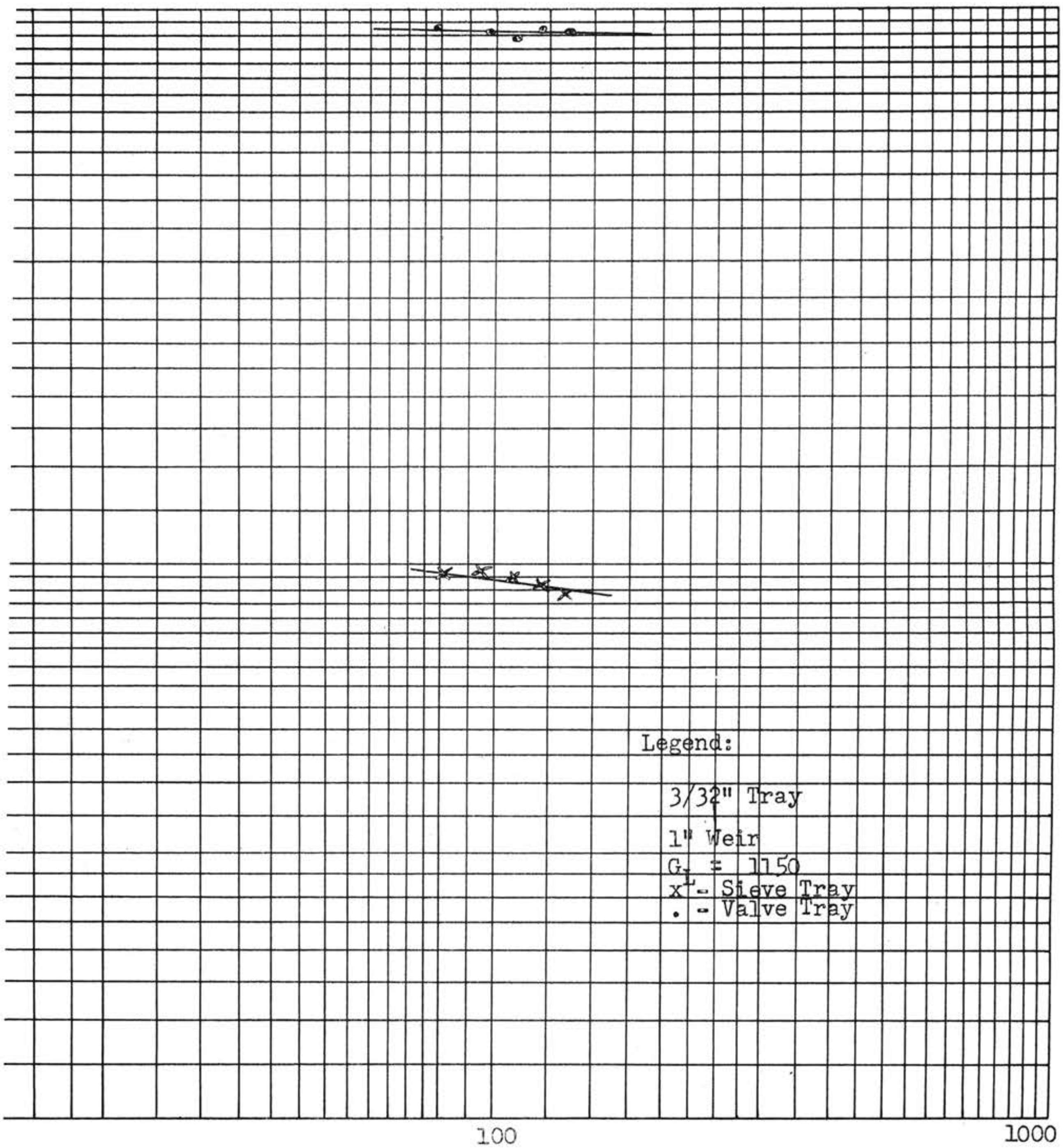


FIGURE 24

MURPHREE VAPOR EFFICIENCY



Air Mass Velocity

FIGURE 25

MURPHREE VAPOR EFFICIENCY

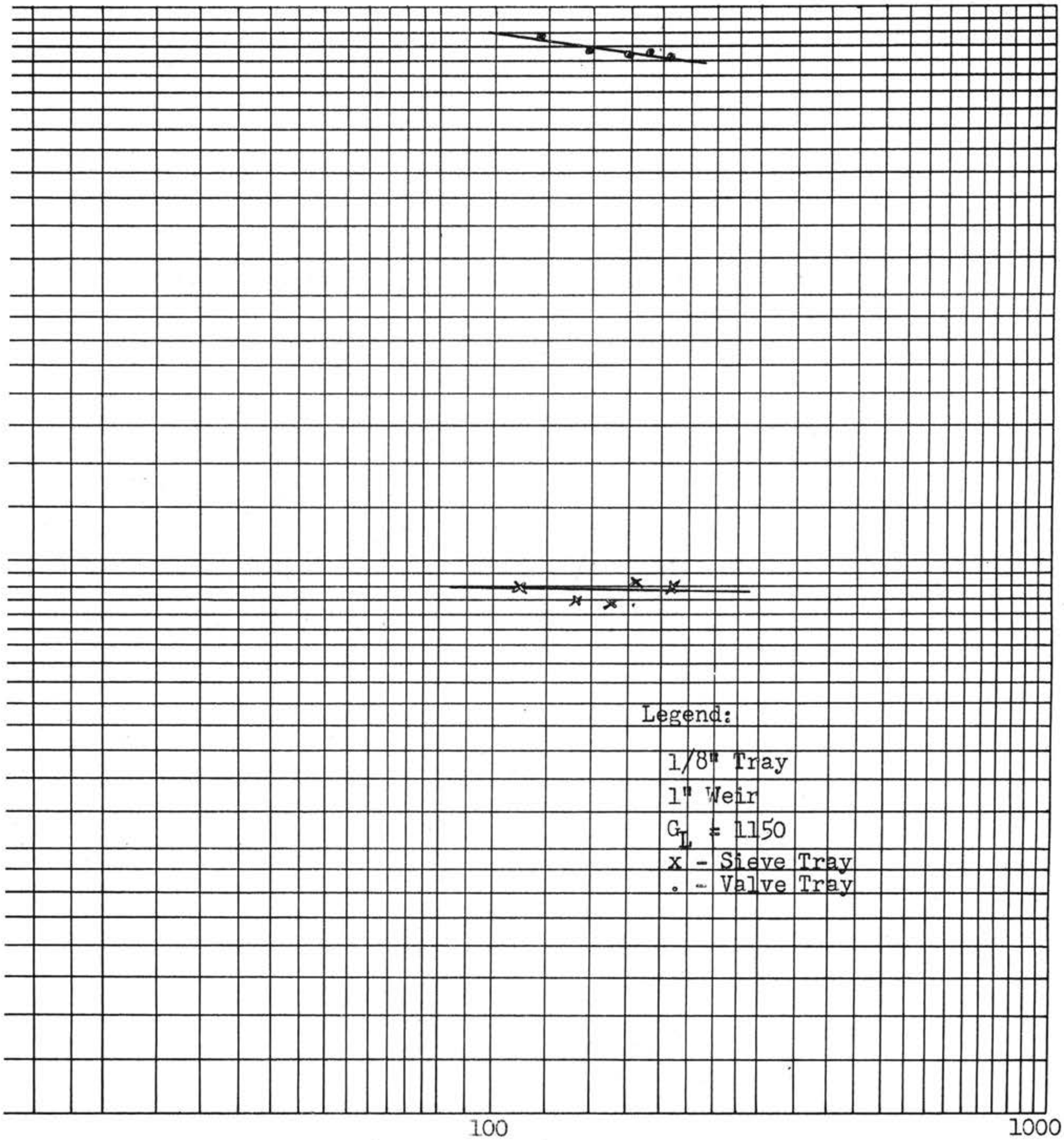


FIGURE 26

MURPHREE VAPOR EFFICIENCY

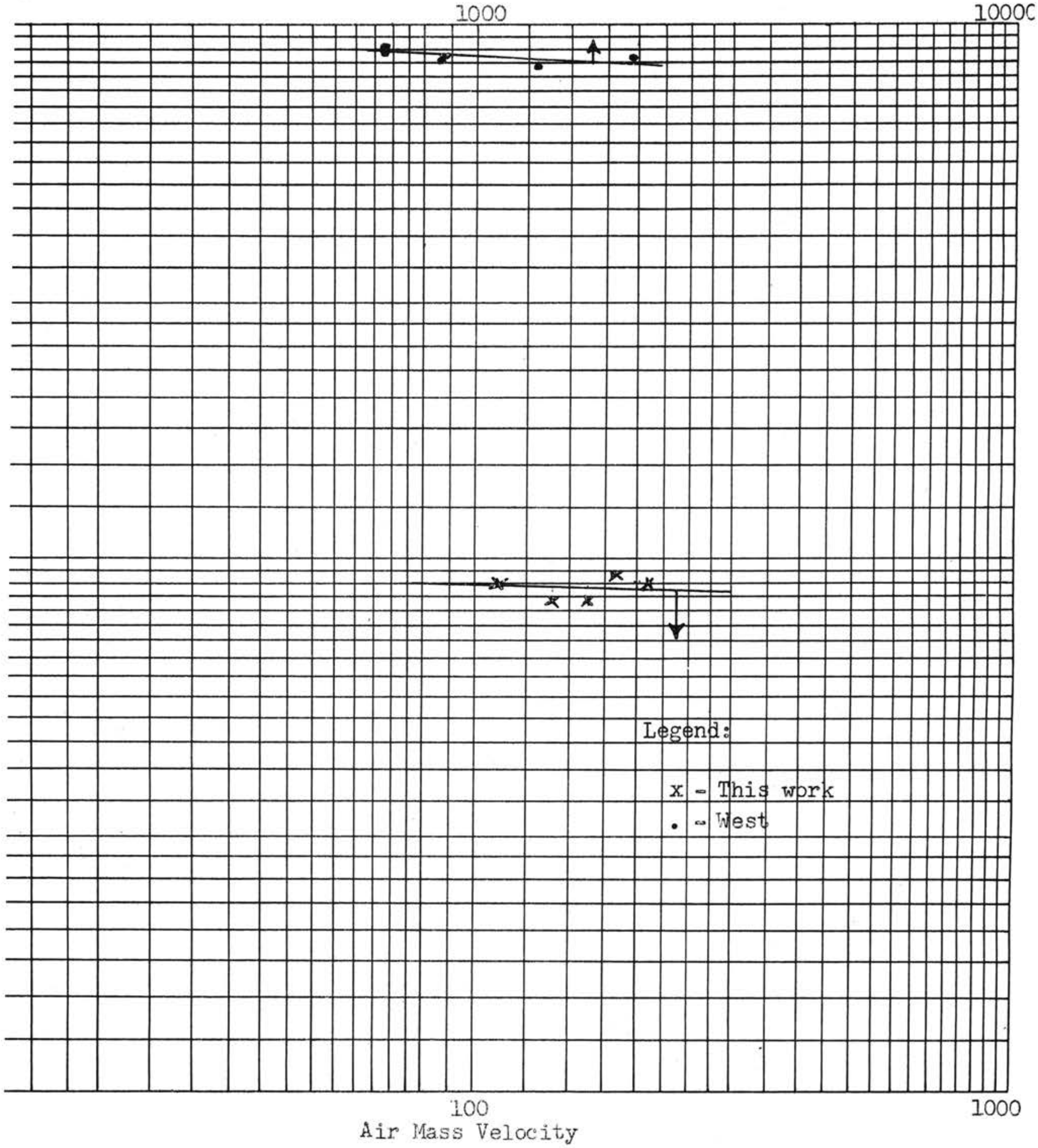


FIGURE 27

COMPARISON OF THIS INVESTIGATION
WITH THAT OF WEST [26]

