

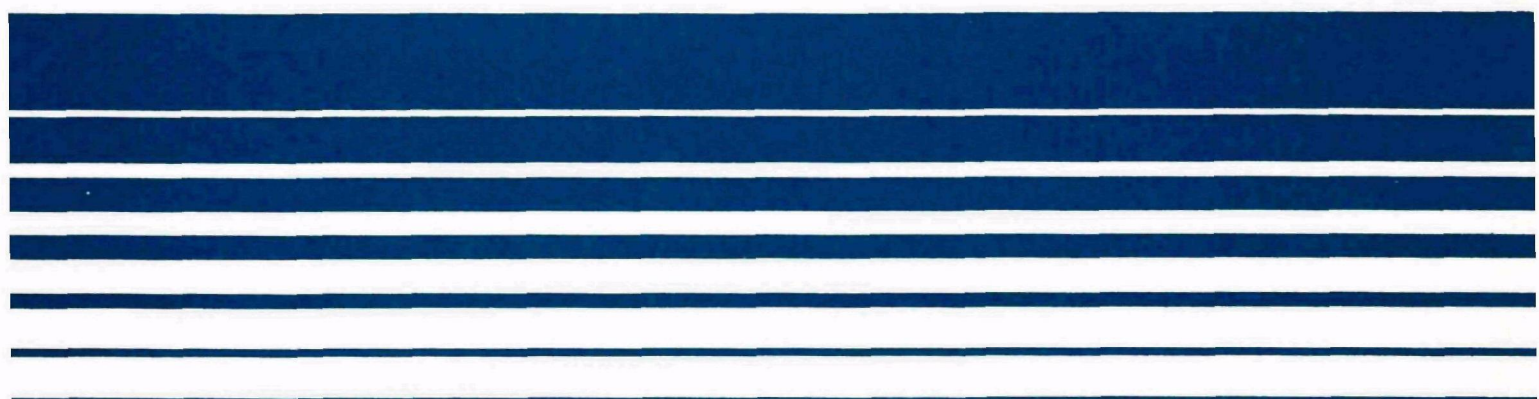
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# **Industrial Surface Coating (Coil)**

## **Emission Test Report Precoat Metals Incorporated St. Louis, Missouri**



EMISSION TEST OF A COIL COATING PLANT IN ST. LOUIS, MISSOURI

by

George W. Scheil

October 1980

FINAL REPORT

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Emission Measurement Branch

Field Testing Section

Environmental Protection Agency

Research Triangle Park, North Carolina 27711

## PREFACE

The work reported herein was conducted by Midwest Research Institute under Environmental Protection Agency Contract No. 68-02-2814, Work Assignment No. 28.

The project was under the supervision of Mr. Douglas E. Fiscus, Head, Field Programs Section and Dr. Ken Wilcox, Program Manager. Dr. George Scheil was field team leader and was assisted in the field by Messrs. Jeff Thomas, Tom Walker, and Charles Brown. The volatile organic carbon lab analyses was performed by Pollution Control Sciences.

Approved for:

MIDWEST RESEARCH INSTITUTE

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October 8, 1980

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## SECTION 1

### INTRODUCTION

This report presents the results of source testing performed during the period August 28 to September 6, 1979, at the Precoat Metals coil coating plant in St. Louis, Missouri. Midwest Research Institute (MRI), U.S. Environmental Protection Agency (EPA), and Research Triangle Institute (RTI) participated in the field testing and Pollution Control Sciences (PCS) performed laboratory analyses for volatile organic carbon (VOC) by tentative EPA Methods 24 and 25 (see Appendices A and B). Separate test series were run at the prime and finish coat ovens and their incinerators. Liquid samples were obtained from the paint being applied, and gas samples were obtained at the inlet and outlet of the incinerator for each test.

Sampling included a material balance of volatile organics in the coil coating process, continuous nitrogen oxides ( $\text{NO}_x$ ) and total hydrocarbons (THC) measurements at the process incinerator outlets, volumetric flow measurements at the inlets and outlets of the incinerators, VOC measurements at the finish oven quench area, and simultaneous VOC measurements at the inlet and outlet of each incinerator.

The results of these tests are to be evaluated by EPA as part of the development of emission standards for this industry.

## SECTION 2

### SUMMARY AND DISCUSSION OF RESULTS

Figures 1 through 6 show the time sequences for the sampling program. Refer to these figures for correlations between the VOC/continuous monitoring runs and the material balance data which follow.

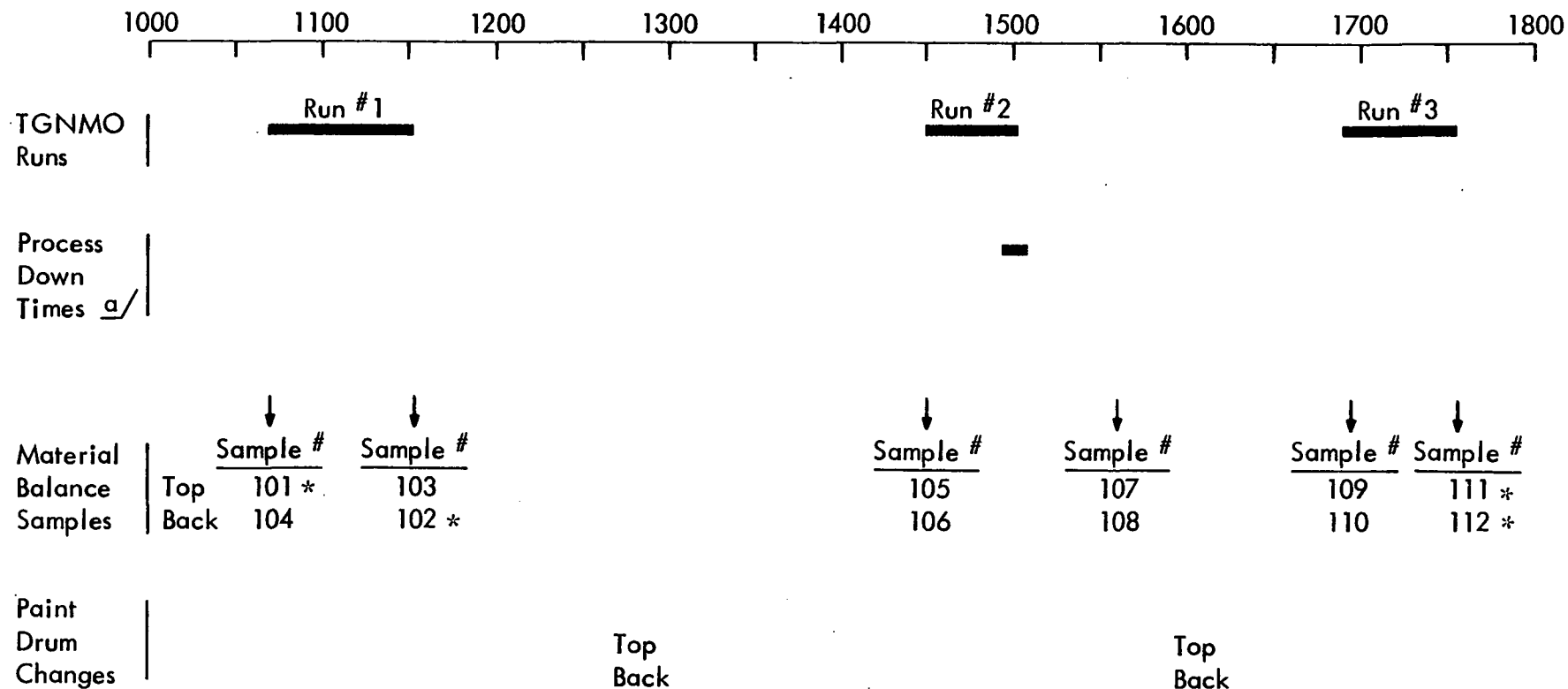
Table 1 lists the results of the VOC sampling at the inlet and outlet of the afterburners and the continuous flame ionization detector (FID) measurements of total hydrocarbons at the outlets. Process upsets occurred during five of the runs. Generally, sampling was halted at the upset if at least 20 min of sampling had occurred. If less than 20 min had elapsed the run was restarted when the line stabilized after the end of the upset. A shortage of sample traps did not allow the runs to be repeated. The interruptions seem to have seriously affected only Runs 2 and 18. After rejecting these two runs serious inconsistencies remain, especially at the lower concentrations, between the THC and VOC results. The accuracy of the manually integrated THC traces is limited during Runs 4 and 6 and 16 through 18 due to rapid variations in the THC concentration. Some heavy tar buildup was also observed in the THC heated line. This tar could not have reached the VOC tanks, which also show a high carbon content. Data sheets for the VOC sampling and analysis results are in Appendix C.

Table 2 contains general information on gas temperatures, composition, and flow rates. Data sheets for velocity traverses are in Appendix D. Log book entries for compositions are in Appendix E.  $\text{NO}_x$  measurements at the outlet were by continuous monitor. The final traverse runs on 9/6 indicate that the flow and composition at the stack is a reasonable composite of the finish and prime ducts with little air leakage.

Moisture for the final traverse at the finish inlet was the average of Runs 7 through 9. The prime inlet moisture was the value from Run 18. Stack moisture was assumed to be the average of the prime and finish outlet moisture for Runs 7 and 9 and 16 through 18.

