

# Inter-Organization Correspondence

RF Goodrich

|                                          |                                                          |                                 |
|------------------------------------------|----------------------------------------------------------|---------------------------------|
| TO<br>A. R. Webber<br>PVC Plant Managers | FIELD POINT OR AKRON DEPARTMENT & BLDG. NO.              | DATE YOUR LETTER                |
| FROM<br>J. C. Schaap<br>A. M. Fairlie    | FIELD POINT OR AKRON DEPARTMENT & BLDG. NO.<br>Cleveland | DATE THIS LETTER<br>May 2, 1974 |

**Ambient Vinyl Chloride Analysis in Pedricktown's Polymerization Buildings: A Study of Sample Point Locations and a Way to Cover the Building Environment More Thoroughly When Using a 6-Point Bendix Sampling System**

## OBJECTIVES

1. Be able to predict floor and building averages with a standard error of less than 10% (for maintaining an accurate record of VCl monomer exposure levels).
2. Accomplish the first objective with a six-probe continuous sampling system.
3. Maintain maximum sensitivity to problems in the building so that plant personnel would be alerted to "excursions" of high VCl monomer concentrations as soon as they occur.

## INTRODUCTION

In February, a study was made of over 100 sets of OVA readings from both the Mass and Pearl-Paste polymerization buildings at Pedricktown. Readings were taken at 16 points in the Mass Building and at 27 points in the Pearl-Paste Building. The results of this study indicated the following, if the best 6 points are selected for each building. <sup>1</sup>

| <u>Building</u> | <u>Points Selected</u> | <u>Standard Error<br/>For Predicting Averages</u> |
|-----------------|------------------------|---------------------------------------------------|
| Mass            | 4,8,9,10,13,15         | 8.3 to 23.7% <sup>2</sup>                         |
| Pearl-Paste     | 1,8,12,16,21,27        | 9.2 to 15.3%                                      |

1. Figures 1 and 2 diagram the location of sampling points for the buildings. Tables 1 and 2 summarize the results of the overall statistical analyses.
2. With a standard error of 23.7%, the 95% confidence limits for predicting a floor average are:

| <u>True Value</u> | <u>Range of Values that Would be Estimated</u> |
|-------------------|------------------------------------------------|
| 10 ppm            | 6.8 - 14.7 ppm                                 |
| 50 ppm            | 34 - 73 ppm                                    |

With a standard error of 9.7%, the 95% confidence limits for predicting a floor average are:

| <u>True Value</u> | <u>Range of Values that Would be Estimated</u> |
|-------------------|------------------------------------------------|
| 10 ppm            | 8.4 - 12 ppm                                   |
| 50 ppm            | 42 - 60 ppm                                    |

This range of error is too great -- and it represents the best set of 6 points that could be found. The "optimum" sets of points for each building were:

| <u>Building</u> | <u>No. of Points<br/>Required</u> | <u>Points Selected</u>     | <u>Standard Error For<br/>Predicting Averages</u> |
|-----------------|-----------------------------------|----------------------------|---------------------------------------------------|
| Mass            | 9                                 | 1,4,6,8,9,10,11,13,15      | 5.3 to 9.7%                                       |
| Pearl-Paste     | 10                                | 1,5,8,12,14,16,20,21,25,27 | 6.8 to 9.2%                                       |

Neither of these solutions meet all three objectives. A possible solution is to place tees and small rotameters on the Bendix probes, (see Figure 3) using them to sample pairs of locations instead of single points.

Working with Pedricktown data (prior to February 4, 1974), the computer was used to simulate paired sampling. This note deals with an evaluation of the results. (Pedricktown has run a similar evaluation of paired sampling for their paste-pearl building -- leading to paired sampling for the Bendix. This report attempts to evaluate alternatives and objections to paired sampling in more detail.)

#### SUMMARY

Paired sampling with one Bendix 6-point analyzer enables the user to predict floor and building averages with almost the same accuracy as would be possible with two Bendix analyzers looking at individual points. At the same time, all 79 single point excursions above 50 ppm were identified by using 35 ppm as an action point. Thus, paired sampling makes possible a much more thorough and accurate coverage of ambient vinyl chloride levels in a building without increasing the investment to two sampling systems.

#### RECOMMENDATIONS

1. All plants should evaluate the "paired" sampling technique (through simulation) and install it wherever greater accuracy and/or more complete coverage of work areas is needed.
2. Plants should use process capability studies and control chart theory to:
  - a. Establish ambient VCl levels below 50 ppm at which action should be taken to seek out and eliminate sources of high VCl.
  - b. Evaluate point, floor, and building capabilities for maintaining selected levels of ambient VCl.
  - c. Contrast process capabilities of various parts of buildings. As the obvious problem areas come under better control, process capability theory can be used to select less obvious problem spots for special work.

BFG31742

24523003

3. Don't use exhaust fan data as the only source for estimating floor and building averages. While these results are useful in showing the total VCI removed, they are not the best indicators of average concentrations in the building based on the data at hand.

## DISCUSSION

### A. Contrasting Sampling by Different Methods

Sets of sampling locations were selected from several different view-points and then evaluated as to their effectiveness in predicting floor and building averages. The following approaches were evaluated.

1. The "best" set of 6 locations for estimating floor and building averages (selected by the computer through multiple correlation).
2. The fewest locations which could be used to estimate floor and building averages with a standard deviation of less than 10% for all estimates (9 points for Mass, 10 points for Pearl and Paste).
3. Paired sampling -- 6 sets -- based upon the most likely points as indicated by the computer in procedure No. 2, above.
4. Readings at the exhaust fans only (6 for Paste and Pearl, 3 for Mass).
5. Readings of the 3 exhaust fans in the Mass building, plus 3 other likely spots in the building.

## RESULTS:

### PERCENT VARIATION EXPLAINED

| <u>Method</u>    | <u>Mass</u>  |                  |                |              | <u>Paste &amp; Pearl</u> |                  |              |
|------------------|--------------|------------------|----------------|--------------|--------------------------|------------------|--------------|
|                  | <u>Floor</u> | <u>Mezzanine</u> | <u>Prepoly</u> | <u>Bldg.</u> | <u>1st Floor</u>         | <u>2nd Floor</u> | <u>Bldg.</u> |
| 1 (Best 6)       | 91.5         | 91.1             | 98.3           | 98.3         | 92.6                     | 94.6             | 96.7         |
| 2 (Best 9 or 10) | 97.2         | 99.0             | 98.3           | 99.3         | 96.7                     | 98.2             | 98.3         |
| 3 (Paired to 6)  | 97.9         | 99.0             | 97.8           | 99.3         | 96.0                     | 98.0             | 97.9         |
| 4 (Fans)         | 91.2         | 72.4             | 91.2           | 89.9         | 74.9                     | 71.5             | 83.5         |
| 5 (Fans +)       | 94.1         | 92.1             | 91.2           | 97.0         | ---                      | ---              | ---          |

