Note: This is a reference cited in *AP 42, Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources.* AP42 is located on the EPA web site at www.epa.gov/ttn/chief/ap42/

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SECONDARY ALUMINUM SMELTING

EMISSION TEST REPORT
VISTA METALS CORPORATION
FONTANA, CALIFORNIA

Contract No. 68-02-3541
Work Assignment 1

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
EMISSIONS MEASUREMENT BRANCH
RESEARCH TRIANGLE PARK, NORTH CAROLINA

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PREFACE

The work described in this report was conducted by personnel from Engineering-Science, Inc. (ES), TRW Environmental Engineering Division, Vista Metals Corporation in Fontana, California, and the U.S. Environmental Protection Agency (EPA).

The scope of work was initially issued under Task Orders 44 and 46 of EPA Contract No. 68-02-2815 and continued under Work Assignment 1 of EPA Contract No. 68-03-3541. Engineering-Science personnel assigned to the project included Mr. George Weant as Project Manager, Mr. Donald R. Holtz, as Task Manager, and Mr. Larry Cottone as Test Team Leader for the Vista Metals test. Mr. Cottone was also responsible for summarizing data in this report.

Mr. Robert Newman of TRW, under contract to the Office of Air Quality Planning and Standards, Industrial Studies Branch of the EPA, was responsible for monitoring process operations during the test program and for preparing Section 3.0, Process Description and Operations, of this report. Mr. Lester Samstag and Mr. Harold Jochai of Vista Metals contributed significantly to the success of the test program through their cooperation and assistance.

Mr. Clyde E. Riley and Mr. Gary McAlister, Office of Air Quality Planning and Standards, Emissions Measurement Branch of the EPA, were the EMB Task Managers. Mr. James A. Eddinger, Office of Air Quality Planning and Standards, Industrial Studies Branch, EPA, served as Project Lead Engineer and was responsible for coordinating the process operation monitoring.

SECTION 1

INTRODUCTION

1.0 INTRODUCTION

1.1 Background

The United States Environmental Protection Agency (EPA) is in the process of developing the Standards of Performance for New Stationary Sources (SPNSS) in the Secondary Aluminum Industry. When promulgated, these standards will reflect the degree of emission limitation achievable through application of the best demonstrated emission control technology available. In developing these standards, EPA utilizes emission data obtained from existing sources in the aluminum industry that appear to be well controlled. EPA engaged Engineering-Science to conduct emission tests on secondary aluminum industry sources to obtain these data and to develop and evaluate emission test methods for the industry.

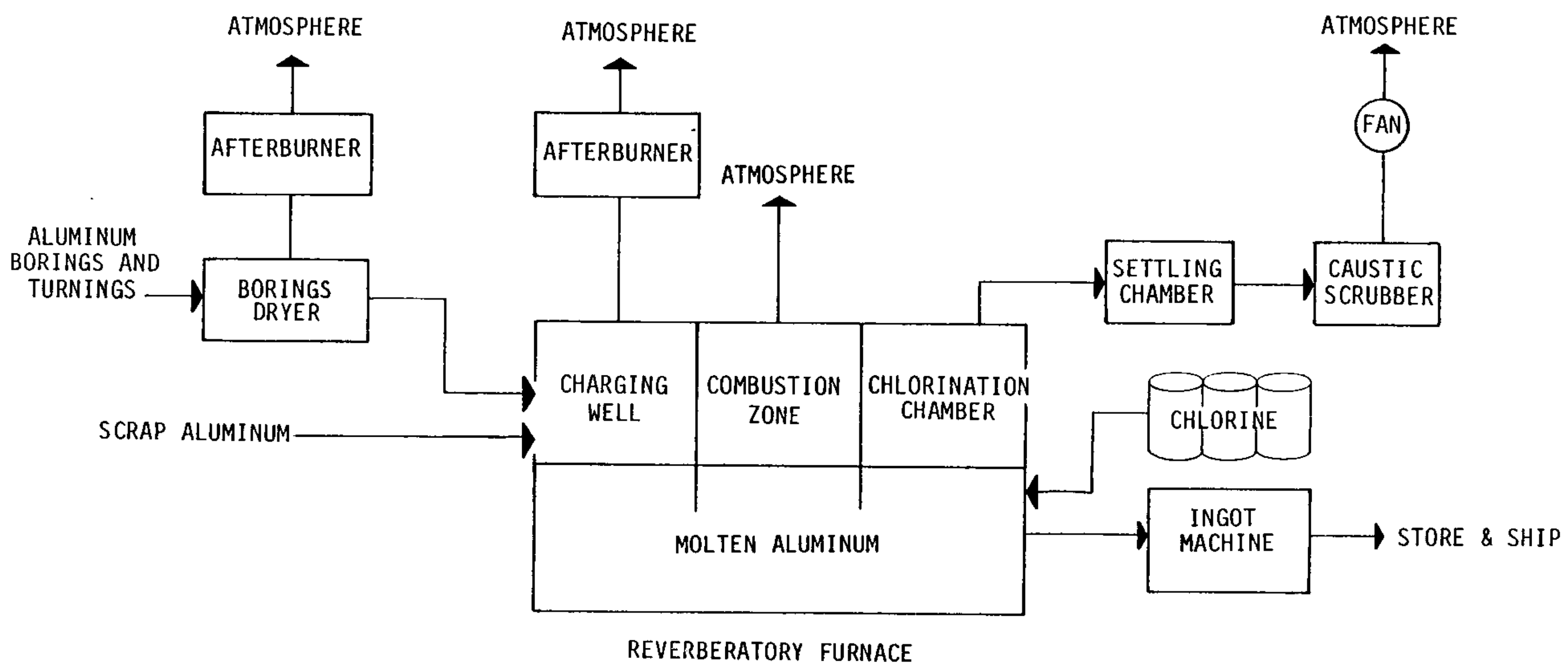
EPA's Office of Air Quality Planning and Standards (OAQPS) selected the Vista Metals Corporation secondary aluminum smelter in Fontana, California, as a site for standards development testing. This report summarizes the test program conducted at Vista Metals.

1.2 Brief Process Description

Figure 1-1 shows a simplified flow diagram of that portion of the Vista Metals Corporation secondary aluminum smelting process pertaining to these tests. The following briefly describes the process:

> Secondary aluminum smelting consists of converting various types of aluminum scrap into aluminum alloy ingots. Selected scrap and alloys are blended and melted in natural gas or fuel oil fired reverberatory furnaces. The magnesium content of the molten metal is reduced to a desirable level by injection of chlorine, the chlorine combining with the magnesium to form magnesium chloride. The magnesium chloride floats to the top of the melt and is removed as dross. Although some chlorine escapes the melt and emits to the control system during most of the chlorination period, the chlorine emission rate probably increases significantly near the end of the cycle when little magnesium remains for reaction.

Schematic of Secondary Aluminum Smelting Process at Vista Metals Corporation, Fontana, California



Following chlorination the metal is poured into ingot molds. The process is a batch operation and schedules vary depending on the type and magnesium content of the scrap charged to the furnace and the specifications for the product. Support facilities, such as the borings dryer and sweat furnace, operate as needed.

The Vista Metals Corporation plant in Fontana, California receives a portion of the aluminum scrap in the form of borings and turnings from machining of aluminum. Because the cutting oils associated with these borings and turnings can interfere with operations if charged directly to the furnace, the borings and turnings are first passed through a borings dryer. A natural gas fired afterburner controls borings dryer emissions.

Dried borings and other scrap are loaded into the furnaces at the charging well and melted by immersion in molten aluminum. Heat to the process comes from the natural gas burned in the reverberatory furnace combustion chamber. The molten aluminum after being brought to temperature is purged with chlorine to remove magnesium impurities before being poured into molds. Emissions from the reverberatory furnace discharge through three individual stacks; one each for the charging well, the gas burner, and the chlorination process. Charging well emissions pass through an afterburner before discharge; combustion chamber emissions discharge directly to the atmosphere, and chlorination chamber emissions pass through a packed bed scrubber before discharge.

1.3 Emission Measurement Program

Engineering-Science conducted an emission measurement program at Vista Metals Corporation, Fontana, California, during the period from May 18 through May 22, 1981. The goals of the test program were to characterize and quantify controlled and uncontrolled emissions from the chlorination process and the borings dryer, determine control equipment efficiencies and evaluate visible and fugitive emissions from the borings dryer and all of the reverberatory furnace sources.

During the test program a representative of TRW, the NPNSS contractor, recorded process data for the reverberatory furnace operation. The chronology of the emission tests is contained in Daily Sampling Logs located in Appendix D. The components of the measuring program were as follows.

1.3.1 Reverberatory Furnace Chlorination Emissions

Total Particulate, Chlorine, and Chlorides in Gas Streams

Three concurrent test runs were performed at scrubber inlet and outlet locations. Test runs planned for the settling chamber inlet were dropped because of very low velocities and plugging of test equipment with acid and particulate. Scrubber inlet and outlet tests were scheduled to coincide as much as possible with the end of the chlorination cycles so that the expected higher chlorine emission rates during that time could be measured.

Particle Size Distribution in Gas Stream at Scrubber Inlet

Six particle size runs were performed at the scrubber inlet.

Visible Emissions at Scrubber Outlet (EPA Method 9)

During each particulate-chlorine-chloride sample run, an observer recorded opacities from the start of chlorination until darkness.

Gas Analysis of Gas Streams

Two Orsat runs were conducted at the scrubber inlet.

Scrubber Solution Collection

Samples of the scrubber liquor were collected periodically during the test runs, and the pH and temperature recorded.

Pressure Drop Across Scrubber

The gas pressure drop across the scrubber was measured periodically during each of the test runs.

1.3.2 Reverberatory Furnace Charging Well Emissions

Fugitive Emissions in Furnace Area (EPA Method 22)

Observations were conducted but simultaneous process data was not documented.

Visible Emissions at Charging Well Stacks (EPA Method 9)

Observations were conducted but simultaneous process data was not documented.

1.3.3 Reverberatory Furnace Combustion Stack Emissions

Visible Emissions at Stack Outlet (EPA Method 9)

No observations were conducted.

1.3.4 Borings Dryer Emissions

Total Particulate, Condensible Hydrocarbons, and Non-Condensible Hydrocarbon Sampling in Gas Streams

One partial test run yielding marginal total particulate and condensable hydrocarbon information was conducted on uncontrolled emissions. A separate test run was conducted for non-condensable hydrocarbons. For the controlled emissions, no particulate and condensible hydrocarbon data were obtained, but a short non-condensable hydrocarbon test run was completed.

Particle Sizing in Uncontrolled Gas Stream

One particle size run was conducted.

Fugitive Emissions in Dryer Area (EPA Method 22)

Emission occurrences were recorded during the test run.

Visible Emissions at Borings Dryer Stack (EPA Method 9)

Because emission testing was unsuccessful, these observations were not conducted.

Gas Analysis of Gas Streams

Orsat grab samples were taken and analyzed for both controlled and uncontrolled gas streams.

1.3.5 Cleanup Evaluation

Prior to emission testing, each sample train to be used was assembled and charged as if ready to perform a test for either chlorine/chloride or condensable hydrocarbons. The unexposed impinger contents and wash were then recovered, prepared, and analyzed according to procedure. The purpose of the cleanup was to establish blank values for the sampling trains and also to familiarize the cleanup and analytical personnel with the procedure.

Audit samples for both chlorine and chloride were prepared by EPA and analyzed by Engineering-Science prior to the analysis of actual field samples. The audit sample results were given immediately to EPA to assess the accuracy of the analysis procedure.

1.4 Description of Report Sections

The remaining sections of this report present the Summary of Results (Section 2.0), Process Description and Operations (Section 3.0), Location of Sampling Points (Section 4.0), and Sampling and Analytical Methods (Section 5.0). Descriptions of methods and procedures, field and laboratory data, and calculations are presented in the various appendices, as noted in the Table of Contents. Appendix L contains the results of audit sample analyses, and Appendix M contains the results of the cleanup evaluations performed on the sampling train equipment.

SECTION 2

SUMMARY OF RESULTS

2.0 SUMMARY OF RESULTS

2.1 Reverberatory Furnace - Chlorination System

The ES site test work plan for this investigation of particulate, chlorine and chloride loadings in the reverberatory furnace chlorination chamber ventilation system included simultaneous measurements at the settling chamber inlet, the settling chamber outlet/scrubber inlet and at the exhaust stack. As predicted by ES and Vista Metals Corporation engineers from a site visit the previous week, velocity measurements at the settling chamber inlet site were found to be below the measurement range of a standard inclined manometer or micromanometer. The design and operation of the chlorination system limits gas flow from the chamber to that amount resulting from displacement by chlorine gas injection, from thermal expansion, and from some vaporization of metals. Since the velocity of gas into the settling chamber was below the usable range of available instrumentation, testing could not be conducted at isokinetic conditions. Also, during the settling chamber inlet velocity traverse the test team found that the pitot tube soon became plugged with a green sticky substance, judged possibly to be hydrochloric acid and aluminum oxide or other oxides and chlorides of aluminum and magnesium. Even if isokinetic sampling could be achieved at this location, the consistency of this substance would likely prevent completion of a test run. The settling chamber appears to collect most of this material, and plant operators said the settling chamber required frequent emptying.

Simultaneous testing was conducted for particulate, chlorine and chlorides at the scrubber inlet and scrubber outlet locations. Single test runs were conducted the evenings of May 19, 20, and 21, 1981. Process operations were monitored by a representative of TRW who also coordinated actual periods of testing to insure samples were collected under normal process operating conditions.

Table 2-1a (English Units) and 2-1b (Metric Units) summarize the results of particulate, chlorine and chloride sampling performed on the inlet (uncontrolled) and outlet (controlled) sides of the chlorination scrubber. The format of Table 2-1a and 2-1b allows a quick evaluation of inlet and outlet loadings during each test run as well as control efficiencies for the different pollutants sampled.

2.1.1 Total Particulate Loading Results

Total particulate includes only the filter catch and particulate washed from the probe and filter holder front-half. Inlet particulate loadings from the test series ranged from 0.179 to 0.364 grains per dry standard cubic foot (DSCF) with an average of 0.283 grains per DSCF. Mass rates into the scrubber ranged from 2.12 to 4.80 pounds per hour with an average of 3.57 pounds per hour. Corresponding scrubber outlet values were 0.009 to 0.029 grains per DSCF with an average of 0.016 grains per DSCF, mass rates ranged from 0.109 to 0.337 pounds per hour with an average of 0.193 pounds per hour. Particulate control efficiencies ranged from 93 to 97.1 percent with an average value of 94.6 percent. Particulate loading results appear to be accurate and should be acceptable for reference in Standards of Performance for New Stationary Source (SPNSS) development.

TABLE 2-1a (English Units)
SUMMARY OF CONTROLLED AND UNCONTROLLED TOTAL PARTICULATE, CHLORINE, AND TOTAL CHLORIDE FROM THE REVERBERATORY FURNACE CHLORINATION SCRUBBER AT THE VISTA METALS CORPORATION, FONTANA, CALIFORNIA

Run Number Date Description	Run 1 May 19, 1981 Uncontrolled	 Controlled	Run 2 May 20, 1981 Uncontrolled	 Controlled	Run 3 May 21, 1981 Uncontrolled	 Controlled	Average Uncontrolled	 Controlled
REVERBERATORY FURNACE CHLORINATION SCRUBBER[a]								
TOTAL PARTICULATE EMISSIONS[b]								
Grains/DSCF (Probe & Filter)[c]	0.179	0.011	0.364	0.029	0.305	0.009	0.283	0.016
Pounds/Hour	2.120	0.132	4.806	0.337	3.782	0.109	3.569	0.193
Collection Efficiency (%)	93.8		93.0		97.1		94.6	
CHLORINE EMISSIONS								
ppmV (average)	> 968	18	> 6283	144	> 1595[d]	26	> 2949	63
Grains/DSCF	> 1.246	0.024	> 8.082	0.186	> 2.03[d]	0.034	> 3.786	0.081
Pounds/Hour	>14.788	0.283	>106.651	2.14	>25.147[d]	0.392	>48.862	0.938
Collection Efficiency (%)	98.1		98.0		98.4		98.1	
CHLORIDE EMISSIONS								
Front-Half (Probe & Filter)								
Grains/DSCF	0.086	0.014	0.107	0.005	0.098	0.002	0.097	0.007
Pounds/Hour	1.018	0.173	1.415	0.057	1.216	0.020	1.202	0.081
Collection Efficiency (%)	83.1		96.0		98.4		93.3	
Back-Half (Impingers)[f]								
Grains/DSCF	0.239[e]	0.026	11.622	0.043	7.148	0.017	6.336	0.029
Pounds/Hour	2.837[e]	0.306	153.354	0.493	88.402	0.196	81.531	0.332
Collection Efficiency (%)	89.2		99.7		99.8		99.6	
Total[f]								
Grains/DSCF	0.325	0.040	11.729	0.048	7.246	0.019	6.433	0.039
Pounds/Hour	3.855	0.479	154.769	0.550	89.618	0.216	82.747	0.415
Collection Efficiency (%)	87.6		99.6		99.8		99.5	

[a]Scrubber Uncontrolled = Inlet values from Table 2-6.
Scrubber Controlled = Outlet values from Table 2-7.
[b]Filter catch and wash from probe and filter holder front half.
[c]Grains per Dry Standard Cubic Foot @ 68°F, 29.92 in Hg.
[d]Values based on run second half emissions equal to the first. Second half analysis results were invalid.
[e]Reanalysis of this sample using a specific ion electricle indicates these numbers may be low by a factor of 13.
[f]Includes chlorine

TABLE 2-1b (Metric Units)
SUMMARY OF CONTROLLED AND UNCONTROLLED TOTAL PARTICULATE, CHLORINE, AND TOTAL CHLORIDE FROM THE REVERBERATORY FURNACE CHLORINATION SCRUBBER AT THE VISTA METALS CORPORATION, FONTANA, CALIFORNIA

Run Number	Run 1		Run 2		Run 3		Average	
Date	May 19, 1981		May 20, 1981		May 21, 1981			
Description	Uncontrolled	Controlled	Uncontrolled	Controlled	Uncontrolled	Controlled	Uncontrolled	Controlled
REVERBERATORY FURNACE CHLORINATION SCRUBBER[a]								
TOTAL PARTICULATE EMISSIONS[b]								
Mg/DNm^3 [c]	408.81	25.21	833.43	67.02	698.76	21.34	647.0	37.857
Kg/Hour	0.962	0.060	2.180	0.153	1.715	0.049	1.619	0.087
Collection Efficiency (%)	93.8		93.0		97.1		94.6	
CHLORINE EMISSIONS								
ppmV (average)	> 968	18	6283	144	1595[d]	26	2949	63
Mg/DNm^3	> 2852	55	18499.7	425.754	4647[d]	78	8666	186.3
Kg/Hour	>6.708	1.128	48.378	0.971	11.41[d]	0.178	22.165	0.387
Collection Efficiency (%)	98.1		98.0		98.4		98.1	
CHLORIDE EMISSIONS								
Front-Half (Probe & Filter)								
Mg/DNm^3	197	32	245	11	224	5	222	16
Kg/Hour	0.462	0.078	0.642	0.026	0.552	0.009	0.552	0.037
Collection Efficiency (%)	83.1		96.0		98.4		93.3	
Back-Half (Impingers)[f]								
Mg/DNm^3	547[e]	60	26603	98	16362	39	14504	65.67
Kg/Hour	1.287[e]	0.139	69.560	0.224	40.098	0.089	36.982	0.151
Collection Efficiency (%)	89.2		99.7		99.8		99.6	
Total[f]								
Mg/DNm^3	744	92	26848	110	16586	43	14726	81.67
Kg/Hour	1.749	0.217	70.202	0.249	40.650	0.098	37.534	0.188
Collection Efficiency (%)	87.6		99.6		98.8		99.5	

[a]Scrubber Uncontrolled = Inlet values from Table 2-6.
Scrubber Controlled = Outlet values from Table 2-7.
[b]Filter catch and wash from probe and filter holder front half.
[c]Milligrams per Dry Normal Cubic Meter @ 20°C, 760 mm Hg.
[d]Values based on run second half emissions equal to the first. Second half analysis results were invalid.
[e]Reanalysis of this sample using a specific ion electricle indicates these numbers may be low by a factor of 13.
[f]Includes chlorine

2.1.2 Chlorine Loading Results

Inlet chlorine measurements ranged from a low of 968 ppmV (1.246 grains/DSCF) to a high of 6283 ppmV (8.082 grains/DSCF) with an average concentration of 2949 ppmV (3.786 grains/DSCF). The corresponding outlet values were a range of 18 to 144 ppmV (0.024 to 0.186 grains/DSCF) with an average of 63 ppmV (0.081 grains/DSCF). Chlorine gas removal efficiencies for the scrubber system ranged from a low of 98.0% to a high of 98.4% with an average value of 98.1%.

During Run No. 2 a process upset resulting in high chlorine concentrations caused sampling solutions at the inlet test location to became saturated with chlorine. Also, during transfer of these samples from the test site to the ES Laboratory, pressure built up in the inlet sample bottle, apparently due to chlorine gas released from solution. These conditions indicate that actual chlorine levels at the inlet location were higher than measured.

Chlorine loadings exceeded total chloride values for test Runs 1, uncontrolled, 2, controlled, and 3, controlled, but it is suspected this inconsistency resulted from chlorine loss during sample handling and storage or from interferences in chloride analysis, and not from problems with chlorine measurement or analysis. Chlorine measurement results, at least at the outlet location, should, therefore, be acceptable for SPNSS reference purposes. Inlet location chlorine concentrations, except for run number 2 which is lower than actual, should also be acceptable. On Run No. 3 inlet, on the second set of impingers that served the latter half of the run, the analyst failed to achieve acceptable chlorine titrations. To make the data from this third run usable, it was assumed the chlorine mass during the second half of the run equaled that of the first. Section 5 further discusses measurements and analysis.

2.1.3 Chloride Loading Results

Particulate chlorides were collected in the front half of the sample train, and gaseous chlorides (including chlorine) were collected in the back half. Particulate chloride loadings at the scrubber inlet ranged from 0.086 to 0.107 grains/DSCF (1.018 to 1.415 pounds/ hour) and averaged 0.097 grains/DSCF (1.202 pounds/hour). Particulate chloride concentrations at the scrubber outlet ranged from 0.002 to 0.014 grains/DSCF (0.020 to 0.173 pounds/hour) with an average of 0.007 grains/DSCF (0.081 pounds/hour). Particulate chloride removal efficiency ranged from 83.1% to 98.4% with an average control efficiency of 93.3%.

Gaseous chlorides, including chlorine, ranged from 0.239 to 11.628 grains/DSCF with an average of 6.336 grains/DSCF at the inlet site. The 0.239 value, however, may be incorrect as subsequent chloride analysis using the specific ion electrical method rather than the the mercuric nitrate method indicated the number should be 3.14. Comparitive analysis of the other samples showed general agreement between the two methods. The range at the outlet site was 0.017 to 0.043 grains/DSCF with an average of 0.032 grains/DSCF. As mentioned previously, there is an obvious inconsistency in the data because some of the chlorine loadings exceeding the gaseous chloride loadings for the same sample. This may be due to chlorine loss from the sample between the chlorine and chloride analysis.

Total chloride loadings at the scrubber inlet ranged from 0.325 to 11.729 grains/DSCF with an average loading of 6.433 grains/DSCF. The corresponding values at the outlet site are a range of 0.019 to 0.048 with an average value of 0.039 grains/DSCF. Because chloride concentrations measured lower in some instances than theoretically possible, these values do not appear suitable for SPNSS reference.

2.1.4 Summary of Particulate, Chlorine and Total Chloride Tests

Tables 2-2 and 2-3 summarize parameters measured during the particulate, chlorine and total chloride tests conducted on the inlet and outlet of the chlorination scrubber at the Vista Metals Corporation, Fontana, California. All tests were accomplished within the specified isokinetic rate of 100 ± 10%.

