

Air



NSPS Revision Nonferrous Smelter Flash Furnace and Electric Slag Cleaning Furnace

**Emission Test Report
Phelps-Dodge
Hidalgo Smelter
Playas, New Mexico**

DCN 82-222-018-06-20
RN 222-018-06

NSPS REVISION
NONFERROUS SMELTER
FLASH FURNACE
AND ELECTRIC SLAG
CLEANING FURNACE

Emission Test Report
Phelps-Dodge
Hidalgo Smelter
Playas, New Mexico

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Contract No. 68-02-3542
Work Assignment No. 6
ESED 80/13

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October 8, 1982

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SECTION 1

INTRODUCTION

This report presents the results of a field testing effort conducted at the Phelps Dodge Hidalgo smelter near Playas, New Mexico. This effort, conducted under U.S. EPA Contract 68-02-3542, Work Assignment No. 6, was part of a series of studies designed to provide background data for a portion of the revision of the New Source Performance Standards for the primary copper industry. During the study, emissions collected by two fugitive gas hooding systems were measured. One system vented the Outokumpu flash furnace matte tapping and slag skimming operations; the other vented the electric slag cleaning furnace (ESCF) slag skimming process. Also, mass loading and SO₂ concentration entering and exiting the scrubber serving the ESCF were measured.

The particulate and sulfur dioxide emission rates were determined using combined EPA Reference Methods 5 and 6. Visible emissions were monitored using the techniques of EPA Reference Methods 9 and 22 (proposed) to determine the capture efficiency of the fugitive gas collection system. While the visible studies are a measure of the fugitive particulate emissions, they may also be indicative of the SO₂ emissions since the two species are presumed to be proportional everywhere in the same gas stream. The sulfuric acid mist emissions from the scrubber were monitored using combined EPA Reference Methods 5 and 8. These Reference Method emission rates are used in conjunction with production data of matte and slag to calculate emission factors for the mass of particulate and sulfur dioxide emitted per mass of matte or slag produced.

Radian personnel performed all particulate, sulfur dioxide, sulfuric acid mist and visible emissions testing. Research Triangle Institute (RTI) personnel made process observations during testing.

The remaining sections of this report present a summary of the results, a process description, sampling and analytical methodologies, quality assurance documentation, and results.

SECTION 2

SUMMARY OF RESULTS

The data collected during the sampling at the Phelps Dodge Hidalgo smelter are summarized in Tables 2-1 and 2-2; complete data are given in Section 8 of this report. Because the tests were performed intermittently, due to the nature of the process evaluated, the test results are given in terms of pounds of pollutant per hour of sampling and in pounds of pollutant generated per ton of product (matte or slag). It should be noted that additional information has been requested from Phelps Dodge (by the process observers, RTI) concerning operation time and production tonnages; therefore, the process observations and production rates (and therefore the emission rate per unit of product) may be subject to small changes in the future.

Several conclusions may be drawn from this study:

- Most of the emissions (particles and SO₂) occur during matte tapping at the launder.
- Lancing adds substantially to the particulate emissions.
- Fugitive emissions, ranging between 20 and 45 percent opacity, were found to exist around the launder and doghouse hoods and greater than 80% of the time around the electric slag cleaning furnace hoods.
- The scrubber on the electric slag cleaning furnace off-gases removed about 95% of the particulate material, about 45% of the sulfur dioxide, but may have increased the sulfuric acid mist content of the off gas slightly.

TABLE 2-1. AVERAGE EMISSION RATES DETERMINED DURING PARTICULATE AND SULFUR DIOXIDE TESTING AT HIDALGO SMELTER

Test	Taps	Particulate		Sulfur Dioxide	
		lb/hr*	lb/ton	lb/hr*	lb/ton
Matte Tapping at Launder	27	45	0.23	320	1.6
Matte Tapping at Doghouse Hooding	27	6.4	0.032	29	0.15
Matte Tapping at Doghouse Hooding (with Lancing)	7	8.6	0.060	24	0.16
Slag Skimming	13	11	0.072	130	0.88

*Testing was intermittent only during tapping or skimming; lb/hr are per hour of sampling.

TABLE 2-2. AVERAGE PARTICULATE, SULFUR DIOXIDE, AND SULFURIC ACID MIST FLOWS ABOUT THE ESCF SCRUBBER AT THE HIDALGO SMELTER.

Test	Particulate lb/hr*	Sulfur Dioxide lb/hr*	Sulfuric Acid lb/hr*
ESCF Scrubber Inlet	100	180	0.03
ESCF Scrubber Outlet	4.9	99	0.07

*Testing was intermittent only during tapping or skimming; lb/hr are per hour of sampling.