Table 3 shows the results of analyses of selected paint samples for density and percent volatiles. Sampling data sheets and analysis results are given in Appendix F.

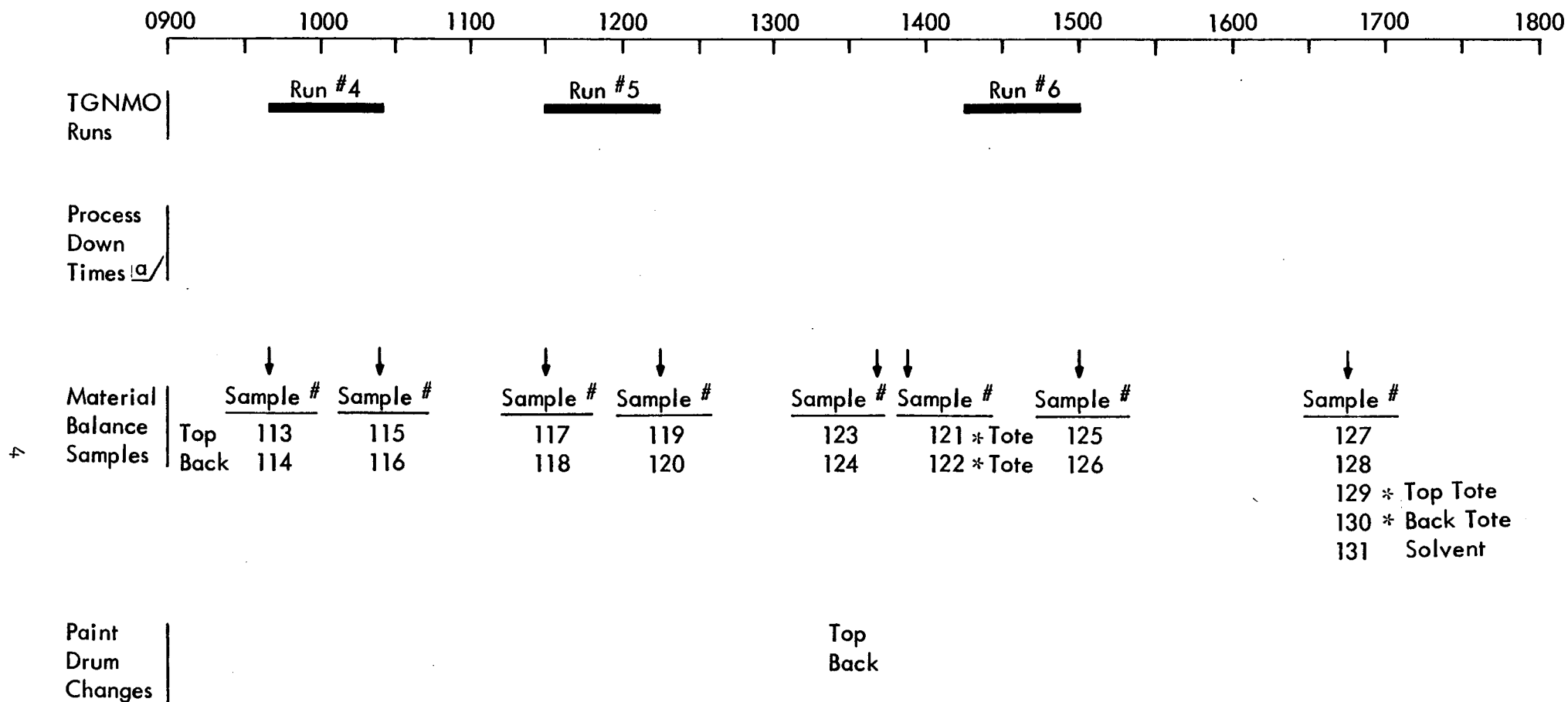




\* Sample Analysis in Table 3.

a/ Only Process Down Times Which Occurred During Sampling Runs Are Noted.

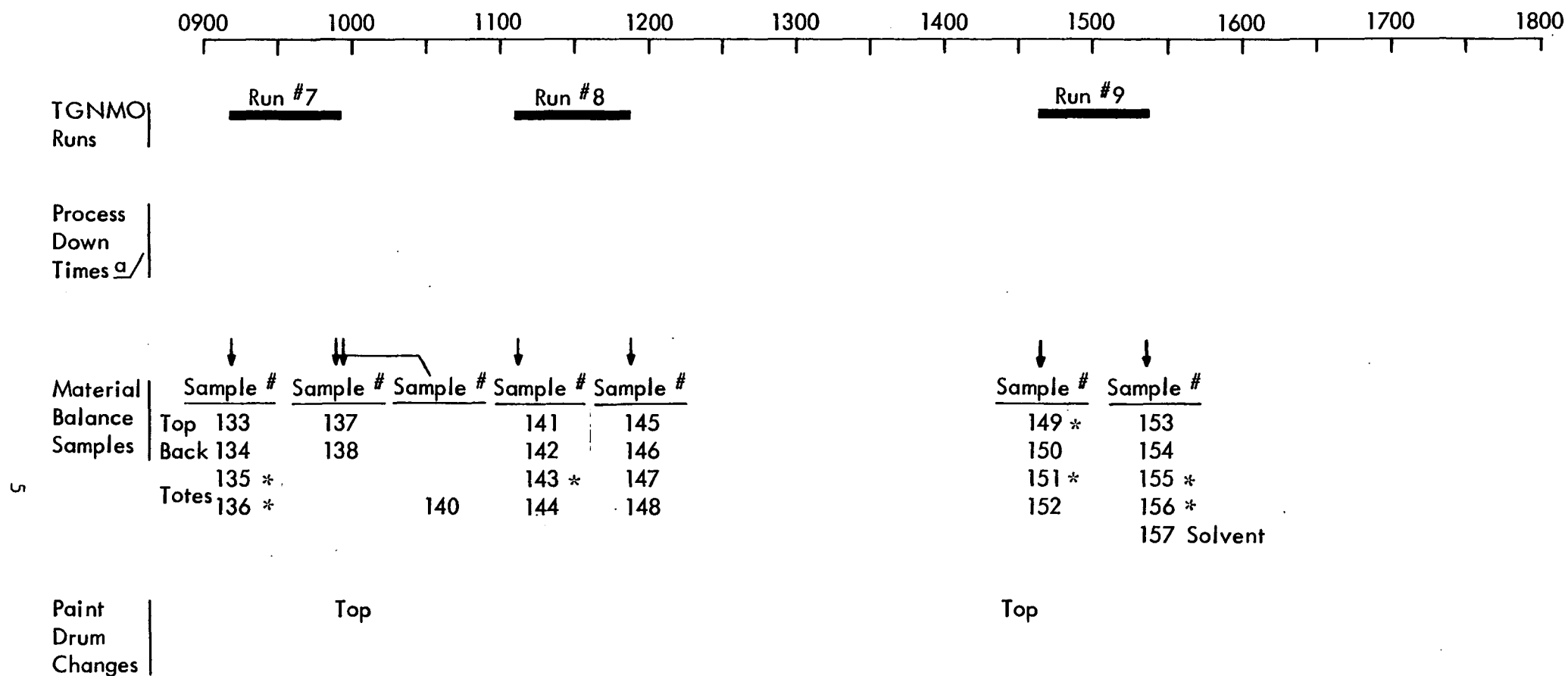
Figure 1. Time chart for finish coater, afterburner temperature 1400°F.



\* Sample Analysis in Table 3.

a/ Only Process Down Times Which Occurred During Sampling Runs Are Noted.