Gas flow rates measured at the two sites were fairly constant. The inlet values were consistently higher than the outlet values. The higher inlet values are possibly the result of turbulence caused by bends and dilution near the inlet port. The test crew experienced some plugging of the pitot tube at the inlet site by particulate material and frequently used a compressor to clear the lines.

Gas measurements were made at the inlet site on May 20 and 21. As expected, due to the high dilution factor, oxygen and CO_2 values were similar to ambient air. The oxygen values exceeded 20.9% (i.e. 21.3%) because the chlorine gas was absorbed as oxygen by the Orsat analyzer.

During the May 20th chlorination, the plant operators expressed concern that magnesium was not being removed from the molten metal as fast as expected, and the greenish gas observed at the air-bleed-in

TABLE 2-2

SUMMARY OF PARTICULATE, CHLORINE, AND TOTAL CHLORIDE MEASUREMENTS ON GASES ENTERING THE REVERBERATORY FURNACE CHLORINATION SCRUBBER AT VISTA METALS CORPORATION, FONTANA, CALIFORNIA

Run Number Date Location	Run #1 5/19/81 Inlet	Run #2 5/20/81 Inlet	Run #3 5/21/81 Inlet	 Average Inlet
Volume Gas Sampled (DSCF)[a]	57.980	95.378	61.472	71.61
Volumetric Flowrate (DSCFM)[b]	1385	1540	1445	1457
% Moisture (Runs 1 & 3 assumed same as Run 2)	3.5	3.6	3.51	3.5
% CO_2	0.13	0.13	0.13	0.13
% O_2	20.9	20.9	20.9	20.9
% CO	< 0.1	< 0.1	< 0.1	< 0.1
Stack Temperature (°F)	63.3	65.0	67.8	65.4
% Isokinetic	104.0	102.5	105.6	104.1
Scrubber Solution pH	10.5	11.0	11.3	11.3
TOTAL PARTICULATE EMISSIONS (Probe & Filter)				
Total Sample Weight (milligrams)	672.6	2255.8	1218.9	1382.4
Grains/DSCF	0.179	0.364	0.305	0.283
Pounds/Hour	2.12	4.806	3.782	3.569
CHLORINE EMISSIONS				
Average ppmV	> 968	> 6283	> 1595[c]	> 2949
Total Sample Weight (milligrams)	> 4,692	> 50,060	> 8,184[c]	>20,979
Grains/DSCF	> 1.246	> 8.012	> 1.03[c]	> 3.786
Pounds/Hour	>14.788	>106.651	>25.147[c]	>48.862
CHLORIDE EMISSIONS				
Front-Half (Probe & Filter)				
Total Sample Weight (milligrams)	323	664	392	460
Grains/DSCF	0.086	0.101	0.097	0.097
Pounds/Hour	1.018	1.415	1.216	1.202
Back-Half (Impingers)[d]				
Total Sample Weight (milligrams)[d]	900[e]	71,978	28,491	33,790
Grains/DSCF[d]	0.239[e]	11.622	7.148	6.336
Pounds/Hour[d]	2.837[e]	153.354	88.402	81.531
Total				
Total Sample Weight (milligrams)	1223	72,641	28,883	34,249
Grains/DSCF	0.325	11.729	7.246	6.433
Pounds/Hour	3.855	154.769	89.618	82.747

a) Dry Standard Cubic Feet @ 68°F, 29.92 inches Hg.
b) Dry Standard Cubic Feet per minute.
c) Chlorine analysis for only the first one-half of this run are valid. These values are based on the assumption that second half emissions equal the first.
d) These values include chlorine as chloride, and may be suspect because of possible chlorine loss to the atmosphere or problems with chloride analysis.
e) Reanalysis of this sample using a specific ion electride indicates these numbers may be low by a factor of 13.

TABLE 2-3

SUMMARY OF PARTICULATE, CHLORINE, AND TOTAL CHLORIDE MEASUREMENTS EXITING THE REVERBERATORY FURNACE CHLORINATION SCRUBBER AT VISTA METALS CORPORATION, FONTANA, CALIFORNIA

Run Number Date Location	Run #1 5/19/81 Outlet	Run #2 5/20/81 Outlet	Run #3 5/21/81 Outlet	Average Outlet
Volume Gas Sampled (DSCF)[a]	72.273	117.518	63.260	84.350
Volumetric Flowrate (DSCFM)[b]	1395	1341	1362	1366
% Moisture	1.6	2.5	2.8	2.3
% CO_2	< 0.1	< 0.1	< 0.1	< 0.1
% O_2	20.9	20.9	20.9	20.9
% CO	< 0.1	< 0.1	< 0.1	< 0.1
Stack Temperature (°F)	65.3	73.5	74.6	71.1
% Isokinetic	97.5	98.2	91.2	95.6
Opacity (%)	12.4	8.4	5.5	8.8
Pressure Drop (inches H_2O)	2.9	2.8	2.9	2.9
TOTAL PARTICULATE EMISSIONS (Probe & Filter)				
Total Sample Weight (milligrams)	51.7	223.5	38.3	104.5
Grains/DSCF	0.011	0.029	0.009	0.016
Pounds/Hour	0.132	0.337	0.109	0.193
CHLORINE EMISSIONS				
Average ppmV	18	144	26	63
Total Sample Weight (milligrams)	111	1417	138	555.3
Grains/DSCF	0.024	0.186	0.034	0.081
Pounds/Hour	0.283	2.14	0.392	0.938
CHLORIDE EMISSIONS				
Front-Half (Probe & Filter)				
Total Sample Weight (milligrams)	68	38	7	38
Grains/DSCF	0.014	0.005	0.002	0.007
Pounds/Hour	0.173	0.057	0.020	0.081
Back-Half (Impingers)[c]				
Total Sample Weight (milligrams)[c]	120	327	69	172
Grains/DSCF[c]	0.026	0.043	0.017	0.029
Pounds/Hour[c]	0.306	0.493	0.196	0.332
Total				
Total Sample Weight (milligrams)	188	365	76	210
Grains/DSCF	0.040	0.048	0.019	0.039
Pounds/Hour	0.479	0.552	0.217	0.415

a) Dry Standard Cubic Feet @ 68°F, 29.92 inches Hg.
b) Dry Standard Cubic Feet per minute.
c) These values include chlorine as chloride, and are suspect because of apparent chlorine loss to the atmosphere or problems with chloride analysis.

location indicated that chlorine was not reacting well with the magnesium. Mr. Jochai of Vista Metals indicated that trace metals in the melt may be inhibiting the reaction. As previously mentioned, high inlet and outlet chlorine/chloride concentrations were measured during this chlorination.

2.1.5. Particle Size Tests

2.1.5.1 Reverberatory Furnace Chlorination Scrubber Inlet

Particle size test results of the scrubber inlet are summarized in Table 2-4 and Figures 2.1., 2.2a, and 2.2b. Test Runs 1 and 2 were conducted on May 18, Run 3 on May 19, Runs 4 and 5 on May 20, and Run 6 on May 21. Test Runs 1 and 2 were conducted during the third quarter of the chlorination period. Run No. 3 was conducted at the end of the chlorination cycle, Run No. 4 within the first quarter of the cycle, and Runs 5 and 6 in approximately the middle of the cycles.

Grain loadings during the scrubber inlet particle sizing runs ranged from a low of 0.789 gr/DSCF for Run No. SI-PS-4, to a high of 5.928 gr/DSCF for Run No. SI-PS-1, and averaged 2.227 gr/DSCF. Run No. SI-PS-1 was conducted during a period of process malfunction due to a broken chlorine injection probe. The chlorine gas supply was shut off, and the broken probe removed at 2015 hours, only 2 minutes after the three minute particle sizing run was terminated. The broken chlorine probe resulted in a process upset condition which could possibly account for the extreme skew in the size distribution toward large particles, and the highest grain loading for the particle size tests performed. In all cases the fraction of particles exceeding a D_p50 cut point of 11 microns was greater than 73%.

TABLE 2-4

PARTICULE SIZE RESULTS[a] AT THE REVERBERATORY FURNACE
CHLORINATION SCRUBBER INLET AT
VISTA METALS CORPORATION, FONTANA, CALIFORNIA

Test Date Time, and Run No.	(1) Sampling Duration (2) Impactor Flow Rate (3) Stack Temp (°F)	Stage Index No.	Delta Weight (mg)	% In Size Range	Cumulative %less than Size Range	Size Range (microns)	Effective Cut Diameter (D_p50-microns)
		SO[b]	692.55	98.45	1.55	>11.35	11.35
5/18/81	(1) 3.0 minutes	S1	1.56	0.22	1.32	7.11-11.35	7.11
		S2	2.96	0.42	0.90	3.32- 7.11	3.32
2010-2013	(2) 0.647 ACFM	S3	3.43	0.49	0.42	2.16- 3.32	2.16
		S4	2.93	--	--	1.11- 2.16	1.11
SI-PS-1	(3) 75°F	S5	0.0	--	--	0.54- 1.11	0.54
		Back-up filter	0.0	--	--	0.0[c]- 0.54	--
		SO[b]	110.75	81.65	18.35	>11.46	11.46
5/18/81	(1) 3.0 minutes	S1	2.86	2.11	16.24	7.18-11.46	7.18
		S2	5.67	4.18	12.06	3.35- 7.18	3.35
2045-2048	(2) 0.635 ACFM	S3	6.23	4.59	7.47	2.18- 3.35	2.18
		S4	5.88	4.34	3.13	1.12- 2.18	1.12
SI-PS-2	(3) 75°F	S5	1.99	1.46	1.67	0.54- 1.12	0.54
		Back-up filter	2.26	1.67	--	0.0[c]- 0.54	--
		SO[b]	129.13	90.22	9.78	>11.23	11.23
5/19/81	(1) 3.0 minutes	S1	2.40	1.68	8.10	7.04-11.23	7.04
		S2	8.81	6.16	1.95	3.29- 7.04	3.29
2108-2111	(2) 0.649 ACFM	S3	1.98	1.38	0.57	2.13- 3.29	2.13
		S4	0.03	0.02	0.54	1.10- 2.13	1.10
SI-PS-3	(3) 62°F	S5	0.78	0.54	--	0.53- 1.10	0.53
		Back-up filter	0.0	--	--	0.0[c]- 0.53	--

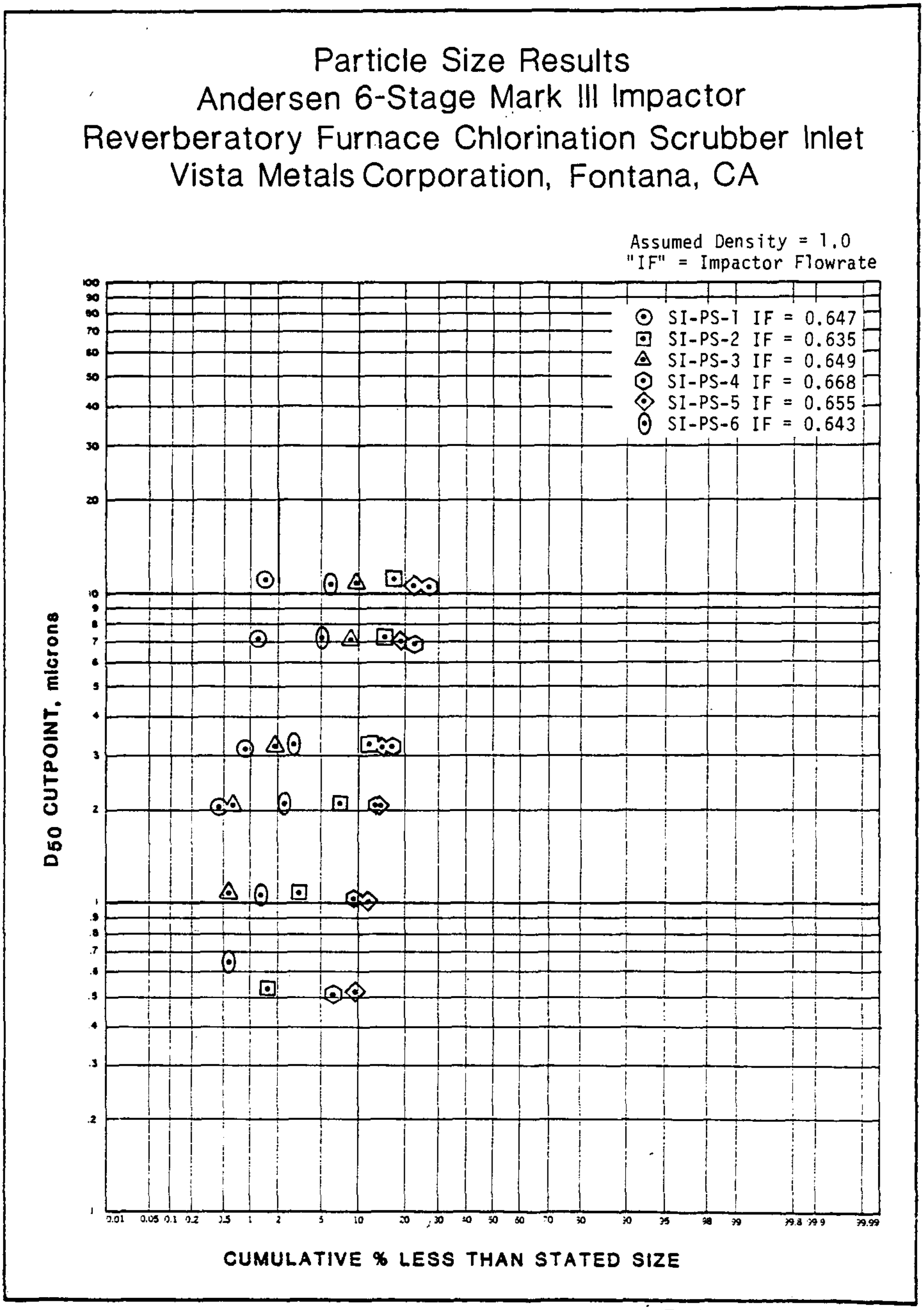
a. particle sizing determinations employed a 6-stage Anderson Mark III impactor.
b. Nozzle, pre-cutter, inlet cone, and zero stage wash weight added to stage 1 weight (index No. SO)
c. Back-up filter has an actual 0.3 micron retention (DOP).

TABLE 2-4 (Cont'd)

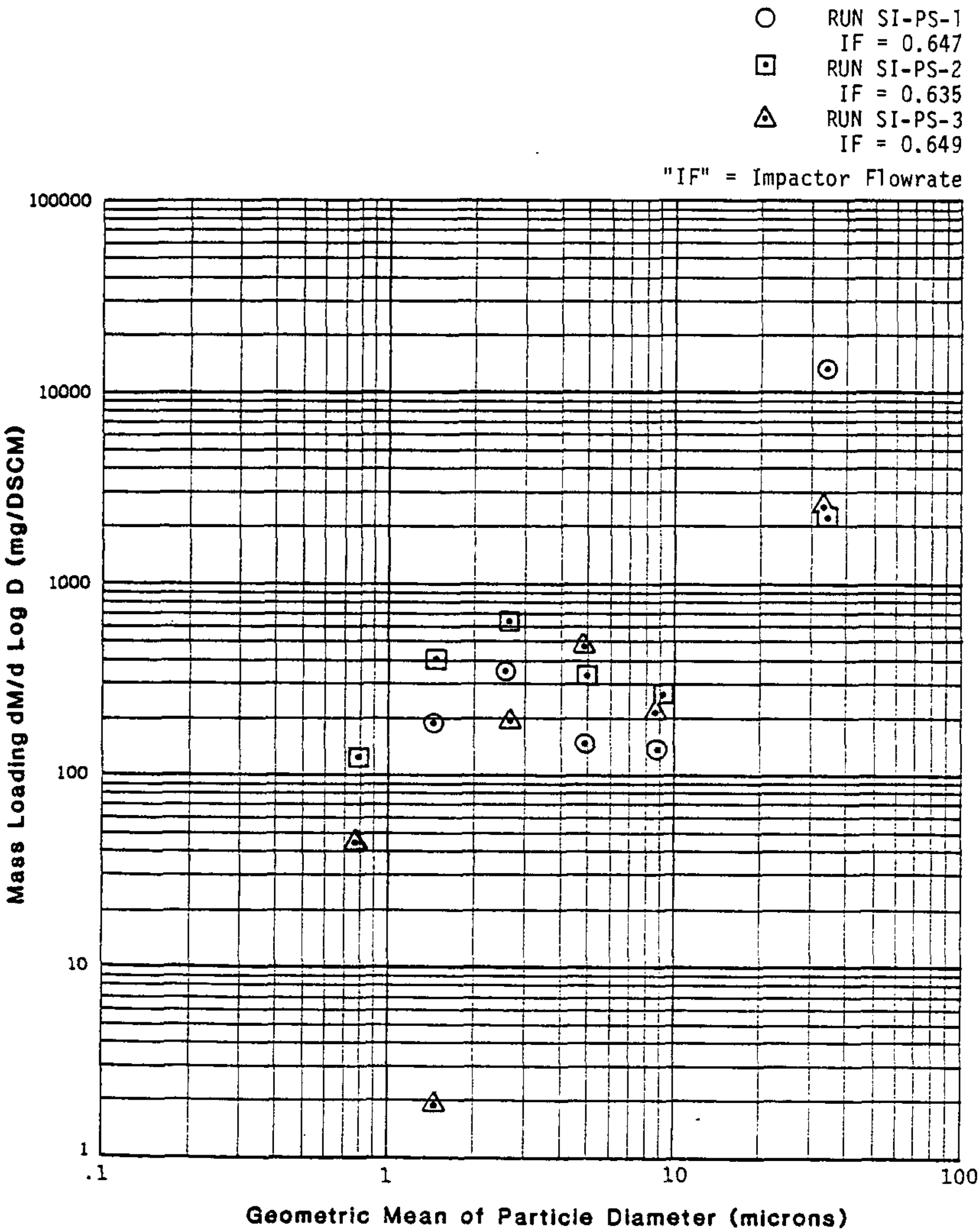
PARTICULE SIZE RESULTS[a] AT THE REVERBERATORY FURNACE
CHLORINATION SCRUBBER INLET AT
VISTA METALS CORPORATION, FONTANA, CALIFORNIA

Test Date Time, and Run No.	(1)Sampling Duration (2)Impactor Flow Rate (3)Stack Temp (°F)	Stage Index No.	Delta Weight (mg)	% In Size Range	Cumulative %less than Size Range	Size Range (microns)	Effective Cut Diameter (D_p50-microns)
		SO[b]	288.78	73.13	26.87	>11.08	11.08
5/20/81	(1)12.0 minutes	S1	17.13	4.34	22.54	6.94-11.08	6.94
		S2	20.87	5.28	17.25	3.24- 6.94	3.24
1811-1823	(2) 0.668 ACFM	S3	15.01	3.80	13.45	2.11- 3.24	2.11
		S4	15.89	4.02	9.43	1.08- 2.11	1.08
SI-PS-4	(3) 64°F	S5	13.19	3.34	6.09	0.52- 1.08	0.52
		Back-up filter	24.04	6.09	--	0.0[c]- 0.52	--
		SO[b]	891.96	77.50	22.50	>11.19	11.19
5/20/81	(1)13.0 minutes	S1	35.05	3.05	19.46	7.01-11.19	7.01
		S2	38.54	3.35	16.11	3.28- 7.01	3.28
2024-2037	(2) 0.655 ACFM	S3	26.06	2.26	13.84	2.13- 3.28	2.13
		S4	27.21	2.36	11.48	1.09- 2.13	1.09
SI-PS-5	(3) 64°F	S5	27.39	2.39	9.09	0.53- 1.09	0.53
		Back-up filter	104.57	9.09	--	0.0[c]- 0.53	--
		SO[b]	241.20	93.67	6.33	>11.34	11.34
5/21/81	(1) 3.0 minutes	S1	3.31	1.29	5.04	7.10-11.34	7.10
		S2	4.25	1.65	3.39	3.32- 7.10	3.32
2028-2031	(2) 0.643 ACFM	S3	2.49	0.97	2.42	2.15- 3.32	2.15
		S4	2.53	0.98	1.44	1.11- 2.15	1.11
SI-PS-6	(3) 69°F	S5	2.03	0.79	0.65	0.54- 1.11	0.54
		Back-up filter	1.68	0.65	--	0.0[c]- 0.54	--

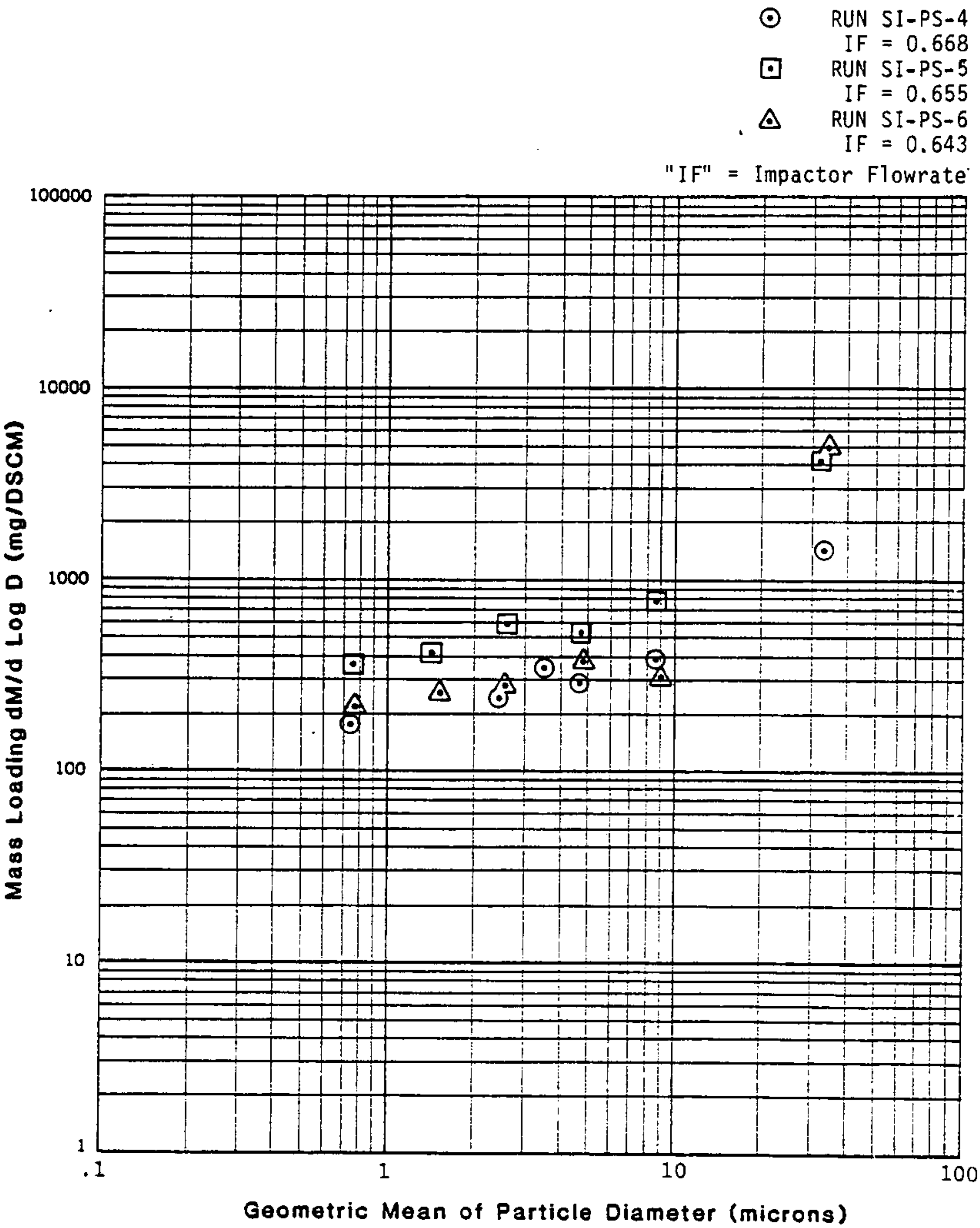
a. particle sizing determinations employed a 6-stage Anderson Mark III impactor.
b. Nozzle, pre-cutter, inlet cone, and zero stage wash weight added to stage 1 weight (index No. SO)
c. Back-up filter has an actual 0.3 micron retention (DOP).