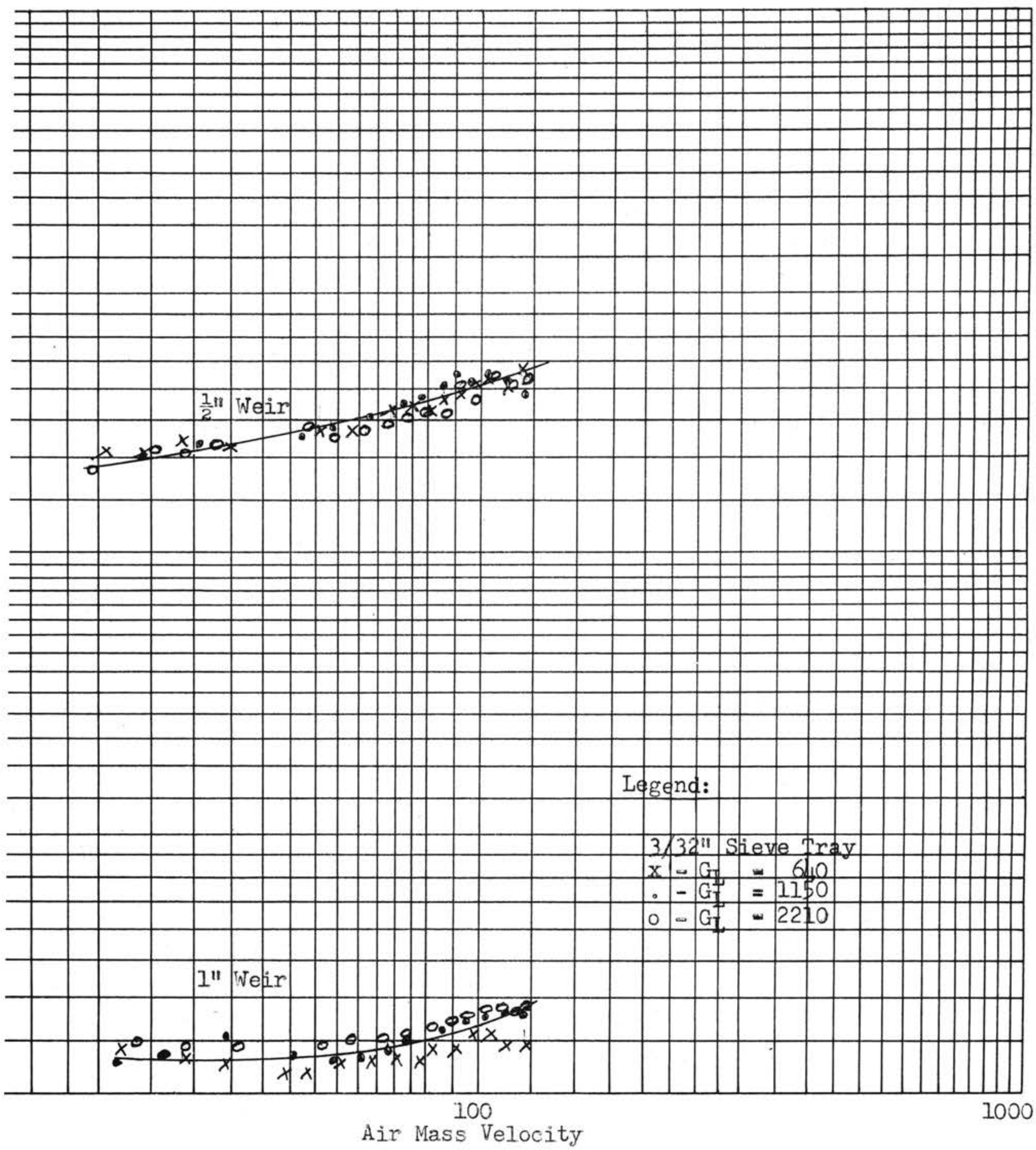


FIGURE 28

AERATION FACTOR

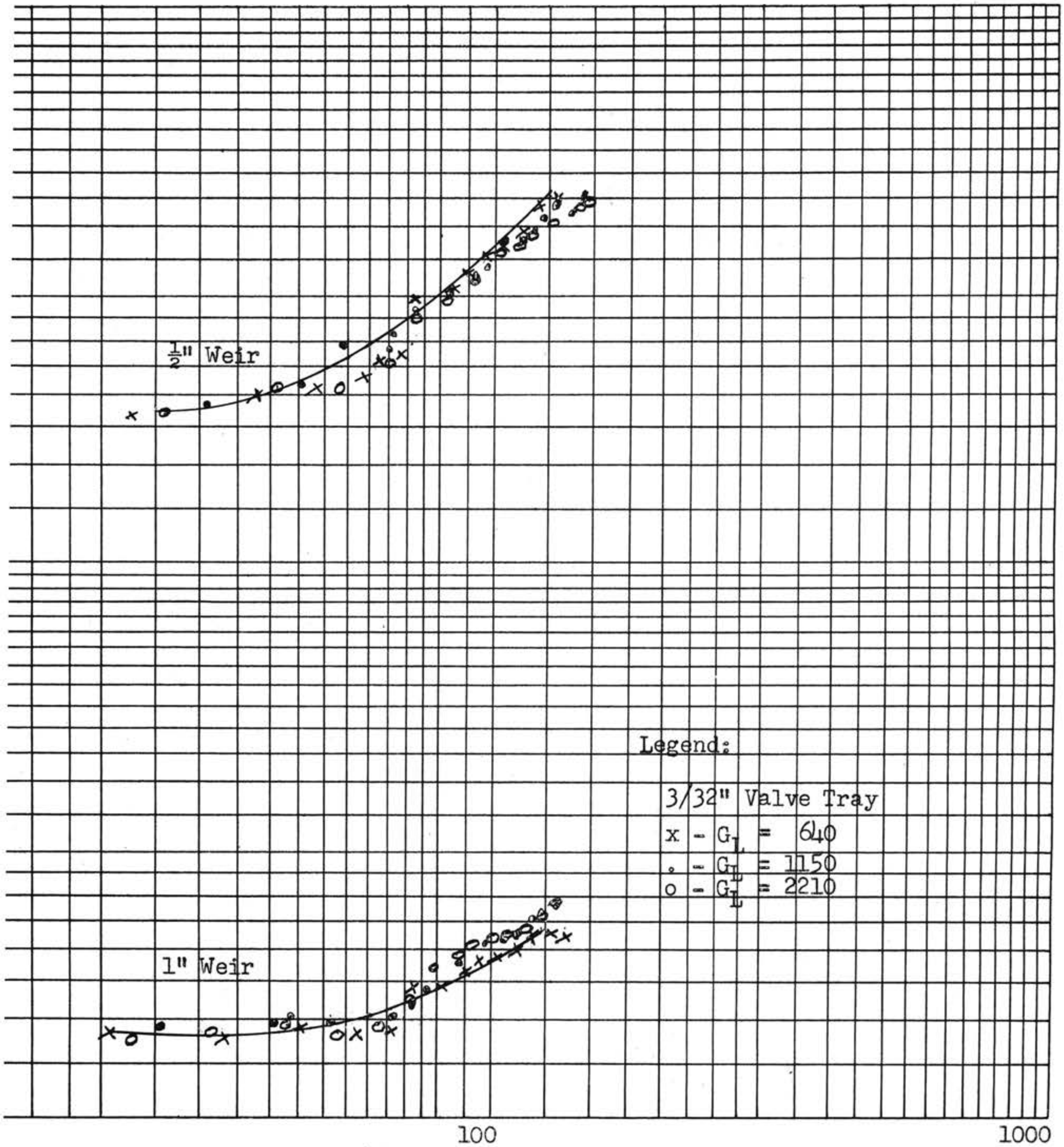


FIGURE 29

AERATION FACTOR

DISCUSSION OF RESULTS

Dry Tray Runs

The dry tray data for the sieve plates are shown plotted on log-log coordinates in Figure 4. A straight line drawn through the points for any one tray has a slope of 2 which gives an equation of the type:

$$\Delta P_D = k\, G_G^{\,2}$$

If the terms of this equation are rearranged, the result is a variation of the familiar orifice equation:

$$G_G = k\sqrt{\Delta P}$$

The constant k, rather than being constant at one value, is 31.9 for the 1/16" sieve tray, 59.2 for the 3/32" and 96.1 for the 1/8".

The conventional form of the orifice equation is:[4]

$$v_o = C_o\sqrt{2gh}$$

If the data plotted are calculated in terms of the orifice equation, the calculated coefficients are 0.74, 0.60 and 0.60 for the 1/16", 3/32" and 1/8" trays respectively. The reason for the larger coefficient for the 1/16" tray is not clear though Arnold[1] also found larger coefficients for smaller diameter holes.

The dry tray data for the valve-type plate are shown in Figure 5. The 1/16" valve tray data may be correlated as a straight line with a slope of 2 which gives the same type of pressure drop equation as was obtained for the sieve tray. As would be expected, however, the pressure drop across the valve tray is slightly greater than the drop across the sieve tray, the constant in the equation for the 1/16" valve tray being 31.3.

The dry tray data for the 3/32" and 1/8" valve trays appear to differ from that for the 1/16" valve tray. Consideration of the action of the valve provides an explanation for this difference. Data for the valve plate with no perforated tray is shown in Figure 6. This data shows that the pressure drop across the valve is not a simple function of air velocity. On the contrary there are two conjunctive effects which must be added to obtain the total drop across the valve plate.

For illustrative purposes, consider the column with the valve tray to be operating at some intermediate air flow rate. The total pressure drop across the valve is the sum of the pressure drop caused by lifting the weight of the valve and the drop caused by the passage of air through the valve hole. At low air rates, one edge of the valve is supported by the tray so that not all of its weight need be counted in the pressure drop. For design purposes however, the drop across the dry valve plate may be calculated as the sum indicated above.

With this explanation for the behavior of the valve, the data obtained for the 3/32" and 1/8" plates is more clear. The lower portions of the two curves are created by the valve being only partly open. In each case, the valve fully opens at a G_G of approximately 80 and that part of the pressure drop curve above this value of G_G may be correlated by the same type equation used for the sieve trays. The value of k for the 3/32" valve tray is 58.2 and that for the 1/8" valve tray is 90.2.

For all valve trays, the pressure drop is greater than the pressure drop of the corresponding sieve tray. The increase is not large and may be calculated as the sum of the weight of the valve and the drop across the valve hole.

<u>Wet Tray Runs</u>

The pressure drop across the sieve trays and valve trays is shown in Figures 7 to 22 as a function of vapor loading, liquid loading and outlet weir height. The curves for the 1/16" trays are plotted at constant water rate with weir height as a parameter to illustrate the variation in tray pressure drop as the liquid seal on the tray is changed. The curves for the 3/32" and 1/8" trays are plotted at constant weir height with liquid loading as a parameter to show the effect of liquid loading on tray pressure drop. In every case, the dry tray pressure drop is shown as a dotted line to permit ready comparison.

Consideration of these curves shows that the pressure drop across the tray increases as the liquid seal on the tray is increased. The magnitude of the increase is a function of the increase in liquid seal. An increase in liquid loading causes an increase in the pressure drop across the tray because of the increase in liquid head above the outlet weir necessary for the weir to handle the increase in liquid load.

Figure 23 is a plot showing the increase in pressure drop for the valve tray above that of the perforated tray under the same conditions of vapor and liquid loading. The best straight line through these points has a slope of unity which indicates that the drop across the wet valve is a linear function of vapor flow rate.

According to the method of Mayfield and his co-workers,[15] the wet tray pressure drop for a sieve tray may be correlated as the sum of the dry tray pressure drop and an aeration factor. This aeration factor is defined as the ratio of the pressure drop through the liquid on the tray to the calculated clear liquid depth on the tray; the calculated clear liquid depth is defined as the sum of the outlet weir height and the weir head as calculated by the Francis weir formula. The aeration factors as determined in this investigation are shown in the tabulated data in the appendix. The aeration factors for the 3/32" sieve and valve trays are shown in Figure 28 and Figure 29 to illustrate the effect of the addition of the valve tray on the aeration factor. Aeration factors for the valve tray are higher than for the perforated tray, the increased pressure drop being caused by the valve and increasing as the vapor flow increases.

Efficiency Runs

Because of the liquid seal maintained on the downcomer in the lower part of the column, some humidification of the inlet air occurred when it came in contact with the water. A series of dry runs were made to determine the magnitude of this humidification and to correct for it. The result of this run is shown in Figure 38. The humidity of the air going to the tray then is the sum of the humidity as determined at the sampling point and the humidification occuring below the tray as given by Figure 38.

The comparative efficiencies of the two plates are shown in Figures 24 to 26. These data indicate that the addition of the valve tray has very little, if any, effect on the Murphree vapor efficiency of a perforated tray. Figure 27 compares efficiency of the 1/8" perforated tray of this investigation with that of West.[26]

CONCLUSIONS AND RECOMMENDATIONS

The purpose of this investigation was to develop a perforated or sieve tray which circumvented the inherent tendency of a conventional perforated tray to dump or by-pass liquid under conditions of low vapor loading. To this effect, the tray used was devised in which a second tray containing a liquid check valve is added to the column below each perforated tray.

Preliminary visual tests demonstrated the combination tray to provide a positive liquid seal on the tray under all vapor loading conditions. If vapor flow in the column is stopped completely, the valve checks the flow of liquid through the tray so that no liquid may leave the tray except by way of the over-flow weir on the outlet edge of the tray.

In subsequent work, the pressure drop for the air-water system was determined under various conditions of liquid and vapor loading and a comparison of these pressure drop data made with similar data for a conventional perforated tray. These data show the pressure drop across the valve tray to be greater than the drop across a perforated tray, the increased drop being a linear function of vapor velocity. In this case:

$$\Delta P = 0.0075\ G_G$$

The addition of the valve tray had practically no effect on the Murphree vapor efficiency of the sieve tray.

Recommendations for future work are:

1. The undertaking of a fundamental study on the mechanics

of bubble formation through a hole or orifice when that orifice is immersed in a liquid. The writer firmly believes that an investigation of this type must be carried out before a generalized correlation can be developed for the pressure drop across perforated trays.

2. An experimental program aimed at determining the effect of hole diameter and column free-space ratio on the pressure drop across perforated trays.
3. A series of experiments designed to produce efficiency and mass transfer coefficient data for perforated trays.