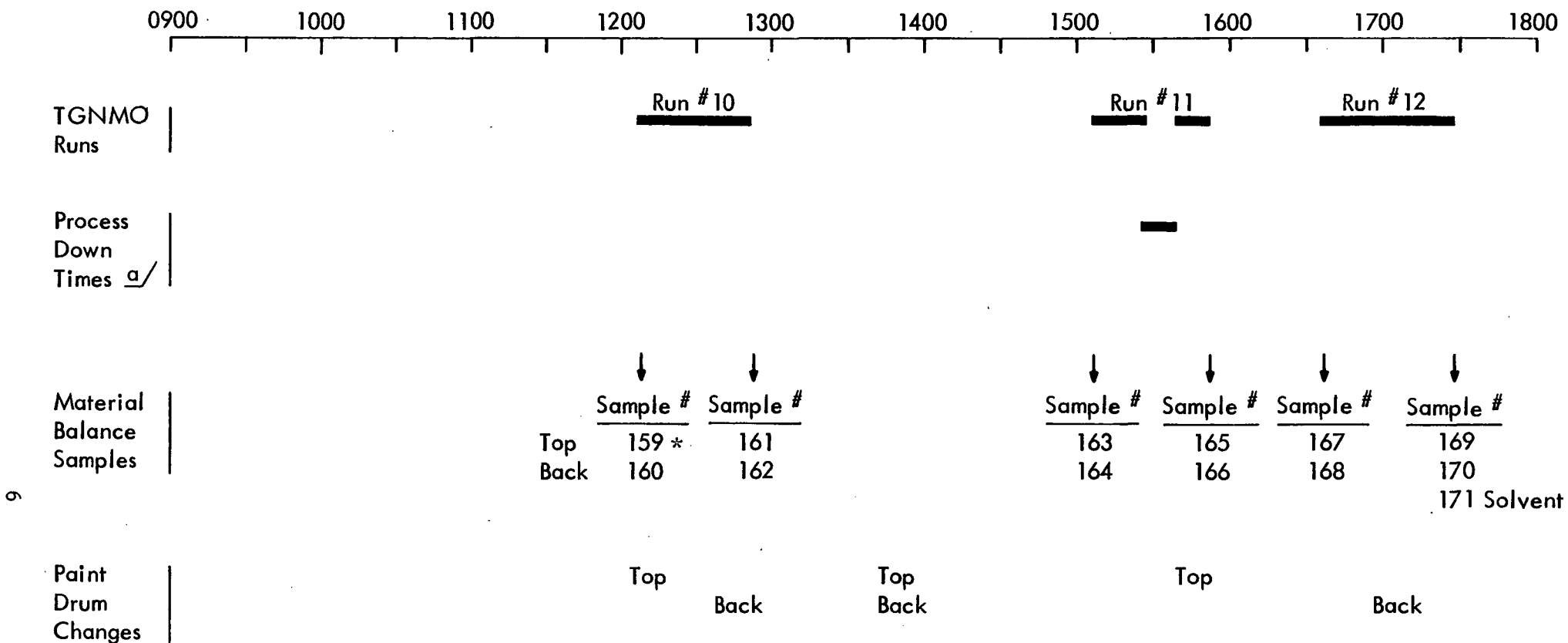
Figure 2. Time chart for finish coater, afterburner temperature 1200°F.



\* Sample Analysis in Table 3.

<sup>a/</sup> Only Process Down Times Which Occurred During Sampling Runs Are Noted.

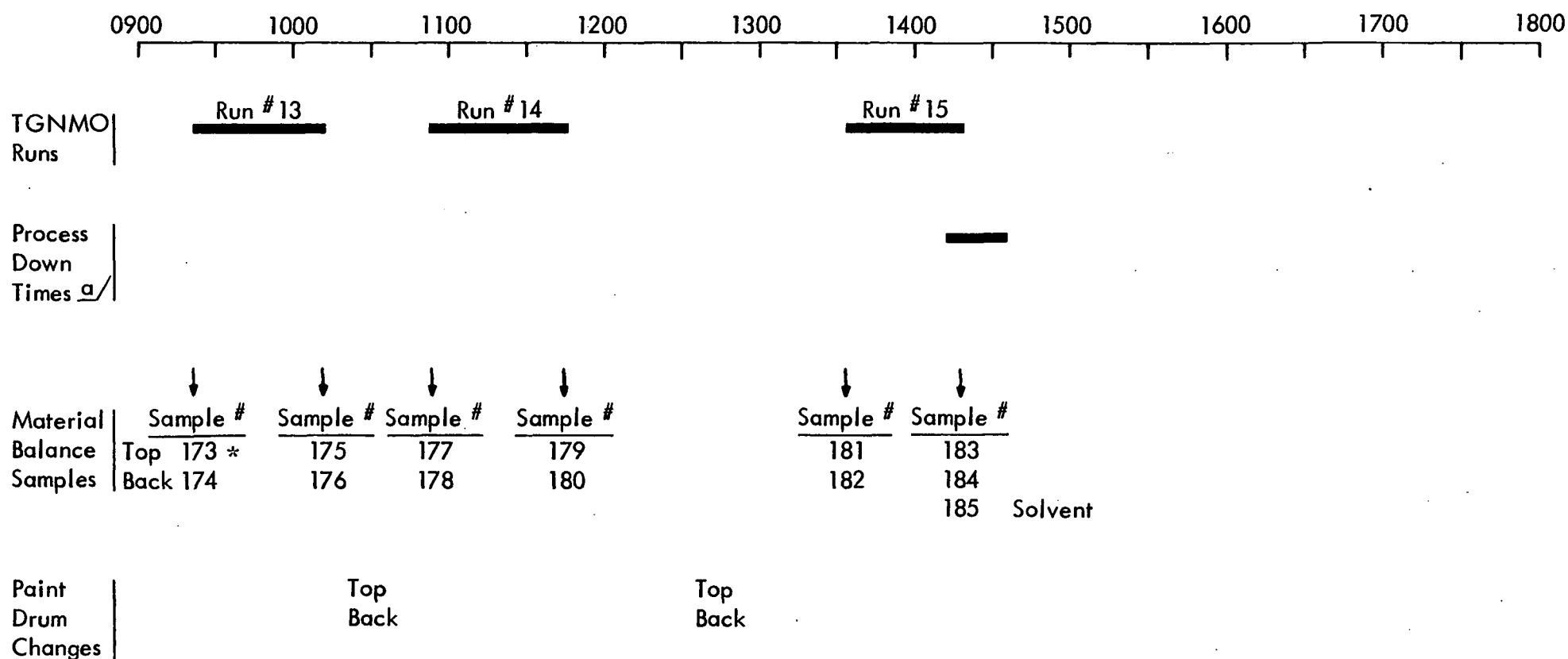
Figure 3. Time chart for finish coater, afterburner temperature 900°F.



\* Sample Analysis in Table 3.

<sup>a/</sup> Only Process Down Times Which Occurred During Sampling Runs Are Noted.

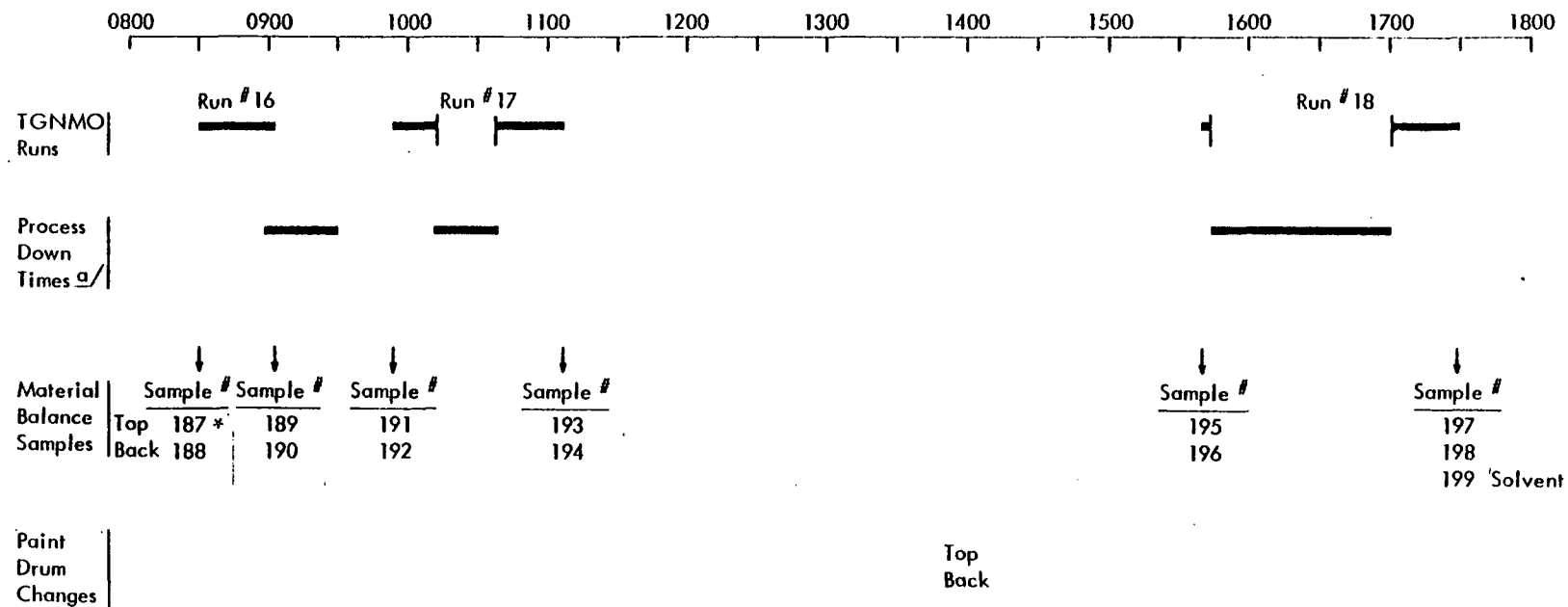
Figure 4. Time chart for prime coater, afterburner temperature 1400°F.



\* Sample Analysis in Table 3.

<sup>a/</sup> Only Process Down Times Which Occurred During Sampling Runs Are Noted.

Figure 5. Time chart for prime coater, afterburner temperature 1200°F.



\* Sample Analysis in Table 3.

a/ Only Process Down Times Which Occurred During Sampling Runs Are Noted.

Figure 6. Time chart for prime coater, afterburner temperature 1000°F.