Particle Size Results
Andersen 6-Stage Mark III Impactor
Reverberatory Furnace Chlorination Scrubber Inlet
Vista Metals Corporation, Fontana, CA
Assumed Density = 1.0
"IF" = Impactor Flowrate
SI-PS-1 IF = 0.647
SI-PS-2 IF = 0.635
SI-PS-3 IF = 0.649
SI-PS-4 IF = 0.668
SI-PS-5 IF = 0.655
SI-PS-6 IF = 0.643
D50 CUTPOINT, microns
CUMULATIVE % LESS THAN STATED SIZE

Particle Size Results
Andersen 6-Stage Mark III Impactor
Reverberatory Furnace Chlorination Scrubber Inlet
Vista Metals Corporation, Fontana, CA



Particle Size Results
Andersen 6-Stage Mark III Impactor
Reverberatory Furnace Chlorination Scrubber Inlet
Vista Metals Corporation, Fontana, CA



If results from Test Run 1 can be considered outliers due to a process malfunction, then it would appear that the middle, not the end of the chlorination cycle exhibits a larger percentage of the emissions from the damaging operation. Chlorination cycle emissions were highly variable however, and because particle size test runs were relatively short there was little opportunity to dampen out the variations.

2.1.6 Visible Emissions Observations

Table 2-5 summarizes visible emission observations made of the reverberatory furnace chlorination scrubber exhaust. Figures 2.3a, 2.3b, and 2.3c graphically illustrate these observations. Observations are presented in six minute averages for each test run. Observations made on May 19, 1981 had the highest (24.0%) and lowest (0%) six minute average opacities during the test program. Of the three sampling days, the visible emissions observer expressed the most confidence in readings on the last day, May 21. Observations on all three days were difficult due to intermittent steam emissions and scattering of the plume by wind, but on the last day the lower wind speed allowed for more confident readings. On the first day, May 19, a 45 second period of high recorded readings was discarded because the observer read the steam plume opacity. This was the first observation where the plume appeared to contain steam.

Visible emissions observations were made on the reverberatory furnace charging well afterburner exhaust on May 28, 1981. No process data was collected during this period. Six minute average observations

TABLE 2-5

VISIBLE EMISSIONS OBSERVATIONS AT THE
REVERBERATORY FURNACE CHLORINATION SCRUBBER OUTLET
AT VISTA METALS CORPORATION, FONTANA, CALIFORNIA

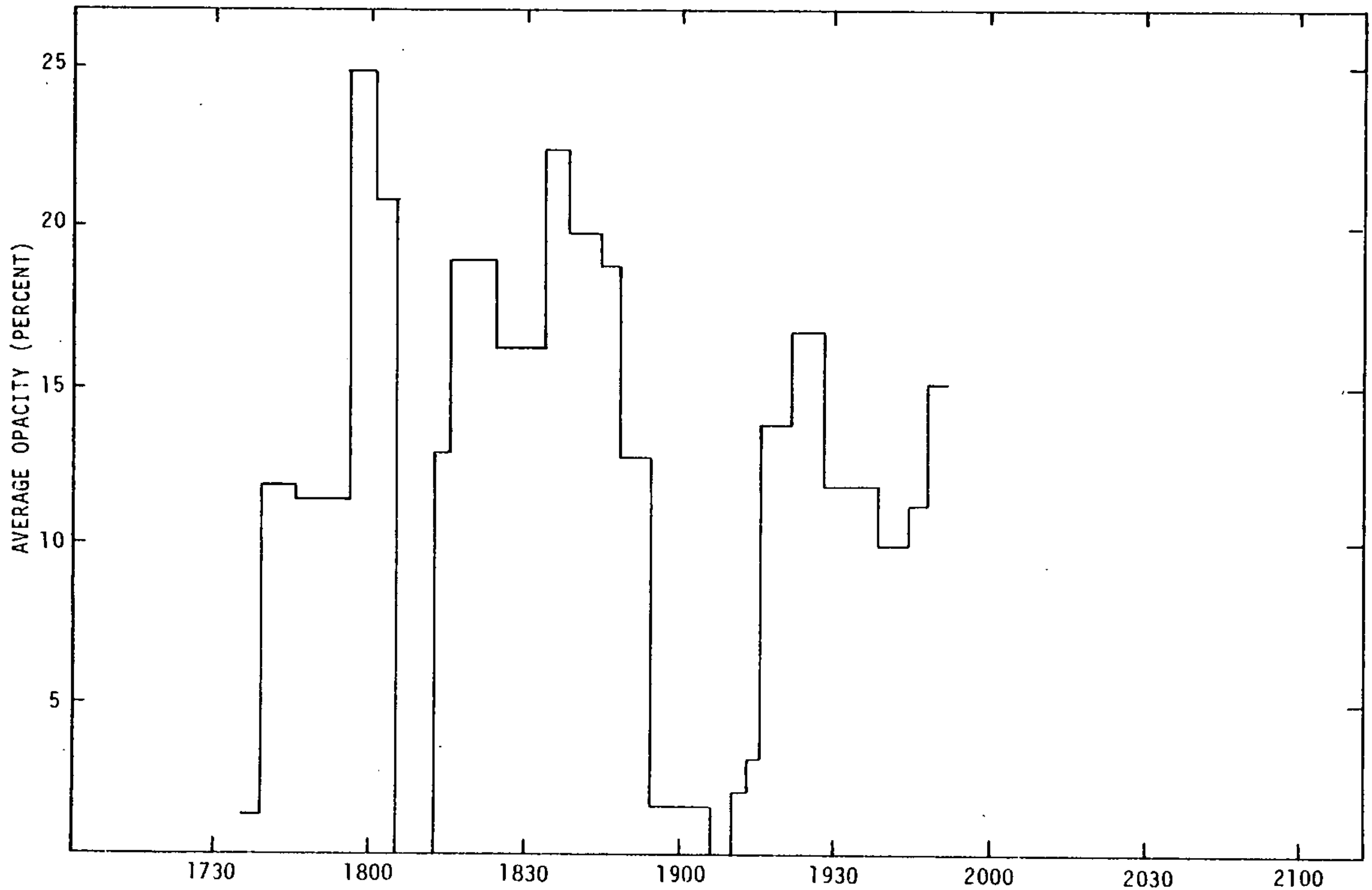
Date	Run Number	Six-Minute Time Period		Average Opacity (Percent)	Observer Location
5/19/81	1	1741:00	1746:45	1.0	150 ft. west of stack
		1747:00	1752:45	11.2*	
		1753:00	1756:10	11.9	
		1800:00	1805:45	24.0	60 ft. north of stack
		1806:00	1811:45	21.0	on plant floor
		1812:00	1813:45	0	
		1815:00	1820:45	12.1	
		1821:00	1826:45	18.5	150 ft. west of stack
		1827:00	1832:45	16.5	(1817 - 150 ft. NW of
		1833:00	1838:45	22.5	stack on roof line)
		1839:00	1844:45	19.6	
		1845:00	1850:45	17.7	Comments: Gusty winds
		1851:00	1856:45	12.5	and steam in the plume
		1857:00	1902:45	1.3	made observations
		1903:00	1908:45	0	difficult.
		1909:00	1914:45	2.9	
		1915:00	1920:45	13.1	
		1921:00	1926:45	15.4	
		1927:00	1932:45	12.9	
		1933:00	1938:45	9.4	
		1939:00	1944:45	10.8	
		1945:00	1950:45	15.2	
		1951:00	1952:45	15.6	
		Average		12.4	
5/20/81	2	1732:00	1737:45	7.5	100 ft. NW of discharge
		1738:00	1743:45	12.9	
		1744:00	1749:45	12.1	Comments: Wind changes
		1750:00	1755:45	11.5	and steam in the plume
		1756:00	1801:45	15.0	interfered with accurate
		1802:00	1807:45	11.9	observations.
		1808:00	1813:45	13.1	
		1814:00	1819:45	11.5	
		1820:00	1825:45	9.8	
		1826:00	1831:45	11.7	
		1832:00	1837:45	11.3	
		1838:00	1843:45	9.6	
		1844:00	1849:45	9.0	

*Due to high bias, data for 1750:15-1750:45 were discarded.

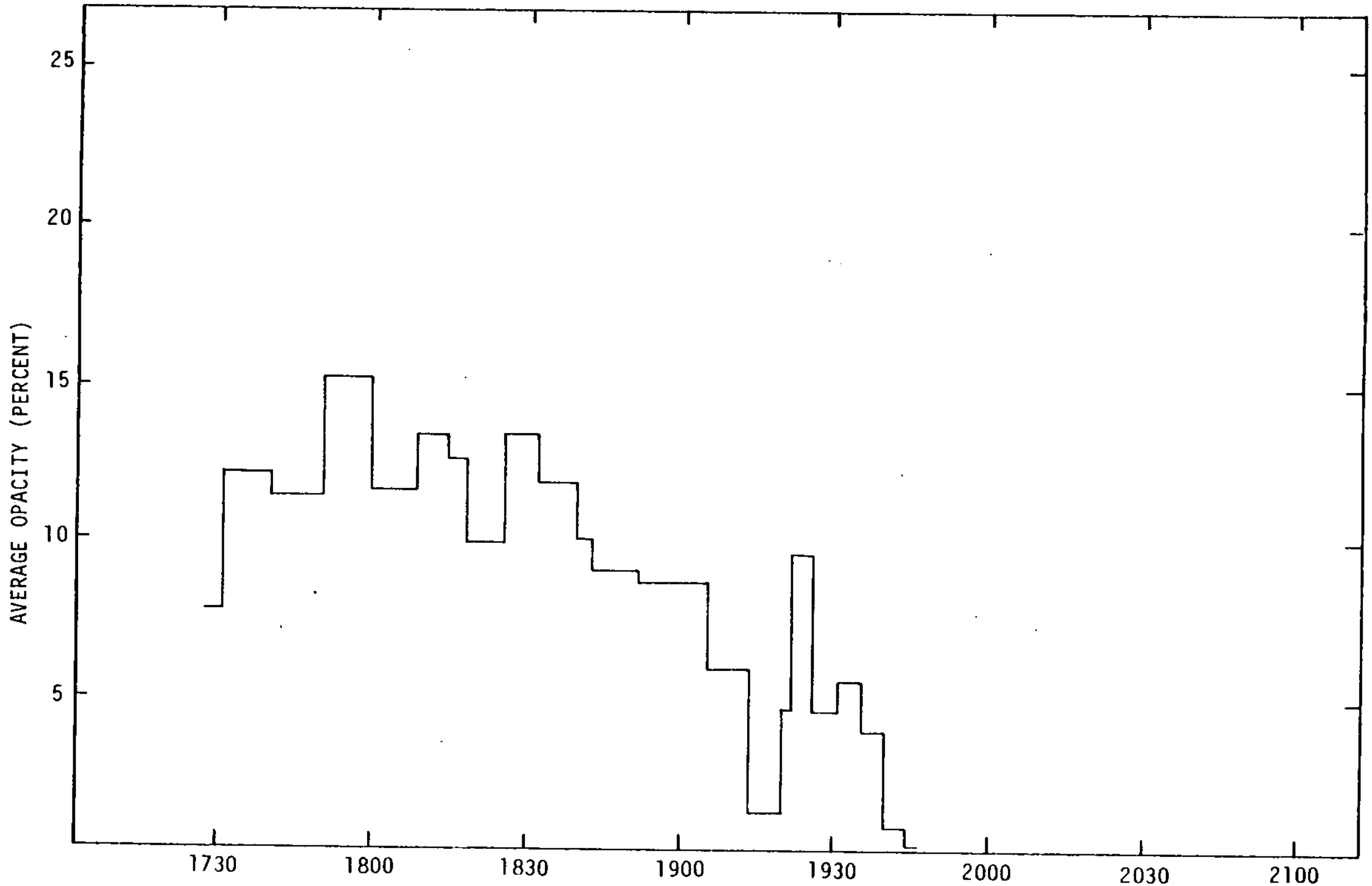
TABLE 2-5 continued

VISIBLE EMISSIONS OBSERVATIONS AT THE
REVERBERATORY FURNACE CHLORINATION SCRUBBER OUTLET
AT VISTA METALS CORPORATION, FONTANA, CALIFORNIA

Date	Run Number	Six-Minute Time Period		Average Opacity (Percent)	Observer Location
5/20/81	2	1850:00	1855:45	8.5	
(cont'd.)		1856:00	1901:45	8.3	
		1902:00	1907:45	5.6	
		1908:00	1913:45	2.3	
		1914:00	1919:45	4.0	
		1920:00	1925:45	9.0	
		1926:00	1931:45	5.0	
		1932:00	1937:45	5.8	
		1938:00	1943:45	4.8	
		1944:00	1949:45	1.0	
		1950:00	1951:45	0.2	
		Average		8.4	
5/21/81	3	1855:00	1900:45	2.3	NW of discharge
		1901:00	1906:45	0	
		1907:00	1912:45	6.7	Comments: Because of improved conditions, the observer had more confidence in these readings than those on May 19 and 20.
		1913:00	1918:45	10.2	
		1919:00	1924:45	15.0	
		1925:00	1930:45	13.1	
		1931:00	1936:45	3.8	
		1937:00	1942:45	3.1	
		1943:00	1948:45	9.6	
		1949:00	1954:45	8.5	
		1955:00	2000:45	3.3	
		2001:00	2006:45	0.6	
		2007:00	2012:45	3.3	
		2013:00	2018:45	5.6	
		2019:00	2024:45	1.5	
		2025:00	2030:45	5.4	
		2031:00	2036:45	4.8	
		2037:00	2042:45	4.6	
		2043:00	2048:45	3.1	
		Average		5.5	

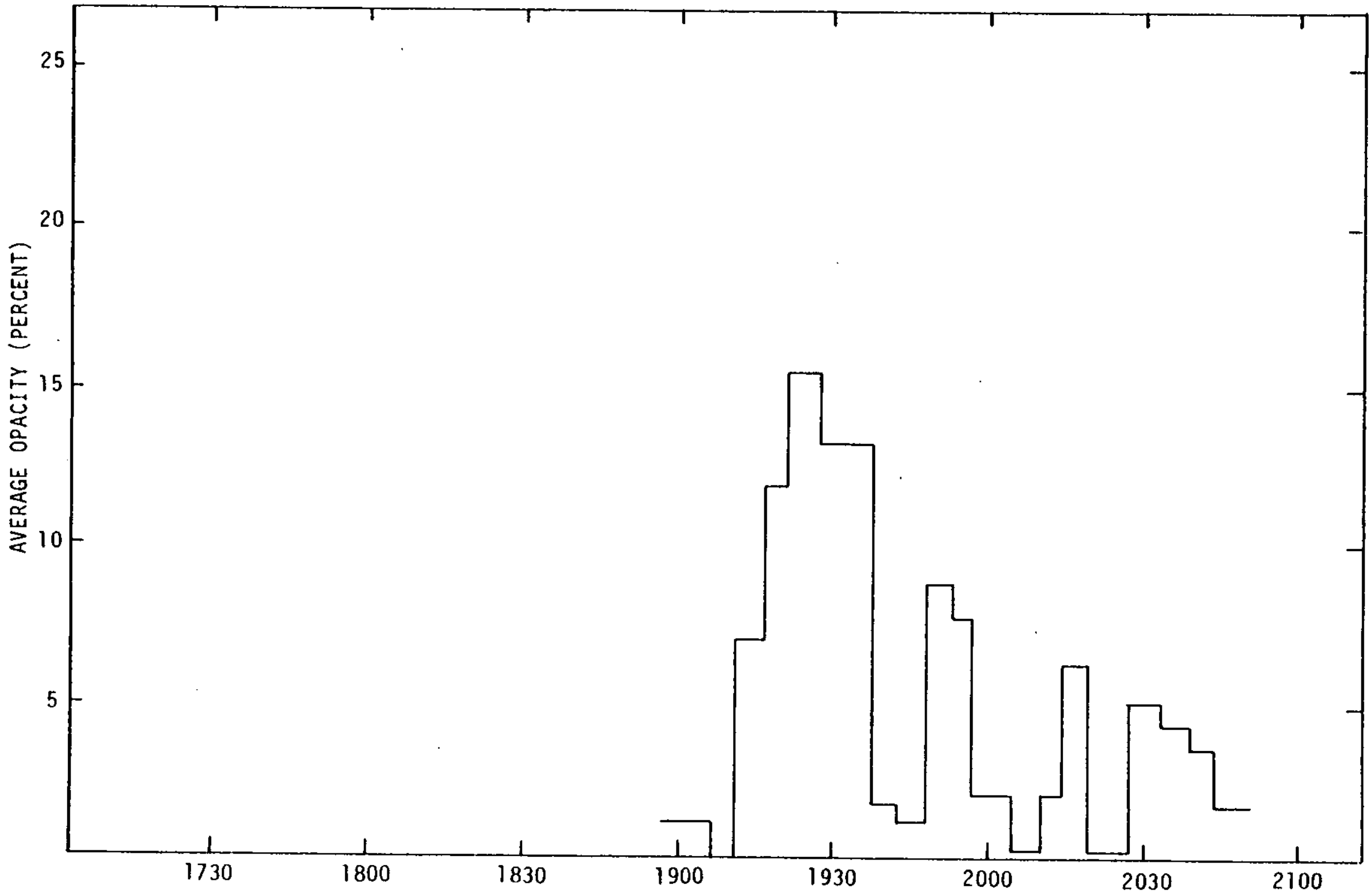


VISIBLE EMISSIONS OBSERVATIONS AT THE REVERBERATORY FURNACE CHLORINATION SCRUBBER OUTLET
AT THE VISTA METALS CORPORATION, FONTANA, CALIFORNIA - MAY 19, 1981



VISIBLE EMISSIONS OBSERVATIONS AT THE REVERBERATORY FURNACE CHLORINATION SCRUBBER OUTLET
AT THE VISTA METALS CORPORATION, FONTANA, CALIFORNIA - MAY 20, 1981

FIGURE 2.3c



VISIBLE EMISSIONS OBSERVATIONS AT THE REVERBERATORY FURNACE CHLORINATION SCRUBBER OUTLET AT THE VISTA METALS CORPORATION, FONTANA, CALIFORNIA - MAY 21, 1981 ranged from 0 to 2.4 percent opacity. Table 2-6 lists these six-minute averages. Figure 2.4 is a graphical representation. Visible emissions at Vista Metals, with some reservations because of the steam plume from the chlorination scrubber, should be acceptable for SPNSS reference purposes.

2.1.7 Fugitive Emissions Observations

Fugitive emission observations were made at the reverberatory furnace charging well on May 28 according to EPA reference Method 22. Emission frequencies ranged from 12.6 to 86.6 percent during the three hours and 10 minutes of observation. Table 2-7 shows these observations.

Fugitive emissions observations were made at the borings dryer charging, central and discharge areas on May 22, 1981. The results of the observations are summarized in Tables 2-8 through 2-10. Emission frequencies were 63% and 75% of the observation periods at the charging area, 96% and 100% at the central area and 100% at the discharge area.

2.1.8 Scrubber Liquor Analysis

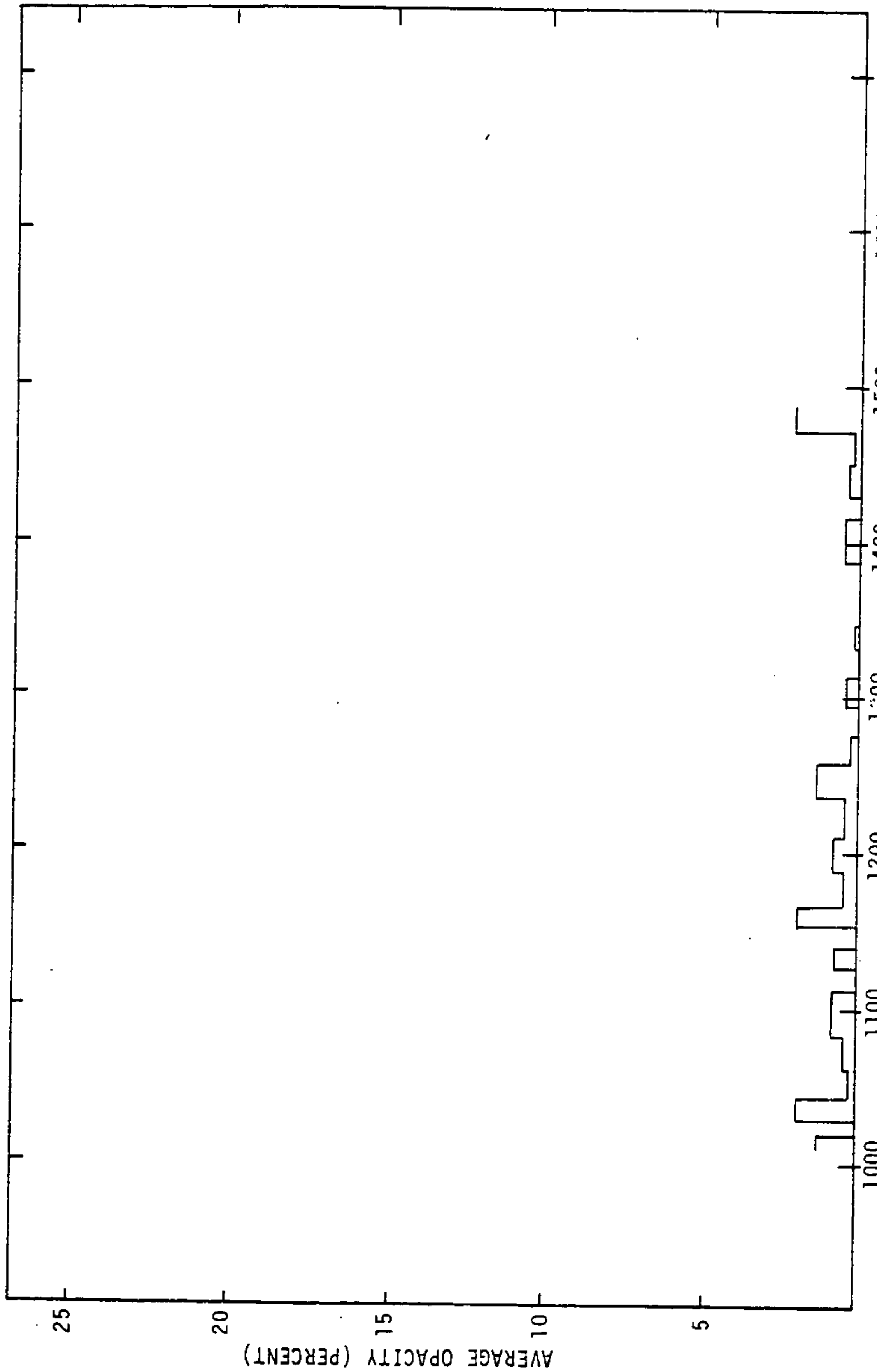
Scrubber liquor samples were collected during conductance of particulate, chlorine, chloride tests on the scrubber inlet and outlet on May 19, 20, and 21. The temperature of the liquor was measured immediately upon sample collection. The pH of the liquor was measured approximately one hour after collection of the samples. This allowed the temperatures of the samples to stabilize.

The temperature of the liquor ranged from a low average of 66°F on May 19 to a high average of 77°F on May 21. The low average pH was 10.4 on May 19 and the high average pH was 11.3 on May 21. These data are summarized in Table 2-11.