### PREDICTION ERROR - STANDARD DEVIATION BY PERCENT

| <u>Method</u>    | <u>Mass</u>  |                  |                |              | <u>Paste &amp; Pearl</u> |                  |              |
|------------------|--------------|------------------|----------------|--------------|--------------------------|------------------|--------------|
|                  | <u>Floor</u> | <u>Mezzanine</u> | <u>Prepoly</u> | <u>Bldg.</u> | <u>1st Floor</u>         | <u>2nd Floor</u> | <u>Bldg.</u> |
| 1 (Best 6)       | 16.9         | 23.7             | 9.7            | 8.3          | 13.9                     | 15.3             | 9.2          |
| 2 (Best 9 or 10) | 9.4          | 7.4              | 9.7            | 5.3          | 9.2                      | 8.8              | 6.8          |

24523004

BFG31743

PREDICTION ERROR - STANDARD DEVIATION BY PERCENT - CONT'd

| <u>Method</u>                   | <u>Mass</u>  |                  |                |              | <u>Paste &amp; Pearl</u> |                  |              |
|---------------------------------|--------------|------------------|----------------|--------------|--------------------------|------------------|--------------|
|                                 | <u>Floor</u> | <u>Mezzanine</u> | <u>Prepoly</u> | <u>Bldg.</u> | <u>1st Floor</u>         | <u>2nd Floor</u> | <u>Bldg.</u> |
| 3 (Paired to 6)                 | 8.0          | 7.3              | 11.1           | 5.4          | 10.0                     | 9.1              | 7.2          |
| 4 (Fans)                        | 17.2         | 45.6             | 23.6           | 21.2         | 27.1                     | 38.8             | 21.7         |
| 5 (Fans + 4<br>Points in Bldg.) | 13.9         | 22.5             | 23.6           | 11.3         | ----                     | ----             | ----         |

(Tables 1 and 2 contain more complete contrasting of the results)

CONCLUSIONS

1. Sampling individual points using only the exhaust fans or all exhaust fans plus a few select locations within the building is not the best way to estimate floor and building average VCl concentrations. (This has proven true also at Henry and Avon Lake. Long Beach and Louisville were not evaluated.)
2. Paired sampling to 6 probes on one Bendix is almost as effective a way to determine floor averages as using 2 Bendix instruments for sampling. The errors of estimating floor and building averages are consistently 1/2 that of exhaust air sampling -- or even better.
3. An effective combination of paired samples is as follows:

| <u>Building</u> | <u>Points</u> <sup>1</sup>                |
|-----------------|-------------------------------------------|
| Mass            | 6, 1 & 4, 2 & 8, 9 & 10, 11 & 12, 13 & 15 |
| Paste and Pearl | 1 & 5, 8, 21, 12 & 14, 16 & 20, 25 & 27   |

B. Process Capability Studies and Upper Control Limits: Can Paired Sampling Detect Excursions?

Process capability evaluations were made on the single and paired points

- a. To determine average VCl levels at various locations when excursions were eliminated.
- b. To determine what upper control limits for VCl might be practical if excursions were virtually eliminated.

---

1. See the diagrams in Figures 1 and 2 for point locations.

- c. To select a base less than 50 ppm VC1 for paired results that might be used as an "action" level. E.g. If this base were exceeded we would be 99% certain that VC1 was abnormally high and that the source should be tracked down and eliminated.
- d. To illustrate how the process capability technique might be used on ambient vinyl chloride data to contrast averages and levels of variability at various points. This would help provide guidance as to what parts of a building need technical or maintenance attention most. Areas needing attention are obvious at first. As technology improves and demands for low VC1 becomes greater, this type of guidance may become increasingly important to the plants.

The 99% (or higher) control limit of paired samples which applied to all sets of paired data was tested on all paired data results to determine whether all excursions of single points greater than 50 ppm would be detected by paired data results. The data were plotted so that the reader may observe the success of this approach.

#### CONCLUSIONS

1. The following table lists the averages, process capabilities, and upper control limits of points for the two buildings. The contrasts in averages and uniformity are obvious.

#### Process Capability and Upper Control Limits for Single and Paired Points

| MASS BUILDING |             |             |                | PASTE & PEARL BUILDING |             |             |                |
|---------------|-------------|-------------|----------------|------------------------|-------------|-------------|----------------|
| <u>Point</u>  | <u>Avg.</u> | <u>SpCL</u> | <u>99% Lim</u> | <u>Point</u>           | <u>Avg.</u> | <u>SpCL</u> | <u>99% Lim</u> |
| (1+4)/2       | 18.3        | 7.10        | 34.9           | (1+5)/2                | 10.2        | 3.79        | 19.0           |
| 1             | 18.0        | 8.78        | 38.5           | 1                      | 8.6         | 2.61        | 14.7           |
| 4             | 19.1        | 7.69        | 37.0           | 5                      | 11.6        | 5.12        | 23.5           |
| 6             | 11.1        | 5.70        | 24.4           | 8                      | 8.7         | 3.54        | 16.9           |
| (2+8)/2       | 10.4        | 4.35        | 20.5           | (12+14)/2              | 8.2         | 2.64        | 14.3           |
| 2             | 10.5        | 4.26        | 20.4           | 12                     | 8.6         | 3.05        | 15.7           |
| 8             | 10.3        | 5.11        | 22.2           | 14                     | 7.6         | 2.25        | 12.8           |
| (9+10)/2      | 15.2        | 7.65        | 33.0           | (16+20)/2              | 15.1        | 6.85        | 31.0           |
| 9             | 13.6        | 7.56        | 31.2           | 16                     | 14.2        | 5.83        | 27.7           |
| 10            | 15.6        | 6.95        | 31.8           | 20                     | 13.6        | 4.93        | 25.0           |
| (11+12)/2     | 14.0        | 7.84        | 32.2           | 21                     | 17.4        | 10.17       | 41.0           |
| 11            | 13.1        | 7.13        | 29.6           | (25+27)/2              | 12.7        | 7.76        | 30.7           |
| 12            | 14.7        | 7.62        | 32.4           | 25                     | 13.7        | 7.78        | 31.8           |
| (13+15)/2     | 17.5        | 6.88        | 33.5           | 27                     | 9.7         | 4.46        | 20.1           |
| 13            | 16.2        | 7.53        | 33.7           |                        |             |             |                |
| 15            | 19.9        | 7.69        | 37.8           |                        |             |             |                |

24523006

BFG31745

2. Thirty-five ppm VCl is an appropriate action point for Pedricktown, at which level plant personnel can be at least 99% certain that there is an unusual source of VCl monomer. (Point 21 in the Paste-Pearl Building is the only point violating this criteria. Its data suggests a flurry of problems over a short period of time which caused its high action limit.) It is probable that the action point for the plant is now lower, based on recent plant improvements.
3. If an action point of 35 ppm is used for paired sampling, essentially all excursions at corresponding single points will be detected. In this study all 79 excursions in the data would have been identified for action.

*A. M. Fairlie*

A. M. Fairlie

*J. C. Schap*

J. C. Schap

AMF-JCS/clb

Atts.

24523007

BFG31746

## A P P E N D I X

### A. Simulation of "Paired" Sampling

Paired sampling was simulated by averaging the results of each pair of points selected for "blending." Thus, if points 1 and 5 were to be blended, the paired result = (point 1 ppm + point 5 ppm)/2. This was done by the computer for each paired set of points and the results analyzed by multiple correlation with floor and building averages.