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APPENDIX

APPENDIX A

CALIBRATION OF AIR AND WATER STREAMS

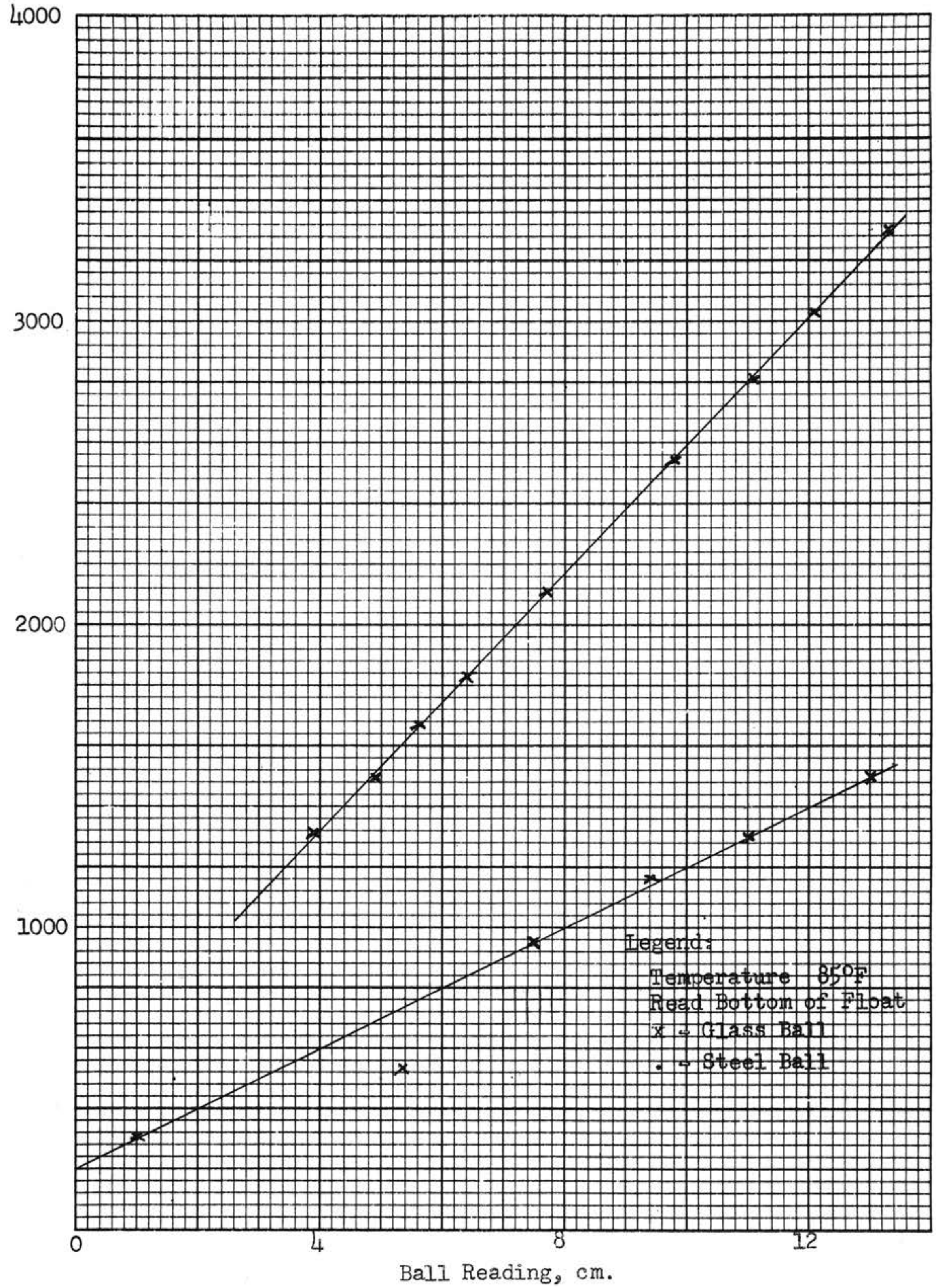

FIGURE 30

CALIBRATION CURVE WATER ROTAMETER

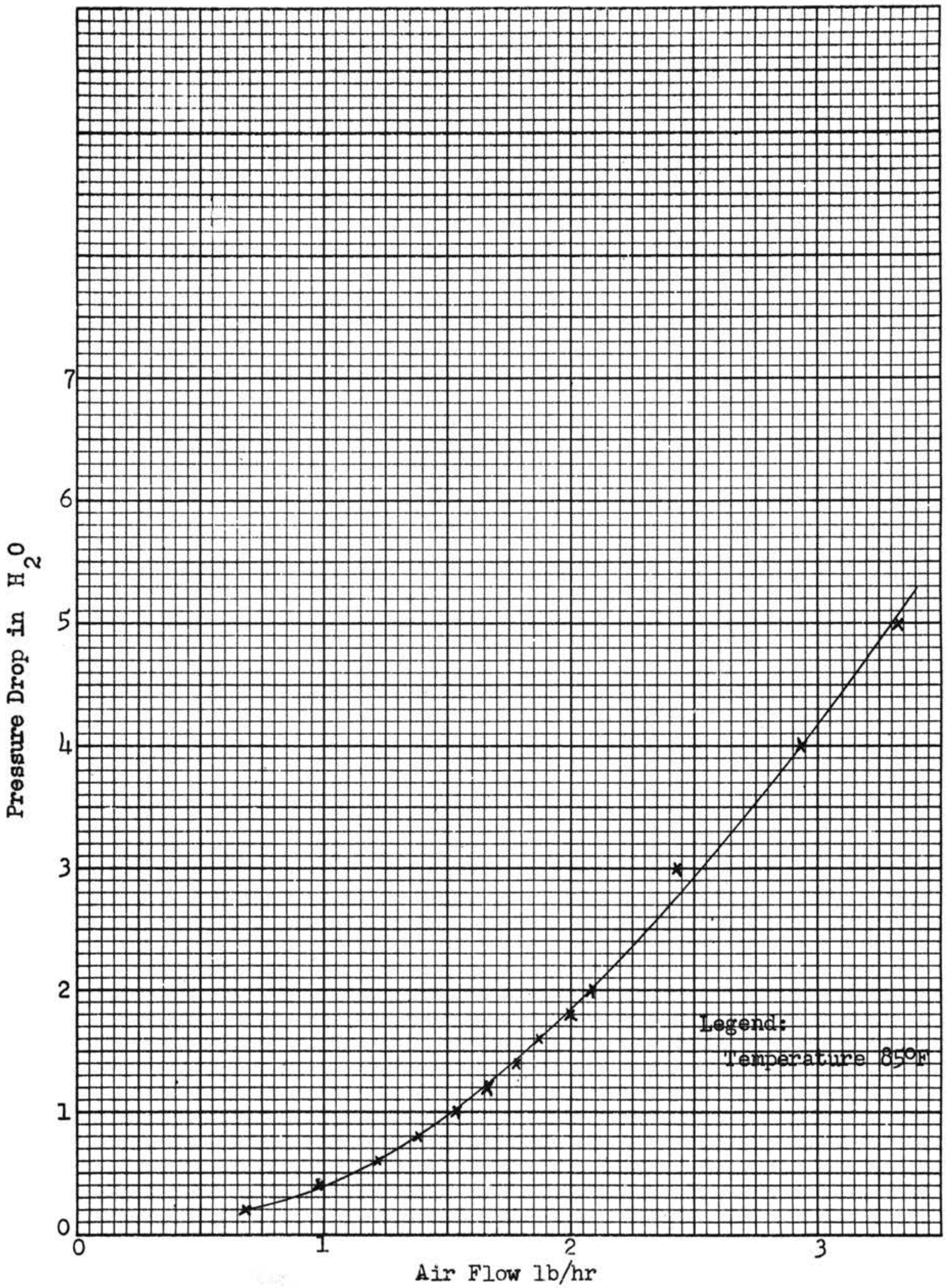

FIGURE 31

CALIBRATION CURVE AIR ORIFICE

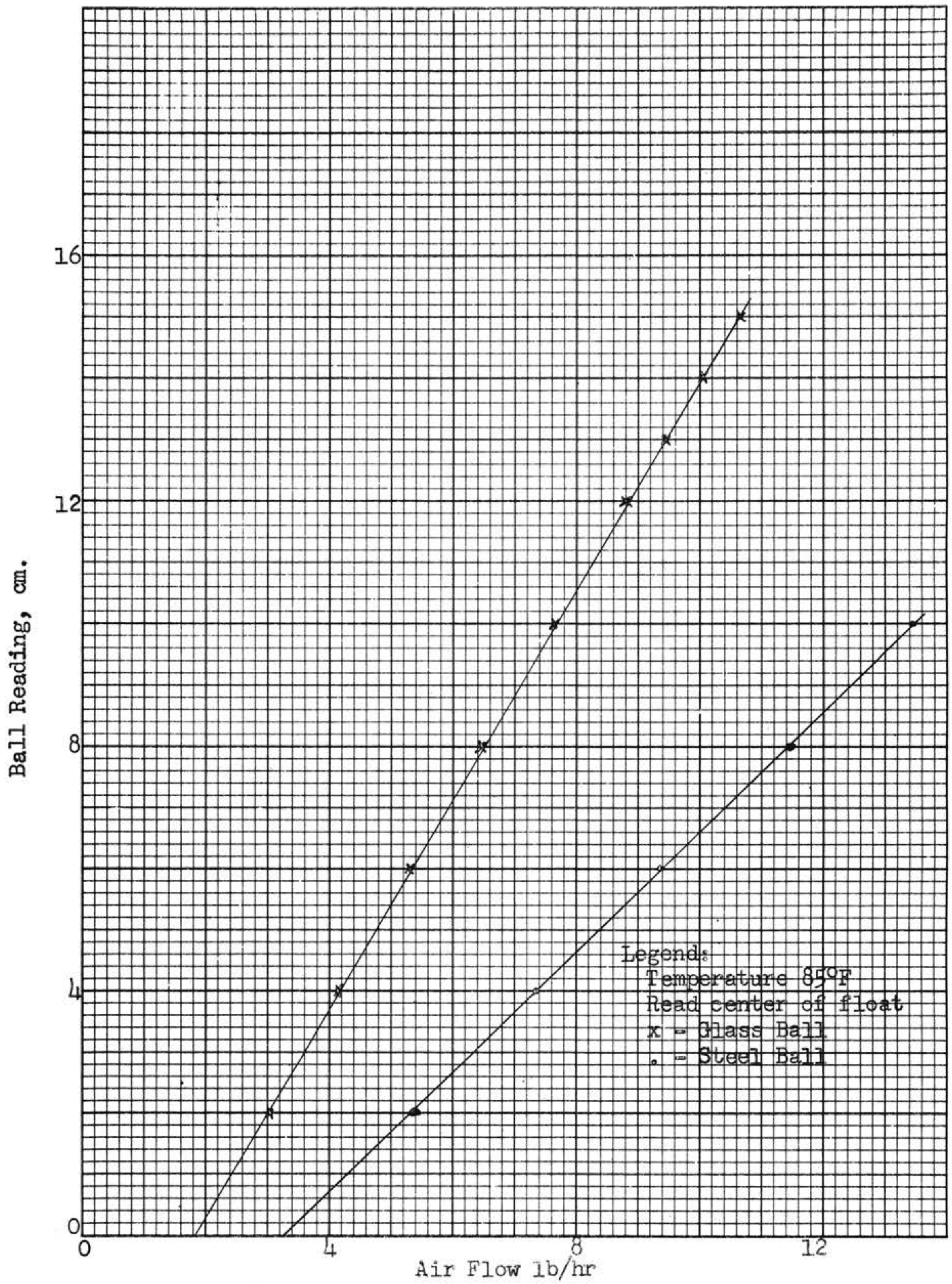

FIGURE 32

CALIBRATION CURVE AIR ROTAMETER

APPENDIX B

THERMOCOUPLE CALIBRATION

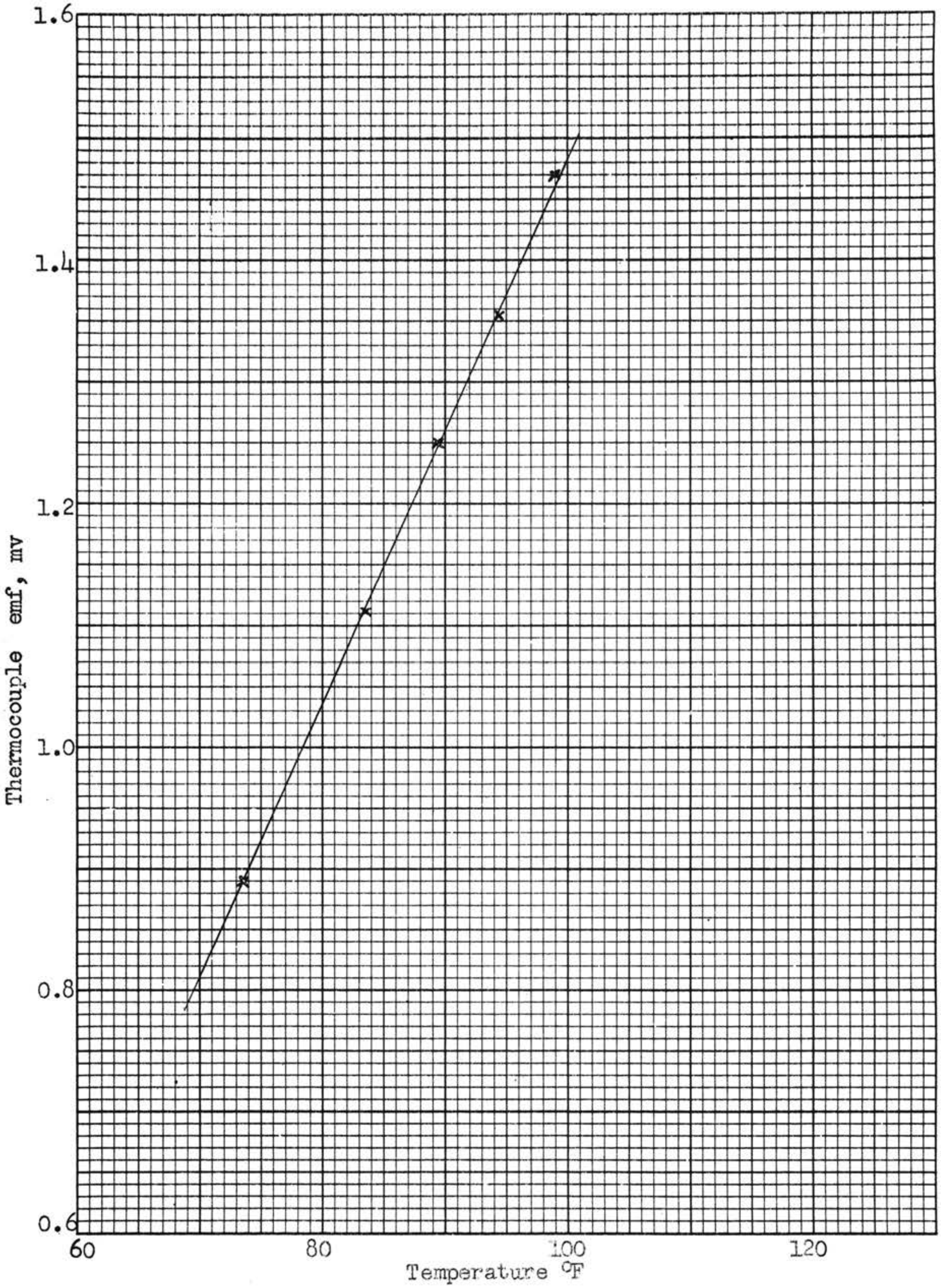

FIGURE 33

CALIBRATION CURVE INLET WATER THERMOCOUPLE

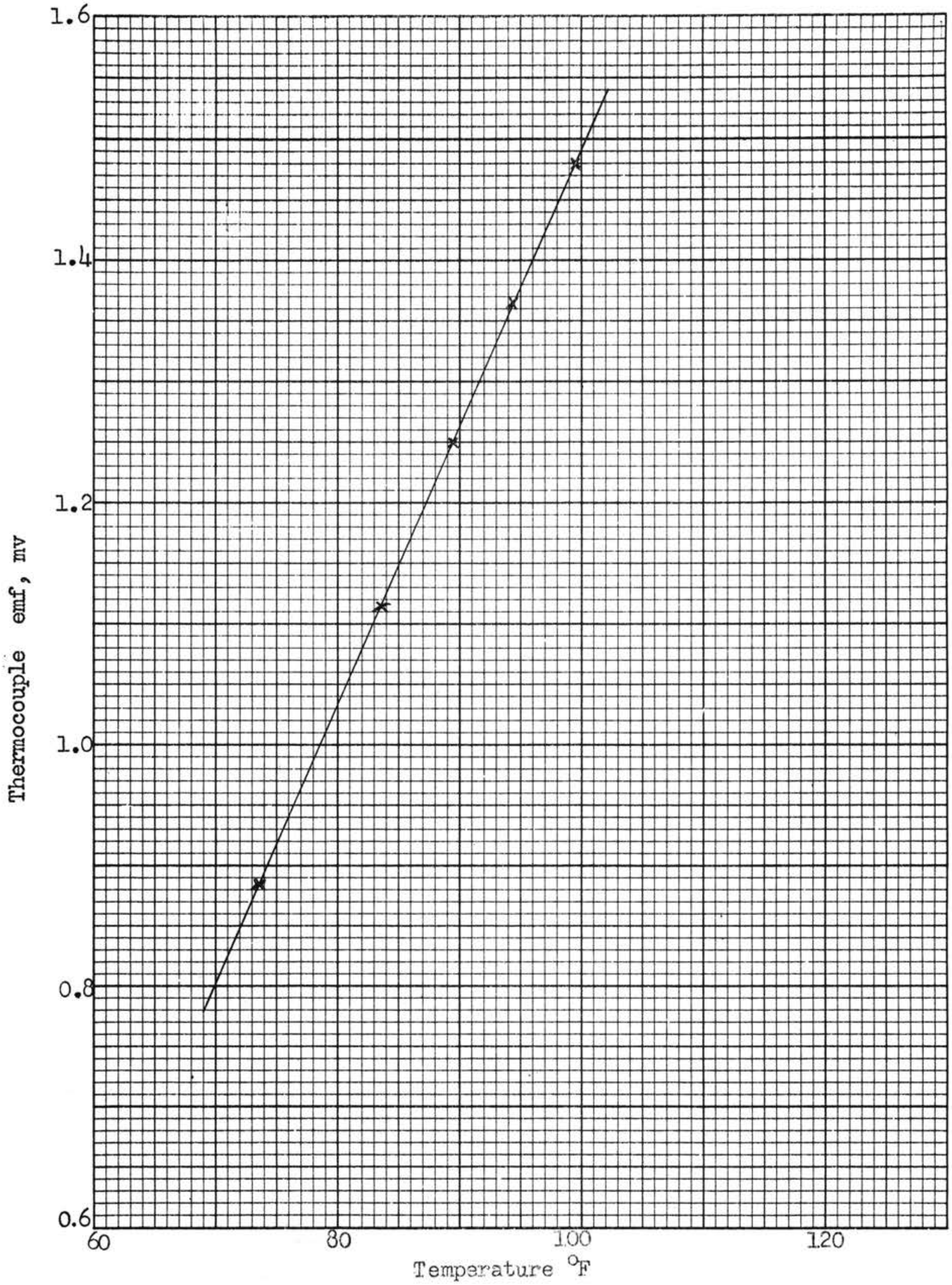

FIGURE 34

CALIBRATION CURVE OUTLET AIR THERMOCOUPLE

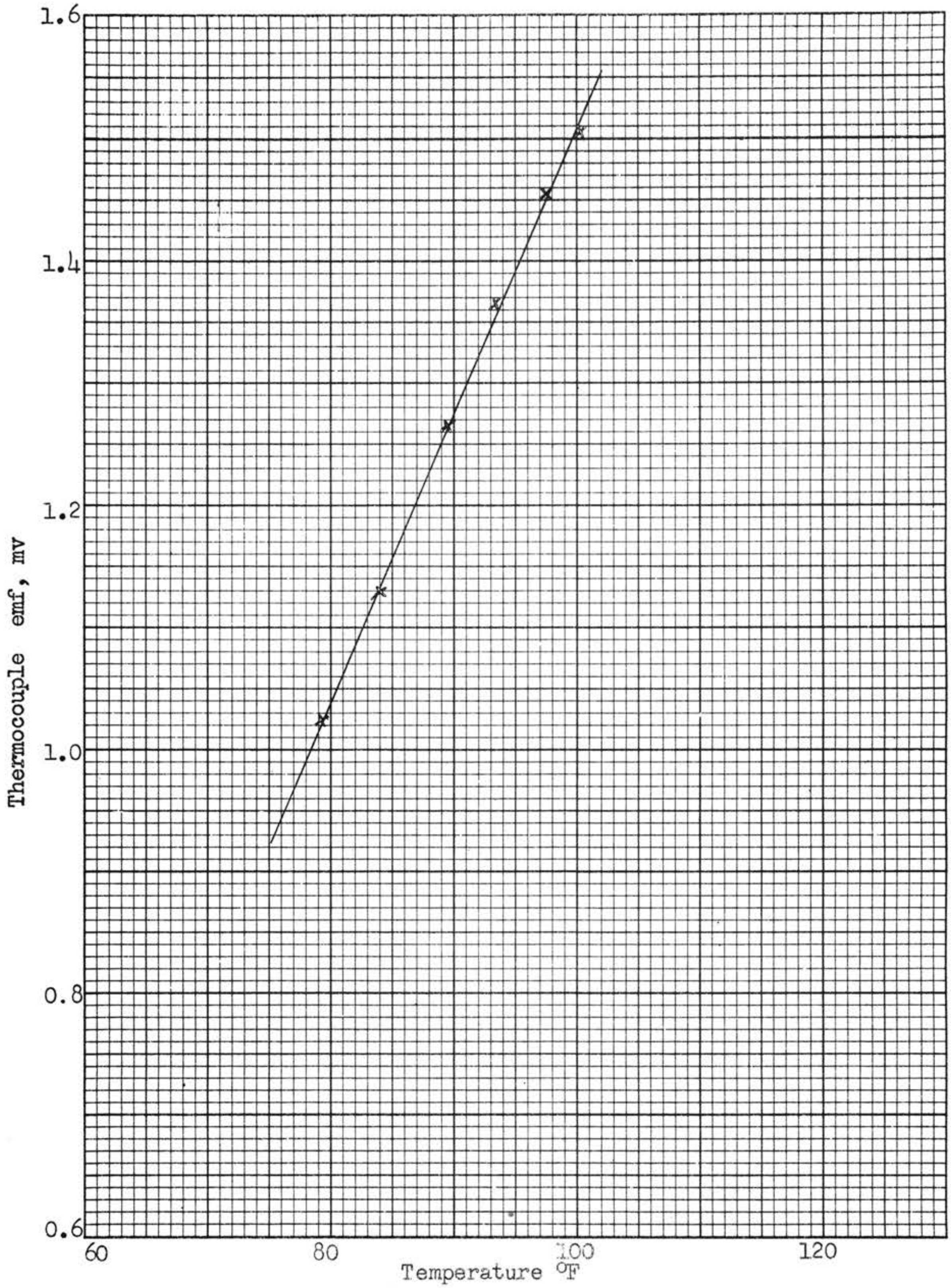

FIGURE 35

CALIBRATION CURVE OUTLET WATER THERMOCOUPLE

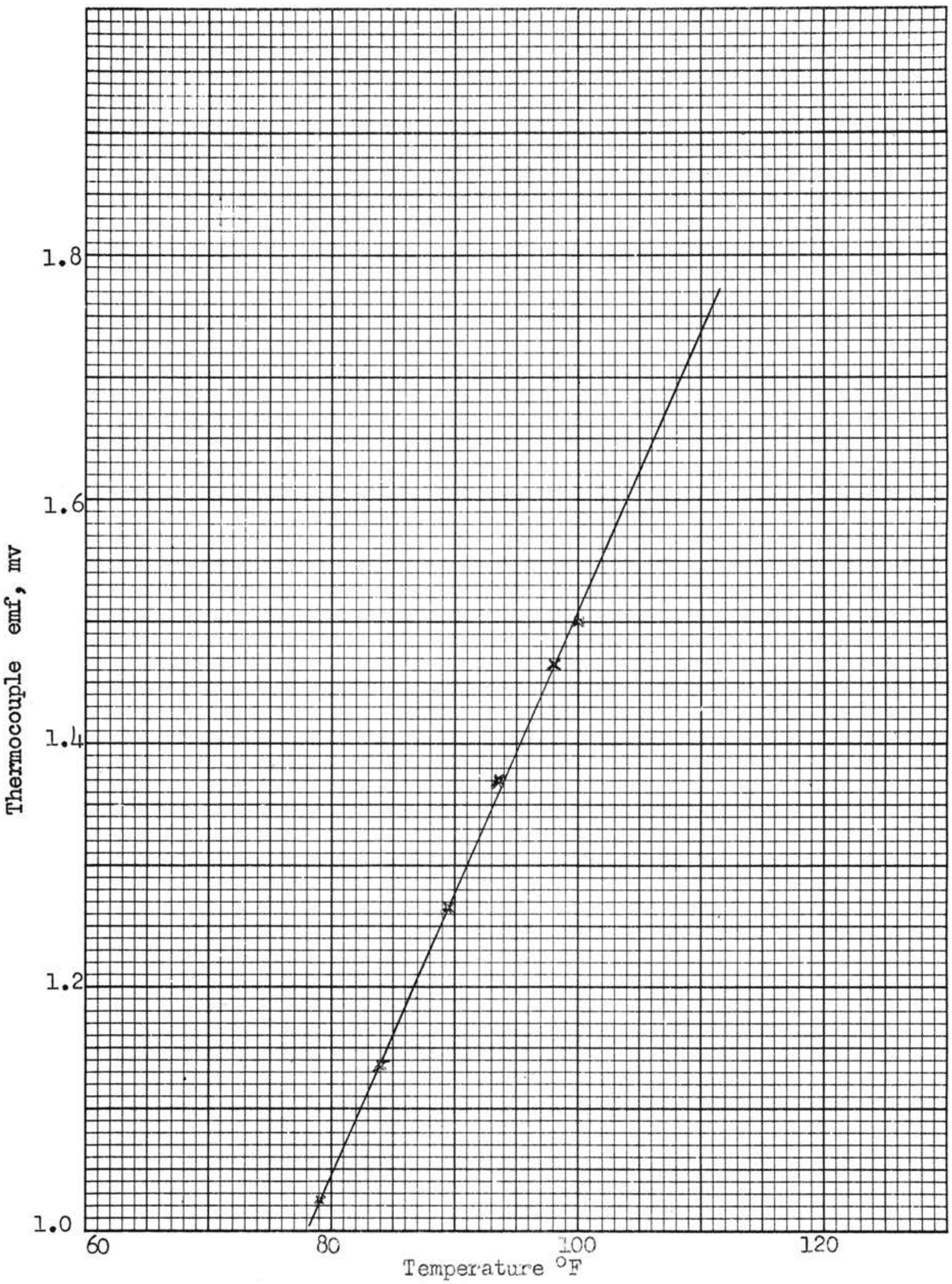

FIGURE 36

CALIBRATION CURVE INLET AIR THERMOCOUPLE

APPENDIX C

PRESSURE DROP DATA

TABLE I

DRY TRAY PRESSURE DROP

1/16" Sieve Tray

Air Rate lb/hr	Pressure Drop in water	Mass Velocity lb/ft^2-hr
2.13	0.61	24.4
2.56	0.84	29.3
3.13	1.18	35.8
3.87	1.86	44.2
4.33	2.35	49.5
4.87	2.98	55.6
5.32	3.58	60.9
5.78	4.37	66.1
6.35	5.36	73.8
6.93	6.40	79.2
7.47	7.31	85.5

TABLE II

DRY TRAY PRESSURE DROP

3/32" Sieve Tray

Air Rate lb/hr	Pressure Drop in water	Mass Velocity lb/ft^2-hr
4.75	0.85	54.4
5.40	1.07	61.7
5.80	1.26	66.4
6.57	1.75	75.1
7.30	1.96	83.5
8.12	2.43	93.
9.08	3.05	104.
10.06	3.84	115.
11.23	4.76	128.
12.26	5.75	140.
13.65	6.73	156.
14.28	7.86	163.

TABLE III

DRY TRAY PRESSURE DROP

1/8" Sieve Tray

Air Rate lb/hr	Pressure Drop in water	Mass Velocity lb/ft^2-hr
4.88	0.31	55.8
5.20	0.37	59.5
6.40	0.56	73.2
7.33	0.74	83.8
8.69	1.04	99.4
10.06	1.44	115.
11.24	1.82	129.
13.20	2.54	151.
14.80	3.33	169.
16.48	4.04	188.
18.04	4.82	206.
19.40	5.61	222.
20.64	6.28	236.

TABLE IV

DRY TRAY PRESSURE DROP

1/16" Valve Tray

Air Rate lb/hr	Pressure Drop in water	Mass Velocity lb/ft^2-hr
2.7	0.96	30.8
3.0	1.21	34.4
3.20	1.46	36.6
3.70	1.80	42.4
4.15	2.26	47.5
4.55	2.78	52.1
5.0	3.31	57.2
5.5	4.02	63.0
5.95	4.71	68.1
6.35	5.45	72.7
6.9	6.40	79.0
7.5	7.60	85.8
8.1	8.98	92.7

TABLE V

DRY TRAY PRESSURE DROP

3/32" Valve Tray

Air Rate lb/hr	Pressure Drop in water	Mass Velocity lb/ft^2-hr
1.73	0.15	19.8
1.94	0.19	22.2
2.21	0.24	25.3
2.30	0.25	26.3
2.52	0.30	28.8
2.77	0.36	31.7
2.99	0.40	34.2
3.1	0.41	35.5
3.68	0.59	41.0
3.95	0.68	45.2
4.24	0.78	48.5
4.46	0.86	51.0
4.87	1.01	55.9
5.15	1.19	59.0
5.5	1.31	63.0
5.9	1.45	67.5
5.95	1.40	68.1
8.6	2.74	98.5
10.2	4.01	117.
11.7	5.31	134.
12.7	6.28	145.
13.5	7.11	154.
14.2	8.00	163.

TABLE VI

DRY TRAY PRESSURE DROP

1/8" Valve Tray

Air Rate lb/hr	Pressure Drop in water	Mass Velocity lb/ft ^{2}-hr
3.15	0.28	36.0
4.3	0.47	49.2
5.15	0.64	59.0
5.7	0.75	65.3
5.95	0.77	67.0
7.05	0.91	80.6
8.55	1.13	97.8
9.9	1.60	113.
11.45	2.11	131.
13.35	2.88	153.
15.05	3.69	172.
16.3	4.35	186.
17.75	5.15	204.
19.15	5.93	219.
20.5	6.81	234.

TABLE VII

DRY TRAY PRESSURE DROP

Valve Plate Only

Air Rate lb/hr	Pressure Drop in water	Mass Velocity lb/ft^2-hr
2.55	0.17	29.2
4.1	0.33	46.9
5.27	0.40	60.5
6.08	0.40	69.6
7.3	0.42	83.5
7.96	0.43	91.1
9.6	0.43	110.
12.05	0.57	138.
14.25	0.8	163.
16.3	1.01	186.
17.95	1.23	205.

TABLE VII a

DRY TRAY PRESSURE DROP

Valve Plate Without Valve

Air Rate lb/hr	Pressure Drop in water	Mass Velocity lb/ft^2-hr
4.2	.08	48.0
7.5	.23	85.8
10.5	0.43	120.
13.7	0.77	157.
17.6	1.20	201.
20.45	1.62	234.

TABLE VIII

DRY TRAY PRESSURE DROP CONSTANT

1/16" Sieve Tray

Mass Velocity	ΔP	$\sqrt{\Delta P}$	k
30	.875	.936	32.0
40	1.56	1.249	32.1
50	2.45	1.565	32.0
60	3.57	1.890	31.8
70	4.84	2.20	31.8
80	6.30	2.51	31.9
90	8.00	2.83	31.8
			Ave. = 31.9

TABLE IX

DRY TRAY PRESSURE DROP CONSTANT

3/32" Sieve Tray

Mass Velocity	ΔP	$\sqrt{\Delta P}$	k
50	.71	0.84	59.4
60	1.03	1.02	59.1
70	1.40	1.18	59.4
80	1.84	1.39	59.1
90	2.32	1.52	59.2
100	2.87	1.69	59.2
125	4.48	2.12	59.0
150	6.45	2.54	59.1
			Ave. = 59.2

TABLE X

DRY TRAY PRESSURE DROP CONSTANT

1/8" Sieve Tray

Mass Velocity	ΔP	$\sqrt{\Delta P}$	k
50	.262	.511	97.8
60	.380	.615	97.6
70	.520	.720	97.2
80	.685	.826	96.8
90	.870	.931	96.7
100	1.08	1.04	96.2