TABLE 2-6

VISIBLE EMISSIONS OBSERVATIONS AT THE
REVERBERATORY FURNACE CHARGING WELL OUTLET AT
VISTA METALS CORPORATION, FONTANA, CALIFORNIA

Date	Run Number	Six-Minute Time Period		Average Opacity (Percent)	Observer Location
5/28/81	1	1015:00	1020:45	1.5	East-southeast (150 ft) from stack
		1021:00	1026:45	1.9	
		1027:00	1032:45	1.5	
		1033:00	1038:45	0.0	Comments: This was a brown plume when visible, and against a blue sky.
		1039:00	1044:45	2.1	
		1045:00	1050:45	0.2	
		1051:00	1056:45	0.8	
		1057:00	1102:45	1.0	
		1103:00	1108:45	0.0	
		1109:00	1114:45	1.0	
		1227:00	1232:45	0.0	
		1233:00	1238:45	0.0	
		1239:00	1244:45	0.0	
		1245:00	1250:45	2.5	
		1251:00	1256:45	0.8	
		1257:00	1302:45	1.0	
		1303:00	1308:45	0.8	
		1309:00	1314:45	1.5	
		1315:00	1320:45	0.2	
		1321:00	1326:45	0.2	
		1335:00	1340:45	0.0	
		1341:00	1346:45	0.0	
		1347:00	1352:45	0.2	
		1353:00	1358:45	0.0	
		1359:00	1404:45	0.6	
		1405:00	1410:45	0.0	
		1411:00	1416:45	0.6	
		1417:00	1420:45	0.4	
		1421:00	1426:45	0.2	
		1427:00	1432:45	2.1	
		Average		0.7	



VISIBLE EMISSIONS OBSERVATIONS AT THE CHARGING WELL AFTERBURNER OUTLET
AT THE VISTA METALS CORPORATION, FONTANA, CALIFORNIA - MAY 28, 1981

TABLE 2-7

FUGITIVE EMISSIONS OBSERVATIONS AT THE REVERBERATORY FURNACE CHARGING WELL AT VISTA METALS CORPORATION, MAY 28, 1981

Clock Time (20 min. intervals)	Duration (min:sec)	Accumulated Emission Time (min:sec)	Emission Frequency (%)
1010-1030	00:32	00:32	
	01:57	02:29	
	00:10	02:39	
	00:16	02:55	
	01:53	04:48	
	00:03	04:51	
	00:52	05:43	
	03:51	09:34	
	01:12	10:46	
	00:39	11:25	
	00:15	11:40	
	00:34	12:14	
	01:45	13:59	
	01:30	15:29	76.5
1045-1105	00:23	00:23	
	04:29	04:52	
	00:31	05:23	26.2
1110-1130	00:01	00:01	
	00:42	00:43	
	01:39	02:08	
	01:21	03:29	
	00:31	04:00	
	00:07	04:07	
	01:22	05:29	
1225-1255	00:16	00:16	
	17:15	17:31	86.6
1255-1315	00:09	00:09	
	00:06	00:15	
	00:47	01:02	
	01:01	02:03	
	00:26	02:29	
	00:15	02:44	
	01:00	02:44	
	01:17	05:01	
	00:55	05:56	
	00:08	06:04	
	01:31	07:35	

TABLE 2-7 continued

FUGITIVE EMISSIONS OBSERVATIONS AT THE REVERBERATORY FURNACE CHARGING WELL AT VISTA METALS CORPORATION, MAY 28, 1981

Clock Time (20 min. intervals)	Duration (min:sec)	Accumulated Emission Time (min:sec)	Emission Frequency (%)
1255-1315 (cont'd.)	00:02	07:37	
	00:07	07:44	
	00:04	07:48	
	00:03	07:51	
	00:29	08:20	
	00:12	08:32	41.6
1315-1335	01:01	01:01	
	04:12	05:13	
	00:39	05:52	27.6
1335-1355	00:02	00:02	
	00:12	00:14	
	01:15	01:29	
	00:07	01:36	
	00:07	01:43	
	00:02	01:45	
	00:04	01:49	
	00:12	02:01	
	00:50	02:51	12.6
1355-1415	00:50	00:50	
	00:01	00:51	
	00:07	00:58	
	00:03	01:01	
	00:03	01:04	
	02:37	02:41	
	01:01	03:42	
	00:16	03:58	
	00:06	04:04	
	00:26	04:30	21.5
1415-1435	00:44	00:44	
	00:54	01:38	
	00:37	02:15	
	00:06	02:21	
	00:12	02:33	
	00:08	02:41	
	00:07	02:48	
	00:09	02:57	

TABLE 2-7 continued

FUGITIVE EMISSIONS OBSERVATIONS AT THE REVERBERATORY FURNACE CHARGING WELL AT VISTA METALS CORPORATION, MAY 28, 1981

Clock Time (20 min. intervals)	Duration (min:sec)	Accumulated Emission Time (min:sec)	Emission Frequency (%)
1415-1435 (Cont'd.)	00:33	03:30	
	00:47	04:17	
	00:06	04:23	
	00:17	04:40	
	00:26	05:06	
	00:26	05:32	
	00:07	05:39	
	01:25	07:04	
	00:21	07:25	
	00:42	08:07	
	00:07	08:14	
	00:12	08:26	
	00:32	08:58	42.9

TABLE 2-8

FUGITIVE EMISSIONS OBSERVATIONS IN THE BORINGS DRYER CHARGING AREA AT VISTA METALS CORPORATION, MAY 22, 1981

Clock Time (20 min. intervals)	Duration (min:sec)	Accumulated Emission Time (min:sec)	Emission Frequency (%)
1049-1110	13:15	13:15	63.1
1340-1400	13:50	13:50	
	01:10	15:00	75.0

TABLE 2-9

FUGITIVE EMISSIONS OBSERVATIONS IN THE BORINGS DRYER CENTRAL AREA AT VISTA METALS CORPORATION, MAY 22, 1981

Clock Time (20 min. intervals)	Duration (min:sec)	Accumulated Emission Time (min:sec)	Emission Frequency (%)
1049-1110	21:00	21:00	100
1340-1400	19:15	19:15	96.3

TABLE 2-10

FUGITIVE EMISSIONS OBSERVATIONS IN THE BORINGS DRYER UNLOADING AREA VISTA METALS CORPORATION, MAY 22, 1981

Clock Time (20 min. intervals)	Duration (min:sec)	Accumulated Emission Time (min:sec)	Emission Frequency (%)
1049-1110	21:00	21:00	100
1340-1400	20:00	20:00	100

2.1.9 Pressure Drop Determinations across Reverberatory Furnace Chlorination Scrubber

Pressure drop across the scrubber system was monitored during the three test runs on the inlet and outlet of that unit. The pressure drop measurements are summarized in Table 2-11. Average pressure drops for each of the three evenings were 2.9, 2.8, and 2.9 inches of water for May 19, 20, and 21 respectively.

2.1.10 Stack Gas Molecular Weight Determinations

Stack gas molecular weight determinations were made based on Orsat analyses and moisture determinations summarized in sections 2.1 and 2.4. As mentioned previously, the chlorine gas at the scrubber inlet was absorbed in the oxygen burrett of the Orsat analyzer. The chlorine absorption resulted in apparent oxygen concentrations as high as 21.3%. Molecular weight determinations were made using 20.9 as the assumed oxygen concentration at the scrubber inlet and outlet sites. Molecular weight determinations are presented in Tables 2.2 and 2.3 and included in computer summaries in Appendix A for scrubber inlet and outlet sites.

Molecular weight determinations were made at the borings dryer outlet with the afterburner not operating. The molecular weight (wet) was determined to be 28.38. The uncontrolled dry gas molecular weight was 29.41. No moisture determination was made with the borings dryer afterburner operating, therefore no wet molecular weight was calculated. The dry gas molecular weight was 30.08 with the afterburner operating.

TABLE 2-11

PRESSURE DROP ACROSS CHLORINATION SCRUBBER
AND TEMPERATURE AND pH OF SCRUBBER LIQUOR
VISTA METALS CORPORATION, FONTANA, CALIFORNIA

Particulate/Chlorine/ Chloride Run Number	Test Date	Time	Scrubber Δp (in. H_2O)	Liquor Temp.(F°)	Liquor PH
M5/Cl - 1	5/19/81	1755	2.0		
		1855	3.1		
		1907	2.9	68	10.5
		1927	2.9		
		1937		70	10.5
		1947	3.2		
		2007		66	10.0
		2015	3.5		
		2035	2.7	64	10.5
		2105	2.5	62	10.5
		Average	2.9	66	10.4
M5/Cl - 2	5/20/81	1740		58	11
		1746	2.7		
		1812		64	11
		1830	3.1		
		1850		67	11
		1855	2.9		
		1910	2.9		
		1935	2.8		
		2015	2.8	76	11
		2045	2.6	80	11
		2115	2.8	86	11
		2120	2.6		
		2145		85	11
		Average	2.8	74	11
M5/Cl - 3	5/21/81	1905	2.7		
		1910		76	11.5
		1933	2.8		
		1935		78	11.5
		2010	2.9		
		2026		83	11.0
		2045	3.2		
		2110		76	11.5
		2140	3.1	70	11.0
		Average	2.9	77	11.3

2.2 Reverberatory Furnace Charging Well Emissions

Visible emissions observations (VEO's) were made on the reverberatory furnace charging well stack on May 28, 1981; however, no record of process operations were made during that observation period. The results are presented in Section 2.6. No other tests were conducted on stack emissions from this source.

2.3 Reverberatory Furnace Combustion Stack Emissions

No testing was conducted on the reverberatory furnace combustion stack during this test program.

2.4 Borings Dryer Emissions

The borings dryer exhaust stack was found to have extremely low flow velocities, most pronounced during uncontrolled operation, and only marginally within the usable range of available instrumentation. With the afterburner in operation the flow velocities increased but the stack gas temperature was high, exceeding 2000°F. Due to these conditions, no comprehensive testing was conducted on either controlled or uncontrolled borings dryer emissions. Some preliminary tests were conducted and are discussed below in Sections 2.4.1 and 2.4.2; however, no data summaries are presented for these tests.

2.4.1 Borings Dryer Uncontrolled

A preliminary velocity traverse was conducted on the borings dryer with the afterburner not operating on May 22, 1981. The velocity head ranged from approximately 0.01 to 0.002 inches of water, well below the usable range of the micromanometer. An attempt was made to collect a particulate sample by EPA Reference Method 5 but the filter became plugged after 1 minute of sampling. The stack temperature was 426°F, and the moisture, determined from the impinger volume change and silica gel, was 9.06%. The particulate concentration was calculated to be 3.354 grains/DSCF (26.103 pounds/hour). The condensible hydrocarbon concentration was determined to be 0.589 grains/DSCF (4.580 pounds/hour). The stack gas flow rate was calculated to be 907 DSCFM. The average oxygen content was 14.8%, carbon dioxide, 5.0%, and carbon monoxide, 0.7%. It is stressed that these data were not collected under acceptable test conditions and are therefore presented here for information purposes only in anticipation that they may be useful for any future testing of this or a similar unit. Field data sheets presenting the borings dryer testing can be found in Appendix C.2.

Noncondensible hydrocarbon testing was also conducted on uncontrolled emissions from the borings dryer. Noncondensible hydrocarbons ranged from 425 to 660 ppmV as hexane. These data are presented in Section 2.13.

2.4.1.1 Particle Size

A single particle size distribution test was conducted on the borings dryer uncontrolled emissions on May 22, 1981. No attempt was made to sample the stream isokinetically due to the extremely low gas flows in the stack and the resulting low gas velocities in the impactor. Extremely low flows through a cascade impactor result in unpredictable sizing characteristics by the jets. Table 2-12 and Figures 2.5 and 2-6 illustrate the results of this test. The grain loading determined during this run was 3.356 grains/DSCF.

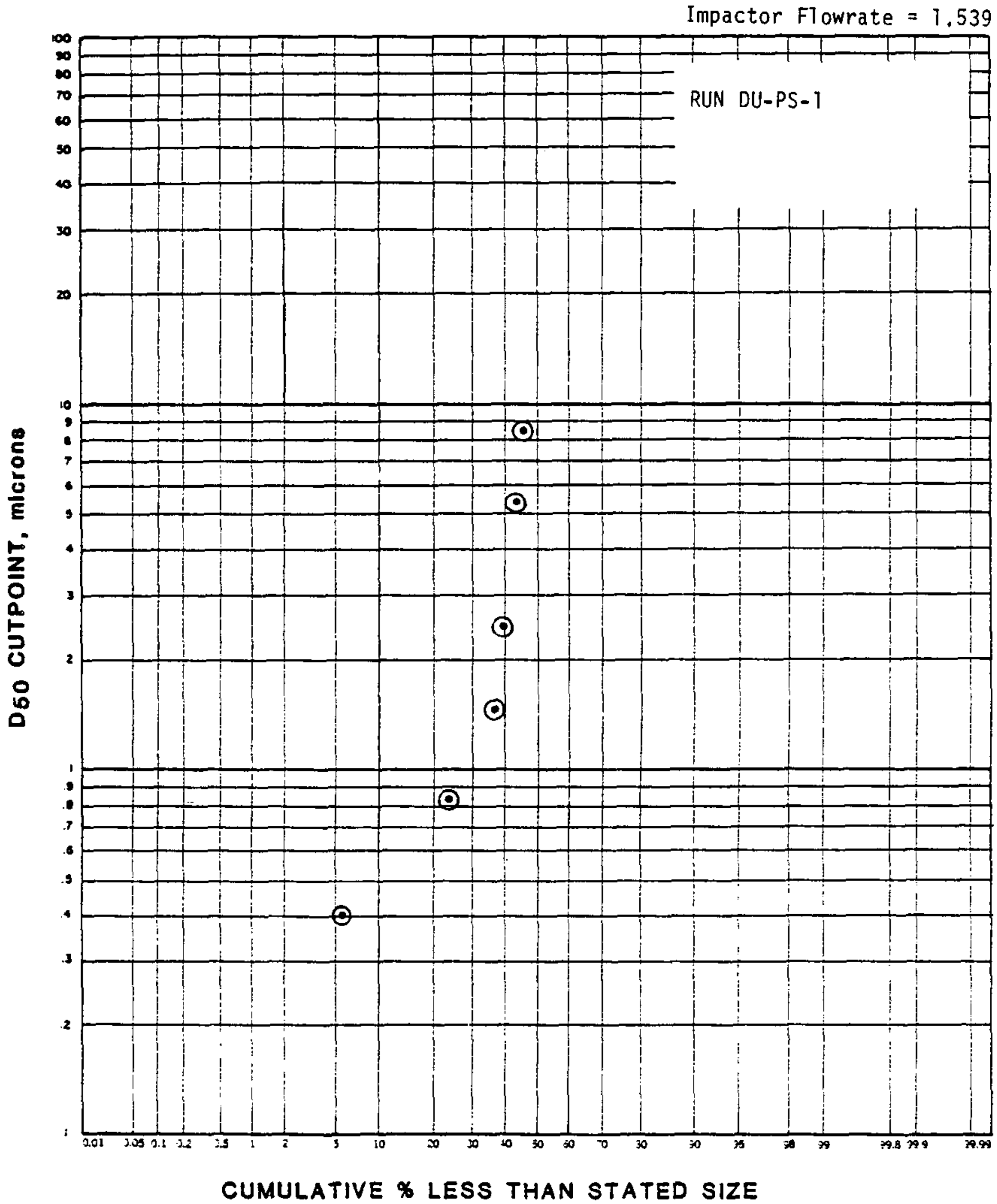
TABLE 2-12

PARTICULE SIZE RESULTS[a] OF UNCONTROLLED BORING
DRYER AT THE VISTA METALS CORPORATION, FONTANA, CALIFORNIA

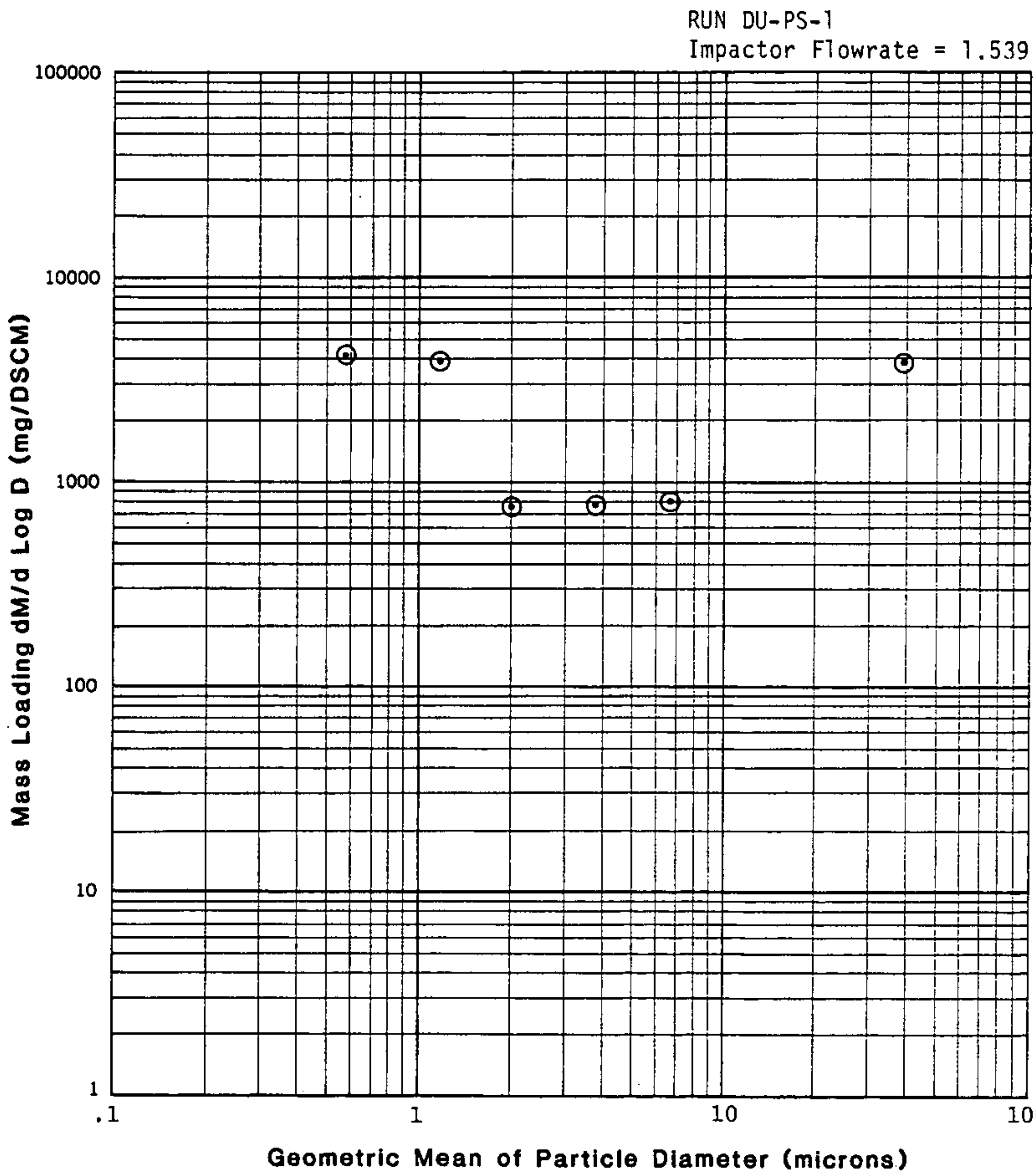
Test Date Time, and Run No.	(1)Sampling Duration (2)Impactor Flow Rate	Stage Index No.	Delta Weight (mg)	Effective Cut Diameter (DPSO-microns)	% In Size Range	Cumulative %less than Size Range	Size Range (microns)
		SO[b]	79.40	8.69	54.89	45.11	>8.69
5/22/81	(1) 0.8 minutes	S1	3.09	5.45	2.14	42.97	5.45-8.69
		S2	4.80	2.54	3.32	39.65	2.54-5.45
1316:10-1317	(2) 1.539 ACFM	S3	2.67	1.65	1.84	37.81	1.65-2.54
		S4	21.46	0.85	14.84	22.97	0.85-1.65
DU-PS-1	(3) 426.0°F	S5	24.81	0.40	17.15	5.82	0.40-0.85
		Back-up filter	8.42	--	5.82	--	0.0[c]-0.40

a. Particle sizing determinations employed at-stage Anderson Mark III impactor.
b. Nozzle, pre-cutter, inlet cone, and zero stage wash weight added to Stage No. 1 weight (index No. SO)
c. Back-up filter has an actual 0.3 micron retention.

Particle Size Results
Andersen 6-Stage Mark III Impactor
Borings Dryer Uncontrolled
Vista Metals Corporation Fontana, CA



Particle Size Results
Andersen 6-Stage Mark III Impactor
Borings Dryer Uncontrolled
Vista Metals Corporation, Fontana, CA



2.4.1.2 Flame Ionization Detector Results - Uncontrolled Noncondensible Hydrocarbon Emissions from the Borings Dryer

Table 2-13 summarizes noncondensible hydrocarbon measurements made on emissions of the uncontrolled borings dryer. Hydrocarbon concentrations are reported as hexane and ranged from a low of 400 to 685 ppmV during normal operation of the dryer. Emission rates were determined based on very rough estimates of the stack gas flow rate.

2.4.2 Borings Dryer Controlled

Controlled emissions from the borings dryer were tested for noncondensible hydrocarbons and Orsat analysis. Noncondensible hydrocarbon concentrations ranged from 2.4 to 3.7 ppmV as hexane. Oxygen content averaged 2.0%; carbon dioxide averaged 8.5% and carbon monoxide averaged 0.5%. Noncondensible hydrocarbons concentrations are presented in Table 2.14 and the Orsat results in Appendix C.2.2.

2.5 Audit Sample Results

The results of analyses of audit samples provided by EPA and analyzed by ES prior to analysis of Vista Metals Corporation test samples are summarized in Table 2-15. The audit samples were analyzed by EPA in September, 1980. During method development work performed by ES in December 1980, several of the audit samples were analyzed for chlorine using Methods 409-D and 409-E (Standard Methods for the Examination of Water and Wastewater, Fourteenth Edition). The results of those analyses averaged 26% below the reported EPA values. Since chlorine is unstable, sample degradation is believed to be the cause for the discrepancy. The December results were used for comparison

TABLE 2-13

FLAME IONIZATION DETECTOR (FID) DATA SUMMARY ON
UNCONTROLLED GASES AT THE BORINGS DRYER
VISTA METALS CORPORATION, FONTANA, CALIFORNIA

					Gaseous Hydrocarbon Concentration					
			Time (min.)		Minimum[b]	Maximum[b]	Point Average		Volumetric Flow	Pollutant Mass Rate[c]
Date	Run No.	Traverse Points	Start	End	ppm (V)	ppm (V)	ppm (V)	gr/DSCF[c]	DSCFM	lbs/hr
5-22-81	1	Stack Center Point	1234	1235	400	470	440	0.699	907.6	5.439
			1235	1236	445	489	473	0.751	907.6	5.844
			1236	1237	490	512	495	0.786	907.6	6.116
			1237	1238	490	532	510	0.810	907.6	6.303
			1238	1239	510	619	560	0.889	907.6	6.918
			1240	1241	579	675	635	1.008	907.6	7.844
			1241	1242	630	685	652	1.035	907.6	8.054
			1242	1243	600	645	610	0.978	907.6	7.611
			1243	1244	578	620	598	0.949	907.6	7.385
			1244	1245	554	600	571	0.906	907.6	7.050
			1245	1246	500	550	528	0.828	907.6	6.521
			1246	1247	460	510	482	0.765	907.6	5.953
			1247[a]	1248	425	465	445	0.706	907.6	5.494
			1248[a]	1249	386	430	408	0.648	907.6	5.043
			1249[a]	1250	342	385	365	0.579	907.6	4.506
			1250[a]	1251	305	342	326	0.518	907.6	4.031
			1251[a]	1252	280	310	295	0.468	907.6	3.642
			1252[a]	1253	255	280	270	0.429	907.6	3.338
			1253[a]	1254	240	214	250	0.397	907.6	3.090
			1254[a]	1255	220	240	230	0.365	907.6	2.840
			1255[a]	1256	202	218	211	0.335	907.6	2.607

a. THCA operator was informed that the borings dryer charging conveyor was down. Test aborted at 1256. Data not included in emission calculations summarized in text.
b. As hexane.
c. A hexane molecular weight of 86 was used to calculate hydrocarbon concentrations and mass flow rate.