Points were selected for pairing in the following manner. The best set of points for estimating floor and building averages were chosen through multiple correlation. This was restricted to less than 12 points, but demanding that the standard error be less than 10% of the true averages. Working from these points, and keeping on the same floor, pairs were selected for blending, based on those which were highly correlated with each other. Thus, the least possible information would be lost by blending sample points. Further, when an excursion occurred, both points would tend to drift high at the same time. As might be anticipated, the pairs selected in this manner tended to be either adjacent, or corresponding to the normal flow of air through the building. (See Figures 1 and 2)

BFG31747

24523008

TABLE 1

24523009

PASTE AND PEARL BUILDING

BFG31748

|                   | <u>Bendix<br/>Probes Rqd.</u> | <u>Points<br/>Sampled</u> | <u>% Variation<br/>Explained</u> | <u>Avg. PPM<br/>VC1</u> | <u>Standard<br/>Error</u> | <u>+ 95%<br/>Limits</u> | <u>Times<br/>Would Miss<br/>Est. 50 PPM</u> |
|-------------------|-------------------------------|---------------------------|----------------------------------|-------------------------|---------------------------|-------------------------|---------------------------------------------|
| Best Set of       | 3                             | 1,8                       | 92.6                             | 9.7                     | 13.9%                     | + 28%                   | 0                                           |
| Six Smplg. Points |                               | 12                        |                                  |                         |                           |                         |                                             |
|                   | 5                             | 1,5                       | 96.7                             | 9.7                     | 9.2%                      | + 18%                   | 0                                           |
| Optimum Model     |                               | 8,12                      |                                  |                         |                           |                         |                                             |
|                   |                               | 14                        |                                  |                         |                           |                         |                                             |
| Sampling Points   | 3                             | 1 & 5                     | 96.0                             | 9.7                     | 10.0%                     | + 20%                   | 0                                           |
| by Pairs as Rqd.  |                               | 8                         |                                  |                         |                           |                         |                                             |
|                   |                               | 12 & 14                   |                                  |                         |                           |                         |                                             |
| Best Set of       | 3                             | 16,21                     | 94.6                             | 14.0                    | 15.3%                     | + 31%                   | 0                                           |
| Six Smplg. Points |                               | 27                        |                                  |                         |                           |                         |                                             |
|                   | 5                             | 16,20                     | 98.2                             | 14.0                    | 8.8%                      | + 18%                   | 0                                           |
| Optimum Model     |                               | 21,25                     |                                  |                         |                           |                         |                                             |
|                   |                               | 27                        |                                  |                         |                           |                         |                                             |
| Sampling Points   | 3                             | 16 & 20                   | 98.0                             | 14.0                    | 9.1%                      | + 18%                   | 0                                           |
| by Pairs as Rqd.  |                               | 21                        |                                  |                         |                           |                         |                                             |
|                   |                               | 25 & 27                   |                                  |                         |                           |                         |                                             |

FIRST FLOOR

SECOND FLOOR

24523010

TABLE 1 CONT.

PASTE AND PEARL BUILDING

| BUILDING | 2nd | 1st Fl. | Best Set of<br>Six Smpg. Points     | Bendix<br>Probes Rqd. | Points<br>Sampled                               | % Variation<br>Explained | Avg. PPM<br>VCI | Standard<br>Error | +<br>-<br>Limits | Times<br>Would Miss<br>Est. 50 PPM |
|----------|-----|---------|-------------------------------------|-----------------------|-------------------------------------------------|--------------------------|-----------------|-------------------|------------------|------------------------------------|
|          |     |         |                                     |                       |                                                 |                          |                 |                   |                  |                                    |
| BUILDING | 2nd | 1st Fl. | Optimum Model                       | 6                     | 1, 8                                            | 96.7                     | 11.7            | 9.2X              | + 18X            | 0                                  |
|          |     |         |                                     |                       | 12, 16                                          |                          |                 |                   |                  |                                    |
|          |     |         |                                     |                       | 21, 27                                          |                          |                 |                   |                  |                                    |
| BUILDING | 2nd | 1st Fl. | Optimum Model                       | 10                    | 1, 5<br>8, 12<br>14, 16<br>20, 21<br>25, 27     | 98.3                     | 11.7            | 6.8X              | + 14X            | 0                                  |
|          |     |         |                                     |                       |                                                 |                          |                 |                   |                  |                                    |
|          |     |         |                                     |                       |                                                 |                          |                 |                   |                  |                                    |
| BUILDING | 2nd | 1st Fl. | Sampling Points<br>by Pairs as Rqd. | 6                     | 1 & 5<br>8, 21<br>12 & 14<br>16 & 20<br>25 & 27 | 97.9                     | 11.7            | 7.2X              | + 14X            | 0                                  |
|          |     |         |                                     |                       |                                                 |                          |                 |                   |                  |                                    |
|          |     |         |                                     |                       |                                                 |                          |                 |                   |                  |                                    |
| BUILDING | 2nd | 1st Fl. | FANS Only                           | 3                     | 1<br>2<br>3                                     | 74.9                     | 9.7             | 27.0              | + 54.2X          | 0                                  |
|          |     |         |                                     |                       |                                                 |                          |                 |                   |                  |                                    |
|          |     |         |                                     |                       |                                                 |                          |                 |                   |                  |                                    |
| BUILDING | 2nd | 1st Fl. | FANS Only                           | 3                     | 15<br>16<br>17                                  | 71.5                     | 14.0            | 38.8              | + 77.6X          | 0                                  |
|          |     |         |                                     |                       |                                                 |                          |                 |                   |                  |                                    |
|          |     |         |                                     |                       |                                                 |                          |                 |                   |                  |                                    |
| BUILDING | 2nd | 1st Fl. | FANS Only                           | 6                     | 1<br>2<br>3<br>15, 16<br>17                     | 83.5                     | 11.7            | 21.7X             | + 43.4X          | 0                                  |
|          |     |         |                                     |                       |                                                 |                          |                 |                   |                  |                                    |
|          |     |         |                                     |                       |                                                 |                          |                 |                   |                  |                                    |

BFG31749

24523011

**BFG31750**

TABLE 2 CONT.

## MASS BUILDING

24523012

|                                     | Bendix<br>Probes Rqd. | Points<br>Sampled                                 | % Variation<br>Explained | Avg. PPM<br>VCL | Standard<br>Error | + 95%<br>Limits | Times<br>Would Miss<br>Est. 50 PPM |
|-------------------------------------|-----------------------|---------------------------------------------------|--------------------------|-----------------|-------------------|-----------------|------------------------------------|
| Best Set of                         | 6                     | 4,8<br>9<br>10<br>13<br>15                        | 98.3                     | 15.6            | 8.3%              | + 16.5%         | 0                                  |
| Six Smpg. Points                    | 9                     | 1,4<br>6,8<br>9,10<br>11,13<br>15                 | 99.3                     | 15.6            | 5.3%              | + 10.6%         | 0                                  |
| Optimum Model                       | 6                     | 6, 1 & 4<br>2 & 8<br>9 & 10<br>11 & 12<br>13 & 15 | 99.3                     | 15.6            | 5.4%              | + 10.7%         | 0                                  |
| Sampling Points<br>by Pairs as Rqd. |                       |                                                   |                          |                 |                   |                 |                                    |
| FANS Only                           | 3                     | 1<br>2<br>16                                      | 91.2                     | 13.0            | 17.2%             | + 34.4%         | 1<br>by 16 ppm                     |
| FANS and 3<br>Likely Points         | 4                     | 1<br>2<br>6<br>16                                 | 94.1                     | 13.0            | 13.9%             | + 27.8%         | 0                                  |
| FANS Only                           | 3                     | 1<br>2<br>16                                      | 72.4                     | 14.9            | 45.6%             | + 91.2%         | 4<br>by 8-30 ppm                   |
| FANS and 3<br>Likely Points         | 5                     | 1<br>2<br>9<br>11<br>16                           | 92.1                     | 14.9            | 22.5%             | + 45.0%         | 1<br>by 4 ppm                      |

BFG31751

TABLE 2 CONT.