TABLE 1. VOC/CONTINUOUS FID RESULTS

| Run No.          | Inlet        |              |               | Outlet       |              |               | THC-continuous FID-outlet |                    |                        |
|------------------|--------------|--------------|---------------|--------------|--------------|---------------|---------------------------|--------------------|------------------------|
|                  | PPM C (trap) | PPM C (tank) | PPM C (total) | PPM C (trap) | PPM C (tank) | PPM C (total) | PPM propane               | PPM C <sub>1</sub> | Remarks                |
| 1                | 16,006       | 582          | 16,588        | 841          | 387          | 1,228         | -                         | -                  |                        |
| 2 <sup>b/</sup>  | 631          | 561          | 1,192         | 304          | 174          | 478           | 0.4                       | 1.2                | Stable trace           |
| 3                | 6,035        | 3,600        | 9,635         | -a/          | -a/          | -a/           | 0.75                      | 2.2                | Stable trace           |
| 4                | 6,711        | 2,121        | 8,832         | 84           | 183          | 267           | 11                        | 33                 | Erratic trace          |
| 5                | 8,066        | 573          | 8,639         | 827          | 239          | 1,066         | 10                        | 30                 | Erratic trace          |
| 6                | 8,941        | 2,846        | 11,787        | 295          | 312          | 607           | 10                        | 30                 | Erratic trace          |
| 7                | 5,734        | 3,732        | 9,466         | 4,557        | 678          | 5,235         | 2,125                     | 6,375              | Stable trace           |
| 8                | 7,058        | 3,425        | 10,483        | 3,084        | 454          | 3,538         | 1,850                     | 5,550              | Stable trace           |
| 9                | 9,389        | 3,242        | 12,631        | 4,571        | 409          | 4,980         | 1,800                     | 5,400              | Stable trace           |
| 10               | 5,466        | 293          | 5,759         | 148          | 123          | 271           | -                         | -                  |                        |
| 11 <sup>b/</sup> | 6,290        | 567          | 6,857         | 100          | 170          | 270           | 8.0                       | 24                 | Stable trace           |
| 12               | 6,570        | 405          | 6,975         | 153          | 145          | 298           | 9.0                       | 27                 | Stable trace           |
| 13               | -a/          | -a/          | -a/           | 184          | 384          | 568           | 12.5                      | 37.5               | Stable trace           |
| 14               | 2,280        | 534          | 2,814         | 276          | 220          | 496           | 11.0                      | 33.0               | Stable trace           |
| 15 <sup>b/</sup> | 1,202        | 535          | 1,737         | 76           | 195          | 271           | 10.5                      | 31.5               | Stable trace           |
| 16               | 926          | 511          | 1,437         | 873          | 591          | 1,464         | 315                       | 945                | Medium stability trace |
| 17 <sup>b/</sup> | 634          | 459          | 1,093         | 533          | 528          | 1,061         | 350                       | 1,050              | Medium stability trace |
| 18 <sup>b/</sup> | 2,593        | 615          | 3,208         | 347          | 458          | 805           | 275                       | 825                | Medium stability trace |

a/ Trap damaged in shipment--not analyzed.

b/ Process upset during run, TGNMO results are of uncertain validity.

TABLE 2. GAS COMPOSITION AND FLOW RATES

| Run No. | Date/time                   | Incinerator temperature (°F) | Coating |                   |                    |                    | Inlet                |  | Flow rate                                      |       |                   |                  |                    | Outlet               |  | NO <sub>x</sub> (ppm NO <sub>2</sub> ) |
|---------|-----------------------------|------------------------------|---------|-------------------|--------------------|--------------------|----------------------|--|--|-------|-------------------|------------------|--------------------|----------------------|--|--|
|         |                             |                              |         | % CO <sub>2</sub> | % O <sub>2</sub>   | % H <sub>2</sub> O | Temperature °F, (°C) |  | dsft <sup>3</sup> /min (dsm <sup>3</sup> /min) |       | % CO <sub>2</sub> | % O <sub>2</sub> | % H <sub>2</sub> O | Temperature °F, (°C) |  |  |
| 1       | 8/28/1042 - 1132            | 1400                         | Finish  | 0.0               | 19.0 <sup>a/</sup> | 7.8                | 702                  |  |  |       | 5.5               | 13.5             | 11.4               | 310 (155)            |  | 34                                     |
| 2       | 8/28/1432 - 1502            | 1400                         |         | <sup>a/</sup>     | <sup>b/</sup>      | 10.1               | (372)                |  | 7,870  |       | 4.6               | 13.3             | 13.2               | 300 (150)            |  | 34                                     |
| 3       | 8/28/1654 - 1733            | 1400                         |         | 2.0               | 16.2               | 8.7                |                      |  |  | (223) | 5.2               | 11.1             | 11.7               | 290 (145)            |  | 36                                     |
| 4       | 8/29/0940 - 1025            | 1200                         |         | 3.0               | 17.0               | 6.8                | 700                  |  |  |       | 4.2               | 15.2             | 9.4                | 280 (135)            |  | 17                                     |
| 5       | 8/29/1129 - 1215            | 1200                         |         | 2.8               | 18.5               | 6.9                | (371)                |  | 8,610  |       | 3.8               | 14.7             | 8.6                | 285 (140)            |  | 15                                     |
| 6       | 8/29/1414 - 1500            | 1200                         |         | 3.1               | 19.5               | 7.1                |                      |  |  | (244) | 4.3               | 14.8             | 8.7                | 290 (145)            |  | 16                                     |
| 7       | 8/30/0910 - 0953            | 900                          |         | 1.6               | 19.1               | 7.4                | 532                  |  |  |       | 3.6               | 17.6             | 7.4                | 290 (145)            |  | 7.9                                    |
| 8       | 8/30/1106 - 1152            | 900                          |         | 1.2               | 18.8               | 7.9                | (278)                |  | 10,070   |       | 2.2               | 17.0             | 3.8                | 290 (145)            |  | 6.7                                    |
| 9       | 8/30/1438 - 1522            | 900                          |         | 1.1               | 19.0               | 7.0                |                      |  |  | (285) | 2.5               | 17.8             | 7.8                | 290 (145)            |  | 7.5                                    |
| 10      | 9/4/1206 - 1251             | 1400                         | Primer  | 3.2               | 18.0               | 10.0               | 715                  |  |  |       | 5.6               | 14.2             | 11.3               | 280 (135)            |  | 29                                     |
| 11      | 9/4/1506 - 1525/1539 - 1552 | 1400                         |         | 3.0               | 16.9               | 8.3                | (379)                |  | 6,540  |       | 5.5               | 13.8             | 8.0                | <sup>c/</sup>        |  | 26                                     |
| 12      | 9/4/1636 - 1728             | 1400                         |         | 3.1               | 17.4               | 10.4               |                      |  |  | (184) | 5.4               | 13.4             | 12.3               | <sup>c/</sup>        |  | 29                                     |
| 13      | 9/5/0922 - 1012             | 1200                         |         | 2.6               | 18.0               | 9.7                | 656                  |  |  |       | 5.1               | 15.6             | 10.5               | <sup>c/</sup>        |  | 37                                     |
| 14      | 9/5/1053 - 1145             | 1200                         |         | 2.0               | 17.6               | 9.9                | (347)                |  | 6,970  |       | 5.2               | 15.2             | 11.5               | <sup>c/</sup>        |  | 30                                     |
| 15      | 9/5/1334 - 1418             | 1200                         |         | 1.9               | 17.0               | 9.3                |                      |  |  | (195) | 5.2               | 15.3             | 11.9               | <sup>c/</sup>        |  | 31                                     |
| 16      | 9/6/0830 - 0903             | 1000                         |         | 2.6               | 18.4               | 9.7                | 716                  |  |  |       | 3.3               | 16.7             | 10.1               | <sup>c/</sup>        |  | 27                                     |
| 17      | 9/6/0954 - 1013/1039 - 1107 | 1000                         |         | 1.8               | 18.0               | 9.9                | (380)                |  | 7,470  | (209) | 3.9               | 17.4             | 10.4               | <sup>c/</sup>        |  | 30                                     |
| 18      | 9/6/1540 - 1544/1701 - 1729 | 1000                         |         | 2.2               | 18.7               | 9.1                |                      |  |  |       | 4.1               | 17.4             | 8.9                | <sup>c/</sup>        |  | 32                                     |
|         | 9/6                         | 1000                         | Finish  | 3.3               | 19.4               | 7.4                | 621 (327)            |  | 9,260  | (260) |                   |                  |                    |                      |  |  |
|         | 9/6                         | 1000                         | Stack   | 3.0               | 16.3               | 8.7                | 935 (502)            |  | 20,910   | (534) |                   |                  |                    |                      |  |  |

<sup>a/</sup> Bag leaked, value suspect, remaining samples at inlet measuring direct from duct.

<sup>b/</sup> Line upset occurred before sample obtained.

<sup>c/</sup> Potentiometer inoperative - temperature not obtainable.