TABLE 2-14

FLAME IONIZATION DETECTOR (FID) DATA SUMMARY ON
CONTROLLED GASES EXITING THE BORINGS DRYER AFTERBURNER
AT THE VISTA METALS CORPORATION, FONTANA, CALIFORNIA

Date	Run No.	Traverse Points	Time (min.) Start	End	Gaseous Hydrocarbon Concentration: Minimum ppm (V)[a]	Maximum ppm (V)[a]	Point Average ppm (V)[a]	gr/DSCF[b]
5-22-81	1	Stack Center Point	1124	1125	2.5	2.8	2.5	0.004
			1125	1126	Chart spike-no data reduction attempted			
			1126	1127	2.4	2.4	2.4	0.004
			1127	1128	2.4	2.6	2.5	0.004
			1128	1129	2.6	2.9	2.0	0.004
			1129	1130	2.9	3.0	3.0	0.005
			1130	1131	3.0	3.1	3.1	0.005
			1131	1132	3.1	3.5	3.2	0.005
			1132	1133	3.5	3.8	3.7	0.006
			1133	1134	3.7	3.8	3.7	0.006
			1134	1135	3.8	3.7	3.7	0.006
			1135	1136	3.6	3.7	3.6	0.006

a. As hexane.
b. A hexane molecular weight of 86 was used to calculate hydrocarbon concentrations.

TABLE 2-15

VISTA METALS AUDIT SAMPLE RESULTS

Audit Sample Number	EPA Results September 1980 (mg/l)	ES Results December 1980 (mg 1)	Component Analyzer[a]	Method[b]	ES Results May 1981 mg/l	% Error[c]
4075	357.6	268.0	Cl_2	A	224	-16.4
5255	458.6	354.0	Cl_2	A	414	+16.9
3095	254.8	183.0	Cl_2		Sample Spilled	
1014	50.96	38.0	Cl_2	D	29	-23.7
1023	50.96	38.0	Cl_2	D	35	-7.9
2268	152.9	108.0	Cl_2	D	150[d]	+38.9[d]
2289	152.9		Cl_2	D	102	-33.3
3076	254.8		Cl_2	D	175	-31.3
3096	254.8		Cl_2	D	180	-29.4
4068	356.7		Cl_2	D	250	-29.9
4078	356.7		Cl_2	D	255	-28.5
5263	458.6		Cl_2	D	320	-30.2
5280	458.6		Cl_2	D	320	-30.2
2235	3000.0		Tot Cl	M	3149.0	+5.0
1230	1000.0		Tot Cl	M	949.7	-5.0
3015	5000.0		Tot Cl	M	4841.0	-3.2
4016	7000.0		Tot Cl	M	6797.9	-2.9
5241	9000.0		Tot Cl	M	8697.3	-3.4

a. Cl_2 = combined chlorine; Tot Cl = Total Chlorides

b. A = arsenite; D = DPD; M = Mecuric Nitrate

c. $\% \text{ Error} = \frac{\text{ES Results} - \text{EPA Results}}{\text{EPA Results}} \times 100$

d. The first titration of this sample required slightly more than the recommended amount titrant, but yielded 93 mg/l and a -13.9% error. The figure listed resulted from a second titration of a smaller aliquot. The first titration results, however, appear more reasonable.

Note: ES results of December 1980 used to determine percent error when those analyses were available. Sample degradation is cited as the possible reason. reason for the consistent negative error.

with the Vista audit results determined in May 1981 when analyses had been conducted.

Arsenite titration of two chlorine audit samples resulted in relative errors of +17 and -16 percent. These errors were determined by comparison with ES December analyses. Audit sample concentrations below the accuracy of the method may have caused these errors, particularly the positive error. In this particular sample, the difference in the amount of titrant used between the blank and the sample was only 3%. Some chlorine sample degradation would be expected between December and May.

Chlorine results of three samples analyzed by the DPD method and compared to ES December results indicated relative errors from -24 to +39%. Another titration of the one positive error sample showed a negative error. The negative error appears more likely. Seven additional DPD titrations for chlorine were compared to EPA September 1980 results and showed -28.5 to -33.3% error. The error in chlorine audit analyses is probably the result of the ClO^- ion reducing to Cl^-, or possibly escaping out of solution.

2.6 Cleanup Evaluation Results

Cleanup evaluation results are presented in Table 2-16. The scrubber inlet and outlet trains were charged with reagents prior to the first test run and these blanks recovered according to normal sample recovery procedures.

TABLE 2-16

CLEANUP EVALUATION RESULTS
AT VISTA METALS CORPORATION, FONTANA, CALIFORNIA

Sample Description	Chlorine (mg)	Chloride (mg)	Particulate (mg)
Inlet train - front-half rinse prior to 1st test run	N/A	0.0	1.2
Inlet train - back-half recovery prior to 1st test run	0.0	0.0	N/A
Outlet train - front-half rinse prior to 1st test run	N/A	0.0	1.7
Outlet train - back-half 1st impinger prior to first test run	0.0	0.0	N/A
Outlet train - 2nd and 3rd impinger prior to 1st test run	0.0	0.0	N/A
Inlet train - front-half rinse after Run 1	N/A	16.99	Not Analyzed
Inlet train - impinger rinse after Run 2	0.0	Not analyzed	Not Analyzed
Filter blank	Not analyzed	0.0	Not Analyzed
Distilled water blank rinse solvent and diluent for all scrubber runs)	Not analyzed	Not analyzed	4.9/1
Acetone blank residue (DU-M5/4-1)	N/A	N/A	1.5/1
Methylene chloride blank residue (DU-M5/4-1)	N/A	N/A	0.0

N/A = Not applicable.

The inlet train front half runs showed no chloride, and showed a particulate residue of 1.2 mg. The inlet train back half rinse showed no chlorine or chloride. The procedure did not require front half chlorine analysis or back half particulate residue. The outlet train front half cleanup evaluation showed no chloride, and showed 1.7 mg particulate residue. The outlet train back half anlaysis, both the first impinger and the combined second and third impinger, showed no chlorine or chloride. The analyst on the chlorine analysis, because the chlorine values were zero on the outlet, did not understand the necessity of recording the zero results on lab data sheets, and therefore failed to do so. An additional water rinse of the front half of the inlet train was done after sample recovery of Run 1 to evaluate the efficiency of cleanup procedures. Similarly, an additional rinse of the inlet train impingers was made following Run 2. The latter evaluation resulted in no residual chlorine in the impingers, but the front half rinse recovered 17 milligrams of chloride. A filter blank analysis showed no chloride.

Blank values were taken of the distilled water used for cleanup and dilution and showed 4.9 mg/l of residue. Distilled water was not analyzed directly for chlorine or chloride as this was essentiall accomplished in the cleanup evaluation sample recovery analysis.

Blank residue values also were taken of acetone and methylene chloride. The acetone showed 1.5 mg/l residue, but none was evident from the methylene chloride.

Blank chlorine values of the sodium arsenite solution used in the chlorination scrubber inlet train were taken before each titration and blank chloride values were taken during chloride analysis. Blank potassium hydroxide chlorine and chloride values were also taken during analysis.

2.13.2 Controlled Noncondensible Hydrocarbon Emissions from the Borings Dryer

Table 2-16 summarizes noncondensible hydrocarbon concentrations measured with the borings dryer afterburner operating. Hydrocarbon concentrations as hexane ranged from 2.4 to 3.8 ppmV.

SECTION 3

PROCESS DESCRIPTION AND OPERATION

3.0 PROCESS OPERATIONS

3.1 General Process Operations

The Vista Metals facility was constructed in 1968. The plant operates 24 hours per day, 5.5 days per week, 50 weeks per year. The plant has a maximum production capacity of 54.4 gigagrams (60,000 tons) of aluminum product per year. Actual production of aluminum product is approximately 33.7 gigagrams (37,000 tons) per year. The amount of aluminum scrap processed by the facility is 37.4 gigagrams (41,300 tons) per year. The plant operates a borings (chip) dryer, a sweat furnace, and six reverberatory furnaces.

The borings dryer processes 315 grams per second (2,500 pounds per hour) of aluminum and operates 18 hours per day, 6 days per week. The dryer operates at a temperature of 477.4 K (400^{o}F). The dryer processes borings which may have up to 20 percent by weight of oil. The feed is controlled depending on the percentage of oil in the borings. The dried borings are passed into a magnetic separator to remove ferrous material. Emissions from the borings dryer are controlled by an afterburner.

The sweat furnace is used to separate aluminum from scrap metal containing significant quantities of iron. The sweat furnace can process a maximum of 252 grams per second (2,000 pounds per hour) of aluminum scrap. The furnace operates 16 hours per day, 4 days per week, 40 weeks per year. The furnace operates at a temperature of 1,088 K (1,500^{o}F) and processes scrap which has between 50 to 90 percent aluminum by weight. Emissions from the sweat furnace are controlled by an afterburner.

The plant has 6 reverberatory furnaces which range in capacity from 27.2 to 40.8 megagrams (60,000 to 90,000 pounds).

Four 40.8 megagram (90,000 pound) furnaces are used to produce aluminum billets. These furnaces process clean aluminum scrap and supply molten aluminum to level pour direct chill billet casting machines. No air pollution control equipment is utilized and emissions are vented directly to the atmosphere.

The Vista Metals plant has two reverberatory furnaces that are used to process scrap associated with the secondary aluminum smelting operation. The two furnaces have capacities of 27.2 megagrams and 31.7 megagrams (60,000 pounds and 70,000 pounds). Both furnaces produce aluminum ingots. These furnaces have a 24-hour heat cycle which consists of 16 hours of charging, 4 hours of demagging and 4 hours of tapping. Only the 31.7 megagram (70,000 pound) furnace was in operation during the week of source testing.

3.2 Reverberatory Furnace Description

There are three sections to each furnace: the charging well, the combustion chamber, and the chlorination chamber. A diagram of the reverberatory furnace is provided in Figure 3.1. No control exists for air emissions from the furnace combustion chamber because emissions apparently consist only of products of combustion. Emissions from the charging well are controlled by the use of an afterburner. The afterburners operate at a temperature of approximately 1,199 K (1,700°F). The purpose of the source test was to evaluate emissions produced during the demagging operation. Demagging is conducted in the furnace chlorination chambers.

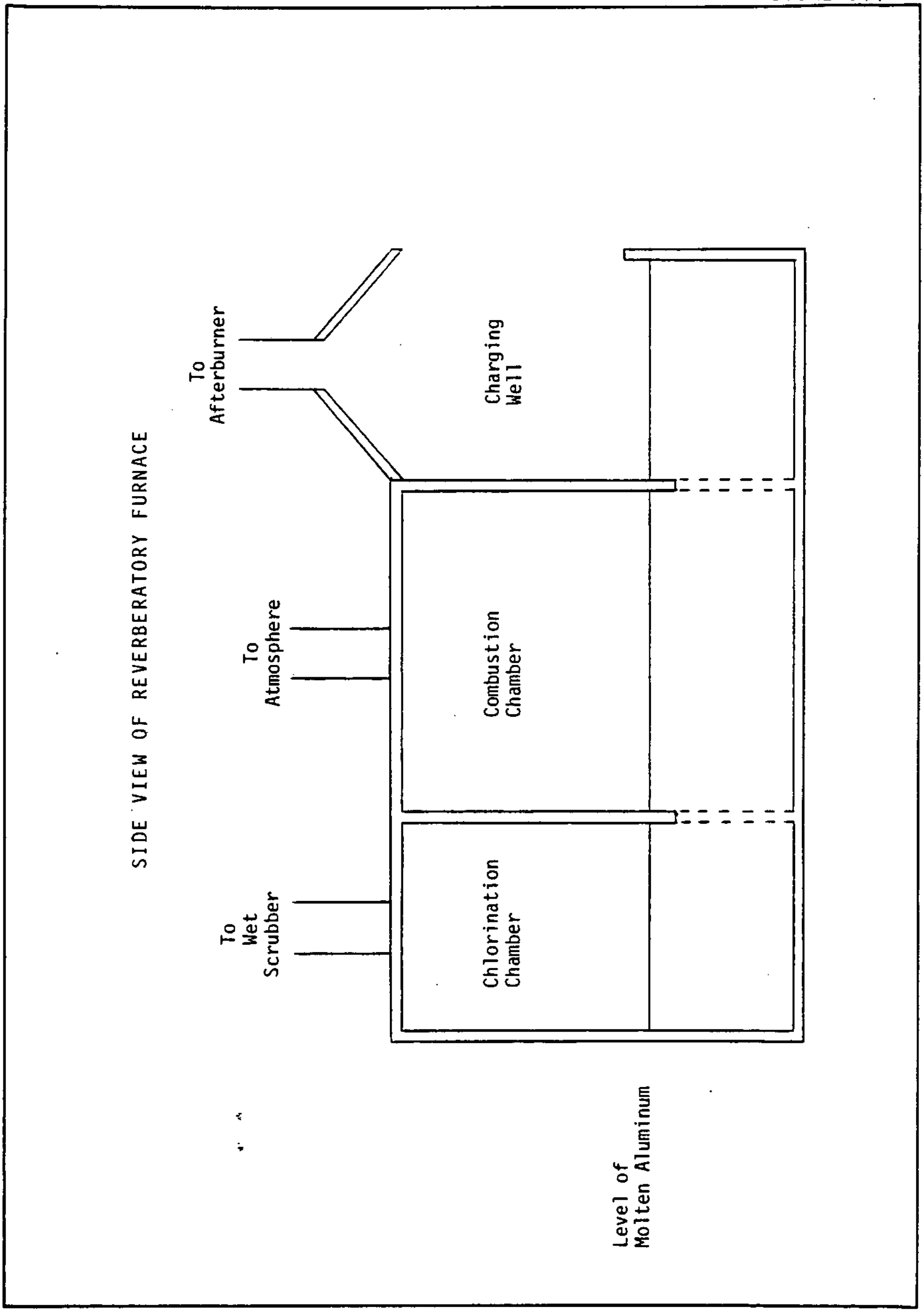
The purpose of the demagging process is to reduce the magnesium content of the molten aluminum. During chlorine demagging operations, chlorine is injected into the melt and reacts with magnesium to form magnesium chloride:

$$Mg + Cl_2 \longrightarrow MgCl_2$$

Magnesium chloride is a liquid at the molten metal temperature and can be skimmed off after demagging is completed.

The reverberatory furnace chlorination chamber at Vista is approximately 1.2 meters (4 feet) wide and 3.03 meters (10 feet) long, and is located to the rear of the furnace. An archway beneath the molten metal level in the common wall between the furnace and the chamber, permits the flow of metal.

FIGURE 3.1


SIDE VIEW OF REVERBERATORY FURNACE
To Afterburner
Charging Well
To Atmosphere
Combustion Chamber
To Wet Scrubber
Chlorination Chamber
Level of Molten Aluminum

During demagging, chlorine gas is sent under pressure through a porcelain-coated iron tube and is bubbled up through the molten aluminum. The end of the tube is placed approximately 0.15 meters (6 inches) from the bottom of the chamber.

There are approximately 8 alloys that are routinely produced at the plant. The allowable magnesium concentration varies based on the type of alloy being produced.

During demagging, chlorine is added so rapidly that large quantities of both aluminum chloride and magnesium chloride are formed and not all of the chlorine reacts with the metals. As a result, a large quantity of aluminum chloride is discharged along with some chlorine gas and some entrained magnesium chloride. Aluminum chloride sublimes at 454 K ($357^{o}F$), so that it is vaporous at the temperature of molten aluminum. As the vapors cool in the atmosphere, submicron fumes are formed. Aluminum chloride is extremely hygroscopic and absorbs moisture from the air, with which it reacts to form hydrogen chloride.

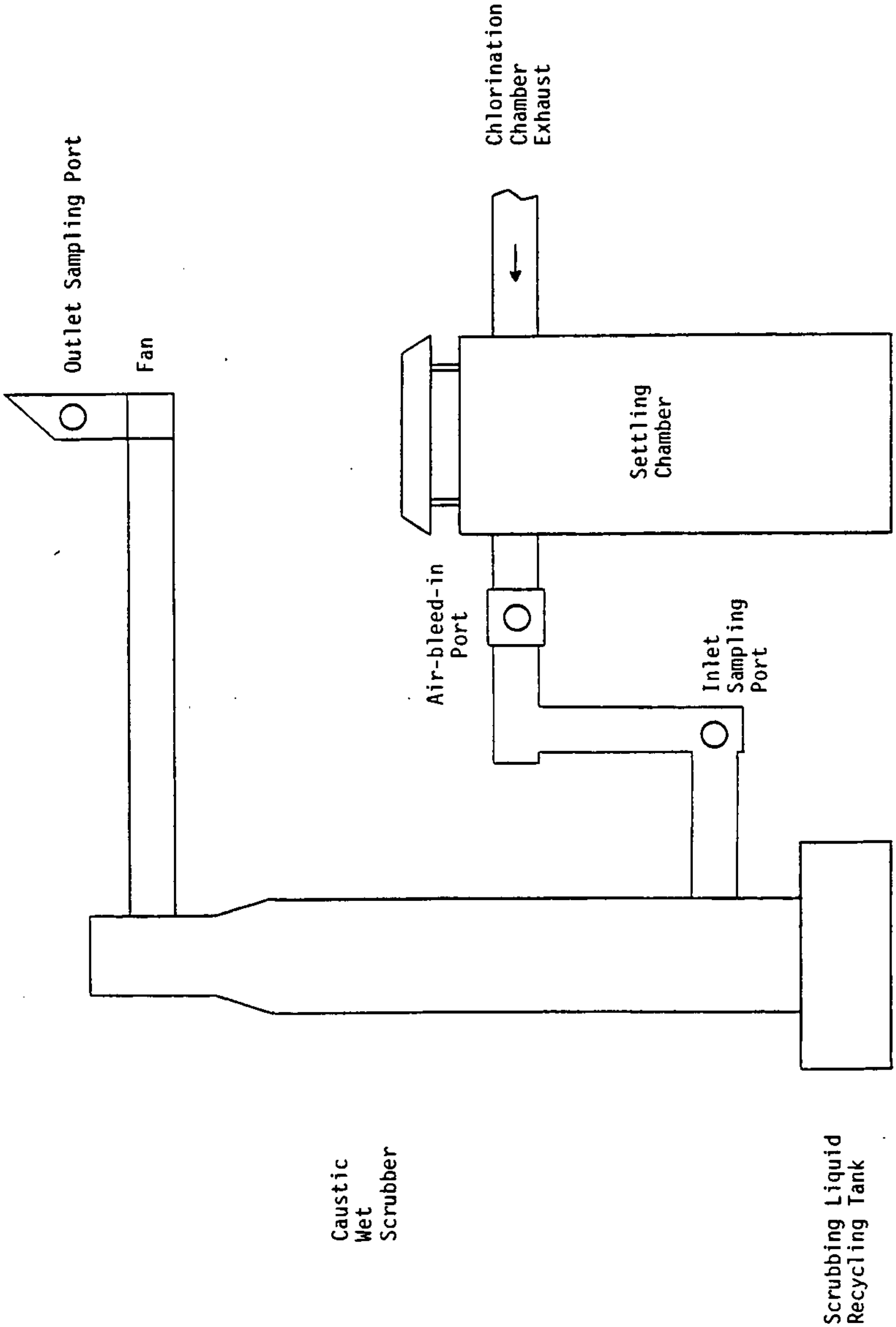
3.3 Emission Control Equipment

Each of the furnace chlorination chambers at Vista are controlled by separate wet scrubbers. A diagram of the scrubber tested is provided in Figure 3.2. The scrubbers are packed tower units that were designed by plant personnel. The principle of design is that the contaminant-laden stream is passed through beds of a fiberglass collection material, and a liquid is passed over the collecting surface to keep it clean and prevent reentrainment of deposited materials. Collection of the contaminant depends upon the length of contact time of the gas stream on the collecting surfaces.

A settling chamber is located prior to each of the wet scrubbers. The settling chamber is necessary because of the high loadings of particulate matter produced during the demagging operations. According to plant personnel the settling chambers are cleaned out once every two weeks.

An air-bleed-in port was located downstream of the settling chamber; prior to the wet scrubber. This port enabled plant workers to observe the density of emissions which would indicate the efficiency of the demagging process.

DIAGRAM OF WET SCRUBBER FOR CONTROLLING DEMAGGING EMISSIONS



Because of the acidic nature of the demagging emissions, both scrubbers at Vista use caustic scrubbing solutions. Scrubbing solutions average between 5 percent to 10 percent caustic (sodium hydroxide). The caustic scrubbing liquids are recycled and pH monitored to insure proper alkalinity is maintained.

3.4 Process Operations During Testing

The demagging tests were run between Sunday, May 17 through Thursday, May 21, 1981. The test on May 17 consisted only of a velocity traverse on the scrubber settling chamber inlet and there was no requirement for the process operation to be monitored. During the week of testing, 3 sets of simultaneous inlet and outlet test runs were conducted on the chlorination scrubber. Six particle size runs were also performed on the scrubber inlet. Visible emission observations were made at the scrubber outlet during the chlorination periods.

During each heat cycle, approximately 27.9 megagrams (62,000 pounds) of aluminum ingot was produced. This figure assumes that 3.6 megagrams (8,000 pounds) of "heel" remained in the furnace after each tapping was completed.

All scrap charged during the week of testing had been pretreated in the borings dryer in order to remove the majority of organic contamination.

The following is a description of the process operation during the week of testing.

Monday, May 18, 1981

A S-14 alloy was being produced during this reverberatory furnace heat cycle. Charging of the furnace was initiated at 5:00 a.m. and was completed by 3:30 p.m. The type of aluminum scrap charged consisted entirely of aluminum turnings and borings. Approximately 0.9 megagram (1 ton) of flux material was added to the furnace during charging operations.

The demagging operation was commenced at 5:35 p.m. The maximum allowable magnesium concentration for the S-14 alloy was .40 percent.

5:35 p.m.

Demagging started. Initial magnesium concentration of aluminum measured to be .95 percent. Initial pH of scrubbing solution measured to be 13. Line pressure of chlorine flow was 207 kilopascals (30 pounds per square inch).

6:00 p.m.

Magnesium concentration at .79 percent.

6:30 p.m.

Chlorine gas turned off and porcelain tube replaced.

6:35 p.m.

Chlorine back on.

7:15 p.m.

Some problem experienced in keeping pH levels of caustic up. Additional sodium hydroxide added to scrubbing solution. Greenish material was observed in the air-bleed-in port downstream of the settling chamber. Supervisor speculated that this may be due to the presence of unreacted chlorine in demagging exhaust.

7:50 p.m.

Magnesium concentration at .59 percent.

8:10 p.m.

Particle size probe inserted in inlet stack. Line pressure of chlorine flow at 207 kilopascals (30 pounds per square inch).

8:13 p.m.

Particle size probe removed.

8:15 p.m.

Chlorine gas turned off and porcelain tube replaced. Two holes found in old porcelain tube.

8:20 p.m.

Chlorine back on.

8:25 p.m.

Magnesium concentration at .59 percent. Green emissions still observed in air-bleed-in port.

8:42 p.m.

Second particle size probe inserted.

8:45 p.m.

Particle size probe removed.

8:47 p.m.

Inlet emissions still greenish in appearance. Supervisor decided to install new tank of chlorine in case tank in use was contaminated. Chlorine turned off and tank replaced.

9:00 p.m.

Emissions observed in port appear white.

10:00 p.m.

Demagging ended. Final magnesium concentration at .40 percent. Because tanks were changed during demagging, chlorine feed rate could not be determined. Furnace temperature during demagging operation was 1033 K (1400^{o}F).