24523013

MASS BUILDING

BFG31752

PREPOLY

BUILDING

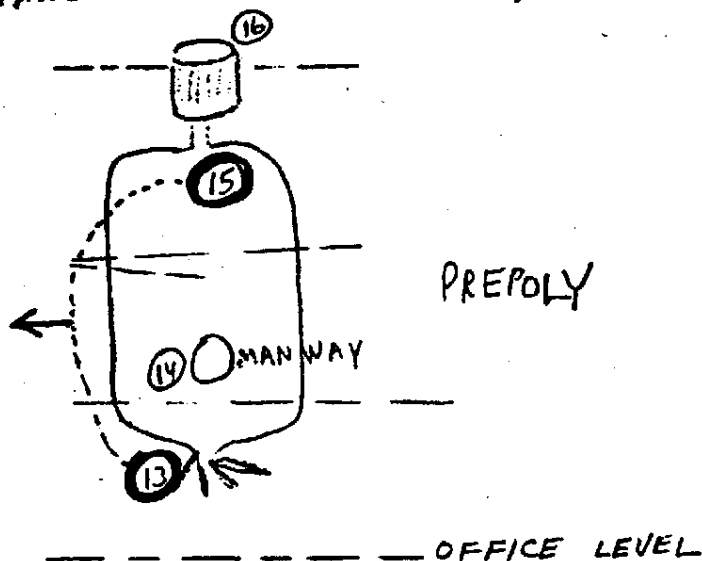
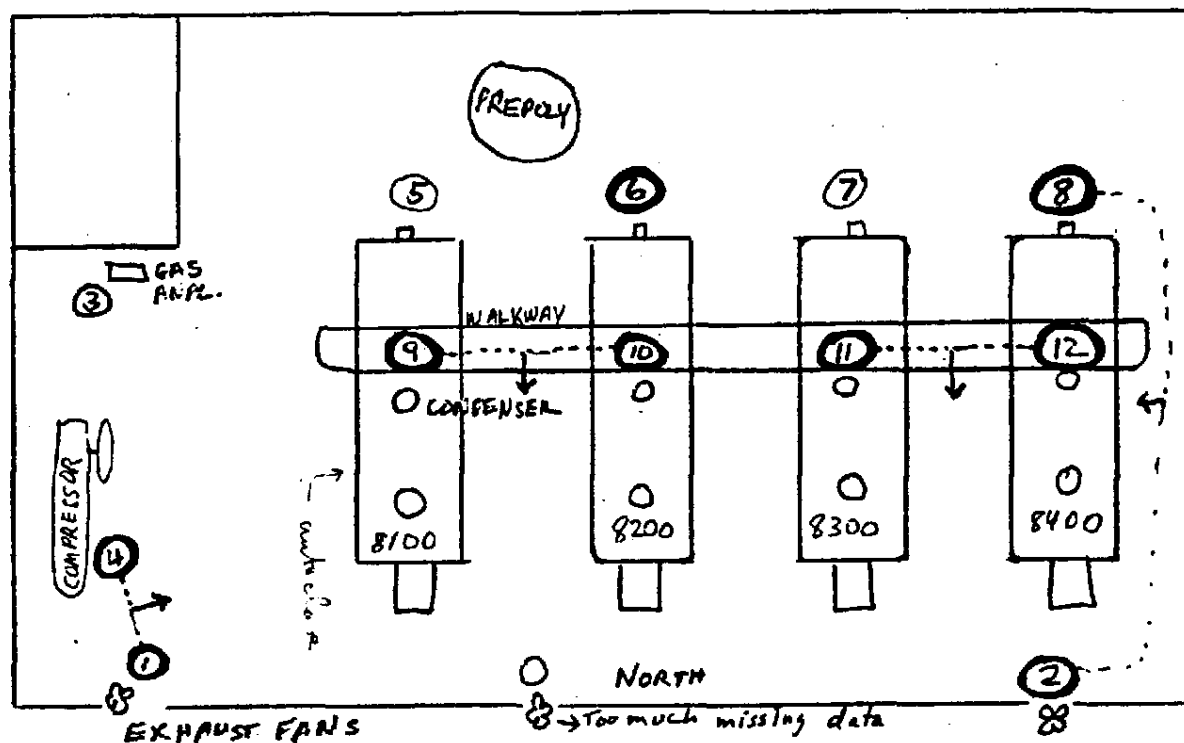
|                             | <u>Bendix<br/>Probes Rqd.</u> | <u>Points<br/>Sampled</u> | <u>% Variation<br/>Explained</u> | <u>Avg. PPM<br/>VC1</u> | <u>Standard<br/>Error</u> | <u>± 95%<br/>Limits</u> | <u>Times<br/>Would Miss<br/>Est. 50 PPM</u> |
|-----------------------------|-------------------------------|---------------------------|----------------------------------|-------------------------|---------------------------|-------------------------|---------------------------------------------|
| FANS Only                   | 3                             | 1<br>2<br>16              | 91.2                             | 19.7                    | 23.6%                     | + 47.2%                 | 0                                           |
| FANS and 3<br>Likely Points | 3                             | 1<br>2<br>16              | 91.2                             | 19.7                    | 23.6%                     | + 47.2                  | 0                                           |
| FANS Only                   | 3                             | 1<br>2<br>16              | 89.9                             | 15.6                    | 21.2%                     | + 42.4%                 | 1<br>by 5 ppm                               |
| FANS and 3<br>Likely Points | 6                             | 1,2<br>6<br>9<br>11<br>16 | 97.0                             | 15.6                    | 11.3%                     | + 22.6%                 | 0                                           |

MARCH  
1973

FIG 1-VCI Vapors in Working Atmosphere  
Pedricktown

O.V.A.