TABLE 3. PAINT SAMPLE ANALYSES

| Sample No. |                        | % Volatile (v/w) | Density gm/cm <sup>3</sup> | % Volatiles (v/v) | Kg C/l solids | lb C/gal. paint | Kg C/l paint |
|------------|------------------------|------------------|----------------------------|-------------------|---------------|-----------------|--------------|
| 101        | Top coat Run 1 before  | 27.23            | 1.3185                     | 39.94             | .368          | 1.84            | .2210        |
| 102        | Back coat Run 1 after  | 31.99            | 1.2506                     | 44.97             | .554          | 2.54            | .3049        |
| 111        | Top coat Run 3 after   | 25.75            | 1.3259                     | 37.84             | .372          | 1.93            | .2312        |
| 112        | Back coat Run 3 after  | 31.61            | 1.2519                     | 44.29             | .528          | 2.43            | .2941        |
| 121        | Top tote Run 6         | 26.47            | 1.3073                     | 39.04             | .405          | 2.06            | .2469        |
| 122        | Back tote Run 6        | 32.86            | 1.2137                     | 45.36             | .540          | 2.46            | .2951        |
| 129        | Top tote Run 6 - end   | 28.48            | 1.3098                     | 42.19             | .445          | 1.78            | .2128        |
| 130        | Back tote Run 6 - end  | 34.17            | 1.2496                     | 48.42             | .663          | 2.85            | .3420        |
| 135        | Top tote Run 7 before  | 25.24            | 1.3087                     | 37.29             | .383          | 2.00            | .2402        |
| 136        | Back tote Run 7 before | 30.69            | 1.2247                     | 42.69             | .493          | 2.36            | .2825        |
| 143        | Top tote Run 8 before  | 25.74            | 1.3073                     | 37.49             | .404          | 2.11            | .2525        |
| 149        | Top coat Run 9 before  | 24.81            | 1.2738                     | 35.67             | .346          | 1.86            | .2226        |
| 151        | Top tote Run 9 before  | 28.28            | 1.3050                     | 41.69             | .434          | 2.11            | .2531        |
| 155        | Top tote Run 9 after   | 27.35            | 1.3022                     | 40.27             | .439          | 2.19            | .2622        |
| 156        | Back tote Run 9 after  | 33.48            | 1.2179                     | 46.35             | .583          | 2.61            | .3128        |
| 159        | Top coat Run 10 before | 46.98            | 1.0928                     | 57.87             | .905          | 3.18            | .3813        |
| 173        | Top coat Run 13 before | 46.47            | 1.1823                     | 60.36             | .804          | 2.66            | .3187        |
| 187        | Top coat Run 16 before | 46.16            | 1.1220                     | 55.98             | .635          | 2.33            | .2795        |

Table 4 summarizes the material balance data.

Table 5 presents the results of sampling at the finish line quench zone. The flow rate and low hydrocarbons content indicate that this vent is not a significant emission source.

Sample calculations are included in Appendix G.

TABLE 4. MATERIAL BALANCE DATA

| Run No.          | Line speed (ft/min) | Metal width (in.) | Metal gauge (in.) | Fe <sup>2</sup> /min (m <sup>2</sup> /min) | Paint used |             | Time (min) | Organic loading <sup>a/</sup> |                 |                  |            | Incinerator inlet |          |                   | Incinerator outlet <sup>b/</sup> |                        |                       |         |
|------------------|---------------------|-------------------|-------------------|--|------------|-------------|------------|-------------------------------|-----------------|------------------|------------|-------------------|----------|-------------------|----------------------------------|------------------------|-----------------------|---------|
|                  |                     |                   |                   |  | Top (gal.) | Back (gal.) |            | Top (lb G/min)                | Back (lb G/min) | Total (lb G/min) | (kg G/min) | lb G/min          | kg G/min | % Removal In oven | lb G/min                         | kg G/min               | % Removal Incinerator | Process |
| 1                | 350                 | 41-9/16           | 0.019             | 1,210 (112)                                | 44.3       | 44          | 51         | 1.65                          | 2.14            | 3.78             | 1.72       | 5.06              | 1.84     | neg.              | 0.31                             | 0.15                   | 92.5                  | 91.8    |
| 2 <sup>c/</sup>  | 350                 | 41-9/16           | 0.019             | 1,210 (112)                                | 14.2       | 17          | 21         | 1.27                          | 2.01            | 3.28             | 1.49       | 0.29              | 0.13     | 96.0              | 0.13                             | 5.3 x 10 <sup>-2</sup> | 58.6                  | 98.1    |
| 3                | 285                 | 41-9/16           | 0.024             | 990 (92)                                   | 36         | 24.2        | 39         | 1.65                          | 1.54            | 3.18             | 1.44       | 2.36              | 1.07     | 75.8              | -                                | -                      | -                     | -       |
| 4                | 350                 | 41-3/8            | 0.019             | 1,210 (112)                                | 18         | 29          | 20         | 1.81                          | 3.73            | 5.54             | 2.52       | 2.36              | 1.07     | 57.4              | 0.071                            | 3.2 x 10 <sup>-2</sup> | 97.0                  | 98.4    |
| 5                | 350                 | 41-3/8            | 0.019             | 1,210 (112)                                | 37.5       | 13.5        | 39         | 1.94                          | 0.89            | 2.83             | 1.28       | 2.36              | 1.07     | 16.6              | 0.29                             | 0.13                   | 87.7                  | 95.5    |
| 6                | 350                 | 41-3/8            | 0.019             | 1,210 (112)                                | 11         | 13          | 22         | 1.01                          | 1.52            | 2.53             | 1.15       | 3.15              | 1.43     | neg.              | 0.16                             | 7.4 x 10 <sup>-2</sup> | 94.9                  | 97.1    |
| 7                | 350                 | 35-3/8            | 0.0175            | 1,030 (96)                                 | 41         | 15.5        | 45         | 1.86                          | 0.89            | 2.73             | 1.24       | 2.95              | 1.34     | neg.              | 1.63                             | 0.74                   | 44.7                  | 46.1    |
| 8                | 350                 | 35-3/8            | 0.0175            | 1,030 (96)                                 | 33.1       | 27.4        | 67         | 1.42                          | 1.50            | 2.92             | 1.33       | 3.28              | 1.59     | neg.              | 1.10                             | 0.50                   | 66.5                  | 62.1    |
| 9                | 350                 | 35-3/8            | 0.0175            | 1,030 (96)                                 | 49.4       | 22          | 46         | 2.17                          | 1.21            | 3.40             | 1.54       | 3.95              | 1.79     | neg.              | 1.57                             | 0.71                   | 60.1                  | 53.8    |
| 10 <sup>c/</sup> | 350                 | 41-9/16           | 0.019             | 1,210 (112)                                | 14.5       | 19.5        | 45         | 1.02                          | 1.38            | 2.40             | 1.09       | 1.17              | 0.53     | 51.2              | 0.055                            | 2.5 x 10 <sup>-2</sup> | 99.1                  | 92.7    |
| 11               | 350                 | 41-9/16           | 0.019             | 1,210 (112)                                | 15         | 17          | 32         | 1.49                          | 1.49            | 3.18             | 1.45       | 1.49              | 0.67     | 56.3              | 0.055                            | 2.5 x 10 <sup>-2</sup> | 96.0                  | 98.1    |
| 12               | 350                 | 41-9/16           | 0.019             | 1,210 (112)                                | 23         | 25          | 52         | 1.41                          | 1.51            | 2.94             | 1.33       | 1.41              | 0.64     | 52.0              | 0.060                            | 2.7 x 10 <sup>-2</sup> | 95.7                  | 98.0    |
| 13               | 350                 | 40                | 0.016             | 1,170 (109)                                | 22         | 21.5        | 49         | 1.19                          | 1.17            | 2.36             | 1.07       | -                 | -        | 0.12              | 5.6 x 10 <sup>-2</sup>           | -                      | 92.9                  | -       |
| 14               | 350                 | 40                | 0.016             | 1,170 (109)                                | 22.8       | 22.2        | 52         | 1.17                          | 1.14            | 2.31             | 1.05       | 0.66              | 0.30     | 71.4              | 0.11                             | 4.8 x 10 <sup>-2</sup> | 91.1                  | 95.2    |
| 15 <sup>c/</sup> | 350                 | 40                | 0.016             | 1,170 (109)                                | 17         | 18.5        | 38         | 1.19                          | 1.30            | 2.49             | 1.11       | 0.37              | 0.17     | 85.1              | 0.060                            | 2.7 x 10 <sup>-2</sup> | 91.6                  | 97.6    |
| 16               | 350                 | 36                | 0.0175            | 1,050 (98)                                 | 14         | 16          | 30         | 1.09                          | 1.24            | 2.33             | 1.06       | 0.33              | 0.15     | 85.8              | 0.33                             | 0.15                   | 0                     | 85.8    |
| 17 <sup>c/</sup> | 350                 | 36                | 0.0175            | 1,050 (98)                                 | 20.5       | 34          | 47         | 1.02                          | 1.69            | 2.71             | 1.23       | 0.26              | 0.12     | 90.4              | 0.24                             | 0.11                   | 7.7                   | 91.1    |
| 18 <sup>c/</sup> | 350                 | 36                | 0.0175            | 1,050 (98)                                 | 13         | 32          | 36         | 0.84                          | 2.07            | 2.91             | 1.32       | 0.75              | 0.34     | 74.2              | 0.185                            | 0.084                  | 75.3                  | 93.6    |

a/ Loading uses a composite of the paint analysis data of Table 3 for each series of runs. Runs 1 through 3 were grouped together (samples 101, 111 and 102, 112). Runs 4 through 9 use 121, 129, 135, 143, 149, 151, 155 and 122, 130, 136, 156. Runs 10 through 12 use 159. Runs 13 through 15 use 171. Runs 16 through 18 use 187.

b/ These data use the Method 25 outlet results which are much higher than indicated by the continuous FID. The continuous FID outlet data would indicate incinerator efficiencies →99.9% for Runs 2 and 3; about 99.7% for Runs 4 through 6; 99.6% for Runs 11 and 12 and 98 to 99% for Runs 14 and 15. The data for Runs 7 through 9 and 16 through 18 are similar for both methods.

c/ Process upset during run, Method 25 results are of uncertain validity.