SECTION 3

PLANT DESCRIPTION

3.1 PROCESS DESCRIPTION

The Outokumpu smelting process is used at the Phelps Dodge Hidalgo smelter. A block flow diagram depicting this process is presented in Figure 3-1. Two furnaces, a flash furnace and an electric slag cleaning furnace, operate as a unit to perform the same function as a reverbatory furnace but at a greater thermal efficiency.

The flash furnace consists of three sections: the reaction shaft, the settling basin and the uptake shaft. The smelting reactions take place in the reaction shaft. Here, finely crushed, dried copper ore concentrate, flux, and recycled dust are suspended in a stream of preheated air. The mixture is continuously fed through burners located at the top of the reaction shaft. Combustion of sulfur and iron generates the heat required to smelt the feed concentrates, and fuel is added as required to maintain the temperature when smelting.

The slagging reactions occur in the furnace settling basin, similar to a typical reverbatory furnace. The smelted feed falls onto the slag layer and sinks through to the matte layer. Slag is intermittently skimmed from the end of the settling basin opposite the reaction shaft. The slag then flows through the launder directly into an electric slag cleaning furnace. All hooding serving the slag skimming operations about the flash furnace was inoperative and therefore not sampled.

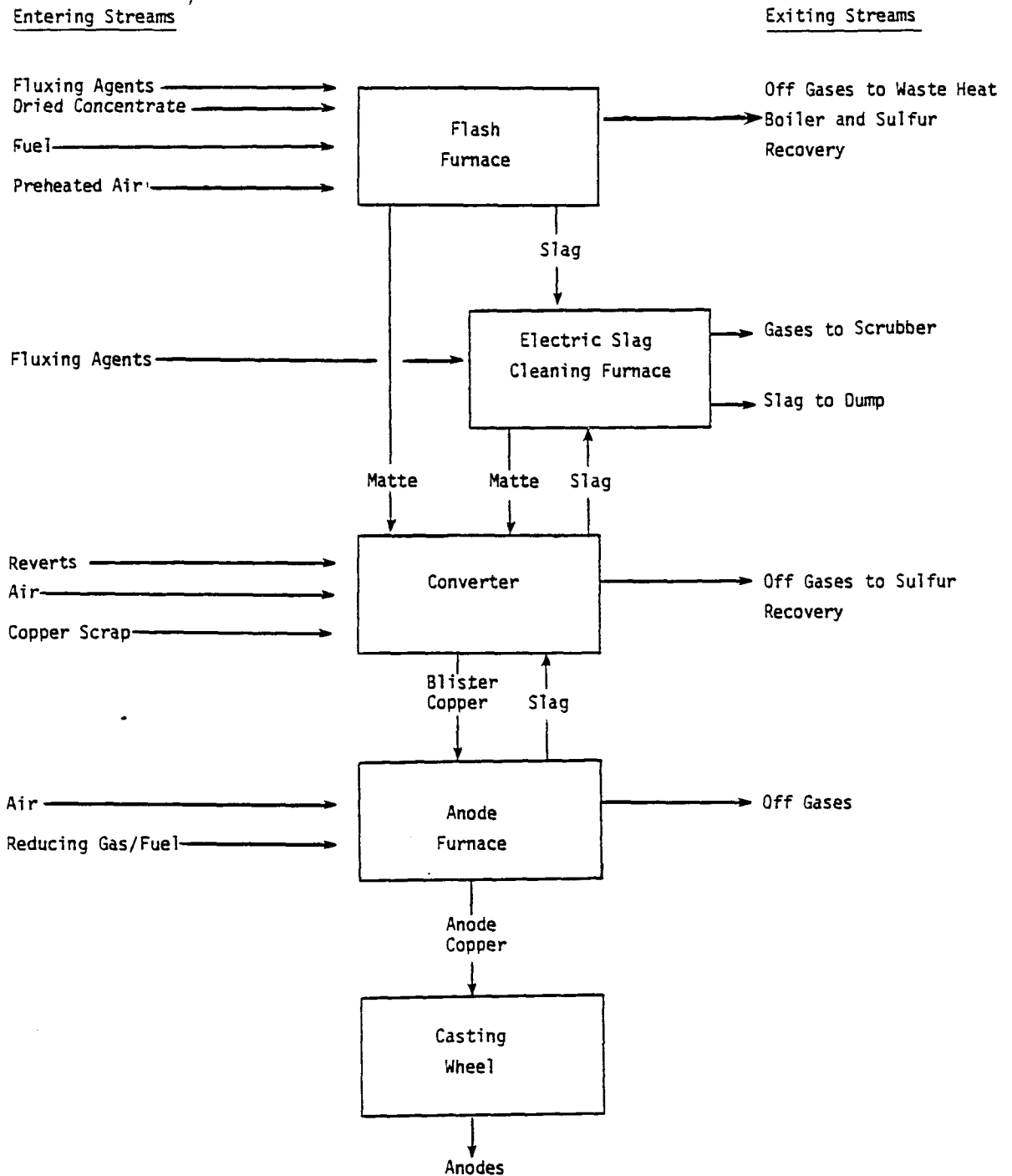


Figure 3-1. Block flow diagram for the Outakumpu process

Matte is intermittently tapped from the reaction shaft end of the settling basin via five tapping ports. Doghouse style hoods vent the areas adjacent to the furnace and are ducted to a single fan. Another set of hoods, which vent all other matte handling operations, are similarly ducted to a separate, single fan. Sampling ports were installed in these two gas streams (i.e., the hood ducting) specifically for this testing effort.

Off gases exit the flash furnace through the uptake shaft at approximately 1300°C and contain 8 to 14 percent sulfur dioxide (SO₂). These gases are then cooled in a waste heat boiler, the SO₂ being recovered as sulfuric acid.

The copper-bearing slag from the flash furnace is further refined in the electric slag cleaning furnace (ESCF). Reverts (waste materials of high copper content generated from the smelting process) are added with the molten slag. The proper temperature is maintained with resistance heating using large carbon electrodes. Both the copper matte and the less dense slag are intermittently tapped from the ESCF via two ports for each. The ports and launders, which convey the molten slag to ladles, are vented with hoods. Gases from these hoods are merged into a single duct. Sampling ports were installed in this duct, serving the ESCF slag skimming operations, specifically for this testing effort.

The off gases from the ESCF are ducted through a water-cooled duct to a scrubber which removes particles and SO₂. Sampling ports at the scrubber's inlet and outlet were also installed for this effort.