MASS BUILDING - 512



24523014

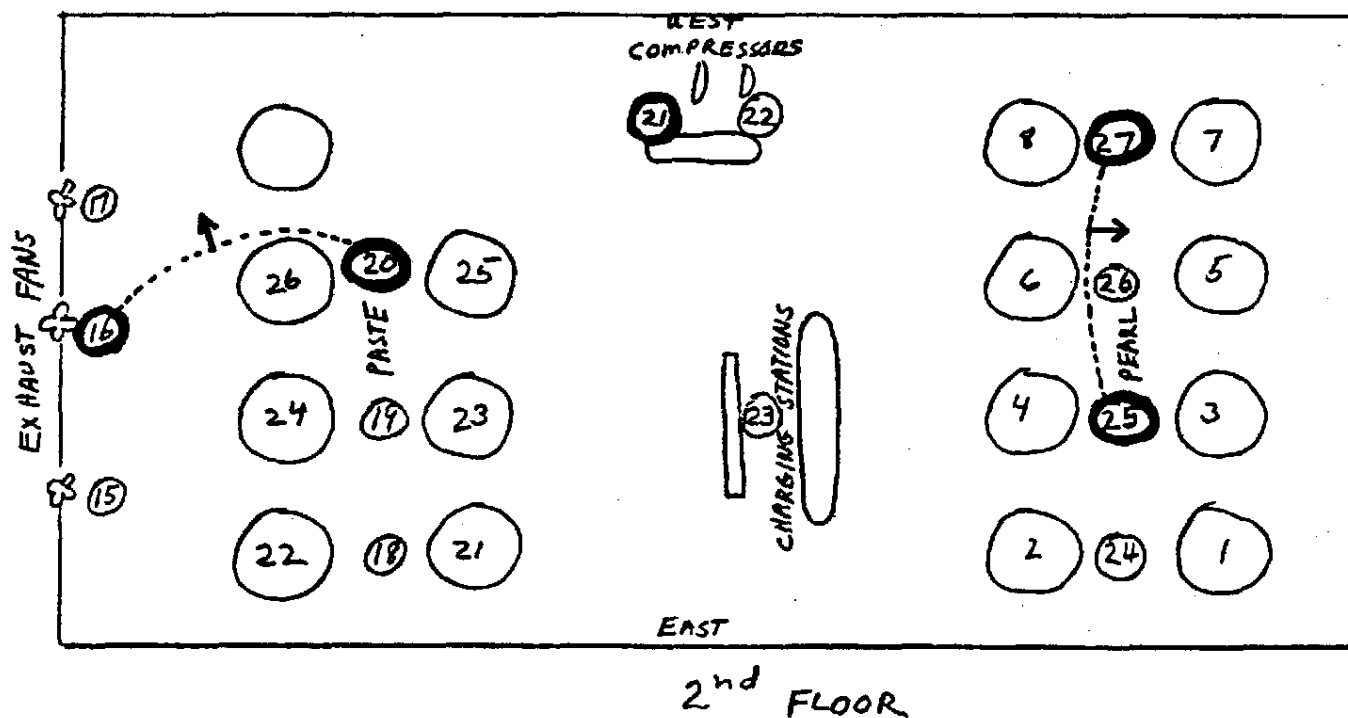
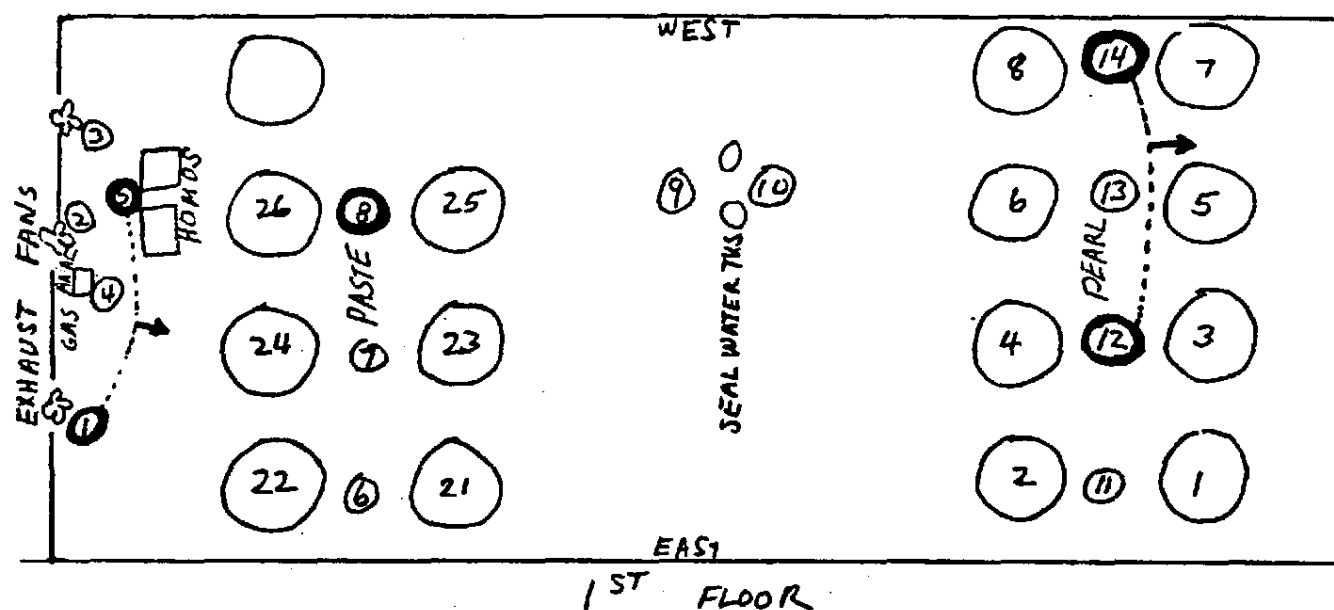
BFG31753

MARCH  
1973

FIG. 2.-VCI Vapors in Working Atmosphere  
Pedricktown

O.V.A.