TABLE 5. QUENCH RETURN DUCT DATA

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THC < 15 ppm Cl 21% oxygen

Flow rate - 200-250 ft/min

Flow - 45 ft<sup>3</sup>/min (1.25 M<sup>3</sup>/min)

VOC results - 129, 122, 164 ppm Cl

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## SECTION 3

### PROCESS DESCRIPTION AND OPERATION

#### PROCESS DESCRIPTION

Precoat Metals is a toll coater of metal coil and is owned by Chromalloy. They operate two coil coating lines in their plant at St. Louis. Both lines can process metal in widths from 18 to 44 in. and thicknesses of .008 to .050 in. In 1978 a B & K Machinery Company system of emission control was installed on the No. 2 line. This system uses zone incinerators inside the ovens to burn the solvent emitted from the metal coatings. A waste gas incinerator is also used with this system in conjunction with a waste heat boiler that supplies process steam for the wet section of the coil coating line and supplies steam for building heat in the winter. The burning of the solvent by the zone incinerators helps supply heat for curing the coatings, and by recirculating the air within the ovens, greatly reduces the amount of dilution air that must be brought into the oven.

The No. 2 line at this plant is fairly typical of coil coating lines in general. It consists of a decoiling or entry station, a joiner station, an inlet accumulator, a wet section for metal cleaning and pretreatment, a prime coat section with oven and quencher, a finish coat section with oven and quencher, an exit accumulator, an inspection station, a metal shear, and a recoil station. Each of the coating stations is enclosed in a coater room. A long metal hood extends from the point on the oven where the metal strip enters to a point very close to the coating applicator rolls. Air, supplied into the coating room from outside, is drawn into the oven through this hood. The hood extends into the coating room approximately 14 ft and completely encloses the metal strip over most of this length. The hood is for the purpose of capturing any solvent that flashes off the strip before entering the oven. Maximum line speed of the No. 2 line is 350 fpm. The ovens are normally operated at temperatures of 800 to 900°F to achieve the curing temperature in the metal strip of 420 to 435°F for the prime coat and 400 to 420°F for the finish coat.

Most of the metal coated by Precoat is used in the building industry for siding, roofing, gutters, awnings, etc. This accounts for about 95 percent of their total production. The remaining 5 percent is used for ducting, signs, and other miscellaneous items. Practically all of the metal is hot dipped galvanized steel. In most instances, the coatings and suppliers are dictated by the customer. Types of coatings used are epoxy resins and primers, polyesters, acrylics,

fluorocarbons, siliconized acrylics and polyesters, and a small amount of polyvinyl chlorides. Coatings suppliers include Conchemco, Midland Dexter, PPG, Mobil, Enterprise, Lily, Whitaker, and others. Prime coats are generally applied with a thickness of 0.2 mil on both sides of the metal; the top coat is usually applied with a thickness of 0.5 mil on the back side and 0.8 mil on the front side. Prime coatings are 30 to 32 percent solids by volume, and top coatings are approximately 50 percent solids by volume.

Some major changes in the No. 2 line have been made since its installation. These changes involved modifications to the tracking system and the water quench system. The line speed has been increased from a maximum of 300 fpm to 350 fpm.

Solvent input on the No. 2 line amounts to approximately 1,300 gal. every 24 hrs. Types of solvents used are mostly aromatic hydrocarbons and glycol ethers such as Solveso 150 and butyl cellosolve. Reclaimed solvent (mostly ketones) is used for cleanup.

#### OPERATION DURING TEST

The weather on August 27 to 31 was clear and sunny with temperatures in the low 90's. The weather during the period September 3 to 7 was clear and sunny with temperatures in the high 80's, except for September 5, which was cloudy with a light rain in the mid afternoon. No effect on the test results is expected from these weather conditions.

There were three instances when the tests were interrupted because of adjustments that had to be made to the system. During Run 18, testing was interrupted for 75 min.; a 27 min. interruption took place during Run 17; and a 15 min. interruption took place during Run 11. In each of these instances sampling was shutdown not more than 2 min. after the interruptive period began and was reinitiated only after the resumption of coating, followed by a short time period to ensure the stabilization of the zone temperatures and the afterburner temperatures.

The preheat burner was shutdown for the second and third tests of the finish afterburner exhaust at 900°F. The preheat burners were shutdown for the three tests of the prime afterburner exhaust at 1,000°F.

With the exception of the instances mentioned above there were no major process or control equipment upsets during the test periods or between the test periods. The process was judged to be running at the expected capacity during the testing.

## SECTION 4

### LOCATION OF SAMPLE POINTS

The process diagram is shown in Figure 7. Primary sampling occurred at Points 1, 5, 9, 10, 11, 12, and 13. Points 9 and 10 (afterburner inlets) are shown in Figure 8. Points 11 and 12 (afterburner outlets) are shown in Figure 9, and Point 13 (stack) is shown in Figure 10. Sampling was also done at Point 6. Points 3, 4, 7, and 8 had poor accessibility and were not sampled.

The primary and finish coat sections were tested separately. Thus, Runs 10 through 18 were at Points 1, 9, and 11. Runs 1 through 9 were at Points 2, 10, and 12.

One test included:

#### Points 1 or 2

1. Grab sample(s) of paint (2), each side coated independently.
2. Paint usage by weight difference.
3. Coil area processed during time limits of step (2).
4. Process data information and test start scheduling.
5. Pain coating characteristics (thickness, adhesion, solids content, etc.).

#### Points 9 or 10

1. Velocity - single point.
2. H<sub>2</sub>O, CO<sub>2</sub>, O<sub>2</sub>, temperature.
3. TGNMO
4. Volumetric flow rate.

#### Points 11 or 12

1. CO<sub>2</sub>, O<sub>2</sub>, temperature.
2. TGNMO
3. THC
4. Continuous NO<sub>x</sub>.

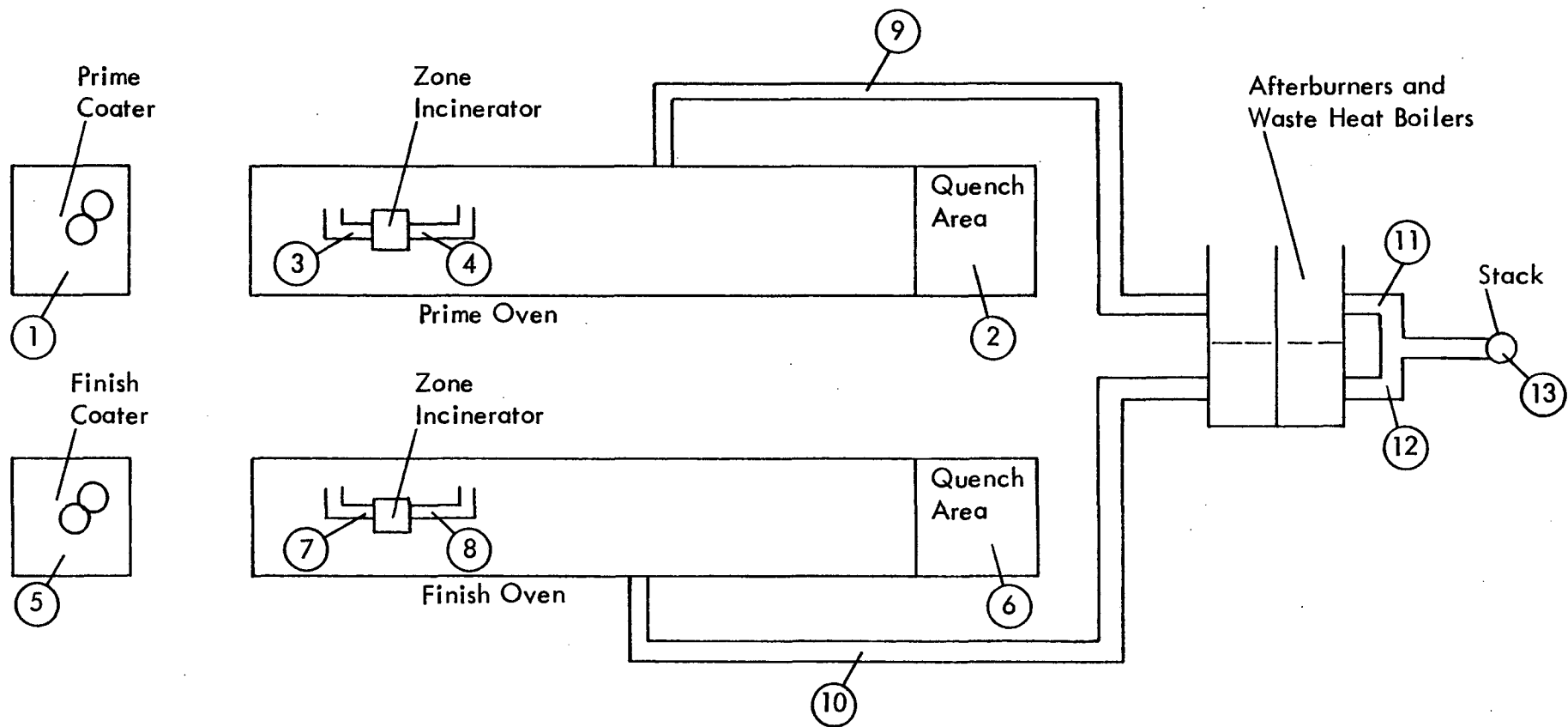


Figure 7. Process diagram - St. Louis, Missouri.