125	1.72	1.31	95.5
150	2.50	1.58	95.0
200	4.48	2.12	94.5
250	7.05	2.66	94.1
			Ave. = 96.1

TABLE XI

DRY TRAY PRESSURE DROP CONSTANT

1/16" Valve Tray

Mass Velocity	ΔP	$\sqrt{\Delta P}$	k
30	.90	.948	31.6
40	1.62	1.272	31.4
50	2.54	1.592	31.4
60	3.68	1.92	31.2
70	5.00	2.24	31.2
80	6.58	2.56	31.2
90	8.30	2.88	31.2
			Ave. = 31.3

TABLE XII

DRY TRAY PRESSURE DROP CONSTANT

3/32" Valve Tray

Mass Velocity	ΔP	$\sqrt{\Delta P}$	k
80	1.86	1.362	58.6
90	2.37	1.541	58.3
100	2.94	1.712	58.3
120	4.27	2.07	58.0
140	5.84	2.42	57.8
160	7.60	2.76	58.0
			Ave. = 58.2

TABLE XIII

DRY TRAY PRESSURE DROP CONSTANT

1/8" Valve Tray

Mass Velocity	ΔP	$\sqrt{\Delta P}$	k
100	1.22	1.103	90.6
120	1.77	1.33	90.4
140	2.42	1.56	89.8
160	3.15	1.773	90.3
180	4.00	2.00	90.0
200	4.95	2.22	90.0
220	6.00	2.45	89.9
240	7.10	2.66	90.3
			Ave. = 90.2

TABLE XIV

WET TRAY PRESSURE DROP

1/16" Sieve Tray
1/2" Weir
G_L = 640 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
1.47	1.35	16.8	.27	1.89
1.78	1.56	20.4	.40	2.04
2.21	1.87	25.3	.62	2.20
2.52	2.04	28.8	.80	2.18
3.07	2.16	35.1	1.21	2.12
3.54	2.91	40.5	1.60	2.20
4.07	3.61	46.6	2.13	2.60
4.33	3.94	49.5	2.41	2.68
4.65	4.32	53.1	2.80	2.66
5.28	5.32	60.4	3.65	2.93
5.94	6.29	67.9	4.60	2.97
6.37	7.13	72.9	5.30	3.21
6.82	8.02	78.0	6.00	3.54
7.12	8.58	81.5	6.65	3.39

TABLE XV

WET TRAY PRESSURE DROP

1/16" Sieve Tray
1/2" Weir
G_L = 1150 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
1.27	1.26	14.5	.20	1.76
1.55	1.43	17.7	.30	1.88
1.75	1.53	20.0	.38	1.91
2.16	1.83	24.7	.59	2.06
2.37	1.96	27.1	.71	2.08
2.77	2.26	31.7	.97	2.14
3.60	2.98	41.1	1.66	2.20
3.94	3.39	45.0	2.00	2.32
4.28	3.84	49.0	2.36	2.46
4.75	4.47	54.4	2.92	2.58
5.38	5.40	61.5	3.72	2.80
5.90	6.20	67.5	4.50	2.83
6.48	7.23	74.1	5.48	2.92
6.98	8.32	79.9	6.30	3.36
7.16	8.72	82.0	6.65	3.45

TABLE XVI

WET TRAY PRESSURE DROP

1/16" Sieve Tray
1/2" Weir
G_L = 2210 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
1.47	1.45	16.8	.27	1.81
1.68	1.53	19.2	.35	1.81
2.06	1.78	23.6	.54	1.90
2.33	1.91	26.6	.69	1.87
2.66	2.14	30.4	.90	1.90
3.01	2.43	34.4	1.16	1.95
3.53	2.93	40.4	1.61	2.02
4.07	3.52	46.6	2.13	2.14
4.35	3.92	49.7	2.44	2.27
4.97	4.73	56.9	3.18	2.38
5.50	5.50	62.9	3.91	2.44
6.27	6.76	71.7	5.07	2.60
6.82	7.95	78.0	6.00	3.00
7.10	8.45	81.2	6.60	2.84

TABLE XVII

WET TRAY PRESSURE DROP

1/16" Sieve Tray
1" Weir
G_L = 640 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
1.30	1.69	14.9	.21	1.38
1.58	1.80	17.9	.30	1.40
1.79	1.89	20.5	.40	1.39
2.27	2.15	26.0	.65	1.40
2.69	2.47	30.8	.92	1.45
3.32	2.87	38.0	1.13	1.63
4.12	3.80	47.1	2.20	1.50
4.87	4.73	55.7	3.06	1.55
5.50	5.63	62.9	3.90	1.62
6.42	7.21	73.4	5.35	1.74
6.92	8.26	79.1	6.12	2.00

TABLE XVIII

WET TRAY PRESSURE DROP

1/16" Sieve Tray
1" Weir
G_L = 1150 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
1.33	1.78	15.3	.23	1.41
1.53	1.87	17.5	.29	1.43
1.76	1.98	20.1	.39	1.44
2.18	2.20	24.9	.60	1.45
2.67	2.50	30.6	.91	1.44
3.03	2.85	34.6	1.16	1.54
3.53	3.27	40.4	1.61	1.51
3.94	3.71	45.0	1.98	1.57
4.53	4.47	51.8	2.65	1.65
5.13	5.34	58.6	3.40	1.76
5.73	6.21	65.5	4.20	1.81
6.30	7.15	72.0	5.10	1.86
6.93	8.50	79.2	6.20	2.09

TABLE XIX

WET TRAY PRESSURE DROP

1/16" Sieve Tray
1" Weir
G_L = 2210 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
1.39	1.82	15.9	.24	1.37
1.62	1.96	18.5	.32	1.43
1.92	2.11	22.0	.47	1.43
2.31	2.35	26.4	.67	1.46
2.64	2.59	30.2	.90	1.47
3.27	3.08	37.4	1.37	1.49
3.94	3.82	45.0	1.98	1.60
4.52	4.54	51.7	2.62	1.67
4.92	5.20	56.4	3.15	1.78
5.27	5.67	60.4	3.65	1.76
5.86	6.59	67.1	4.45	1.86
6.42	7.66	73.5	5.35	2.01
6.92	8.73	79.1	6.20	2.20

TABLE XX

WET TRAY PRESSURE DROP

1/16" Sieve Tray
$1\frac{1}{2}$" Weir
G_L = 640 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
1.28	2.12	14.6	.205	1.22
1.56	2.16	17.8	.30	1.19
1.87	2.29	21.4	.44	1.19
2.15	2.37	24.6	.59	1.13
2.56	2.64	29.3	.84	1.15
3.18	3.09	36.4	1.30	1.15
3.85	3.66	44.0	1.90	1.13
4.30	4.16	49.1	2.37	1.15
4.87	4.88	55.7	3.07	1.16
5.30	5.65	60.6	3.64	1.29
5.98	6.58	68.5	4.65	1.24
6.70	8.03	76.6	5.80	1.43
7.16	8.94	82.0	6.64	1.47
7.50	9.68	85.8	7.70	1.27