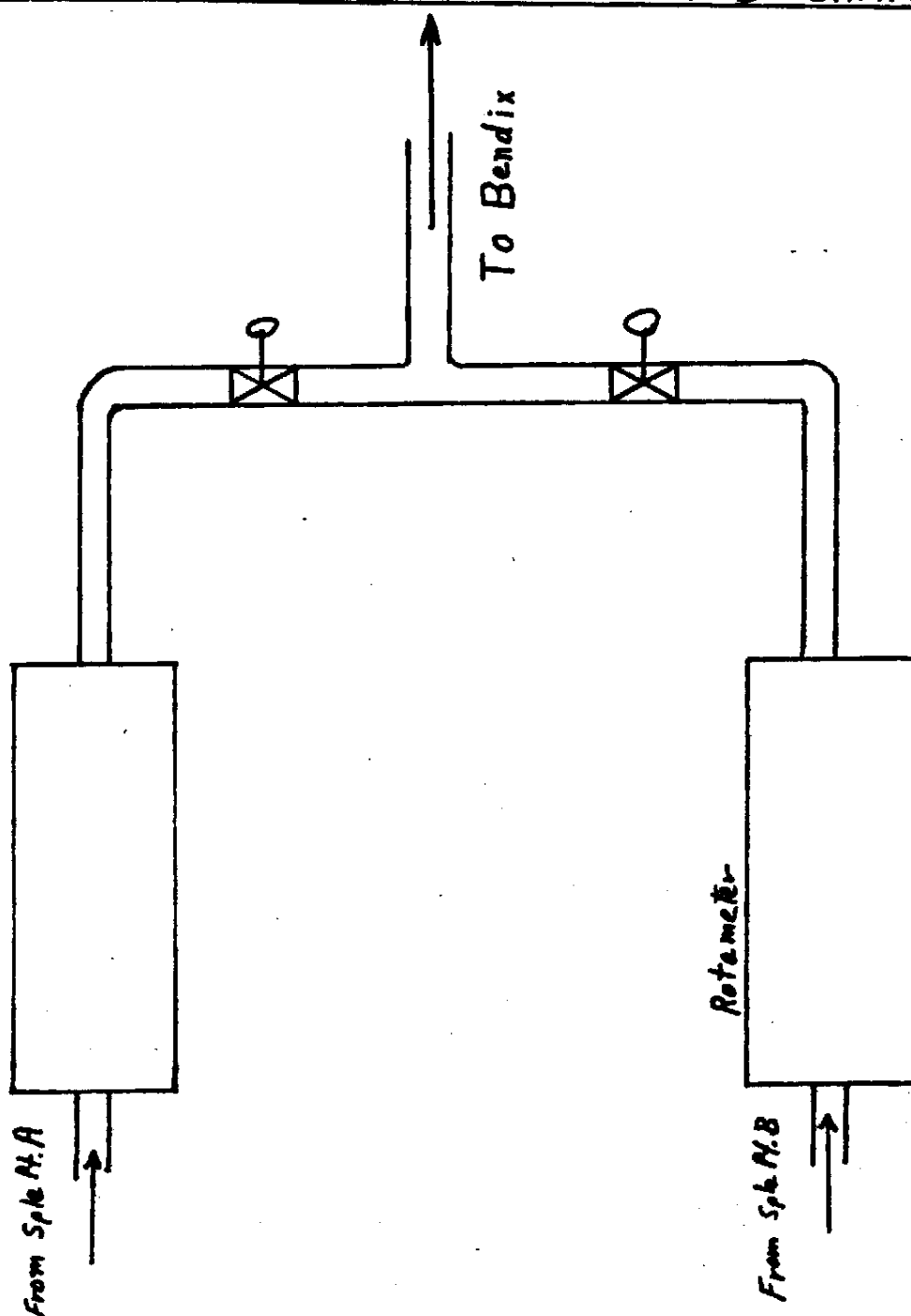
POLY BUILDING - 513



24523015

BFG31754

FIG. 3.-FLOW CHART FOR PAIRED SAMPLING



24523016

BFG31755

24523017

BFG31756

Fig. 4  
PEDRICKTOWN MASS - First Floor

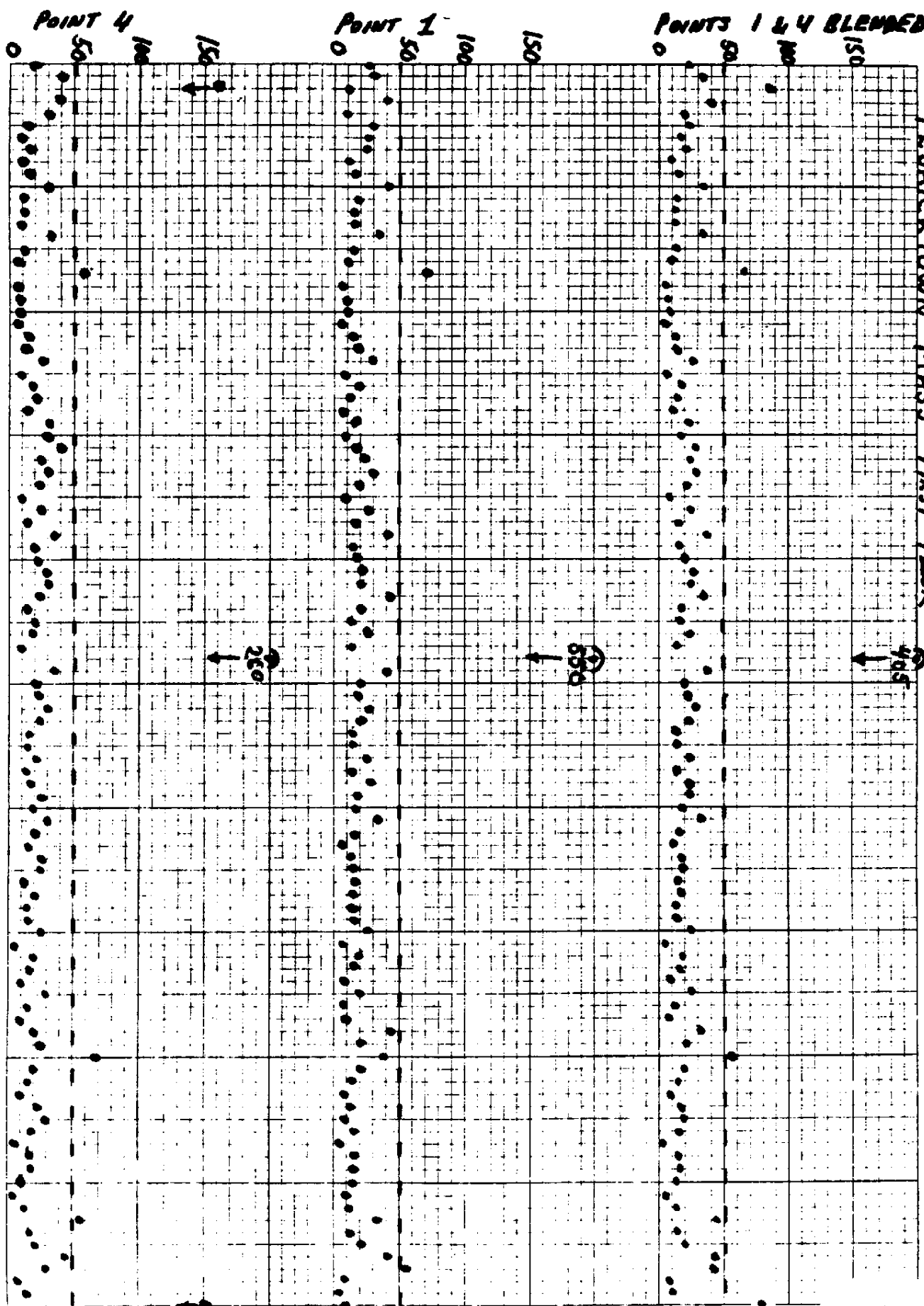
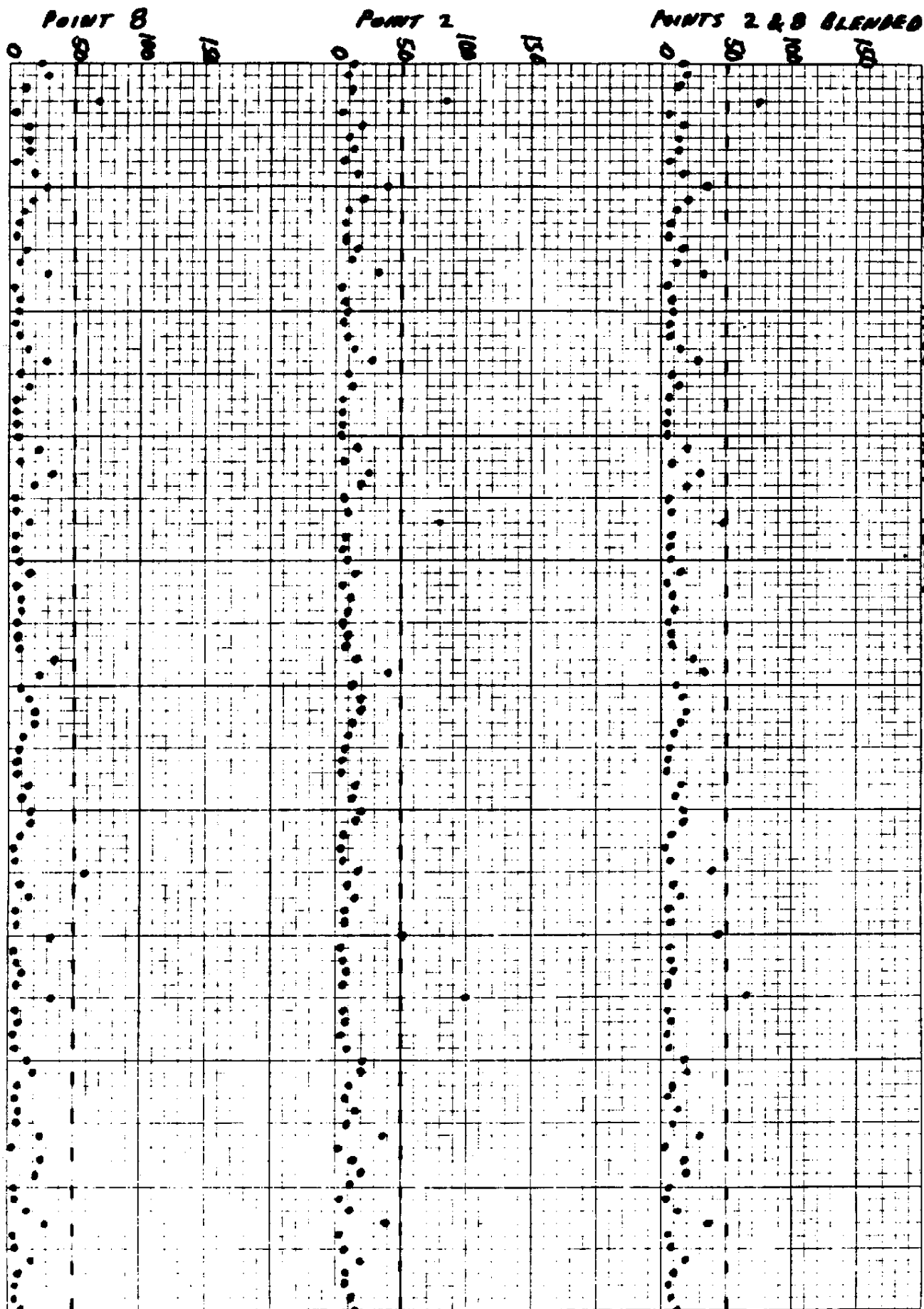