The ladles of molten matte are transferred to a converter by an overhead crane for further refining. In the converter, iron sulfide (FeS) is oxidized to iron oxide (FeO) and SO₂. Quartz is added to the converter to bind with the FeO to form a slag. This slag is recycled to the ESCF via ladles and an overhead crane. "White metal" remains after removal of the

iron. Copper sulfide (Cu_2S) is converted to a 98 percent pure copper called "blister copper." Cold copper scrap is added during the blowing cycle to absorb the heat produced by exothermic reactions. The blister copper is then transferred to an anode furnace (again by ladles and crane) where blown air oxidizes any remaining sulfide and results in a copper containing Cu_2O as an impurity. The Cu_2O is then reduced with reformed natural gas to produce a 99+ percent pure copper which is ready for anode casting.

SECTION 4

SAMPLING METHODOLOGY

Emission rates of particulate material and sulfur dioxide were determined at the following locations:

- the duct serving the fugitive gas collection hoods for the matte tapping operations at the flash furnace,
- the duct serving the fugitive gas collection hoods for the slag skimming operations from the ESCF,
- the ESCF SO₂ scrubber inlet, and
- the ESCF SO₂ scrubber outlet.

Sulfuric acid mist concentrations were also determined at the scrubber inlet and outlet. In addition, visible emissions escaping the hooding systems were measured, and the opacity of the emissions from the ESCF scrubber stack outlet were visually determined.

During the pretest site survey at the Phelps Dodge Hidalgo smelter, five sampling locations were selected. Two of these were located on the matte tapping emissions duct from the flash furnace, one each was located at the inlet to and outlet from the ESCF scrubber, and the fifth was located on the duct from the slag skimming emissions from the ESCF. A more detailed description of these sampling points is given below. Finally, the hooding serving the slag skimming operations on the flash furnace was inoperative at the time and therefore not sampled.

4.1 SAMPLING LOCATIONS

Flash Furnace Matte Tapping and Handling

The emissions from the flash furnace matte tapping operations are collected by two hooding systems. The combined gases from these two systems could not be sampled without interference from emissions from other operations. Therefore, a port was installed in each duct just downstream from the hoods, before they are combined.

The first set of hoods, five "doghouse" style hoods, vent the areas adjacent to each of the four matte tapping ports of the Hidalgo flash furnace. The emissions captured by these hoods are routed into a single duct, a blower, and then on to the main duct and eventually to a stack. The sampling plane was in the inlet duct approximately five feet above the second (furnace) floor. Figure 4-1 is a sketch of the ports for this location. The ports were three inch pipe nipples, six inches long, welded to the duct. The ports were at right angles to each other and the duct axis. This sampling location meets the criteria for sampling locations as described in EPA Reference Method 1.