TABLE XXI

WET TRAY PRESSURE DROP

1/16" Sieve Tray
$1\frac{1}{2}$" Weir
G_L = 1150 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
1.46	2.20	16.7	.27	1.21
1.84	2.34	21.0	.42	1.20
2.34	2.67	26.8	.70	1.23
2.68	2.88	30.6	.91	1.23
2.98	3.07	34.1	1.15	1.20
3.34	3.33	38.2	1.44	1.18
3.82	3.98	43.6	1.87	1.32
4.59	4.82	52.5	2.70	1.33
5.20	5.70	59.5	3.50	1.37
5.88	6.72	67.4	4.50	1.39
6.25	7.40	71.5	5.08	1.45
6.75	8.32	77.2	5.90	1.51

TABLE XXII

WET TRAY PRESSURE DROP

1/16" Sieve Tray
$1\frac{1}{2}$" Weir
G_L = 2210 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
1.12	2.28	12.8	.145	1.29
1.58	2.37	18.1	.312	1.25
1.82	2.47	20.8	.42	1.24
2.24	2.73	25.6	.64	1.27
2.73	3.08	31.2	.95	1.29
3.70	3.85	42.3	1.76	1.27
4.23	4.52	48.4	2.30	1.34
4.87	5.32	55.7	3.06	1.37
5.32	6.13	60.9	3.70	1.47
5.95	7.19	68.1	4.60	1.57
6.55	7.86	72.6	5.20	1.61
6.76	8.60	77.3	5.90	1.64

TABLE XXIII

WET TRAY PRESSURE DROP

3/32" Sieve Tray
1/2" Weir
G_L = 640 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
1.38	.90	15.8		
1.60	.95	18.3		
1.82	1.01	20.8	.12	1.56
2.12	1.06	24.2	.17	1.56
2.48	1.14	28.4	.23	1.60
3.06	1.25	35.0	.35	1.58
4.47	1.69	51.1	.74	1.67
5.05	1.91	57.8	.96	1.67
5.95	2.36	68.1	1.33	1.81
6.58	2.68	75.2	1.62	1.86
7.06	2.91	80.8	1.88	1.81
7.50	3.19	85.7	2.10	1.91
8.13	3.61	93.0	2.48	1.98
8.65	3.95	99.0	2.80	2.02
9.16	4.34	105.	3.17	2.05
9.76	4.74	112.	3.60	2.00
10.4	5.32	119.	4.05	2.22

TABLE XXIV

WET TRAY PRESSURE DROP

3/32" Sieve Tray
1/2" Weir
G_L = 1150 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
1.18	.94	13.5		
1.58	.99	18.1		
2.11	1.09	24.1	.16	1.55
2.73	1.24	31.2	.28	1.60
4.08	1.60	46.7	.62	1.63
4.70	1.84	53.7	.82	1.70
5.50	2.21	62.9	1.15	1.77
6.30	2.60	72.0	1.48	1.87
6.75	2.86	77.2	1.70	1.93
7.45	3.32	85.2	2.10	2.04
7.86	3.60	90.0	2.32	2.14
8.45	3.93	96.6	2.70	2.05
8.96	4.34	103.	3.07	2.12
9.78	4.83	112.	3.60	2.05
10.3	5.18	118.	4.02	1.93

TABLE XXV

WET TRAY PRESSURE DROP

3/32" Sieve Tray
1/2" Weir
G_L = 2210 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
1.18	.98	13.5		
1.66	1.05	19.0	.10	1.46
2.23	1.20	25.5	.18	1.57
2.50	1.24	28.6	.24	1.54
2.93	1.35	33.5	.32	1.58
4.20	1.79	48.0	.66	1.74
4.75	1.91	54.3	.84	1.64
5.37	2.18	61.5	1.08	1.69
5.90	2.43	67.5	1.31	1.72
6.48	2.73	74.1	1.58	1.77
7.00	3.01	80.0	1.84	1.80
7.53	3.35	86.0	2.20	1.77
8.03	3.84	91.8	2.50	2.06
8.46	4.10	96.8	2.70	2.15
9.16	4.53	105.	3.17	2.09
9.87	5.01	113.	3.70	2.02
10.7	5.63	122.	4.30	2.04

TABLE XXVI

WET TRAY PRESSURE DROP

3/32" Sieve Tray
1" Weir
G_L = 640 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
1.05	1.30	12.0		
1.54	1.34	17.6		
1.93	1.40	22.0	.19	1.22
2.59	1.49	29.6	.25	1.16
2.97	1.56	34.0	.33	1.15
3.78	1.69	43.2	.54	1.07
4.25	1.82	48.6	.68	1.07
4.90	2.07	56.0	.89	1.10
5.60	2.36	64.0	1.17	1.11
6.17	2.65	70.6	1.42	1.15
6.88	3.00	78.7	1.78	1.14
7.23	3.23	82.6	1.95	1.20
7.92	3.67	90.6	2.37	1.21
8.55	4.08	97.7	2.71	1.28
9.15	4.51	105.	3.15	1.27
9.90	5.02	113.	3.70	1.23
10.70	5.60	122.	4.30	1.22

TABLE XXVII

WET TRAY PRESSURE DROP

3/32" Sieve Tray
1" Weir
G_L = 1150 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
1.45	1.40	16.6		
1.91	1.44	21.8	.19	1.13
2.31	1.51	26.4	.20	1.19
2.98	1.72	34.1	.33	1.26
4.00	1.86	45.7	.60	1.15
4.78	2.06	54.7	.85	1.10
5.38	2.37	61.5	1.08	1.17
6.00	2.67	68.6	1.35	1.20
6.52	2.99	74.6	1.60	1.26
7.45	3.49	85.2	2.07	1.29
8.33	4.04	95.2	2.60	1.31
8.87	4.46	101.	2.95	1.35
9.95	5.22	114.	3.70	1.38
10.5	5.61	120.	4.14	1.34

TABLE XXVIII

WET TRAY PRESSURE DROP

3/32" Sieve Tray
1" Weir
$G_L = 2210$ lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
1.48	1.48	16.9		
2.00	1.59	22.9	.15	1.25
2.52	1.65	28.8	.24	1.23
3.17	1.79	36.2	.37	1.23
4.52	2.18	51.6	.76	1.23
5.10	2.43	58.3	.98	1.26
5.77	2.70	66.0	1.25	1.26
6.42	3.04	73.5	1.46	1.29
7.15	3.43	81.9	1.93	1.30
7.87	3.87	90.0	2.32	1.35
8.33	4.18	95.2	2.60	1.37
9.08	4.73	104.	3.10	1.42
9.57	5.07	109.	3.40	1.45
10.40	5.59	119.	4.05	1.34
10.60	5.81	121.	4.20	1.40

TABLE XXIX

WET TRAY PRESSURE DROP

3/32" Sieve Tray
$1\frac{1}{2}$" Weir
G_L = 640 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
1.37	1.83	15.7		
2.05	1.86	23.4	.155	1.07
2.55	1.89	29.2	.242	1.06
3.02	1.93	34.6	.340	1.02
3.37	1.98	38.6	.425	.99
3.90	2.09	44.6	.570	.97
4.57	2.24	52.4	.380	.93
5.12	2.47	58.6	.980	.95
5.70	2.67	65.2	1.21	.93
6.35	2.99	72.6	1.52	.98
6.97	3.32	79.7	1.83	.95
7.45	3.60	85.2	2.07	.97
8.25	4.11	94.4	2.56	.98
8.88	4.58	102.	3.00	1.01
9.48	4.94	108.	3.40	.98
9.78	5.23	112.	3.65	1.01
10.4	5.63	119.	4.05	1.01

TABLE XXX

WET TRAY PRESSURE DROP

3/32" Sieve Tray
$1\frac{1}{2}$" Weir
G_L = 1150 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
1.05	1.86	12.0		
1.64	1.88	18.8		
2.34	1.97	26.8	.21	1.10
3.76	2.19	43.0	.53	1.04
4.40	2.34	50.4	.73	1.01
5.39	2.72	61.6	1.08	1.02
6.08	3.05	69.6	1.38	1.04
6.92	3.56	79.2	1.78	1.11
7.53	3.93	86.1	2.15	1.11
8.15	4.31	93.2	2.50	1.13
8.87	4.70	101.	2.95	1.09
9.57	5.23	109.	3.40	1.14
10.4	5.77	119.	4.05	1.07

TABLE XXXI

WET TRAY PRESSURE DROP

3/32" Sieve Tray
$1\frac{1}{2}$" Weir
G_L = 2210 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
1.44	1.98	16.5		
1.87	2.04	21.4	.13	1.16
2.22	2.09	25.4	.18	1.16
2.68	2.14	30.6	.27	1.12
3.25	2.24	37.2	.40	1.11
4.25	2.48	48.6	.67	1.10
4.70	2.64	53.7	.83	1.10
5.50	2.94	62.9	1.14	1.09
6.00	3.21	68.6	1.36	1.12
6.42	3.39	73.5	1.55	1.11
6.87	3.70	78.5	1.77	1.17
7.66	4.17	87.6	2.20	1.19
8.15	4.47	93.1	2.48	1.21
8.75	4.88	100.	2.77	1.28
9.16	5.10	105.	3.17	1.17
9.77	5.59	112.	3.60	1.21
10.18	5.81	116.	3.90	1.16

TABLE XXXII

WET TRAY PRESSURE DROP

1/8" Sieve Tray
1/2" Weir
G_L = 640 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
3.95	.97	45.2	.21	1.33
4.98	1.14	57.0	.34	1.40
5.50	1.17	62.9	.42	1.32
5.95	1.24	68.1	.49	1.32
6.57	1.37	75.3	.60	1.35
7.10	1.46	81.2	.71	1.32
8.25	1.71	94.4	.96	1.32
9.48	2.01	108.	1.28	1.28
9.90	2.19	125.	1.40	1.39
10.70	2.30	134.	1.65	1.14
11.30	2.39	141.	1.83	.97
13.27	3.04	152.	2.55	.86
13.95	3.25	160.	2.84	.72
14.90	3.59	170.	3.22	.65
15.79	3.93	180.	3.62	.55
17.13	4.42	196.	4.30	.21

TABLE XXXIII

WET TRAY PRESSURE DROP

1/8" Sieve Tray
1/2" Weir
G_L = 1150 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
4.48	1.09	51.3	.28	1.35
5.08	1.15	58.1	.36	1.31
5.55	1.22	63.5	.43	1.31
6.12	1.31	70.0	.52	1.31
6.57	1.40	75.2	.60	1.33
7.15	1.52	81.8	.72	1.33
7.85	1.68	89.8	.87	1.35
8.75	1.93	100.	1.08	1.42
10.1	2.21	115.	1.45	1.27
11.68	2.68	133.	1.95	1.22
12.72	2.98	146.	2.38	1.00
14.08	3.39	161.	2.90	.82
15.20	3.74	174.	3.38	.60
16.22	4.12	186.	3.90	.37
17.96	4.76	205.	4.70	.10

TABLE XXXIV

WET TRAY PRESSURE DROP

1/8" Sieve Tray
1/2" Weir
G_L = 2210 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
4.80	1.21	55.0	.32	1.37
5.10	1.26	58.4	.36	1.38
5.45	1.31	62.4	.41	1.38
5.93	1.40	67.8	.49	1.40
6.52	1.48	74.6	.60	1.35
7.16	1.62	82.0	.72	1.38
7.85	1.82	89.8	.87	1.46
8.95	2.08	102.	1.14	1.45
9.77	2.29	112.	1.37	1.41
10.60	2.53	121.	1.60	1.43
11.62	2.84	133.	1.95	1.37
13.06	3.29	149.	2.45	1.29
13.84	3.49	159.	2.80	1.06
14.75	3.81	169.	3.20	1.02
15.67	4.16	179.	3.57	.91
16.93	4.62	194.	4.20	.65
17.72	4.83	203.	4.65	.28

TABLE XXXV

WET TRAY PRESSURE DROP

1/8" Sieve Tray
1" Weir
$G_L = 640$ lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
2.56	1.20	29.3		
3.27	1.20	37.4	.14	.99
3.93	1.24	45.0	.21	.96
4.32	1.26	49.4	.25	.94
5.10	1.33	58.4	.36	.91
5.85	1.41	66.9	.48	.87
6.48	1.49	74.1	.58	.85
7.22	1.63	82.6	.73	.84
7.73	1.76	88.4	.84	.86
8.22	1.86	94.0	.95	.85
8.87	2.00	102.	1.14	.80
9.48	2.14	108.	1.28	.80
10.3	2.37	118.	1.53	.79
11.10	2.59	127.	1.77	.77
12.12	2.90	139.	2.13	.72
12.78	3.04	146.	2.37	.63
13.93	3.46	159.	2.80	.62
14.67	3.69	168.	3.15	.51
15.47	3.97	177.	3.55	.39
16.21	4.21	185.	3.84	.35
17.61	4.74	202.	4.60	.13

TABLE XXXVI

WET TRAY PRESSURE DROP

1/8" Sieve Tray
1" Weir
G_L = 1150 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
4.40	1.36	50.3	.27	.99
5.10	1.43	58.4	.36	.97
5.76	1.50	66.0	.46	.95
6.88	1.68	78.6	.66	.93
7.93	1.94	90.6	.89	.95
8.67	2.12	99.1	1.06	.96
9.48	2.35	108.	1.28	.97
10.50	2.60	120.	1.57	.94
11.62	2.94	133.	1.95	.90
12.55	3.22	143.	2.28	.86
13.73	3.61	157.	2.75	.78
15.98	4.31	183.	3.75	.58
17.01	4.71	195.	4.27	.40
17.92	5.06	205.	4.72	.31
18.83	5.43	215.	5.20	.21
19.91	5.85	228.	5.85	.00

TABLE XXXVII

WET TRAY PRESSURE DROP

1/8" Sieve Tray
1" Weir
G_L = 2210 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
3.42	1.43	39.2	.16	1.10
4.40	1.54	50.4	.27	1.10
5.33	1.67	61.0	.39	1.11
6.00	1.81	68.6	.50	1.14
6.71	1.94	76.9	.64	1.13
7.22	2.04	82.6	.74	1.13
7.53	2.15	86.1	.80	1.17
8.36	2.34	95.6	.98	1.18
9.16	2.56	105.	1.20	1.18
10.18	2.84	116.	1.41	1.24
11.00	3.08	126.	1.75	1.16
11.83	3.64	135.	2.00	1.43
13.64	3.78	156.	2.70	.94
14.87	4.22	170.	3.23	.86
15.78	4.67	180.	3.62	.91
16.58	4.92	190.	4.04	.76
17.64	5.30	202.	4.60	.61
18.56	5.67	212.	5.00	.58

TABLE XXXVIII

WET TRAY PRESSURE DROP

1/8" Sieve Tray
$1\frac{1}{2}$" Weir
$G_L = 640$ lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
2.85	1.66	32.6	.11	.99
4.00	1.70	45.7	.22	.95
4.68	1.72	53.5	.30	.91
5.20	1.74	59.5	.37	.87
5.72	1.77	65.5	.46	.84
6.30	1.80	72.1	.55	.80
6.93	1.90	79.3	.68	.78
7.22	1.98	82.6	.74	.79
8.55	2.20	97.8	1.02	.75
9.36	2.39	107.	1.25	.73
10.30	2.63	118.	1.53	.70
11.10	2.83	127.	1.78	.67
12.24	3.17	140.	2.17	.64
13.64	3.61	156.	2.70	.58
15.08	3.94	172.	3.30	.41
16.00	4.41	183.	3.80	.39
16.86	4.72	193.	4.20	.33
17.79	5.12	203.	4.75	.24
19.01	5.61	218.	5.40	.13

TABLE XXXIX

WET TRAY PRESSURE DROP

1/8" Sieve Tray
$1\frac{1}{2}$" Weir
G_L = 1150 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
4.05	1.81	46.3	.23	1.00
4.92	1.84	56.2	.33	.96
5.50	1.88	62.9	.42	.93
6.07	1.97	69.5	.51	.93
6.42	2.00	73.4	.57	.91
6.86	2.05	78.6	.66	.89
7.23	2.14	82.6	.73	.90
8.03	2.27	91.7	.92	.86
8.55	2.41	97.6	1.02	.87
9.90	2.71	113.	1.40	.83
11.00	3.00	126.	1.75	.80
12.85	3.58	147.	2.40	.75
13.77	3.81	157.	2.75	.68
14.65	4.10	167.	3.15	.61
15.47	4.43	177.	3.50	.59
16.78	4.88	192.	4.15	.46
17.76	5.28	203.	4.65	.40
18.75	5.56	214.	5.15	.26