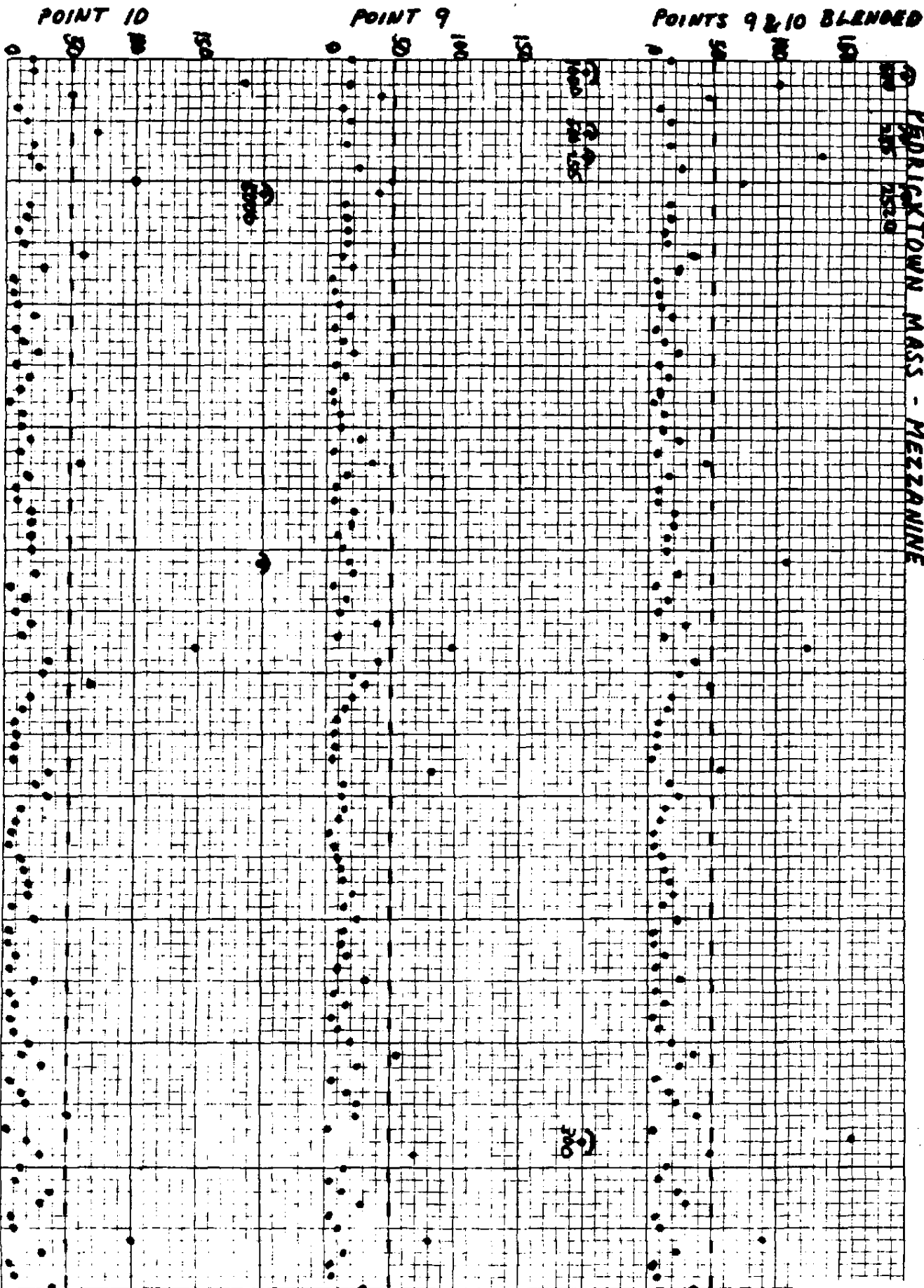
Fig. 5.-  
PEDRICKTOWN MASS - FIRST FLOOR