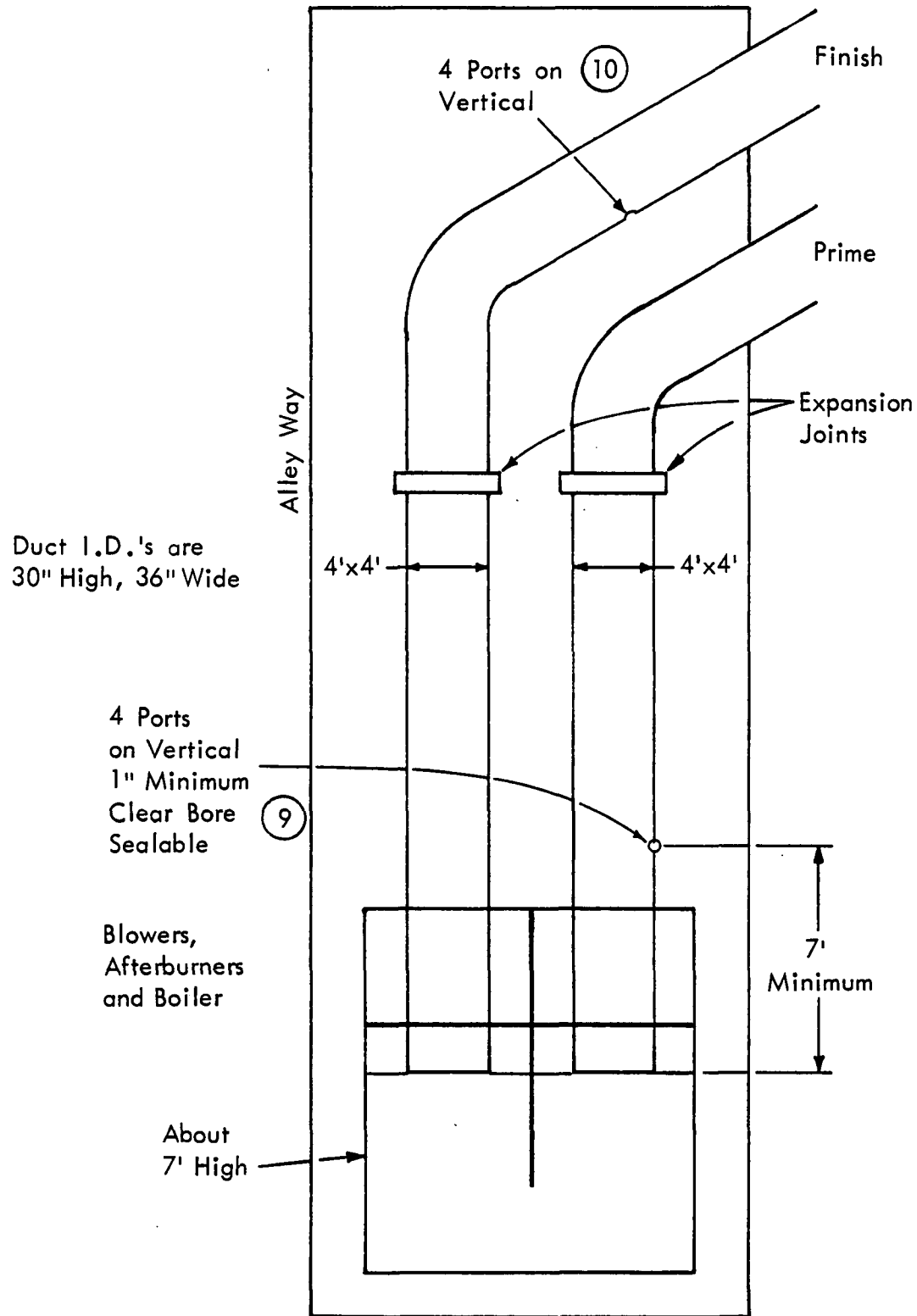


Figure 8. Afterburner inlet ducts (top view)

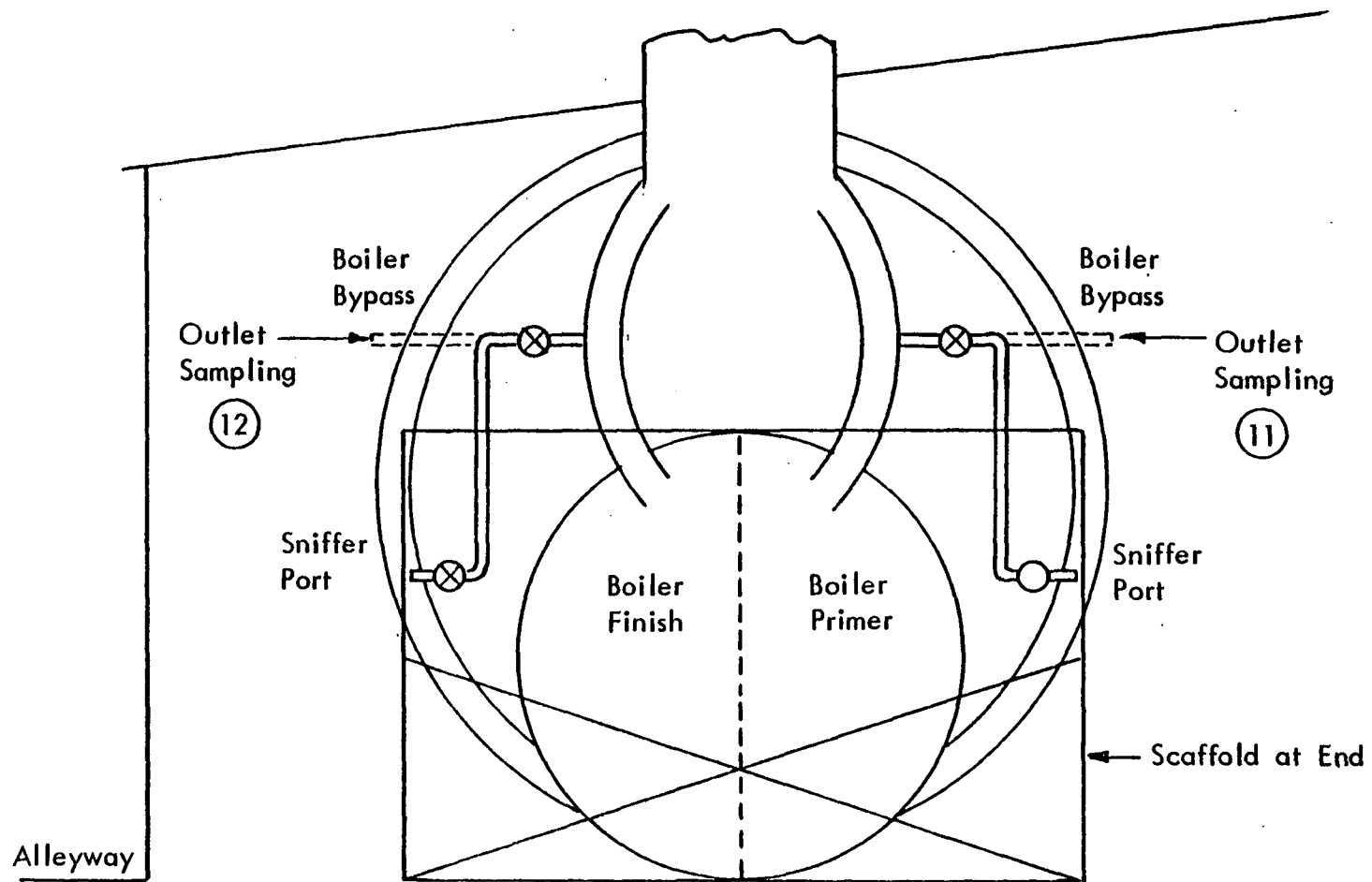


Figure 9. Boiler/bypass outlet (end view).