TABLE XL

WET TRAY PRESSURE DROP

1/8" Sieve Tray
$1\frac{1}{2}$" Weir
G_L = 2210 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
3.13	1.99	35.8	.13	1.13
4.40	2.02	45.7	.22	1.09
4.97	2.06	56.9	.34	1.04
5.38	2.13	61.6	.40	1.05
5.92	2.20	67.8	.49	1.04
6.92	2.39	79.1	.67	1.04
7.35	2.51	84.1	.76	1.06
8.55	2.76	97.8	1.03	1.05
9.75	3.01	111.	1.35	1.01
10.70	3.30	122.	1.65	1.00
12.12	3.70	139.	2.13	.95
12.73	3.89	146.	2.36	.92
14.04	4.33	161.	2.90	.86
14.96	4.67	171.	3.30	.83
16.16	5.04	185.	3.83	.73
16.69	5.25	191.	4.10	.70
18.16	5.86	208.	4.85	.61
19.05	6.15	218.	5.40	.45

TABLE XLI

WET TRAY PRESSURE DROP

1/16" Valve Tray
1/2" Weir
G_L = 640 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
1.24	1.34	14.2	.20	2.00
1.77	1.68	20.2	.40	2.24
2.15	1.98	24.6	.61	2.30
2.55	2.33	29.2	.86	2.58
3.30	2.93	37.8	1.43	2.63
3.90	3.51	44.6	2.00	2.65
4.26	4.13	48.8	2.40	3.01
5.13	5.03	58.6	3.50	2.69
5.70	5.95	65.2	4.31	2.88
6.35	6.96	72.6	5.40	2.74
7.00	8.09	80.1	6.60	2.62

TABLE XLII

WET TRAY PRESSURE DROP

1/16" Valve Tray
1/2" Weir
G_L = 1150 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
1.35	1.51	15.4	.22	2.14
1.76	1.81	20.2	.40	2.24
2.07	2.03	23.7	.56	2.45
2.50	2.32	28.6	.82	2.50
3.27	2.92	37.4	1.41	2.51
3.83	3.96	43.8	1.95	2.51
4.47	4.22	51.2	2.65	2.62
5.03	4.96	57.5	3.35	2.68
5.55	5.74	63.5	4.10	2.73
6.20	6.69	71.0	5.15	2.56
6.75	7.75	77.2	6.05	2.83

TABLE XLIII

WET TRAY PRESSURE DROP

1/16" Valve Tray
1/2" Weir
G_L = 2210 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
1.50	1.69	17.2	.29	2.15
1.91	2.01	21.8	.47	2.37
2.20	2.19	25.2	.63	2.40
2.72	2.59	31.2	.98	2.48
3.35	3.14	38.4	1.48	2.55
4.20	3.92	48.1	2.35	2.42
4.75	4.71	54.4	3.00	2.63
5.30	5.47	60.6	3.75	2.64
6.00	6.48	68.6	4.80	2.58
6.90	7.99	79.0	6.35	2.52

TABLE XLIV

WET TRAY PRESSURE DROP

1/16" Valve Tray
1" Weir
G_L = 640 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
1.24	1.55	14.2	.20	1.26
1.75	1.93	20.0	.40	1.43
2.07	2.13	23.6	.55	1.48
2.32	2.29	26.6	.74	1.45
2.90	2.87	33.2	1.12	1.64
3.50	3.41	40.0	1.61	1.68
4.40	4.39	50.5	2.60	1.67
5.50	5.78	63.0	4.00	1.66
6.25	6.89	71.5	5.20	1.53
6.80	7.78	77.8	6.25	1.43

TABLE XLV

WET TRAY PRESSURE DROP

1/16" Valve Tray
1" Weir
G_L = 1150 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
1.60	1.95	18.3	.33	1.47
2.05	2.24	23.5	.55	1.54
2.30	2.51	26.3	.69	1.65
3.00	3.05	34.3	1.18	1.70
3.65	3.63	41.7	1.75	1.71
4.40	4.45	50.9	2.60	1.68
5.00	5.19	57.2	3.37	1.65
5.90	6.49	67.5	4.65	1.67
6.75	7.88	77.2	6.03	1.68

TABLE XLVI

WET TRAY PRESSURE DROP

1/16" Valve Tray
1" Weir
G_L = 2210 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
2.00	2.28	22.9	.50	1.55
2.45	2.60	28.0	.79	1.57
3.00	3.17	34.3	1.18	1.73
3.85	3.95	44.0	1.96	1.73
4.50	4.73	51.5	2.70	1.77
5.10	5.52	57.4	3.35	1.89
5.85	6.66	68.1	4.73	1.68
6.60	7.81	75.5	5.80	1.75

TABLE XLVII

WET TRAY PRESSURE DROP

1/16" Valve Tray
$1\frac{1}{2}$" Weir
G_L = 640 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
1.24	2.18	14.2	.20	1.26
1.75	2.33	20.0	.40	1.23
2.20	2.60	25.2	.63	1.25
2.80	3.07	32.0	1.03	1.30
3.60	3.81	41.1	1.71	1.34
4.35	4.52	49.8	2.50	1.29
5.10	5.51	58.4	3.48	1.29
5.95	6.70	68.1	4.75	1.24
6.85	7.82	78.4	6.30	.97

TABLE XLVIII

WET TRAY PRESSURE DROP

1/16" Valve Tray
$1\frac{1}{2}$" Weir
G_L = 1150 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
1.43	2.35	16.4	.26	1.31
1.96	2.62	22.4	.50	1.32
2.33	2.86	26.6	.71	1.34
2.85	3.32	32.6	1.08	1.40
3.70	4.01	42.4	1.82	1.37
4.48	4.77	51.3	2.70	1.29
5.00	5.52	57.2	3.35	1.36
5.70	6.54	65.2	4.35	1.37
6.60	7.98	75.5	5.80	1.36

TABLE XLIX

WET TRAY PRESSURE DROP

1/16" Valve Tray
$1\frac{1}{2}$" Weir
G_L = 2210 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
2.10	2.70	24.0	.57	1.29
2.60	3.04	29.8	.89	1.30
3.40	3.70	38.9	1.51	1.33
4.10	4.60	46.9	2.25	1.42
4.75	5.49	54.4	3.05	1.48
5.55	6.52	63.5	4.12	1.46
6.60	8.23	75.5	5.80	1.47

TABLE L

WET TRAY PRESSURE DROP

3/32" Valve Tray
1/2" Weir
G_L = 640 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
1.95	1.22	22.3	.19	1.81
3.33	1.63	37.8	.49	2.00
4.33	1.97	49.6	.81	2.03
5.20	2.36	59.5	1.14	2.14
5.53	2.57	62.2	1.26	2.30
6.03	2.95	69.3	1.42	2.68
6.72	3.41	72.0	1.71	2.98
7.35	3.81	84.1	2.05	3.08
7.86	4.29	90.0	2.37	3.36
8.45	4.77	96.7	2.75	3.54
9.08	5.27	104.	3.20	3.63
9.78	5.94	112.	3.70	3.93
10.6	6.81	121.	4.30	4.40
11.0	7.27	126.	4.70	4.50

TABLE LI

WET TRAY PRESSURE DROP

3/32" Valve Tray
1/2" Weir
G_L = 1150 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
2.68	1.48	30.6	.34	1.90
3.95	1.95	45.1	.69	2.10
4.25	2.32	54.4	.84	2.46
5.70	2.65	65.2	1.21	2.40
5.82	2.83	66.6	1.27	2.60
6.32	3.21	72.3	1.52	2.82
7.23	3.80	82.7	1.97	3.04
8.03	4.42	91.8	2.45	3.28
8.46	4.80	96.8	2.75	3.42
9.17	5.42	105.	3.23	3.65
9.78	5.96	112.	3.70	3.76
10.18	6.36	116.	4.00	3.93
10.50	6.73	120.	4.24	4.15
11.0	7.34	126.	4.70	4.40
11.41	7.64	131.	5.10	4.23
11.83	8.09	135.	5.38	4.51

TABLE LII

WET TRAY PRESSURE DROP

3/32" Valve Tray
1/2" Weir
G_L = 2210 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
2.22	1.44	25.4	.24	1.85
3.67	1.96	42.0	.60	2.09
4.65	2.27	53.2	.92	2.08
5.67	2.77	65.0	1.30	2.26
6.33	3.31	72.5	1.52	2.75
7.13	3.85	81.6	1.93	2.95
8.04	4.61	92.0	2.47	3.29
8.87	5.32	101.	3.00	3.57
9.35	5.76	107.	3.40	3.63
10.18	6.54	116.	4.00	3.90
11.0	7.33	126.	4.70	4.05
11.52	7.95	132.	5.20	4.23
12.04	8.51	138.	5.70	4.32

TABLE LIII

WET TRAY PRESSURE DROP

3/32" Valve Tray
1" Weir
G_L = 640 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
1.85	1.68	21.1	.17	1.41
2.94	1.87	33.6	.40	1.37
3.95	2.21	45.1	.69	1.42
4.97	2.46	56.8	1.03	1.34
5.85	2.86	67.0	1.37	1.39
6.44	3.38	73.6	1.55	1.71
7.02	3.73	80.3	1.89	1.72
7.86	4.34	90.0	2.37	1.84
8.35	4.72	95.5	2.67	1.92
8.88	5.13	102.	3.10	1.90
9.68	5.87	111.	3.63	2.00
10.30	6.47	118.	4.13	2.19
11.10	7.14	127.	4.80	2.19
11.52	7.62	133.	5.30	2.17

TABLE LIV

WET TRAY PRESSURE DROP

3/32" Valve Tray
1" Weir
$G_L \approx 1150$ lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
2.27	1.88	26.0	.25	1.48
3.60	2.22	41.1	.58	1.49
3.84	2.31	43.9	.65	1.51
4.58	2.54	52.4	.90	1.49
5.72	2.99	65.5	1.32	1.52
6.42	3.35	73.5	1.55	1.64
6.62	3.53	75.6	1.65	1.71
7.73	4.39	88.4	2.30	1.90
8.55	5.04	97.8	2.82	2.02
9.07	5.51	104.	3.20	2.10
9.68	6.00	111.	3.63	2.16
10.18	6.48	116.	4.00	2.26
10.80	7.06	123.	4.50	2.33
11.30	7.60	129.	4.90	2.46

TABLE LV

WET TRAY PRESSURE DROP

3/32" Valve Tray
1" Weir
G_L = 2210 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
2.00	1.77	22.9	.20	1.37
2.73	1.97	31.2	.35	1.42
3.67	2.30	42.0	.60	1.48
4.70	2.48	53.7	.94	1.34
5.55	2.94	63.5	1.27	1.45
6.26	3.39	71.6	1.50	1.64
6.92	3.95	79.1	1.80	1.87
7.63	4.45	87.2	2.20	1.96
8.03	4.78	91.8	2.45	2.03
8.75	5.32	100.	2.93	2.08
9.16	5.75	105.	3.23	2.19
10.18	6.56	116.	4.00	2.22
10.80	7.18	123.	4.50	2.33
11.30	7.68	129.	4.90	2.42

TABLE LVI

WET TRAY PRESSURE DROP

3/32" Valve Tray
$1\frac{1}{2}$" Weir
G_L = 640 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
2.00	1.97	22.9	.20	1.13
2.87	2.12	32.8	.37	1.11
3.53	2.26	40.4	.56	1.08
4.64	2.65	53.1	.92	1.10
4.82	2.81	55.1	.99	1.16
6.12	3.37	70.1	1.46	1.22
6.72	3.73	77.0	1.72	1.28
7.03	4.08	80.5	1.90	1.39
7.93	4.54	90.7	2.42	1.35
8.56	5.07	98.0	2.82	1.43
9.18	5.57	105.	3.23	1.49
9.78	6.12	112.	3.70	1.54
10.40	6.71	119.	4.15	1.55
11.10	7.40	127.	4.80	1.66
11.92	8.32	136.	5.60	1.73
12.55	8.91	144.	6.20	1.73

TABLE LVII

WET TRAY PRESSURE DROP

3/32" Valve Tray
$1\frac{1}{2}$" Weir
G_L = 1150 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
2.06	2.12	23.6	.21	1.19
3.07	2.39	35.2	.44	1.22
3.72	2.54	42.5	.62	1.20
4.92	2.87	56.3	1.02	1.16
6.30	3.43	72.1	1.51	1.20
6.82	3.93	78.0	1.76	1.36
7.44	4.36	85.0	2.10	1.41
8.15	4.89	93.3	2.55	1.46
8.76	5.34	100.	2.93	1.51
9.47	5.99	108.	3.45	1.59
9.98	6.50	114.	3.85	1.66
10.60	7.06	121.	4.35	1.69
11.40	7.81	130.	5.00	1.75
11.92	8.36	136.	5.50	1.79

TABLE LVIII

WET TRAY PRESSURE DROP

3/32" Valve Tray
$1\frac{1}{2}$" Weir
G_L = 2210 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
2.16	2.20	24.7	.23	1.19
2.90	2.36	33.2	.39	1.19
3.53	2.56	40.4	.56	1.21
4.92	3.10	56.3	1.02	1.26
5.95	3.60	68.1	1.41	1.33
6.84	4.17	78.3	1.79	1.44
7.93	4.96	90.8	2.42	1.54
8.75	5.64	100.	2.93	1.54
9.35	6.12	107.	3.33	1.69
9.78	6.54	112.	3.70	1.72
10.40	7.15	119.	4.20	1.79
10.90	7.55	124.	4.60	1.79
11.42	8.12	131.	5.10	1.83

TABLE LIX

WET TRAY PRESSURE DROP

1/8" Valve Tray
1/2" Weir
G_L = 640 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
2.50	1.34	28.6	.19	2.02
3.68	1.52	42.1	.36	2.03
4.28	1.57	49.0	.47	1.93
5.03	1.63	57.5	.62	1.77
5.38	1.67	61.6	.69	1.72
6.43	1.75	73.5	.83	1.61
6.82	1.80	78.1	.88	1.61
7.40	1.91	84.6	.94	1.70
7.52	1.98	86.1	.96	1.79
8.55	2.22	97.8	1.17	1.84
9.68	2.63	111.	1.52	1.95
10.60	2.99	121.	1.80	2.08
11.30	3.30	129.	2.05	2.19
12.53	3.75	143.	2.52	2.16
13.26	3.96	152.	2.85	1.95
14.15	4.31	162.	3.24	1.88
15.05	4.72	172.	3.65	1.88
16.28	5.27	186.	4.30	1.81
16.90	5.68	193.	4.60	1.89
17.81	6.31	204.	5.10	2.12
18.54	6.64	212.	5.55	1.91

TABLE LX

WET TRAY PRESSURE DROP

1/8" Valve Tray
1/2" Weir
G_L = 1150 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
2.46	1.21	28.2	.18	1.72
4.07	1.53	46.6	.43	1.83
5.84	1.65	66.8	.76	1.48
7.13	2.01	81.6	.90	1.85
8.24	2.36	94.2	1.09	2.12
9.16	2.71	105.	1.35	2.26
10.40	3.17	119.	1.71	2.43
11.62	3.58	133.	2.15	2.38
12.34	3.93	141.	2.45	2.46
13.16	4.31	150.	2.76	2.58
14.24	4.79	163.	3.25	2.56
15.05	5.13	172.	3.65	2.46
15.78	5.55	180.	4.00	2.56
16.61	5.92	190.	4.44	2.46
17.31	6.33	198.	4.80	2.54
18.12	6.75	208.	5.30	2.41

TABLE LXI

WET TRAY PRESSURE DROP

1/8" Valve Tray
1/2" Weir
G_L = 2210 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
2.57	1.15	29.4	.19	1.48
3.67	1.36	42.0	.36	1.54
6.22	1.77	71.2	.81	1.48
6.82	1.95	78.0	.87	1.66
8.23	2.37	94.1	1.09	1.97
9.35	2.77	107.	1.40	2.10
10.30	3.08	118.	1.70	2.12
10.96	3.39	125.	1.92	2.26
12.04	3.82	138.	2.35	2.26
13.15	4.36	150.	2.77	2.44
14.76	5.14	169.	3.50	2.52
15.88	5.64	182.	4.10	2.36
16.83	6.12	193.	4.60	2.34
17.72	6.54	203.	5.05	2.39
18.76	7.10	214.	5.60	2.30