Tuesday, May 19, 1981

A 380 alloy was being produced during the reverberatory furnace heat cycle. Charging of the furnace was initiated at 3:00 a.m. and was completed at approximately 4:00 p.m. The type of aluminum scrap processed during this period consisted of aluminum borings and turnings.

The demagging operation was started at 5:35 p.m. The maximum allowable magnesium concentration for the 380 alloy was .30 percent.

5:35 p.m.

Demagging started. Initial magnesium concentration of aluminum measured to be .76 percent. Initial pH of scrubbing solution measured to be 13. Line pressure of chlorine flow was 276 kilopascals (40 pounds per square inch).

6:20 p.m.

Chlorine runs out. New tank installed. Chlorine used in old tank was 100 kilograms (220 pounds).

6:30 p.m.

Chlorine turned back on. Line pressure 276 kilopascals (40 pounds per square inch).

6:35 p.m.

Magnesium concentration at .70 percent.

7:00 p.m.

Testing started at scrubber inlet and outlet.

7:15 p.m.

Magnesium concentration at .61 percent.

7:20 p.m.

Chlorine gas turned off and porcelain tube replaced.

7:23 p.m.

Chlorine gas back on. Line pressure of chlorine flow at 276 kilopascals (40 pounds per square inch).

7:55 p.m.

Magnesium concentration at .55 percent.

8:20 p.m.

Magnesium concentration at .46 percent.

8:50 p.m.

Magnesium concentration at .38 percent.

9:05 p.m.

Test stopped.

9:05 p.m.

Particle size probe inserted.

9:12 p.m.

Particle size probe removed.

9:13 p.m.

Demagging ended. Final magnesium concentration at .29 percent. Amount of chlorine used in second tank was 549 kilograms (1210 pounds). Total chlorine used during demagging was 649 kilograms (1430 pounds). This is equivalent to a process rate of 48 grams per second (381 pounds per hour).

Chlorine pressure remained constant at 276 kilopascals (40 pounds per square inch). Furnace temperature during demagging operation was 1033 K (1400^{O}F).

Wednesday, May 20, 1981

A 380 alloy was being produced during the reverberatory furnace heat cycle. Charging of the furnace was initiated at approximately 5:00 a.m. and completed at 4:00 p.m. The type of aluminum scrap processed during this period consisted of aluminum borings and turnings.

The demagging operation was started at 5:30 p.m. The maximum allowable magnesium concentration for the 380 alloy was .30 percent.

5:30 p.m.

Demagging started. Initial magnesium concentration measured to be .90 percent. Line pressure of chlorine flow was 276 kilopascals (40 pounds per square inch). Initial pH of scrubbing solution measured to be 13.

6:10 p.m.

Particle size probe inserted.

6:20 p.m.

Particle size probe removed. Chlorine runs out. New tank installed.

6:30 p.m.

Chlorine turned back on. Line pressure at 276 kilopascals (40 pounds per square inch).

6:35 p.m.

Testing started at scrubber inlet and outlet.

6:40 p.m.

Magnesium concentration at .80 percent.

7:25 p.m.

Magnesium concentration at .72 percent.

7:40 p.m.

Batch of copper radiators added to the charging well.

7:50 p.m.

Chlorine gas turned off and porcelain tube replaced.

7:53 p.m.

Chlorine gas back on. Line pressure of chlorine flow was 276 kilopascals (40 pounds per square inch).

8:05 p.m.

Magnesium concentration at .67 percent.

8:20 p.m.

Test stopped.

8:25 p.m.

Particle size probe inserted.

8:35 p.m.

Magnesium concentration at .62 percent.

8:35 p.m.

Particle size probe removed.

8:45 p.m.

Second test run started at scrubber inlet and outlet.

9:10 p.m.

Magnesium concentration at .59 percent.

9:27 p.m.

Chlorine gas turned off and porcelain tube replaced.

9:34 p.m.

Chlorine gas turned back on. Line pressure at 276 kilopascals (40 pounds per square inch).

9:35 p.m.

Test stopped.

9:40 p.m.

Magnesium concentration at .54 percent.

11:05 p.m.

Demagging ended. Final magnesium concentration at .30 percent. Amount of chlorine used in first tank could not be accurately determined. Amount of chlorine used in second tank was 886 kilograms (1970 pounds). Based on the time period this tank was in use, the chlorine process weight would be equivalent to 55 grams per second (437 pounds per hour).

Chlorine pressure remained constant at 276 kilopascals (40 pounds per square inch) throughout demagging operation. Furnace temperature remained constant at 1033 K (1400^{o}F).

During this demagging period, the magnesium concentrations were dropping off slowly. This would indicate the emissions would increase. This contention is supported by the fact that more caustic than usual had to be added to the scrubber during the demagging period.

Thursday, May 21, 1981

A A108Z alloy was being produced during the reverberatory furnace heat cycle. Charging of the furnace was started at approximately 5:00 a.m. and completed at 4:00 p.m. The type of aluminum scrap processed during this period consisted of aluminum borings and turnings.

Demagging was started at 5:50 p.m. The maximum allowable magnesium concentration for the A108Z alloy was .10 percent.

5:50 p.m.

Demagging started. Initial magnesium concentration at .74 percent. Line pressure of chlorine flow was 276 kilopascals (40 pounds per square inch). Initial pH of scrubbing solution measured to be 13.

6:00 p.m.

Chlorine runs out. Amount of chlorine used in first tank was 4.5 kilograms (10 pounds).

6:05 p.m.

New tank installed. Chlorine turned back on. Line pressure of chlorine flow was 276 kilopascals (40 pounds per square inch).

6:50 p.m.

Magnesium concentration at .70 percent.

7:20 p.m.

Magnesium concentration at .65 percent.

7:30 p.m.

Source test run started at scrubber inlet and outlet.

7:50 p.m.

Magnesium concentration at .60 percent.

8:20 p.m.

First traverse completed at scrubber inlet.

8:20 p.m.

Magnesium concentration at .58 percent.

8:25 p.m.

Particle size probe inserted.

8:32 p.m.

Chlorine gas turned off and porcelain tube replaced.

8:35 p.m.

Particle size probe removed.

8:40 p.m.

Chlorine gas turned back on. Line pressure at 276 kilopascals (40 pounds per square inch).

8:45 p.m.

Second traverse started at scrubber inlet.

9:10 p.m.

Batch of copper radiators added to charging well.

9:25 p.m.

Magnesium concentration at .37 percent.

9:40 p.m.

Test stopped.

9:55 p.m.

Magnesium concentration at .32 percent.

10:30 p.m.

Magnesium concentration at .27 percent.

11:00 p.m.

Magnesium concentration at .17 percent.

11:30 p.m.

Demagging ended. Final magnesium concentration at .10 percent. Total amount of chlorine used during demagging was 895 kilograms (1990 pounds). Chlorine process rate was equivalent to 44 grams per second (352 pounds per hour).

Chlorine pressure remained constant at 276 kilopascals (40 pounds per square inch). Furnace temperature remained constant at 1033 K (1400^{o}F).

3.5 Conclusions

According to discussions with plant personnel, during the demagging test runs, the chlorination process was operating within the range of normal conditions. The test run done on Wednesday, May 20, 1981, was conducted during conditions which would be representative of "worst-case" emissions. This is because magnesium concentrations dropped slowly resulting in a greater emission rate of molecular chlorine and aluminum chloride. The presence of molecular chlorine may have contributed to the "greenish" appearance of emissions as viewed in the inlet port to the wet scrubber.

On several occasions during testing the chlorine flow was turned off for short periods of time. This would be necessary when a porcelain tube was being replaced or a new tank of chlorine installed. Porcelain tubes were replaced when a hole would occur in the lance.

The brief interruptions in chlorine flow never lasted more than a few minutes and should not affect the results of the stack tests. It should be noted that these interruptions are a normal part of the plant's demagging process.

SECTION 4

LOCATION OF SAMPLING POINTS

4.0 LOCATION OF SAMPLING POINTS

The borings dryer and the Number 2 reverberatory furnace were tested at the Vista Metals Corporation, Fontana, California, facility. Figure 4-1 shows the plant layout with respect to these two processes.

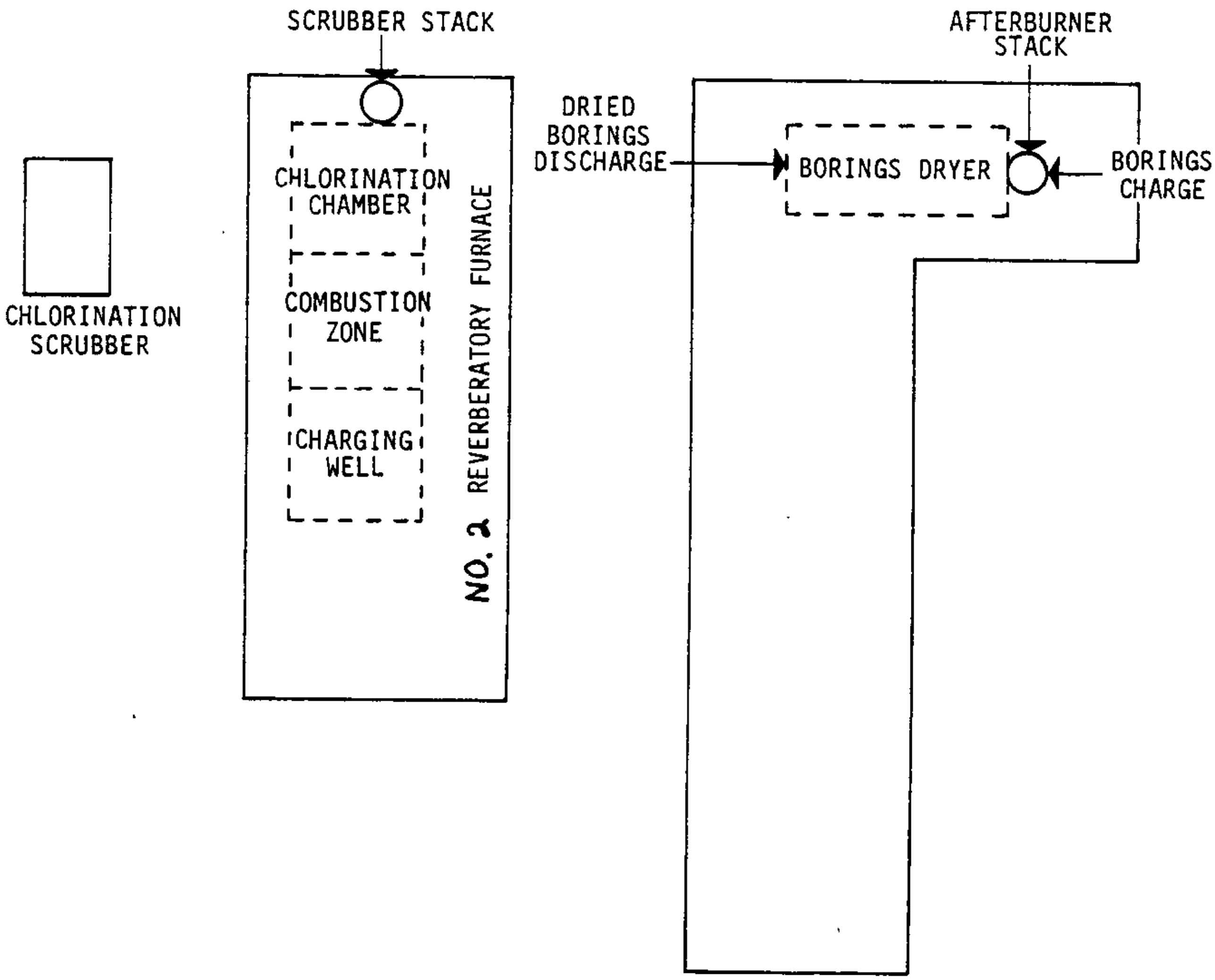
4.1 Reverberatory Furnace Chlorination Process Control Equipment

The reverberatory furnace chlorination process is a sealed system. The only gases vented from the system are apparently the result of thermal expansion, including vaporization of metal, and displacement by the introduction of chlorine gas at the rate of approximately 20 standard cubic feet per minute. As a result, the gas flow from the process is quite low and is estimated to be less than 1 CFM, since a significant amount of the chlorine is bound during the demagging process.

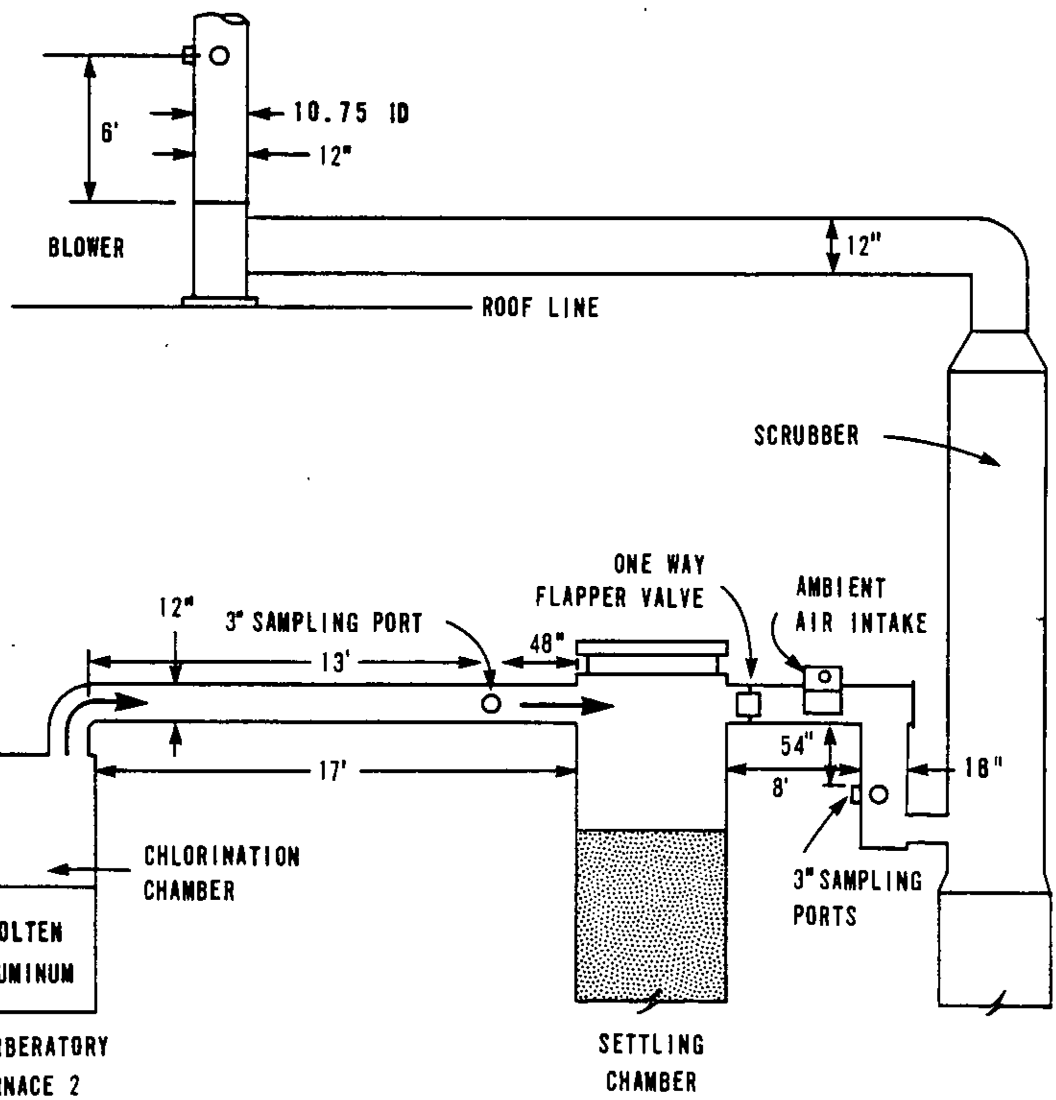
The vented gas passes through a 12-inch diameter duct and into a settling chamber where particulate matter falls out of the gas stream. At the outlet of the settling chamber is a one-way flapper valve which inhibits flow back into the chlorination system. Immediately downstream of the flapper valve is an opening in the side of the duct which allows approximately 1300-1400 SCFm of ambient air to be drawn into the system by the blower located at the base of the stack. The result is that the exhaust gas stream is greatly diluted, and in effect is actually drawn into the scrubber system by a hooding arrangement, rather than an induced draft on the chlorination exhaust stream.

The gases then pass into the base of the packed bed scrubber and flow upward through the countercurrent liquor flow in the scrubber. The scrubbed gases pass through a horizontal, 12-inch diameter duct, through the blower and out the stack. Figure 4-2 illustrates the chlorination gas handling system.

Overhead View of Plant Layout
Vista Metals Corporation, Fontana, California



REVERBERATORY FURNACE NO. 2 CHLORINATION CHAMBER
AND SCRUBBER SYSTEM AT
VISTA METALS CORP. FONTANA CALIFORNIA



4.1.1 Settling Chamber Inlet

Approximately 17 feet downstream of the last flow disturbance (a 90° elbow) and approximately 48 inches upstream of the settling chamber inlet, a single port was installed in the settling chamber inlet duct. Due to the potential for explosion should air leak into the chlorination chamber, Vista Metals installed a gate valve to allow the port to be closed during testing. Due to the extremely low gas flows (Δp of approximately 0.015) and extremely high grain loadings (the S-type pitot tube was plugged within 1 minute of insertion into the gas stream), no testing was conducted at this site. This is explained in more detail in Section 2.1.

4.1.2 Scrubber Inlet Test Site

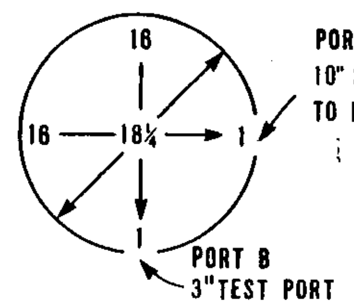
The scrubber inlet test site was located in an 18.25 inch internal diameter duct. The two access ports were located 54 inches downstream of a 90° horizontal to vertical elbow and 9 inches upstream of a 90° vertical to horizontal elbow. The test location is illustrated in Figure 4-3. One of the two sampling ports was a 3-inch diameter hole cut in the duct. The second port was a 10-inch by 4-inch slot. Both ports were closed to leakage using tape while testing was in progess. A second slot and a condensation drain were sealed with tape to minimize leakage into the system downstream of the test location. Sampling points employed during the test program are indicated in Figure 4-3.

4.1.3 Scrubber Outlet Test Site

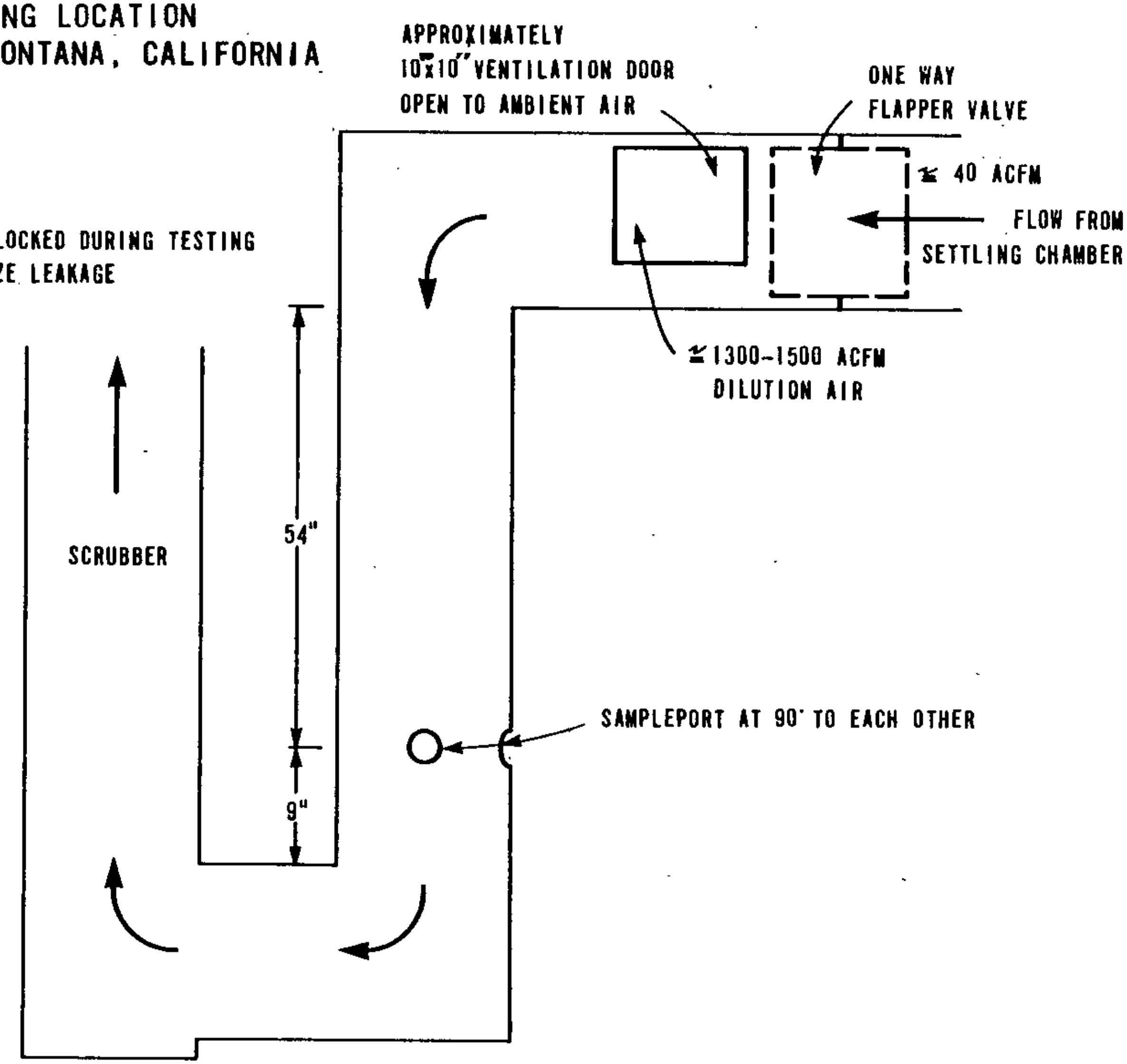
The scrubber outlet test site was located in the 10.75-inch diameter stack. Two 3-inch test ports were located at 90 degrees to each other

REVERBERATORY FURNACE CHLORINATION SYSTEM
SCRUBBER INLET SAMPLING LOCATION
VISTA METALS CORPORATION, FONTANA, CALIFORNIA

CROSS SECTION THROUGH SCRUBBER
INLET TEST LOCATION



TRAVERSE POINT	DISTANCE FROM POINT TO PORT OPENING (INCHES)
1	1.0
2	1.0
3	1.6
4	2.3
5	3.1
6	4.0
7	5.2
8	6.8
9	11.4
10	13.1
11	14.2
12	15.2
13	16.0
14	16.7
15	17.2
16	17.2



approximately 44 inches downstream of the fan and approximately 11 inches upstream of the stack outlet. Figure 4-4 illustrates the sampling location and provides the location of the sampling points.

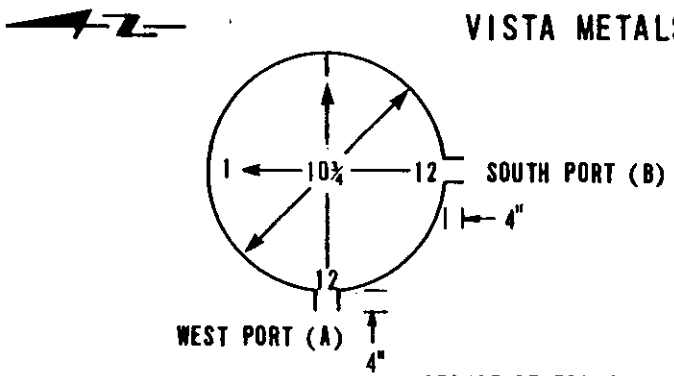
4.2 Borings Dryer

Ventilation of the borings dryer is by natural draft. The product discharge point is also where combustion air enters the process. Flue gases from the dryer burner pass into the afterburner chamber and up the 47-inch internal diameter stack. Figure 4-5 illustrates the sampling location and sampling points. The stack gas velocity is quite low (Δ p was approximately 0.001) and, with the afterburner in operation, stack gas temperatures were in excess of 2000°F. Only preliminary tests were performed on this unit as explained in Section 2.4.