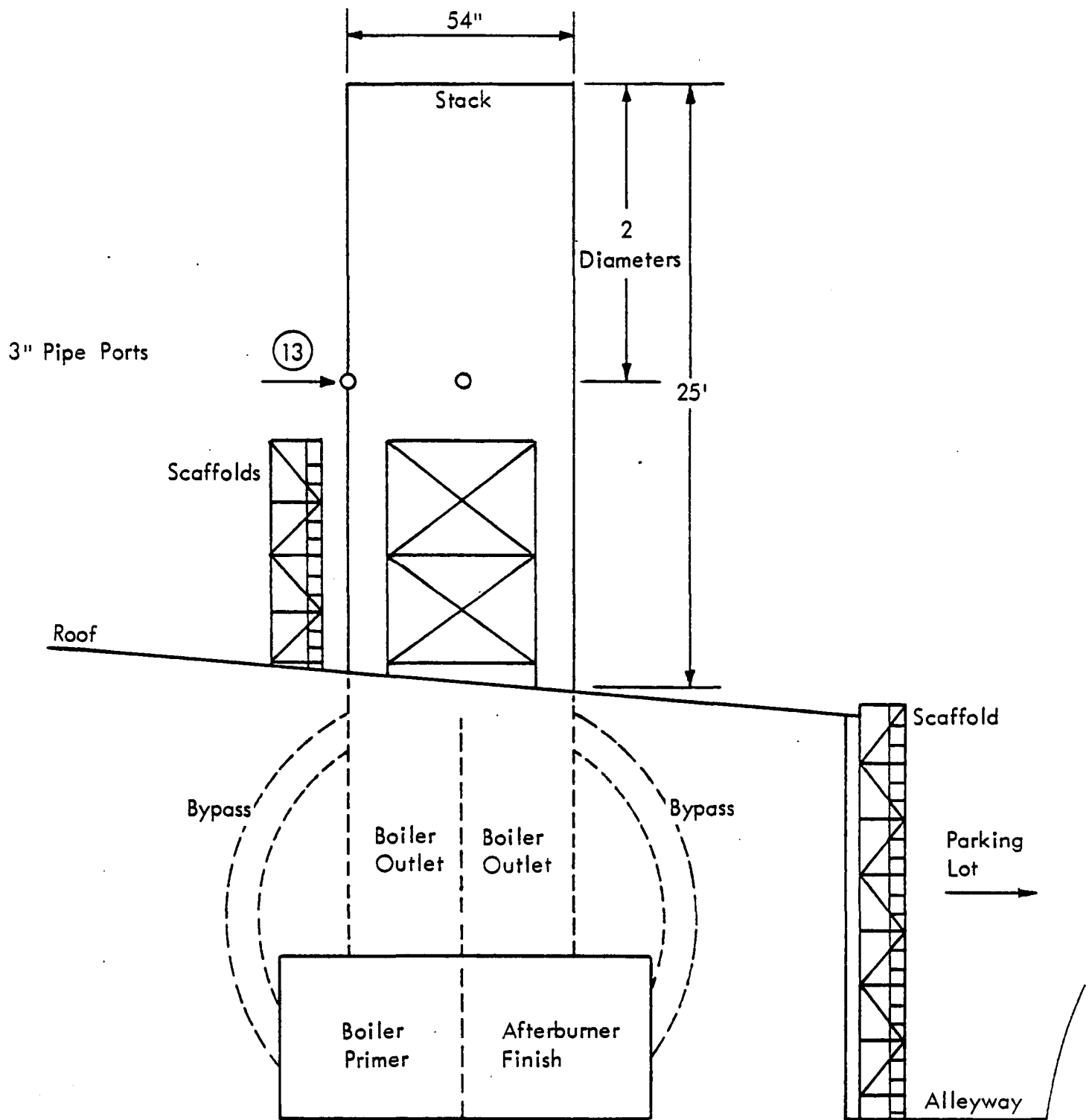


Figure 10. Stack (end view).

There was also sampling at the finish quench area--continuous FID measurements--flow rate, and VOC--for the final test day.

One set of velocity traverses was completed at Points 9, 10, and 13, including  $O_2$ ,  $CO_2$ , and temperature to confirm that the flow and composition out the stack was a reasonable composite of the flows going into the incinerator.

## SECTION 5

### SAMPLING AND ANALYTICAL PROCEDURES

The sampling equipment for VOC was prepared by PCS. MRI personnel conducted the sampling and the sample trains were returned to PCS for analysis according to Method 25 (see Appendix B).

The cold trap inlet lines were too short to reach into the ductwork. MRI had to attach 2 ft extensions to obtain enough length for sampling. The extensions had to be reused, but inlet and outlet extensions were not exchanged, nor do the trap portions of the samples show any pattern of buildup. The high levels reported also appear in the tanks, which could not be affected by any compounds remaining in the extensions. The extensions were attached during leak checks so that any volatiles remaining would have gone to the vacuum pump.

The line upsets may have affected some samples since it usually took 1 to 3 min. for the sample trains to be shut off after an interruption. The control valve was closed but the probe not capped during the interruption which isolated the tank but may have allowed some transfer to or from the trap.

The VOC analytical procedure used by PCS followed the EPA proposed Method 25 except in the calibration procedure and catalyst checks:

1. Calibration of the analyzer for the analysis of the combusted trap contents is performed at the following conditions:
  - a. Oxidation catalyst - on-line
  - b. Reduction catalyst - on-line
  - c. Column - 100°C

An attenuation is chosen based on estimated concentrations from the trap burnout traces (NDIR output) and triplicate injections of two or three standards (CO<sub>2</sub> in air) are made. Triplicate injections of the intermediate collection tanks are then made and concentrations calculated by comparing peak areas to the best fit straight line of the standard data.

2. Calibration for the analysis of the tank portion of the sample is done again using standards chosen to bracket the expected range of the samples being analyzed. An attenuation is chosen on the FID to provide adequate sensitivity and two or three calibration standards are injected in triplicate. Peak areas are measured by an electronic integrator and the best fit straight line is calculated for the resulting area versus concentration data. From this, the sample concentrations are calculated for the nonmethane organics backflush peak. This calibration procedure is done at a minimum before and after analysis of a set of samples. Recalibration is, of course, done should any of the samples require a sensitivity change.

3. The oxidation catalyst efficiency check is made at the following conditions:

- a. Reduction catalyst - bypassed
- b. Oxidation catalyst - on-line at  $860 \pm 20^{\circ}\text{C}$
- c. Column - either at  $0^{\circ}\text{C}$  or  $100^{\circ}\text{C}$

Injectons of a standard mixture of  $\text{CH}_4$  are made at maximum sensitivity and any response noted. If oxidation is 100 percent no response will show up. If a response is noted, the concentration is measured and an efficiency of oxidation calculated. An average efficiency of 99.5 percent or greater for triplicate injections is judged acceptable.

4. The reduction catalyst check is performed as follows:

- a. Reduction catalyst - on-line at approximately  $400^{\circ}\text{C}$ .
- b. Oxidation catalyst - bypassed.
- c. Column -  $0^{\circ}\text{C}$  to permit separation of  $\text{CO}$  and  $\text{CH}_4$ .

Injectons of a mixture of equal concentrations  $\text{CO}_2$  and  $\text{CH}_4$  are made and the resulting peak areas compared. Efficiencies typically are 99 to 100 percent, which is considered adequate since the manufacturers analysis of the standard mixture is accurate to only  $\pm 2$  percent.

A heated sample line was used for the continuous  $\text{NO}_x$  and THC analyzers. A Tee fitting placed at the inlet to the sample conditioning manifold split off the flow to the Beckman model 402 THC analyzer, which has its own heated line, oven, stainless steel pump and flame ionization detector. The remaining sample passes through a particulate filter, a Permapure extractive dryer, Teflon-coated diaphragm pump and finally one of a pair of calibrated rotameters for the necessary analyzer dilution within the continuous monitor manifold system.  $\text{NO}_x$  measurements at the outlet were made using a Bendix 8101B chemiluminescent analyzer set to the total ( $\text{NO} + \text{NO}_2$ ) mode. Since this instrument has a highest range of 5 ppm the sample gas was diluted with prepurified nitrogen for analysis. Calibration was with a 150 ppm  $\text{NO}$  in nitrogen gas for  $\text{NO}_x$  and with a 99 ppm propane in nitrogen gas mixture for THC. Both continuous analyzers have linear responses (within 10 percent) and are normally stable over several hours within the same limits.

Velocity was determined using EPA Method 2 once each day at the inlet and on the final day at both inlets and at the common stack. Stack temperature at other times was too high to complete traverses safely due to radiation from the unlined stack.

CO<sub>2</sub> and O<sub>2</sub> at the outlet were measured by Fyrite from an integrated gas bag. The ambient temperature at the inlet caused failure of the Tedlar bags so that sampling was conducted directly from a line connected with the duct port. After analyzing the sample from Run 16-Inlet, the oxygen measuring Fyrite was recharged and a gasket was found to have been installed backwards, which caused all previous O<sub>2</sub> readings to indicate 1 percent high.

Moisture was measured using EPA Method 4 (midget impinger train). The moisture readings during the last nine runs were low due to the theft of the balance used to weigh the silica gel impinger. The moisture content for Runs 10 through 18 was corrected by adding 0.6 percent H<sub>2</sub>O to the measured values (saturated H<sub>2</sub>O vapor at 0°C).

Paint samples for material balance were obtained in one pint paint cans direct from the paint drums. Selected samples were analyzed by PCS according to tentative EPA Method 24 (see Appendix A). Paint consumption was determined with a measuring stick inserted into each drum of paint during the run. Variations in level of the paint trays and frequent use of return drums made the paint consumption difficult to determine during the tests. As a result, some of the run to run data scatter shown for the results are expected to be the result of paint volume measurement errors and not true variations in paint consumption.