TABLE LXII

WET TRAY PRESSURE DROP

1/8" Valve Tray
1" Weir
G_L = 640 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
2.00	1.46	22.9		
2.76	1.60	31.6	.22	1.29
3.72	1.54	42.5	.36	1.11
4.47	1.65	51.2	.51	1.07
5.03	1.80	57.5	.62	1.10
5.35	1.88	61.2	.69	1.11
7.23	2.05	82.7	.91	1.07
8.20	2.38	93.8	1.07	1.23
9.48	2.80	109.	1.32	1.38
10.90	3.34	125.	1.92	1.33
11.84	3.77	135.	2.25	1.42
13.34	4.42	153.	2.90	1.42
14.67	4.89	168.	3.50	1.30
16.34	5.68	187.	4.40	1.38
17.22	6.14	197.	4.80	1.25
18.00	6.53	206.	5.25	1.20
19.44	7.40	222.	6.10	1.22

TABLE LXIII

WET TRAY PRESSURE DROP

1/8" Valve Tray
1" Weir
G_L = 1150 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
2.95	1.73	33.7	.24	1.36
3.88	1.65	44.4	.39	1.15
4.33	1.74	49.5	.48	1.15
5.93	1.95	67.8	.78	1.06
7.02	2.16	80.4	.89	1.15
8.23	2.53	94.1	1.07	1.33
9.18	2.85	105.	1.35	1.36
10.90	3.20	115.	1.62	1.44
11.10	3.63	127.	2.00	1.48
11.95	3.96	137.	2.32	1.49
12.55	4.25	144.	2.56	1.54
13.45	4.58	154.	2.92	1.51
14.47	5.06	165.	3.36	1.55
15.62	5.53	179.	3.93	1.46
16.62	5.96	190.	4.46	1.36
17.54	6.52	200.	4.95	1.34
18.35	6.92	210.	5.44	1.35
19.17	7.40	219.	5.92	1.35

TABLE LXIV

WET TRAY PRESSURE DROP

1/8" Valve Tray
1" Weir
G_L = 2210 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
2.90	1.79	33.2	.24	1.35
3.32	1.82	38.0	.30	1.32
3.67	1.84	42.0	.36	1.29
4.00	1.93	45.7	.41	1.32
4.67	2.00	53.5	.54	1.27
6.22	2.20	71.2	.81	1.21
6.83	2.28	78.1	.87	1.23
7.35	2.41	84.1	.93	1.29
7.95	2.61	91.0	1.02	1.38
8.87	2.97	101.	1.25	1.49
9.48	3.12	108.	1.44	1.46
10.18	3.38	111.	1.51	1.63
10.80	3.61	123.	1.87	1.51
11.42	3.80	131.	2.10	1.48
12.04	4.12	138.	2.35	1.54
13.14	4.62	150.	2.78	1.60
14.28	5.13	163.	3.26	1.63
15.28	5.59	175.	3.80	1.56
16.82	6.32	193.	4.60	1.50
18.04	7.05	206.	5.27	1.55
18.44	7.30	211.	5.50	1.56

TABLE LXV

WET TRAY PRESSURE DROP

1/8" Valve Tray
$1\frac{1}{2}$" Weir
G_L = 640 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
2.68	2.29	30.6	.21	1.33
3.43	2.34	39.2	.32	1.29
4.47	2.50	51.1	.50	1.28
6.12	2.61	70.0	.80	1.15
6.62	2.74	75.7	.85	1.21
7.35	2.91	84.1	.93	1.26
7.93	3.08	90.6	1.01	1.32
8.35	3.18	95.5	1.11	1.32
9.07	3.35	104.	1.32	1.30
9.68	3.60	111.	1.52	1.33
10.50	3.85	120.	1.78	1.32
10.80	3.93	123.	1.85	1.33
11.82	4.45	135.	2.24	1.42
12.84	4.70	147.	2.65	1.31
14.05	5.26	161.	3.20	1.31
14.89	5.66	170.	3.57	1.33
15.57	6.47	178.	3.91	1.63
17.22	6.85	197.	4.80	1.31
17.91	7.29	205.	5.20	1.33
18.63	7.66	213.	5.60	1.31
19.95	8.44	228.	6.40	1.30

TABLE LXVI

WET TRAY PRESSURE DROP

1/8" Valve Tray
$1\frac{1}{2}$" Weir
G_L = 1150 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
1.92	2.39	22.0		
3.10	2.42	35.4	.26	1.35
4.64	2.65	53.0	.53	1.33
5.52	2.88	63.2	.71	1.36
7.12	2.90	81.5	.90	1.25
8.96	3.41	103.	1.30	1.32
10.20	3.81	117.	1.69	1.32
11.10	4.09	127.	2.00	1.31
11.84	4.42	135.	2.24	1.36
13.14	4.90	150.	2.77	1.33
14.06	5.36	161.	3.20	1.35
15.11	5.82	173.	3.70	1.33
16.37	6.47	187.	4.40	1.29
17.34	6.90	198.	4.90	1.25
18.42	7.59	211.	5.50	1.31
19.03	8.00	218.	5.90	1.31

TABLE LXVII

WET TRAY PRESSURE DROP

1/8" Valve Tray
$1\frac{1}{2}$" Weir
G_L = 2210 lbs/hr-ft^2

Air Rate	Pressure Drop	Mass Velocity	Dry Tray Pressure Drop	Aeration Factor
2.10	2.15	24.0		
2.63	2.42	30.1	.20	1.35
3.72	2.65	42.6	.37	1.38
5.35	2.83	61.2	.68	1.30
7.52	2.92	86.0	.95	1.19
9.58	3.40	110.	1.48	1.16
10.80	3.90	123.	1.87	1.25
12.35	4.54	141.	2.46	1.26
13.85	5.08	158.	3.10	1.20
14.98	5.93	171.	3.62	1.40
16.10	6.46	184.	4.20	1.37
16.71	6.62	191.	4.50	1.29
17.72	7.31	203.	5.10	1.34
18.53	7.96	212.	5.52	1.48

APPENDIX D

EFFICIENCY DATA

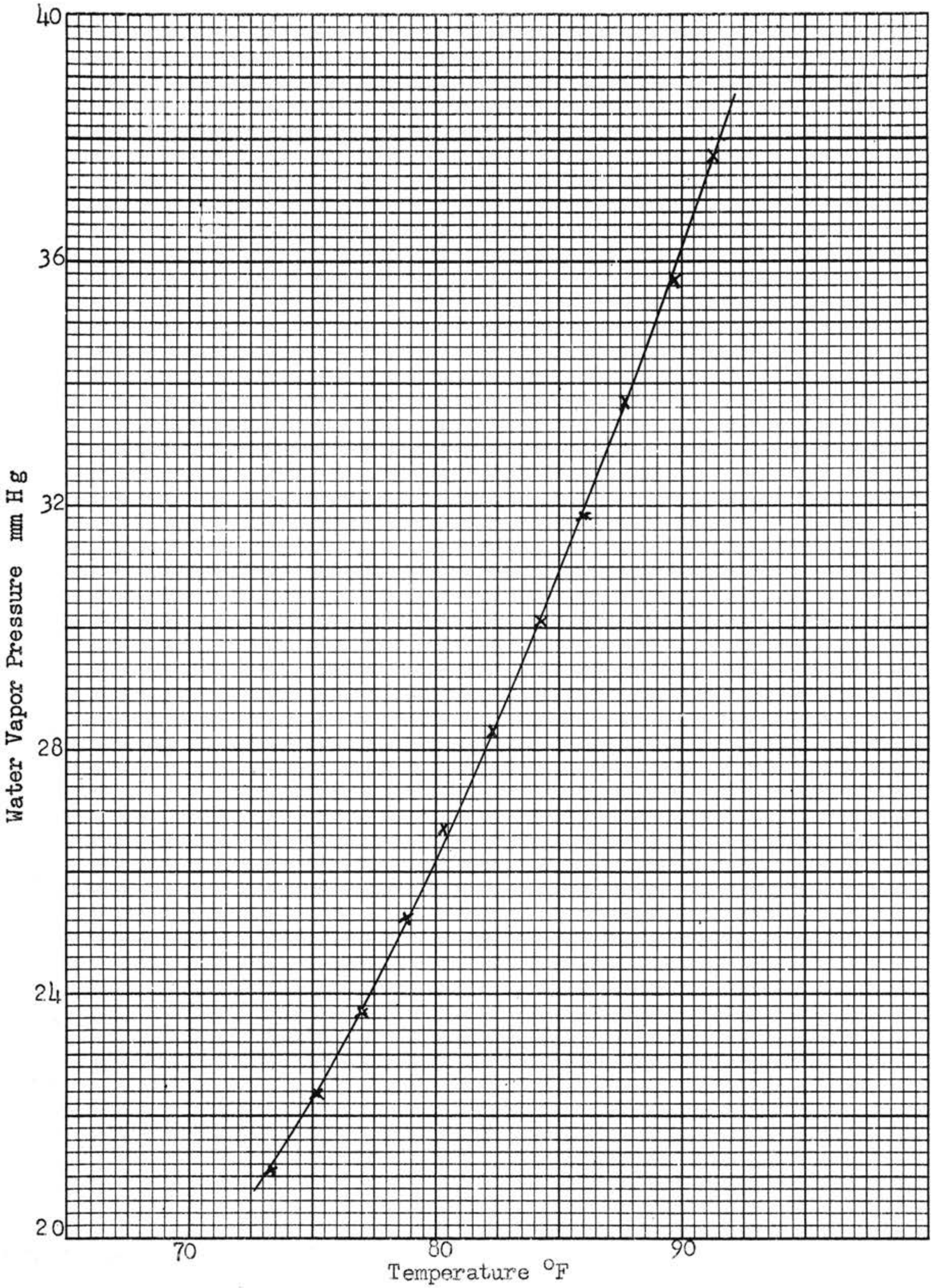

FIGURE 37

VAPOR PRESSURE OF WATER[18]

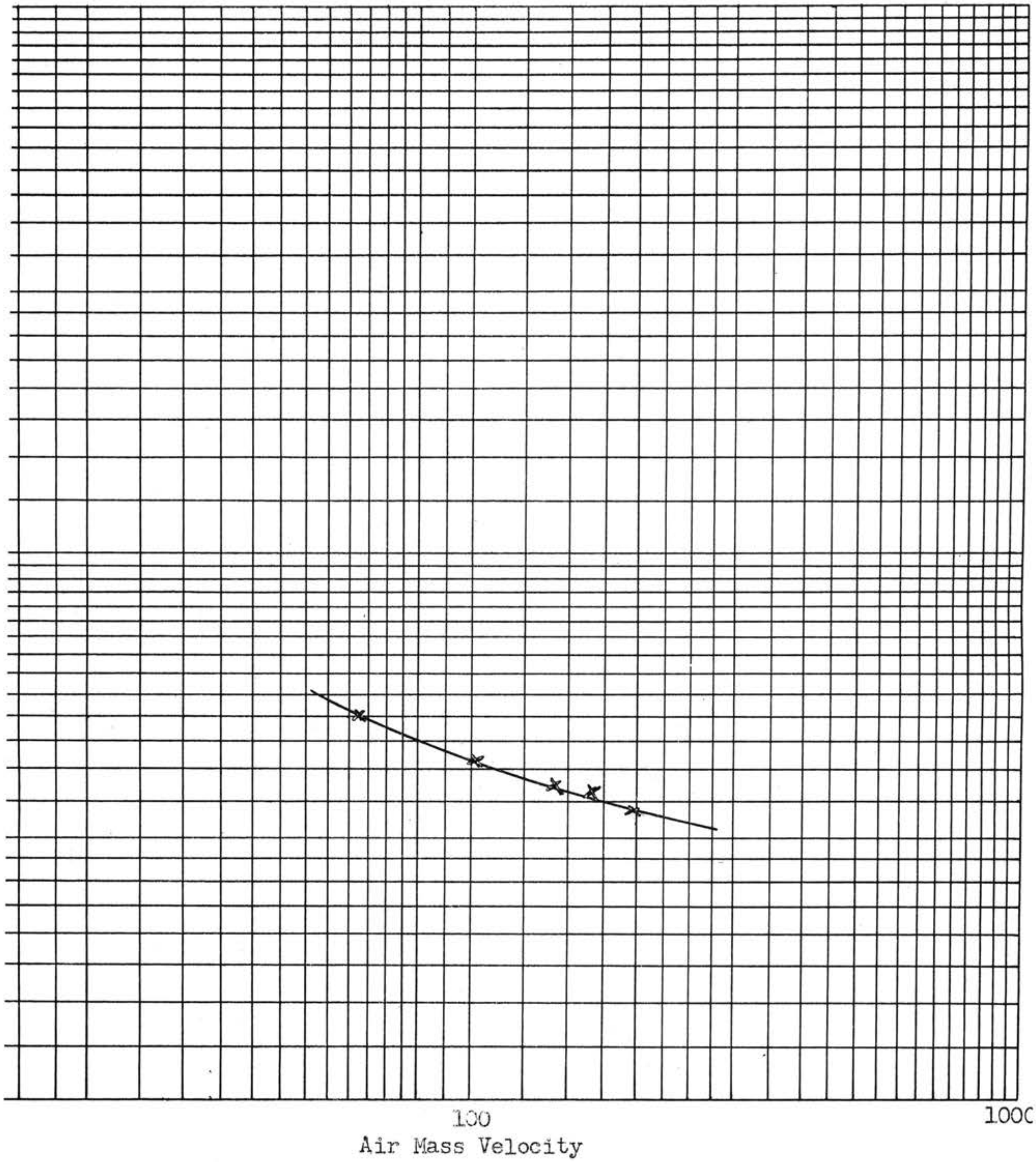

FIGURE 38

HUMIDIFICATION OCCURING BELOW
FIRST TRAY

TABLE LXVIII

DETERMINATION OF INLET HUMIDITY

CORRECTION FACTOR

1/8" Valve Tray
Bar. = 740

		Inlet Air					Outlet Air					
Air Rate	Mass Vel.	Vol. Wet Air	Temp	Vol. Dry Air	Wt. H_2O	H_o	Vol. Wet Air	Temp.	Vol. Dry Air	Wt. H_2O	H_1	ΔH
$\frac{lb}{hr}$	$\frac{lb}{ft^2 hr}$	ft^3	^oF	ft^3	gm	$\frac{gm}{mol}$	ft^3	^oF	ft^3	gm	$\frac{gm}{mol}$	$\frac{gm}{mol}$
17.2	197	.5387	88	.514	.0982	78.5	.5236	88	.499	.1376	113.5	35.0
14.5	166	.5112	88	.489	.0938	79.0	.5035	89	.479	.1345	116.0	37.0
12.2	140	.5097	88	.485	.0929	78.5	.5104	89	.485	.1371	116.5	38.0
8.83	101	.5141	89	.490	.0964	81.2	.5075	90	.483	.1431	122.2	41.0
5.45	62.4	.5108	90	.486	.0739	62.7	.5068	91	.481	.1320	113.2	50.5

TABLE LXIX

EFFICIENCY DETERMINATION

1/16" Sieve Tray
1" Weir
Bar. = 739
G_L = 1150

			Inlet Air					Outlet Air										
Air Rate	Mass Vel.	ΔH	Vol. Wet Air	Temp	Vol. Dry Air	Wt. H_2O	H_o	Vol. Wet Air	Temp	Vol. Dry Air	Wt. H_2O	H_2	Water Temp. In	Water Temp. Out	Av.	V.P. H_2O	H^*	E_{mv}
$\frac{lb}{hr}$	$\frac{lb}{ft^2 hr}$	$\frac{gm}{mol}$	ft^3	°F	ft^3	gm	$\frac{gm}{mol}$	ft^3	°F	ft^3	gm	$\frac{gm}{mol}$	°F	°F	°F	mm.Hg	$\frac{gm}{mol}$	%
7.2	82.4	44.5	.5352	89	.510	.0477	38.6	.1959	89	.186	.1435	318	83.7	81.7	82.7	28.6	329	95.5
6.85	78.4	45.5	.5193	89	.495	.0426	35.5	.2092	89	.199	.1481	308	83.9	81.8	82.8	28.8	332	90.5
6.12	70.0	47.6	.5259	89	.501	.0444	36.4	.2156	89	.205	.1611	324	83.8	81.9	82.9	28.9	333	96.5
5.50	62.9	49.8	.5093	90	.484	.0433	36.8	.2198	90	.209	.1661	328	84.0	82.1	83.1	29.0	334	98.0
4.65	53.2	54.0	.5384	90	.511	.0469	37.6	.2120	90	.202	.1637	335	84.2	82.2	83.2	29.2	337	99.2