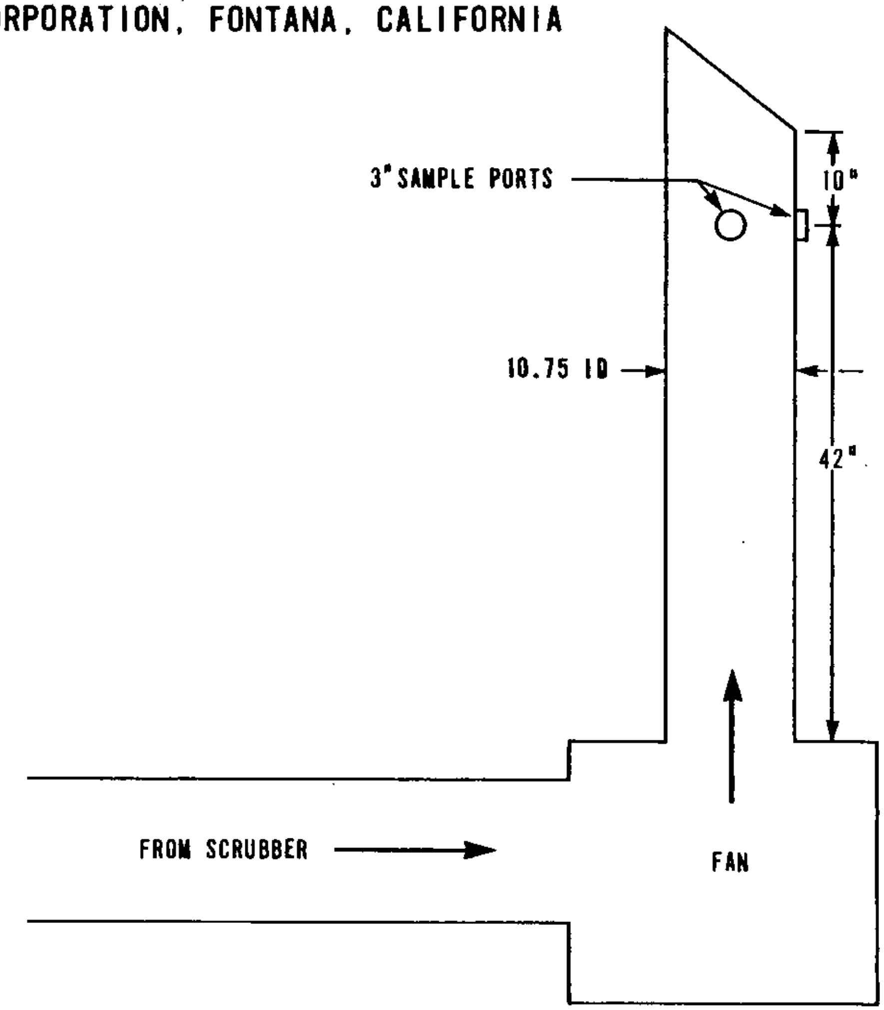
4.3 Particle Size Test Locations

Particle size distribution determinations were made at the reverberatory furnace chlorination scrubber inlet and at the borings dryer. Both test sites were sampled using a straight nozzle rather than the button-hook design. The same test port location was used at the borings dryer site as that described in Section 4.2. At the reverberatory furnace chlorination scrubber, there existed a second slot, 4 inches by 10 inches, downstream of the slot used for particulate and velocity testing described in Section 4.1. Insertion of the Andersen Impactor through this downstream location allowed sampling in the same plane used for particulate and velocity determinations. A single point of average velocity was used for particle size sample collection.

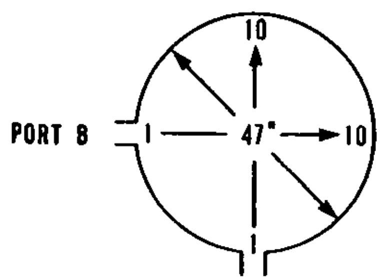
REVERBERATORY FURNACE CHLORINATION SCRUBBER OUTLET SAMPLING LOCATION VISTA METALS CORPORATION, FONTANA, CALIFORNIA



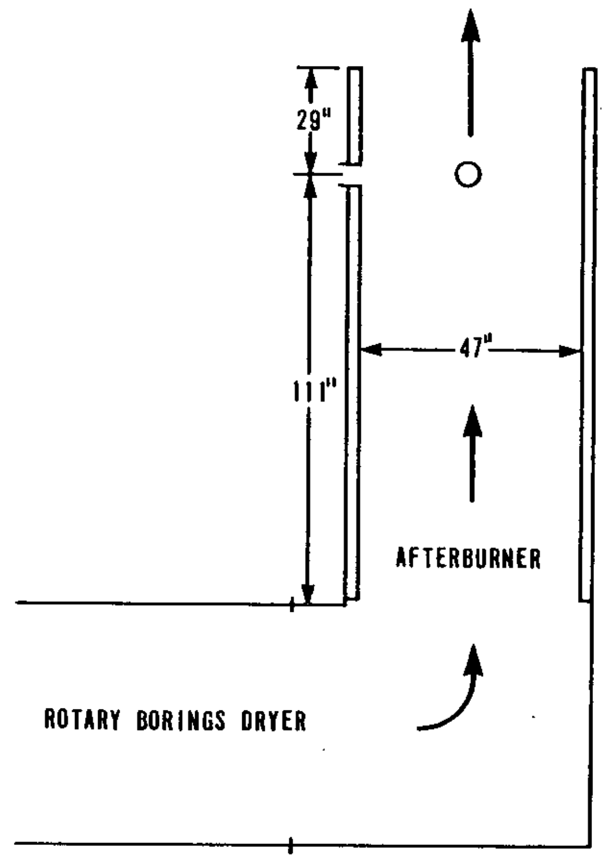
TRAVERSE POINT	DISTANCE OF POINT FROM OUTSIDE OF PORT (INCHES)
1	13¾
2	13¾
3	13½
4	12 7/8
5	12
6	11
7	7 7/8
8	6 5/8
9	5 7/8
10	5¼
11	5
12	5



BORINGS DRYER EMISSIONS SAMPLING LOCATION
VISTA METALS CORPORATION, FONTANA, CALIFORNIA



TRAVERSE POINT	DISTANCE OF POINT FROM OUTSIDE OF PORT (INCHES)
1	8.2
2	10.9
3	13.9
4	17.6
5	23.1
6	37.9
7	43.4
8	47.1
9	50.2
10	52.8



4.4 Visible Emission Observation Locations

The observer locations, wind direction, sun locations, and source locations recorded during visible emission observations made at Vista Metals Corporation are illustrated in Figure 4-6. Observation points were selected to meet EPA Method 9 criteria as closely as practicable. Observations on May 19, 20, and 21 were made from rooftop level while those made on May 28 were conducted from the ground.

4.5 Fugitive Emission Observation Locations

Figure 4-6 indicates the ground level location of the observer for fugitive emissions from the furnace charging well and the borings dryer processes. All observations were made from ground level.

4.6 Scrubber Liquor Sampling Locations

Figure 4-7 illustrates the Vista Metals Corporation chlorination scrubber system. Scrubber liquor samples were collected at the scrubber discharge into the caustic mix tank.

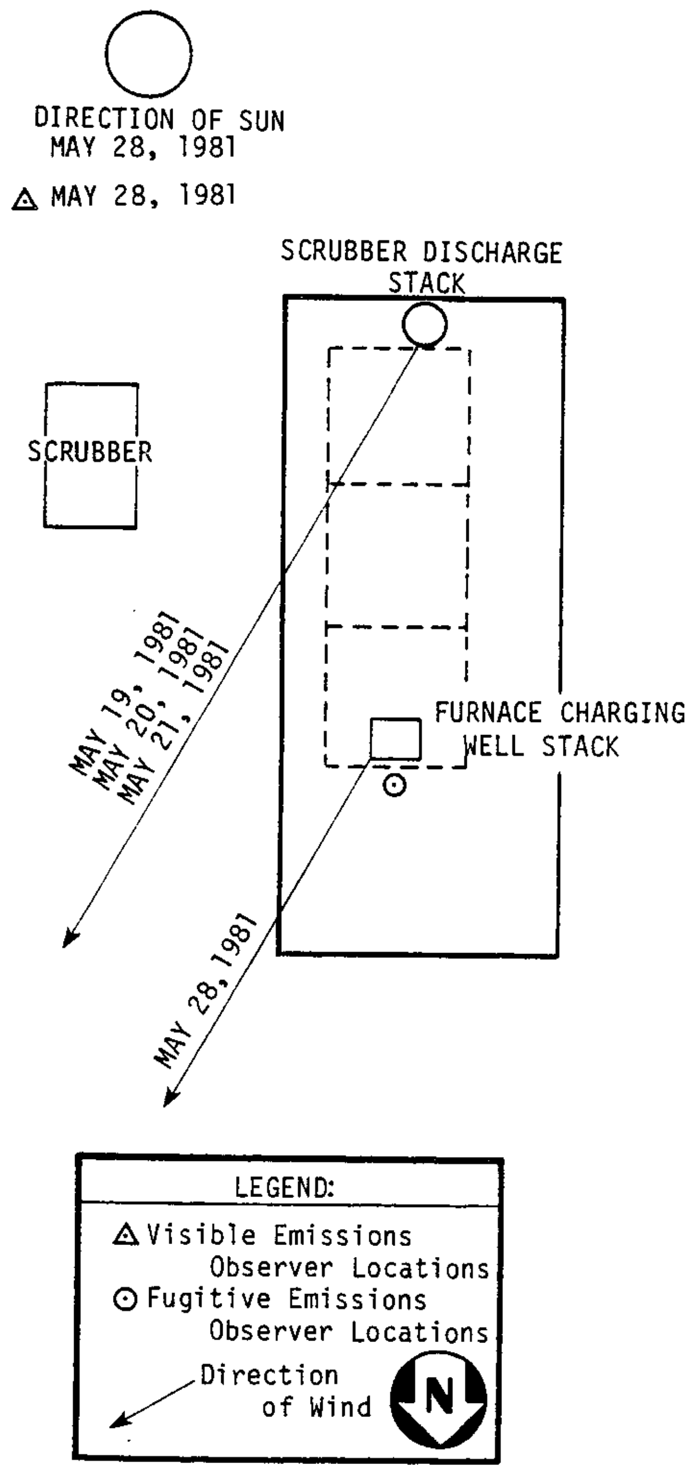
4.7 Pressure Drop Measurement Locations

The location of the taps used for monitoring pressure drop across the scrubber are illustrated in Figure 4-7. The inlet tap was a slot near the base of the scrubber. Both tubes were inserted several inches into the ducts.

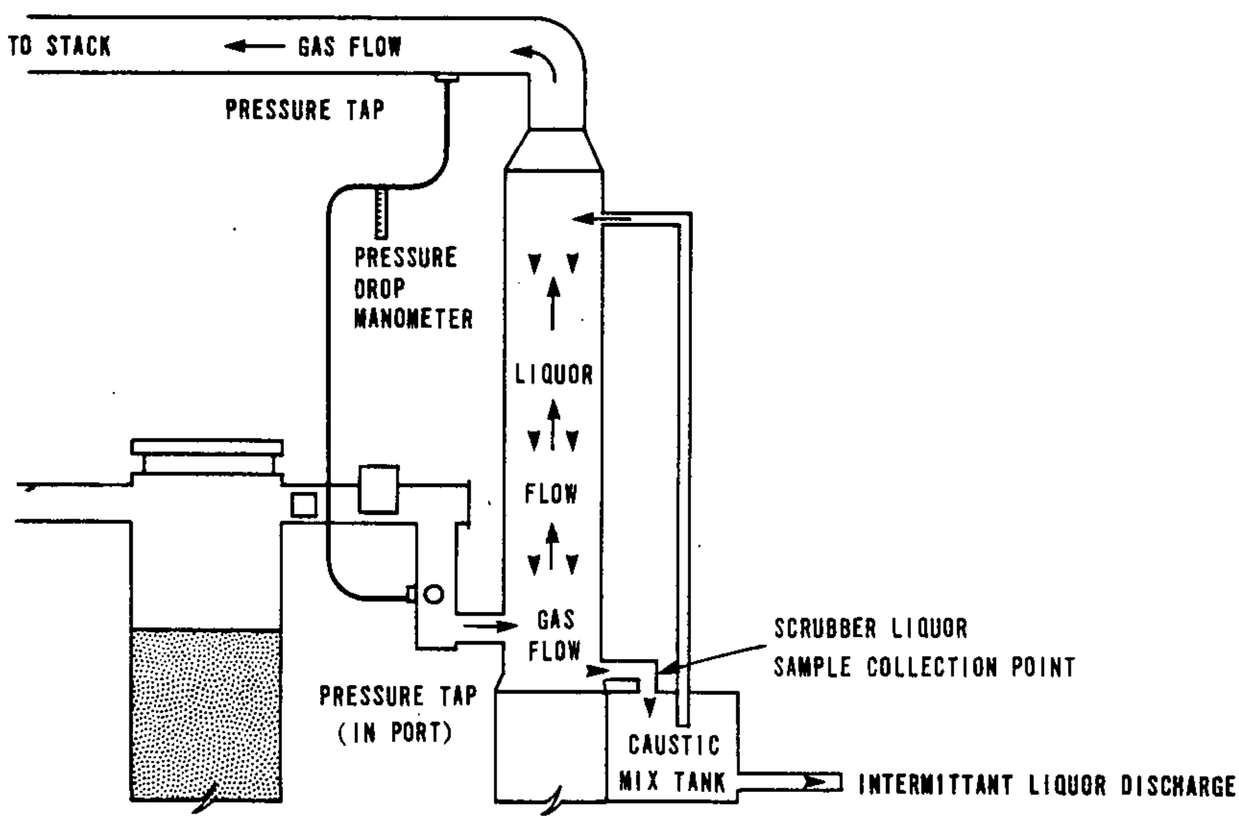
4.8 Stack Gas Molecular Weight Sampling Locations

Samples for Orsat analysis were taken at the chlorination scrubber inlet and outlet test ports and at the borings dryer test ports. Chlorination scrubber inlet and outlet Orsat samples were taken during testing from the unused port. Borings dryer Orsat samples were taken during both controlled and uncontrolled operation.

Overhead View of Emission Sources and Observer Locations for Conduct of Visible Emission and Fugitive Emission Observations at Vista Metals Corporation, Fontana, California



CHLORINATION SCRUBBER LIQUOR SAMPLING LOCATION AND PRESSURE DROP MEASUREMENT LOCATIONS VISTA METALS CORPORATION, FONTANA, CALIFORNIA



APPENDIX A

Computer Summary of Chlorination

PARTICULATE EMISSION SUMMARY

RUN CODE	DRY GAS VOLUME (NM3)	MOISTURE (%)	ORSAT ANALYSIS (%) CO2	O2	CO	EXHAUST FLOW RATE (NM3/MIN)	STACK TEMP. (C)	ISOKINETIC (%)		PART. CONC. (MG/NM3) FRONT	TOTAL	EMISSION RATE (KG/HR) FRONT	TOTAL
SI-M5-1	1.66	3.46	0.1	20.9	0.0	39.2	17.	106.0					
									CL2......	0.000	2823.320	0.000	6.643
									CL-......	194.359	735.916	0.457	1.731
									PART......	404.724	0.000	0.952	0.000
SO-M5-1	2.05	1.57	0.0	20.9	0.0	39.5	19.	97.5					
									CL2......	0.000	54.124	0.000	0.128
									CL-......	33.157	91.669	0.079	0.217
									PART......	25.209	0.000	0.060	0.000
SI-M5-2	2.73	3.56	0.1	20.9	0.0	43.6	18.	103.5					
									CL2......	0.000	18310.230	0.000	47.906
									CL-......	242.868	26569.588	0.635	69.516
									PART......	825.094	0.000	2.159	0.000
SO-M5-2	3.33	2.51	0.0	20.9	0.0	38.0	23.	98.2					
									CL2......	0.000	424.922	0.000	0.969
									CL-......	11.395	109.484	0.026	0.249
									PART......	67.022	0.000	0.153	0.000
SI-M5-3	1.76	3.48	0.1	20.9	0.0	40.9	20.	106.6					
									CL2......	0.000	4644.759	0.000	11.406
									CL-......	222.476	16392.297	0.546	40.255
									PART......	691.776	0.000	1.699	0.000
SO-M5-3	1.79	2.89	0.0	20.9	0.0	38.5	24.	91.2					
									CL2......	0.000	76.877	0.000	0.178
									CL-......	3.900	42.338	0.009	0.098
									PART......	21.336	0.000	0.049	0.000

*The third digits of some of the above values may not compare exactly with those in the text and other tables, as runs and computer programs were used and different persons performed the calculations.

PARTICULATE EMISSION SUMMARY

RUN CODE	DRY GAS VOLUME (SCF)	MOISTURE (%)	ORSAT ANALYSIS (%) CO2	O2	CO	EXHAUST FLOW RATE (SCFM)	STACK TEMP. (F)	ISOKIN-ETIC (%)		CONC. (GR/SCF) FRONT	TOTAL	EMISSION RATE (LB/HR) FRONT	TOTAL
SI-M5-1	58.57	3.46	0.1	20.9	0.0	1385.0	63.	105.0					
									CL2......	0.000	1.234	0.000	14.645
									CL-......	0.085	0.322	1.008	3.617
									PART......	0.177	0.000	2.099	0.000
SO-M5-1	72.27	1.87	0.0	20.9	0.0	1395.8	65.	97.8					
									CL2......	0.000	0.024	0.000	0.283
									CL-......	0.014	0.040	0.173	0.479
									PART......	0.011	0.000	0.132	0.000
SI-M5-2	96.35	3.86	0.1	20.9	0.0	1540.2	65.	103.5					
									CL2......	0.000	8.001	0.000	105.616
									CL-......	0.106	11.611	1.401	153.257
									PART......	0.361	0.000	4.759	0.000
SO-M5-2	117.52	2.51	0.0	20.9	0.0	1341.9	74.	98.2					
									CL2......	0.000	0.186	0.000	2.135
									CL-......	0.005	0.048	0.057	0.550
									PART......	0.029	0.000	0.337	0.000
SI-M5-3	62.09	3.48	0.1	20.9	0.0	1445.6	68.	106.6					
									CL2......	0.000	2.030	0.000	25.147
									CL-......	0.097	7.163	1.204	88.748
									PART......	0.302	0.000	3.745	0.000
SO-M5-3	63.26	2.89	0.0	20.9	0.0	1360.9	75.	91.2					
									CL2......	0.000	0.034	0.000	0.392
									CL-......	0.002	0.019	0.020	0.216
									PART......	0.009	0.000	0.109	0.000

*The third digits of some of the above values may not compare exactly with those in the text and other tables, as runs and computer programs were used and different persons performed the calculations.

VELOCITY TRAVERSE CALCULATIONS ******

RUN ID. SI-MS-1 VISTA METALS PARTICULATES SCRUBBER INLET 5-19-81
NO. OF POINTS = 32

TRAVERSE POINT	VELOCITY HEAD IN H2O	STACK TEMP DEG.F
1	0.05	66.
2	0.05	68.
3	0.04	65.
4	0.04	66.
5	0.04	66.
6	0.04	65.
7	0.04	68.
8	0.04	67.
9	0.04	67.
10	0.04	66.
11	0.03	65.
12	0.02	63.
13	0.02	62.
14	0.02	62.
15	0.02	61.
16	0.02	61.
17	0.13	61.
18	0.13	62.
19	0.11	63.
20	0.11	63.
21	0.11	63.
22	0.11	63.
23	0.10	63.
24	0.08	63.
25	0.06	61.
26	0.06	63.
27	0.05	63.
28	0.05	63.
29	0.05	61.
30	0.05	61.
31	0.04	61.
32	0.04	60.

PARTICULATE EMISSION DATA REPORT

SI-MS-1 VISTA METALS PARTICULATES SCRUBBER INLET 5-19-81

BAROMETRIC PRESSURE (IN. HG)	29.90
AVG. ORIFICE PRES. DROP (IN. H2O)	1.300
VOLUME OF DRY GAS SAMPLED, METER COND.(DCF)	58.837
DRY GAS METER GAMMA	1.000
AVG. METER TEMP. (F)	71.8
VOLUME OF DRY GAS SAMPLED (DSCF)	58.565
TOTAL H2O COLLECTED (ML)	44.5
VOLUME OF H2O COLLECTED (SCF)	2.10
% MOISTURE IN STACK GAS BY VOLUME	3.46
MOLE FRACTION OF DRY GAS	0.965
% CARBON DIOXIDE	0.13
% OXYGEN	20.89
% CARBON MONOXIDE	0.00
MOLECULAR WEIGHT OF DRY GAS	28.86
MOLECULAR WEIGHT OF STACK GAS	28.48
AVERAGE STACK GAS VELOCITY, STACK COND. (FPS)	13.0
AVERAGE STACK GAS TEMPERATURE (F)	63.3
ABSOLUTE STACK GAS PRESSURE (IN. HG)	29.88
STACK GAS FLOW RATE (ACFM)	1424.
STACK GAS FLOW RATE (DSCFM)	1385.
NET TIME OF TEST (MIN.)	96.
STACK DIAMETER (IN.)	18.3
SAMPLING NOZZLE DIAMETER (IN.)	0.375
% ISOKINETIC	105.0
F FACTOR (DSCF/10**6BTU)	0.
EMISSION RATE-FRONT HALF- (LB/10**6BTU)	0.000
% EXCESS AIR	-53184.9

STANDARD CONDITIONS *68 DEG F *29.92 IN. HG

ENGINEERING SCIENCE INC.
ARCADIA, CALIF.

VELOCITY TRAVERSE CALCULATIONS ******

RUN ID. 50-M5-1 VISTA METALS PARTICULATES SCRUBBER OUTLET 5-19-81
NO. OF POINTS = 25

TRAVERSE POINT	VELOCITY HEAD IN H2O	STACK TEMP DEG.F
1	0.43	62.
2	0.42	56.
3	0.38	70.
4	0.35	67.
5	0.36	70.
6	0.44	70.
7	0.50	70.
8	0.50	72.
9	0.50	71.
10	0.54	70.
11	0.52	69.
12	0.54	68.
13	0.47	57.
14	0.44	63.
15	0.44	63.
16	0.42	65.
17	0.40	64.
18	0.40	64.
19	0.41	64.
20	0.40	63.
21	0.39	63.
22	0.40	63.
23	0.40	63.
24	0.40	63.
25	0.40	63.