24523018

FIG. 6.-

PEDRICKTOWN MASS. - MEZZANINE



NO. 341-10 DIETZGEN GRAPH PAPER  
10 X 10 PER INCH

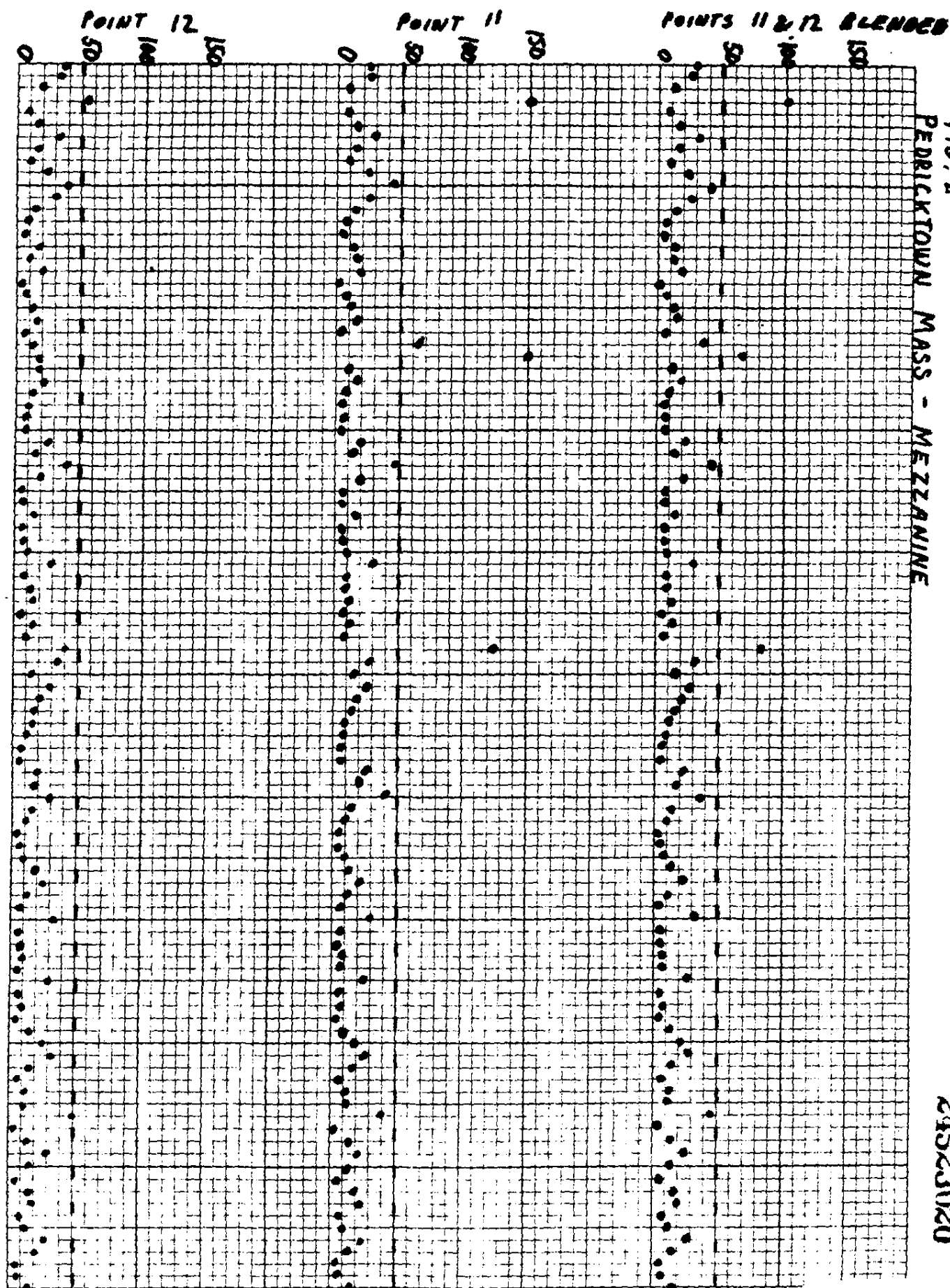
EUGENE DIETZGEN CO.  
MADE IN U. S. A.

BFG31758

NO. 341-10 DIETZGEN GRAPH PAPER  
10 X 10 PER INCH

EUGENE DIETZGEN CO.  
MADE IN U. S. A.

Fig. 7 -  
PEDRICKTOWN MASS - MEZZANINE



24523020

BFG31759

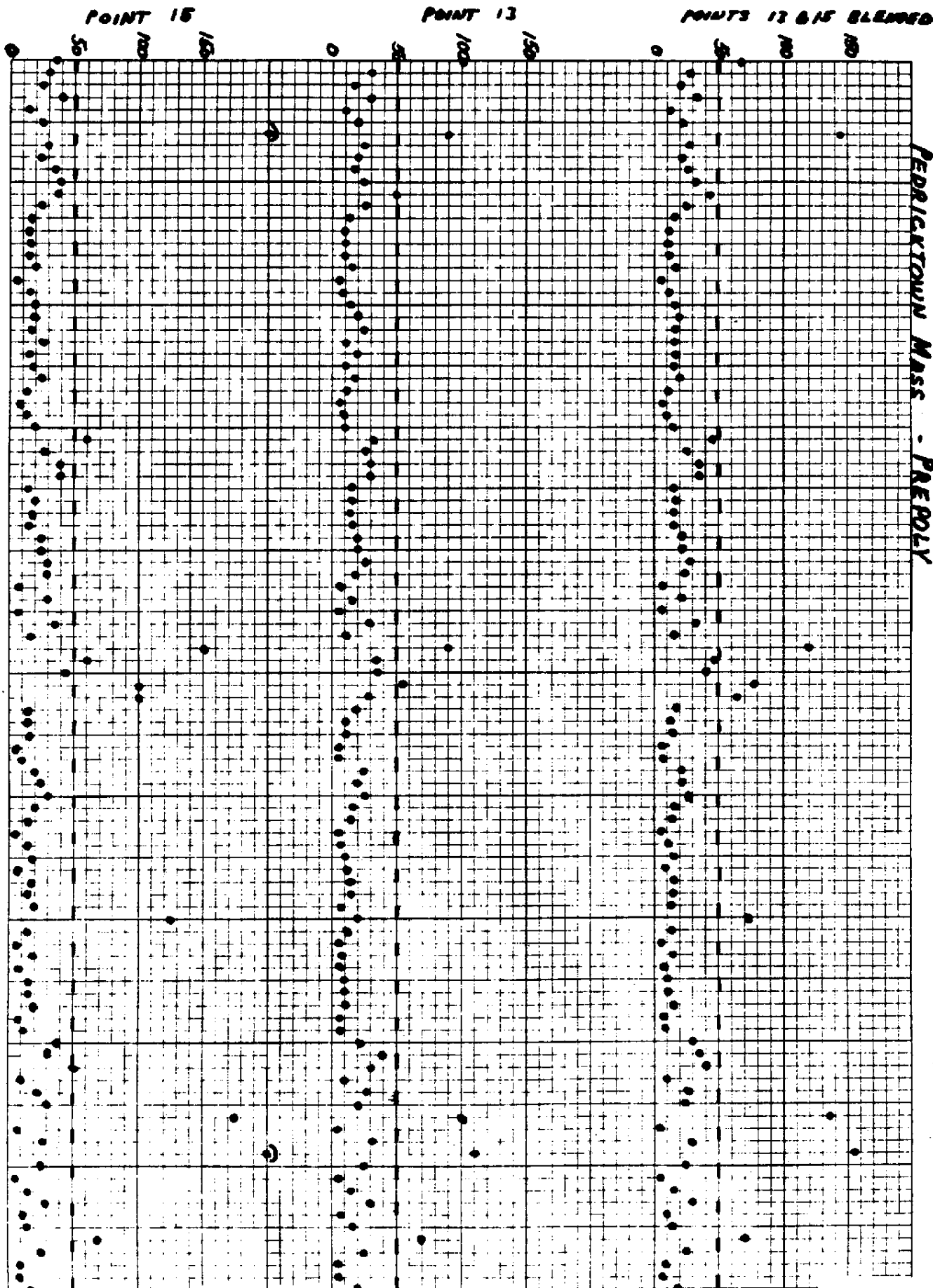
NO. 341-10 DIETZGEN GRAPH PAPER  
10 X 10 PER INCH

EUGENE DIETZGEN CO.  
MADE IN U. S. A.

FIG. 8.-

PEDRICKTOWN MASS. - PREPOLY

24523021



BFG31760