TABLE LXX

EFFICIENCY DETERMINATION

3/32" Sieve Tray
1" Weir
Bar. = 738
G_L = 1150

			Inlet Air					Outlet Air										
Air Rate	Mass Vel.	ΔH	Vol. Wet Air	Temp	Vol. Dry Air	Wt. H_2O	H_o	Vol. Wet Air	Temp	Vol. Dry Air	Wt. H_2O	H_2	Water Temp. In	Water Temp. Out	Av.	V.P. H_2O	H^*	E_{mv}
$\frac{lb}{hr}$	$\frac{lb}{ft^2 hr}$	$\frac{gm}{mol}$	ft^3	°F	ft^3	gm	$\frac{gm}{mol}$	ft^3	°F	ft^3	gm	$\frac{gm}{mol}$	°F	°F	°F	mm.Hg	$\frac{gm}{mol}$	%
11.6	133	38	.5719	86	.546	.0676	51.0	.2112	87	.201	.1581	324	86.7	82.9	84.8	30.7	355	88.4
10.7	122	39	.5125	87	.488	.0630	53.1	.2128	87	.203	.1596	324	85.5	82.6	84.1	30.0	345	91.7
9.27	106	41	.5361	87	.510	.0656	53.1	.2087	88	.199	.1587	328	85.2	82.0	83.6	29.5	340	95.2
8.35	95.5	42	.5183	87	.494	.0624	51.9	.2199	88	.209	.1672	330	84.6	82.3	83.5	29.4	340	96.0
7.00	80.1	45	.4978	88	.475	.0609	52.8	.2153	89	.204	.1608	325	84.9	82.1	83.5	29.4	340	96.0

TABLE LXXI

EFFICIENCY DETERMINATION

1/8" Sieve Tray
1" Weir
Bar. = 738
G_L = 1150

			Inlet Air					Outlet Air										
Air Rate	Mass Vel.	ΔH	Vol. Wet Air	Temp	Vol. Dry Air	Wt. H_2O	H_o	Vol. Wet Air	Temp	Vol. Dry Air	Wt. H_2O	H_2	Water Temp. In	Water Temp. Out	Av.	V.P. H_2O	H^*	E_{mv}
$\frac{lb}{hr}$	$\frac{lb}{ft^2 hr}$	$\frac{gm}{mol}$	ft^3	°F	ft^3	gm	$\frac{gm}{mol}$	ft^3	°F	ft^3	gm	$\frac{gm}{mol}$	°F	°F	°F	mm.Hg	$\frac{gm}{mol}$	%
18.45	211	33.7	.5866	88	.560	.0608	45.0	.2029	88	.193	.1487	318	85.4	82.3	83.9	29.8	344	90.0
15.95	182	34.8	.5188	89	.494	.0554	46.1	.3356	89	.319	.2662	345	86.6	84.3	85.5	31.4	363	93.6
14.15	162	36.0	.5116	89	.486	.0653	55.3	.2082	90	.198	.1512	317	86.8	83.5	85.2	31.1	359	84.0
12.35	141	37.3	.5141	89	.489	.0563	47.5	.2034	91	.193	.1489	319	86.8	84.0	85.4	31.3	362	84.5
9.8	112	40.0	.5230	90	.497	.0627	52.0	.2016	91	.191	.1538	333	86.6	83.8	85.2	31.1	359	90.2

TABLE LXXII

EFFICIENCY DETERMINATION

1/16" Valve Tray
1" Weir
Bar. = 739
G_L = 1150

Air Rate	Mass Vel.	ΔH	Inlet Air: Vol. Wet Air	Inlet Air: Temp	Inlet Air: Vol. Dry Air	Inlet Air: Wt. H_2O	H_o	Outlet Air: Vol. Wet Air	Outlet Air: Temp	Outlet Air: Vol. Dry Air	Outlet Air: Wt. H_2O	H_2	Water Temp. In	Water Temp. Out	Av.	V.P. H_2O	H^*	E_{mv}
$\frac{lb}{hr}$	$\frac{lb}{ft^2 hr}$	$\frac{gm}{mol}$	ft^3	°F	ft^3	gm	$\frac{gm}{mol}$	ft^3	°F	ft^3	gm	$\frac{gm}{mol}$	°F	°F	°F	mm.Hg	$\frac{gm}{mol}$	%
7.3	83.5	44.2	.5147	91	.488	.0890	75.5	.1974	92	.187	.1465	326	84.0	81.0	82.5	28.5	328	99.2
6.9	79.	45.3	.4810	91	.456	.0820	74.3	.2015	92	.191	.1506	326	83.8	81.6	82.7	28.7	331	98.6
5.8	66.4	48.6	.5133	91	.486	.0845	71.8	.2038	93	.193	.1593	343	85.2	82.9	84.1	30.0	346	98.6
4.5	51.5	55.0	.4927	91	.466	.0823	72.9	.2024	93	.191	.1524	332	85.2	83.2	84.2	30.1	348	92.7
3.5	40.0	64.0	.5033	92	.476	.0845	73.5	.2045	93	.194	.1648	352	85.9	84.2	85.0	30.9	357	97.8

TABLE LXXIII

EFFICIENCY DETERMINATION

3/32" Valve Tray
1" Weir
Bar. = 740
G_L = 1150

			Inlet Air					Outlet Air										
Air Rate	Mass Vel.	ΔH	Vol. Wet Air	Temp	Vol. Dry Air	Wt. H_2O	H_o	Vol. Wet Air	Temp	Vol. Dry Air	Wt. H_2O	H_2	Water Temp. In	Water Temp. Out	Water Temp. Av.	V.P. H_2O	H^*	E_{mv}
$\frac{lb}{hr}$	$\frac{lb}{ft^2hr}$	$\frac{gm}{mol}$	ft^3	°F	ft^3	gm	$\frac{gm}{mol}$	ft^3	°F	ft^3	gm	$\frac{gm}{mol}$	°F	°F	°F	mm.Hg	$\frac{gm}{mol}$	%
11.6	133	38	.6589	89	.625	.0811	53.6	.3064	90	.291	.2239	318	84.8	81.8	83.3	29.2	336	92.6
10.7	122	39	.5043	89	.479	.0588	50.8	.2051	90	.195	.1519	322	84.9	82.4	83.7	29.7	342	92.2
9.6	110	40.2	.5183	89	.492	.0546	50.0	.2087	90	.198	.1538	321	85.3	83.5	84.4	30.3	349	89.3
8.55	98	41.8	.5124	90	.486	.0593	50.4	.1325	90	.126	.1013	333	86.2	84.0	85.1	31.0	358	90.6
6.9	79	45.2	.5053	90	.480	.0591	50.8	.2035	91	.193	.1585	340	86.1	84.0	85.1	31.0	358	93.2

TABLE LXXIV

EFFICIENCY DETERMINATION

1/8" Valve Tray
1" Weir
Bar. = 734
G_L = 1150

			Inlet Air					Outlet Air										
Air Rate	Mass Vel.	ΔH	Vol. Wet Air	Temp	Vol. Dry Air	Wt. H_2O	H_o	Vol. Wet Air	Temp.	Vol. Dry Air	Wt. H_2O	H_2	Water Temp In	Water Temp Out	Water Temp Av.	V.P. H_2O	H^*	E_{mv}
$\frac{lb}{hr}$	$\frac{lb}{ft^2hr}$	$\frac{gm}{mol}$	ft^3	°F	ft^3	gm	$\frac{gm}{mol}$	ft^3	°F	ft^3	gm	$\frac{gm}{mol}$	°F	°F	°F	mm.Hg	$\frac{gm}{mol}$	%
17.83	204	34.0	.5301	89	.504	.0692	56.8	.2128	89	.200	.1463	304	85.6	82.6	84.1	30.0	349	82.6
16.38	187	34.6	.5224	89	.496	.0676	56.4	.2087	89	.198	.1478	310	86.2	83.3	84.8	30.7	357	82.5
15.64	179	35.0	.5231	89	.496	.0650	54.3	.2082	90	.197	.1480	312	86.3	83.6	85.0	30.9	360	82.4
12.90	148	36.7	.5290	89	.502	.0678	56.0	.1990	90	.189	.1439	317	86.6	83.6	85.1	31.0	361	83.6
10.70	122	38.8	.5220	90	.495	.0669	56.2	.2108	90	.200	.1591	332	86.2	83.6	85.0	30.9	360	89.5

APPENDIX E

SAMPLE CALCULATIONS AND NOMENCLATURE

SAMPLE CALCULATIONS

Dry Tray Run

Data: Pressure drop data for 3/32" sieve tray dry, air rate 8.12 lb/hr, ΔP 1.69" H_2O

Area of column
inside diameter = 4 inches

$$\frac{\pi \times 4^2}{4 \times 144} = 0.0874 \text{ ft}^2$$

$$G_G = \frac{8.12}{0.0874} = 93 \text{ lb/hr-ft}^2$$

Orifice Coefficient

Data: Point on smoothed curve of pressure drop for 3/32" sieve tray
$G_G = 100, \Delta P = 2.87$

$$.359 \times \frac{545}{492} = 398 \text{ cu. ft. molar volume at } 85^{\circ}\text{F and 760mm Hg}$$

$$\frac{100 \times .0874}{28.9} \times \frac{398}{3600} = .0334 \text{ ft}^3/\text{sec.}$$

$$\frac{.0334}{4.79 \times 10^{-4}} = 70.5 \text{ ft/sec. hole velocity}$$

$$\frac{2.87}{12} \times \frac{62}{.0726} = 203 \text{ ft. of air}$$

$$v_o = C_o \sqrt{2gh}$$

$$70.5 = C_o \sqrt{2g \times 203}$$

$$C_o = \frac{70.5}{114} = .62$$

$$G_G = k\sqrt{\Delta P}$$

$$100 = k\sqrt{2.87}$$

$$k = 59.0$$

Wet Tray Run

Data: 3/32" sieve tray, $1\frac{1}{2}$" weir, water rate 640 lbs/hr-ft^2
Air Rate = 3.37 lbs/hr, ΔP = 1.98

$$G_G = \frac{3.37}{.0874} = 38.6 \text{ lbs/ft}^2\text{-hr}$$

at G_G = 38.6 dry tray pressure drop = 0.425 in. H_2O (Fig. 4)

$\Delta P - \Delta P_D$ = 1.98 - 0.425 = 1.55

Height liquid over weir = 0.066" (Page 128)

Liquid seal = 1.5 + 0.066 = 1.57"

Aeration factor = $\frac{1.55}{1.57}$ = 0.99

Efficiency Run

Data: 3/32" sieve tray, 1" weir, G_L = 1150 lbs/ft^2-hr.
Air Rate = 11.6 lbs/hr. Bar. Press = 738

G_G = 11.6/0.0874 = 133 lbs/ft^2-hr

ΔH = 38 (Fig. 38)

Inlet air sample

Volume of sample 0.5719 ft^3

Temperature at which measured 86°F

Weight of water collected 0.0676

Volume of dry air in sample

at 86°F $V.P._{H_2O}$ = 31.9 mm Hg

$$\frac{\text{mol DA}}{\text{mol WA}} = \frac{738 - 31.9}{738} = 0.957$$

0.957 x 0.5719 = 0.546 ft^3 dry air in sample

Molar Volume $= 359 \times \frac{546}{492} \times \frac{760}{738} = 410.3$

$\frac{0.0676}{0.546} \times 410.3 = 51.0$ gm H_2O/lb mol dry air entering column

$51.0 + 38 = 89.0 \frac{\text{gm } H_2O}{\text{lb. mol D.A.}}$ below first plate

Outlet air sample

Same procedure used as for calculating the inlet air sample:

$H_2 = 324$ gm H_2O/lb mol D. A.

Equilibrium moisture content

Ave. H_2O temp. $= 84.8^\circ F$

at $84.8^\circ F$ $V.P._{H_2O} = 30.7$ mm Hg (Figure 37)

$\frac{30.7}{738 - 30.7} = 0.0434 \frac{\text{mol } H_2O}{\text{mol D.A.}}$

$0.0434 \times 18.0 \times 454 = 355$ gm H_2O/lb. mol D.A.

Murphree Vapor Efficiency

$H_2 = 324$

$H_1 = 89.0$

$H^* = 355$

$\frac{H_2 - H_1}{H^* - H_1} = \frac{324 - 89.0}{355 - 89.0} \times 100 = 88.4\%$

Fluid height over weir

Ave. diameter 0.69"

Length of weir $= \pi D = \pi \times 0.69 = 2.17$ inches.

$G_W = 1.0 = 640$ lb/ft^2-hr

$4.4 = 1150$ lb/ft^2-hr

$11.4 = 2210$ lb/ft^2-hr

Francis weir formula

$Q = 0.0067\ W h_{ow}^{1.5}$

Q = discharge ft^3/sec

W = length of weir in inches

h_{ow} = head above weir, in fluid

$G = 1.0$

$$\frac{640 \times .0874}{62.4} = 0.896\ ft^3/hr.$$

$0.896 = 0.0067 \times 3600 \times 2.17\ h_{ow}^{1.5}$

$0.896 = 52.4\ h_{ow}^{1.5}$

$h_{ow}^{1.5} = .0171$

$h_{ow} = .066$ inches H_2O .07

$G = 4.4$

$$\frac{1150 \times .0874}{62.4} = 1.61\ ft^3/hr.$$

$1.61 = 52.4\ h_{ow}^{1.5}$

$h_{ow}^{1.5} = .0308$

$h_{ow} = .098$ inches H_2O .10

$G = 11.4$

$$\frac{2210 \times .0874}{62.4} = 3.10\ ft^3/hr.$$

$3.1 = 52.4\ h_{ow}^{1.5}$

$h_{ow}^{1.5} = .0591$

$h_{ow} = .151$ inches H_2O .15

Proof of Dry Tray Pressure Drop

$P_2 - P_1 = W$

W is over area of float

$A_{valve} = \frac{\pi \times 1^2}{4} = .785 \text{ in}^2$

$\frac{W}{A} = \frac{1.9328 \text{ gm}}{.785 \text{ in}^2} = 2.47 \text{ gm/in}^2$

$\frac{2.47}{454} = 0.00545 \text{ lb/in}^2$

$h = \frac{.00545 \times 144}{62.4} = .0126 \text{ ft.} = .15 \text{ in } H_2O$

$v_o = C_o \sqrt{2g \Delta h}$

$G\ 9.5 = \frac{50,000}{28,700} \text{ cc/min} = 1.74 \text{ ft}^3\text{/min} = .029 \text{ ft}^3\text{/sec}$

$A \text{ hole} = \frac{\pi \times 0.5^2}{4} = .197 \text{ in}^2 = .00136 \text{ ft}^2$

$\frac{.029}{.00136} = 21.4 \text{ ft/sec}$

$21.4 = 0.61 \times 8.01 \sqrt{\Delta h}$

$4.38 = \sqrt{\Delta h}$

$\Delta h = 19.2$ ft of air

$19.2 \times 12 \times \frac{.077}{62.4} = .285 \text{ in } H_2O$

$.285 + .15 = 0.435$

Per Cent Free Space

Area of column = $\frac{\pi \times 4^2}{4}$ = 12.6 in^2

1/16" holes	10 x .00307/12.6 x 100 =	0.244%
3/32" holes	10 x .00690/12.6 x 100 =	0.548%
1/8 " holes	10 x . 0123/12.6 x 100 =	0.977%

NOMENCLATURE

A = Aeration factor.

C_o = constant in orifice equation.

E_{mv} = Murphree vapor efficiency.

G_G = vapor mass velocity based on free cross-section of column.

G_L = liquid mass velocity based on free cross-section of column.

g = acceleration of gravity

H = humidity, grams water/pound-mole dry air.

H_o = humidity of air at tower entrance.

H_1 = humidity of air at point just below plate.

H_2 = humidity of air leaving column.

H^* = humidity of air in equilibrium with water on tray.

ΔH = change in humidity occuring below first tray.

Δh = head loss across orifice.

k = a constant.

ΔP = pressure drop, inches water.

ΔP_D = pressure drop across dry tray.

ΔP_S = pressure drop across sieve tray.

ΔP_V = pressure drop across valve tray.

v_o = velocity through orifice

VITA

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Publications: "Stabilization of Light Hydrocarbon Liquids in the Field - An Economic Study", Campbell, J. M., and Maddox, R. N., <u>Oil and Gas J. 50</u>, (Dec. 1952).

THESIS TITLE: A STUDY OF THE PERFORMANCE CHARACTERISTICS OF THE VALVE-TYPE PERFORATED TRAY

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