PARTICULATE EMISSION DATA REPORT
METRIC SYSTEM

ST-M5-1 VISTA METALS PARTICULATES SCRUBBER INLET 5-19-81

BAROMETRIC PRESSURE (MM HG)	759.
AVG. ORIFICE PRES. DROP (MM H2O)	33.02
VOLUME OF DRY GAS SAMPLED, METER COND.(M3)	1.666
DRY GAS METER GAMMA	1.000
AVG. METER TEMP. (C)	22.1
VOLUME OF DRY GAS SAMPLED (NM3)	1.658
TOTAL H2O COLLECTED (ML)	44.5
VOLUME OF H2O COLLECTED (NM3)	0.059
% MOISTURE IN STACK GAS BY VOLUME	3.46
MOLE FRACTION OF DRY GAS	0.965
% CARBON DIOXIDE	0.13
% OXYGEN	20.89
% CARBON MONOXIDE	0.00
MOLECULAR WEIGHT OF DRY GAS	28.86
MOLECULAR WEIGHT OF STACK GAS	28.48
AVERAGE STACK GAS VELOCITY, STACK COND. (MPS)	3.96
AVERAGE STACK GAS TEMPERATURE (C)	17.4
ABSOLUTE STACK GAS PRESSURE (MM HG)	759.
STACK GAS FLOW RATE (M3/M)	40.32
STACK GAS FLOW RATE (NM3/M)	39.22
NET TIME OF TEST (MIN.)	96.
STACK DIAMETER (M)	0.465
SAMPLING NOZZLE DIAMETER (CM)	0.952
% ISOKINETIC	105.0
F FACTOR (NM3/10**6BTU)	0.00
EMISSION RATE-FRONT HALF- (KG/10**6BTU)	0.000
% EXCESS AIR	-53184.9

STANDARD CONDITIONS *20 DEG C *760 MM HG

ENGINEERING SCIENCE INC.
ARCADIA, CALIF.

PARTICULATE EMISSION DATA REPORT

SO-M5-1 VISTA METALS PARTICULATES SCRUBBER OUTLET 5-19-81

BAROMETRIC PRESSURE (IN. HG)	29.90
AVG. ORIFICE PRES. DROP (IN. H2O)	1.710
VOLUME OF DRY GAS SAMPLED, METER COND.(DCF)	73.942
DRY GAS METER GAMMA	1.000
AVG. METER TEMP. (F)	82.1
VOLUME OF DRY GAS SAMPLED (DSCF)	72.273
TOTAL H2O COLLECTED (ML)	24.4
VOLUME OF H2O COLLECTED (SCF)	1.15
% MOISTURE IN STACK GAS BY VOLUME	1.57
MOLE FRACTION OF DRY GAS	0.984
% CARBON DIOXIDE	0.00
% OXYGEN	20.89
% CARBON MONOXIDE	0.00
MOLECULAR WEIGHT OF DRY GAS	28.84
MOLECULAR WEIGHT OF STACK GAS	28.67
AVERAGE STACK GAS VELOCITY, STACK COND. (FPS)	37.0
AVERAGE STACK GAS TEMPERATURE (F)	65.3
ABSOLUTE STACK GAS PRESSURE (IN. HG)	29.92
STACK GAS FLOW RATE (ACFM)	1411.
STACK GAS FLOW RATE (DSCFM)	1396.
NET TIME OF TEST (MIN.)	100.
STACK DIAMETER (IN.)	10.8
SAMPLING NOZZLE DIAMETER (IN.)	0.249
% ISOKINETIC	97.5
F FACTOR (DSCF/10**6BTU)	0.
EMISSION RATE-FRONT HALF- (LB/10**6BTU)	0.000
% EXCESS AIR	********

STANDARD CONDITIONS *68 DEG F *29.92 IN. HG

ENGINEERING SCIENCE INC.
ARCADIA, CALIF.

PARTICULATE EMISSION DATA REPORT
METRIC SYSTEM

SO-M5-1 VTSTA METALS PARTICULATES SCRUBBER OUTLET 5-19-81

BAROMETRIC PRESSURE (MM HG)	759.
AVG. ORIFICE PRES. DROP (MM H2O)	43.43
VOLUME OF DRY GAS SAMPLED, METER COND.(M3)	2.094
DRY GAS METER GAMMA	1.000
AVG. METER TEMP. (C)	27.8
VOLUME OF DRY GAS SAMPLED (NM3)	2.046
TOTAL H2O COLLECTED (ML)	24.4
VOLUME OF H2O COLLECTED (NM3)	0.033
% MOISTURE IN STACK GAS BY VOLUME	1.57
MOLE FRACTION OF DRY GAS	0.984
% CARBON DIOXIDE	0.00
% OXYGEN	20.89
% CARBON MONOXIDE	0.00
MOLECULAR WEIGHT OF DRY GAS	28.84
MOLECULAR WEIGHT OF STACK GAS	28.67
AVERAGE STACK GAS VELOCITY, STACK COND. (MPS)	11.26
AVERAGE STACK GAS TEMPERATURE (C)	18.5
ABSOLUTE STACK GAS PRESSURE (MM HG)	760.
STACK GAS FLOW RATE (M3/M)	39.94
STACK GAS FLOW RATE (NM3/M)	39.52
NET TIME OF TEST (MIN.)	100.
STACK DIAMETER (M)	0.274
SAMPLING NOZZLE DIAMETER (CM)	0.632
% ISOKINETIC	97.5
F FACTOR (NM3/10**6BTU)	0.00
EMISSION RATE-FRONT HALF- (KG/10**6BTU)	0.000
% EXCESS AIR	********

STANDARD CONDITIONS *20 DEG C *760 MM HG

ENGINEERING SCIENCE INC.
ARCADIA, CALIF.

VELOCITY TRAVERSE CALCULATIONS ******

RUN ID. SI-M5-2 VISTA METALS PARTICULATES SCRUBBER INLET 5-20-81
NO. OF POINTS = 48

TRAVERSE POINT	VELOCITY HEAD IN H2O	STACK TEMP DEG.F
1	0.07	69.
2	0.07	69.
3	0.06	69.
4	0.06	69.
5	0.06	69.
6	0.05	69.
7	0.05	69.
8	0.05	69.
9	0.05	68.
10	0.05	67.
11	0.07	66.
12	0.09	65.
13	0.07	65.
14	0.06	65.
15	0.06	64.
16	0.06	64.
17	0.05	63.
18	0.05	62.
19	0.06	64.
20	0.05	65.
21	0.05	66.
22	0.05	66.
23	0.05	65.
24	0.05	65.
25	0.05	65.
26	0.06	64.
27	0.08	64.
28	0.09	66.
29	0.10	66.
30	0.11	65.
31	0.12	64.
32	0.12	64.
33	0.12	64.
34	0.12	64.
35	0.09	64.
36	0.09	64.
37	0.08	64.
38	0.08	64.
39	0.08	64.
40	0.07	64.
41	0.05	64.
42	0.05	64.
43	0.05	64.
44	0.05	64.
45	0.05	64.
46	0.05	60.
47	0.05	59.
48	0.05	59.

PARTICULATE EMISSION DATA REPORT

ST-M5-2 VISTA METALS PARTICULATES SCRUBBER INLET 5-20-81

BAROMETRIC PRESSURE (IN. HG)	29.93
AVG. ORIFICE PRES. DROP (IN. H2O)	1.530
VOLUME OF DRY GAS SAMPLED, METER COND.(DCF)	97.281
DRY GAS METER GAMMA	1.000
AVG. METER TEMP. (F)	75.3
VOLUME OF DRY GAS SAMPLED (DSCF)	96.347
TOTAL H2O COLLECTED (ML)	75.3
VOLUME OF H2O COLLECTED (SCF)	3.55
% MOISTURE IN STACK GAS BY VOLUME	3.56
MOLE FRACTION OF DRY GAS	0.964
% CARBON DIOXIDE	0.13
% OXYGEN	20.89
% CARBON MONOXIDE	0.00
MOLECULAR WEIGHT OF DRY GAS	28.86
MOLECULAR WEIGHT OF STACK GAS	28.47
AVERAGE STACK GAS VELOCITY, STACK COND. (FPS)	14.5
AVERAGE STACK GAS TEMPERATURE (F)	65.0
ABSOLUTE STACK GAS PRESSURE (IN. HG)	29.91
STACK GAS FLOW RATE (ACFM)	1588.
STACK GAS FLOW RATE (DSCFM)	1540.
NET TIME OF TEST (MIN.)	144.
STACK DIAMETER (IN.)	18.3
SAMPLING NOZZLE DIAMETER (IN.)	0.375
% ISOKINETIC	103.5
F FACTOR (DSCF/10**6BTU)	0.
EMISSION RATE-FRONT HALF- (LB/10**6BTU)	0.000
% EXCESS AIR	-53184.9

STANDARD CONDITIONS *68 DEG F *29.92 IN. HG

ENGINEERING SCIENCE INC.
ARCADIA, CALIF.

PARTICULATE EMISSION DATA REPORT
METRIC SYSTEM

SI-M5-2 VISTA METALS PARTICULATES SCRUBBER INLET 5-20-81

BAROMETRIC PRESSURE (MM HG)	760.
AVG. ORIFICE PRES. DROP (MM H2O)	38.86
VOLUME OF DRY GAS SAMPLED, METER COND.(M3)	2.755
DRY GAS METER GAMMA	1.000
AVG. METER TEMP. (C)	24.1
VOLUME OF DRY GAS SAMPLED (NM3)	2.728
TOTAL H2O COLLECTED (ML)	75.3
VOLUME OF H2O COLLECTED (NM3)	0.101
% MOISTURE IN STACK GAS BY VOLUME	3.56
MOLE FRACTION OF DRY GAS	0.964
% CARBON DIOXIDE	0.13
% OXYGEN	20.89
% CARBON MONOXIDE	0.00
MOLECULAR WEIGHT OF DRY GAS	28.86
MOLECULAR WEIGHT OF STACK GAS	28.47
AVERAGE STACK GAS VELOCITY, STACK COND. (MPS)	4.42
AVERAGE STACK GAS TEMPERATURE (C)	18.3
ABSOLUTE STACK GAS PRESSURE (MM HG)	760.
STACK GAS FLOW RATE (M3/M)	44.98
STACK GAS FLOW RATE (NM3/M)	43.61
NET TIME OF TEST (MIN.)	144.
STACK DIAMETER (M)	0.465
SAMPLING NOZZLE DIAMETER (CM)	0.952
% ISOKINETIC	103.5
F FACTOR (NM3/10**6BTU)	0.00
EMISSION RATE-FRONT HALF- (KG/10**6BTU)	0.000
% EXCESS AIR	-53184.9

STANDARD CONDITIONS *20 DEG C *760 MM HG

ENGINEERING SCIENCE INC.
ARCADIA, CALIF.

VELOCITY TRAVERSE CALCULATIONS ******

RUN ID. SO-M5-2 VISTA METALS PARTICULATES SCRUBBER OUTLET
NO. OF POINTS = 42

TRAVERSE POINT	VELOCITY HEAD IN H2O	STACK TEMP DEG.F
1	0.47	64.
2	0.47	66.
3	0.47	66.
4	0.42	66.
5	0.45	67.
6	0.45	68.
7	0.45	69.
8	0.50	69.
9	0.50	69.
10	0.50	70.
11	0.50	71.
12	0.50	71.
13	0.50	72.
14	0.50	72.
15	0.49	72.
16	0.49	72.
17	0.50	73.
18	0.50	73.
19	0.44	73.
20	0.42	73.
21	0.40	74.
22	0.38	74.
23	0.38	74.
24	0.39	74.
25	0.39	74.
26	0.39	74.
27	0.39	75.
28	0.37	75.
29	0.37	75.
30	0.37	77.
31	0.39	77.
32	0.35	77.
33	0.37	77.
34	0.37	78.
35	0.37	78.
36	0.25	80.
37	0.25	81.
38	0.25	79.
39	0.39	79.
40	0.41	80.
41	0.35	80.
42	0.35	80.

PARTICULATE EMISSION DATA REPORT

SO-M5-2 VISTA METALS PARTICULATES SCRUBBER OUTLET

BAROMETRIC PRESSURE (IN. HG)	29.93
AVG. ORIFICE PRES. DROP (IN. H2O)	1.700
VOLUME OF DRY GAS SAMPLED, METER COND.(DCF)	122.529
DRY GAS METER GAMMA	1.000
AVG. METER TEMP. (F)	93.0
VOLUME OF DRY GAS SAMPLED (DSCF)	117.518
TOTAL H2O COLLECTED (ML)	64.2
VOLUME OF H2O COLLECTED (SCF)	3.03
% MOISTURE IN STACK GAS BY VOLUME	2.51
MOLE FRACTION OF DRY GAS	0.975
% CARBON DIOXIDE	0.00
% OXYGEN	20.89
% CARBON MONOXIDE	0.00
MOLECULAR WEIGHT OF DRY GAS	28.84
MOLECULAR WEIGHT OF STACK GAS	28.56
AVERAGE STACK GAS VELOCITY, STACK COND. (FPS)	36.4
AVERAGE STACK GAS TEMPERATURE (F)	73.5
ABSOLUTE STACK GAS PRESSURE (IN. HG)	29.95
STACK GAS FLOW RATE (ACFM)	1389.
STACK GAS FLOW RATE (DSCFM)	1342.
NET TIME OF TEST (MIN.)	168.
STACK DIAMETER (IN.)	10.8
SAMPLING NOZZLE DIAMETER (IN.)	0.249
% ISOKINETIC	98.2
F FACTOR (DSCF/10**6BTU)	0.
EMISSION RATE-FRONT HALF- (LB/10**6BTU)	0.000
% EXCESS AIR	********

STANDARD CONDITIONS *68 DEG F *29.92 IN. HG

ENGINEERING SCIENCE INC.
ARCADIA, CALIF.

VELOCITY TRAVERSE CALCULATIONS ******

RUN ID. SI-MS-3 VISTA METALS PARTICULATES SCRUBBER INLET 8-21-81
NO. OF POINTS = 32

TRAVERSE POINT	VELOCITY HEAD IN H2O	STACK TEMP DEG.F
1	0.10	73.
2	0.10	73.
3	0.10	72.
4	0.09	72.
5	0.09	72.
6	0.07	72.
7	0.07	72.
8	0.07	72.
9	0.05	72.
10	0.05	72.
11	0.05	72.
12	0.05	70.
13	0.06	69.
14	0.06	69.
15	0.04	69.
16	0.04	69.
17	0.05	67.
18	0.05	65.
19	0.06	65.
20	0.06	65.
21	0.06	65.
22	0.00	65.
23	0.00	65.
24	0.05	65.
25	0.05	64.
26	0.05	64.
27	0.05	64.
28	0.08	63.
29	0.08	63.
30	0.10	63.
31	0.10	63.
32	0.10	64.

PARTICULATE EMISSION DATA REPORT
METRIC SYSTEM

SO-M5-2 VISTA METALS PARTICULATES SCRUBBER OUTLET

BAROMETRIC PRESSURE (MM HG)	760.
AVG. ORIFICE PRES. DROP (MM H2O)	43.18
VOLUME OF DRY GAS SAMPLED, METER COND.(M3)	3.470
DRY GAS METER GAMMA	1.000
AVG. METER TEMP. (C)	33.9
VOLUME OF DRY GAS SAMPLED (NM3)	3.328
TOTAL H2O COLLECTED (ML)	64.2
VOLUME OF H2O COLLECTED (NM3)	0.086
% MOISTURE IN STACK GAS BY VOLUME	2.51
MOLE FRACTION OF DRY GAS	0.975
% CARBON DIOXIDE	0.00
% OXYGEN	20.89
% CARBON MONOXIDE	0.00
MOLECULAR WEIGHT OF DRY GAS	28.84
MOLECULAR WEIGHT OF STACK GAS	28.56
AVERAGE STACK GAS VELOCITY, STACK COND. (MPS)	11.10
AVERAGE STACK GAS TEMPERATURE (C)	23.1
ABSOLUTE STACK GAS PRESSURE (MM HG)	761.
STACK GAS FLOW RATE (M3/M)	39.34
STACK GAS FLOW RATE (NM3/M)	38.00
NET TIME OF TEST (MIN.)	168.
STACK DIAMETER (M)	0.274
SAMPLING NOZZLE DIAMETER (CM)	0.632
% ISOKINETIC	98.2
F FACTOR (NM3/10**6BTU)	0.00
EMISSION RATE-FRONT HALF- (KG/10**6BTU)	0.000
% EXCESS AIR	********

STANDARD CONDITIONS *20 DEG C *760 MM HG

ENGINEERING SCIENCE INC.
ARCADIA, CALIF.

PARTICULATE EMISSION DATA REPORT

SI-M5-3 VISTA METALS PARTICULATES SCRUBBER INLET 5-21-81

BAROMETRIC PRESSURE (IN. HG)	29.90
AVG. ORIFICE PRES. DROP (IN. H2O)	1.770
VOLUME OF DRY GAS SAMPLED, METER COND.(DCF)	63.916
DRY GAS METER GAMMA	1.000
AVG. METER TEMP. (F)	85.5
VOLUME OF DRY GAS SAMPLED (DSCF)	62.093
TOTAL H2O COLLECTED (ML)	47.5
VOLUME OF H2O COLLECTED (SCF)	2.24
% MOISTURE IN STACK GAS BY VOLUME	3.48
MOLE FRACTION OF DRY GAS	0.965
% CARBON DIOXIDE	0.13
% OXYGEN	20.89
% CARBON MONOXIDE	0.00
MOLECULAR WEIGHT OF DRY GAS	28.86
MOLECULAR WEIGHT OF STACK GAS	28.48
AVERAGE STACK GAS VELOCITY, STACK COND. (FPS)	13.7
AVERAGE STACK GAS TEMPERATURE (F)	67.8
ABSOLUTE STACK GAS PRESSURE (IN. HG)	29.88
STACK GAS FLOW RATE (ACFM)	1499.
STACK GAS FLOW RATE (DSCFM)	1446.
NET TIME OF TEST (MIN.)	96.
STACK DIAMETER (IN.)	18.3
SAMPLING NOZZLE DIAMETER (IN.)	0.375
% ISOKINETIC	106.6
F FACTOR (DSCF/10**6BTU)	0.
EMISSION RATE-FRONT HALF- (LB/10**6BTU)	0.000
% EXCESS AIR	-53184.9

STANDARD CONDITIONS *68 DEG F *29.92 IN. HG

ENGINEERING SCIENCE INC.
ARCADIA, CALIF.

PARTICULATE EMISSION DATA REPORT
METRIC SYSTEM

SI-MS-3 VISTA METALS PARTICULATES SCRUBBER INLET 5-21-81

BAROMETRIC PRESSURE (MM HG)	759.
AVG. ORIFICE PRES. DROP (MM H2O)	44.96
VOLUME OF DRY GAS SAMPLED, METER COND.(M3)	1.810
DRY GAS METER GAMMA	1.000
AVG. METER TEMP. (C)	29.7
VOLUME OF DRY GAS SAMPLED (NM3)	1.758
TOTAL H2O COLLECTED (ML)	47.5
VOLUME OF H2O COLLECTED (NM3)	0.063
% MOISTURE IN STACK GAS BY VOLUME	3.48
MOLE FRACTION OF DRY GAS	0.965
% CARBON DIOXIDE	0.13
% OXYGEN	20.89
% CARBON MONOXIDE	0.00
MOLECULAR WEIGHT OF DRY GAS	28.86
MOLECULAR WEIGHT OF STACK GAS	28.48
AVERAGE STACK GAS VELOCITY, STACK COND. (MPS)	4.17
AVERAGE STACK GAS TEMPERATURE (C)	19.9
ABSOLUTE STACK GAS PRESSURE (MM HG)	759.
STACK GAS FLOW RATE (M3/M)	42.45
STACK GAS FLOW RATE (NM3/M)	40.93
NET TIME OF TEST (MIN.)	96.
STACK DIAMETER (M)	0.465
SAMPLING NOZZLE DIAMETER (CM)	0.952
% ISOKINETIC	106.6
F FACTOR (NM3/10**6BTU)	0.00
EMISSION RATE-FRONT HALF- (KG/10**6BTU)	0.000
% EXCESS AIR	-53184.9

STANDARD CONDITIONS *20 DEG C *760 MM HG

ENGINEERING SCIENCE INC.
ARCADIA, CALIF.

VELOCITY TRAVERSE CALCULATIONS ******

RUN ID. SO-M5-3 VISTA METALS PARTICULATES SCRUBBER OUTLET
NO. OF POINTS = 24

TRAVERSE POINT	VELOCITY HEAD IN H2O	STACK TEMP DEG.F
1	0.37	73.
2	0.37	75.
3	0.42	79.
4	0.42	78.
5	0.46	80.
6	0.46	79.
7	0.48	79.
8	0.43	78.
9	0.42	78.
10	0.45	78.
11	0.44	81.
12	0.44	82.
13	0.49	76.
14	0.49	75.
15	0.47	74.
16	0.47	73.
17	0.49	72.
18	0.41	72.
19	0.41	71.
20	0.40	69.
21	0.35	68.
22	0.34	68.
23	0.34	67.
24	0.48	66.

PARTICULATE EMISSION DATA REPORT

SO-M5-3 VISTA METALS PARTICULATES SCRUBBER OUTLET

BAROMETRIC PRESSURE (IN. HG)	29.90
AVG. ORIFICE PRES. DROP (IN. H2O)	1.680
VOLUME OF DRY GAS SAMPLED, METER COND.(DCF)	64.713
DRY GAS METER GAMMA	1.000
AVG. METER TEMP. (F)	82.0
VOLUME OF DRY GAS SAMPLED (DSCF)	63.260
TOTAL H2O COLLECTED (ML)	39.9
VOLUME OF H2O COLLECTED (SCF)	1.88
% MOISTURE IN STACK GAS BY VOLUME	2.89
MOLE FRACTION OF DRY GAS	0.971
% CARBON DIOXIDE	0.00
% OXYGEN	20.89
% CARBON MONOXIDE	0.00
MOLECULAR WEIGHT OF DRY GAS	28.84
MOLECULAR WEIGHT OF STACK GAS	28.52
AVERAGE STACK GAS VELOCITY, STACK COND. (FPS)	37.2
AVERAGE STACK GAS TEMPERATURE (F)	74.6
ABSOLUTE STACK GAS PRESSURE (IN. HG)	29.92
STACK GAS FLOW RATE (ACFM)	1419.
STACK GAS FLOW RATE (DSCFM)	1361.
NET TIME OF TEST (MIN.)	96.
STACK DIAMETER (IN.)	10.8
SAMPLING NOZZLE DIAMETER (IN.)	0.249
% ISOKINETIC	91.2
F FACTOR (DSCF/10**6BTU)	0.
EMISSION RATE-FRONT HALF- (LB/10**6BTU)	0.000
% EXCESS AIR	********

STANDARD CONDITIONS *68 DEG F *29.92 IN. HG

ENGINEERING SCIENCE INC.
ARCADIA, CALIF.

PARTICULATE EMISSION DATA REPORT
METRIC SYSTEM

SO-M5-3 VISTA METALS PARTICULATES SCRUBBER OUTLET

BAROMETRIC PRESSURE (MM HG)	759.
AVG. ORIFICE PRES. DROP (MM H2O)	42.67
VOLUME OF DRY GAS SAMPLED, METER COND.(M3)	1.832
DRY GAS METER GAMMA	1.000
AVG. METER TEMP. (C)	27.8
VOLUME OF DRY GAS SAMPLED (NM3)	1.791
TOTAL H2O COLLECTED (ML)	39.9
VOLUME OF H2O COLLECTED (NM3)	0.053
% MOISTURE IN STACK GAS BY VOLUME	2.89
MOLE FRACTION OF DRY GAS	0.971
% CARBON DIOXIDE	0.00
% OXYGEN	20.89
% CARBON MONOXIDE	0.00
MOLECULAR WEIGHT OF DRY GAS	28.84
MOLECULAR WEIGHT OF STACK GAS	28.52
AVERAGE STACK GAS VELOCITY, STACK COND. (MPS)	11.33
AVERAGE STACK GAS TEMPERATURE (C)	23.7
ABSOLUTE STACK GAS PRESSURE (MM HG)	760.
STACK GAS FLOW RATE (M3/M)	40.18
STACK GAS FLOW RATE (NM3/M)	38.54
NET TIME OF TEST (MIN.)	96.
STACK DIAMETER (M)	0.274
SAMPLING NOZZLE DIAMETER (CM)	0.632
% ISOKINETIC	91.2
F FACTOR (NM3/10**6BTU)	0.00
EMISSION RATE-FRONT HALF- (KG/10**6BTU)	0.000
% EXCESS AIR	********

STANDARD CONDITIONS *20 DEG C *760 MM HG

ENGINEERING SCIENCE INC.
ARCADIA, CALIF.