All emissions from flash furnace matte handling beyond the four previously described doghouse hoods were collected in a single duct. The location for the horizontal test plane was in this duct downstream (and in the vertical run) and directly above the fan. This location was approximately one-half duct diameter upstream of (below) the elbow which directs the flow horizontal and parallel to the converter aisle. This test plane was approximately one foot above the third floor level. This test plan did not meet the 8 and 2 duct diameter criteria as specified in EPA Reference Method 1. Therefore, the EPA project officer requested that 12 sampling points be used. Figure 4-2 is a sketch showing the location of the sampling ports. The ports were three inch pipe nipples, six inches in length, and welded to the duct. The axes of the nipples were at right

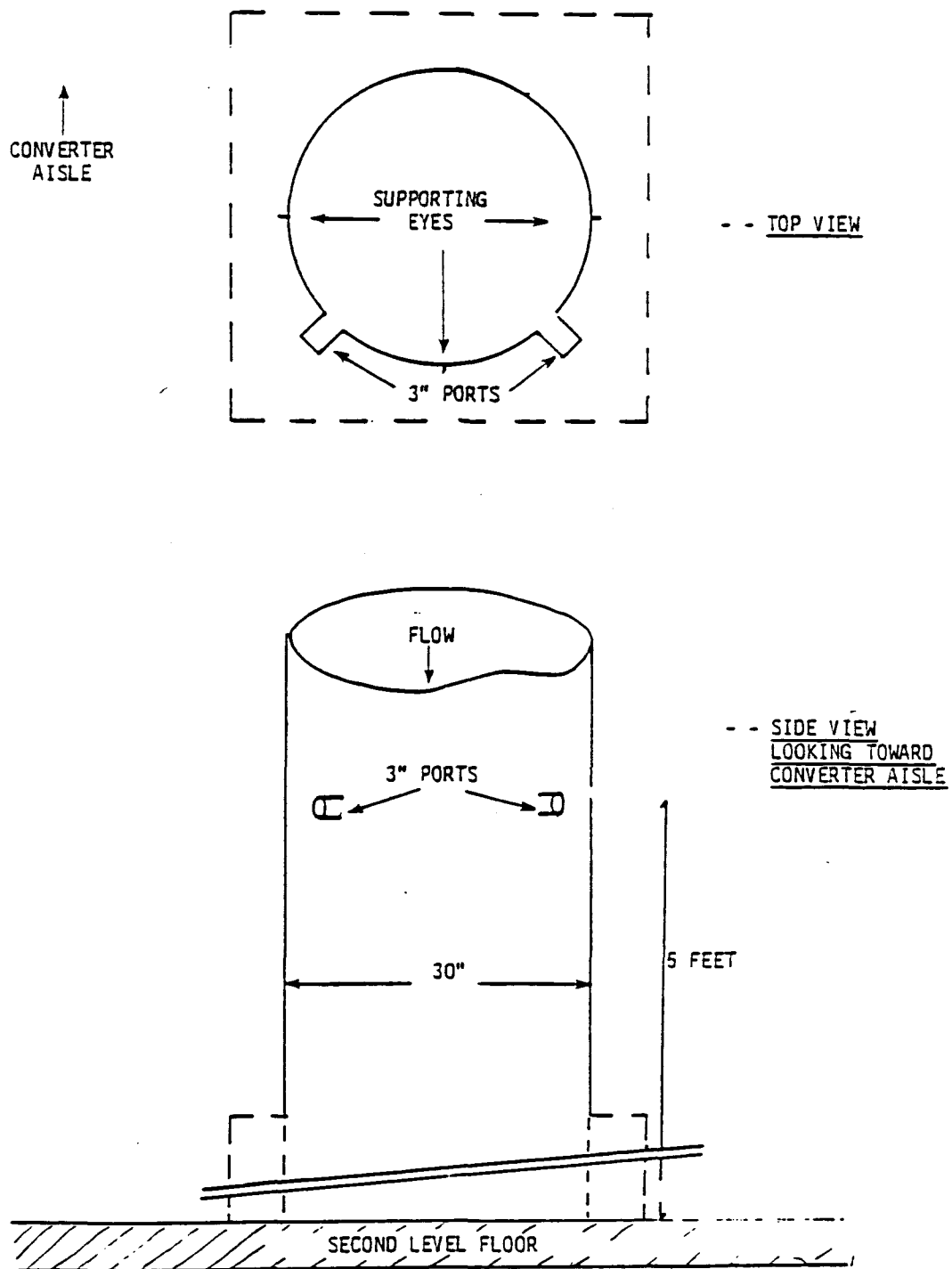


Figure 4-1. Sampling port location for flash furnace doghouse hooding

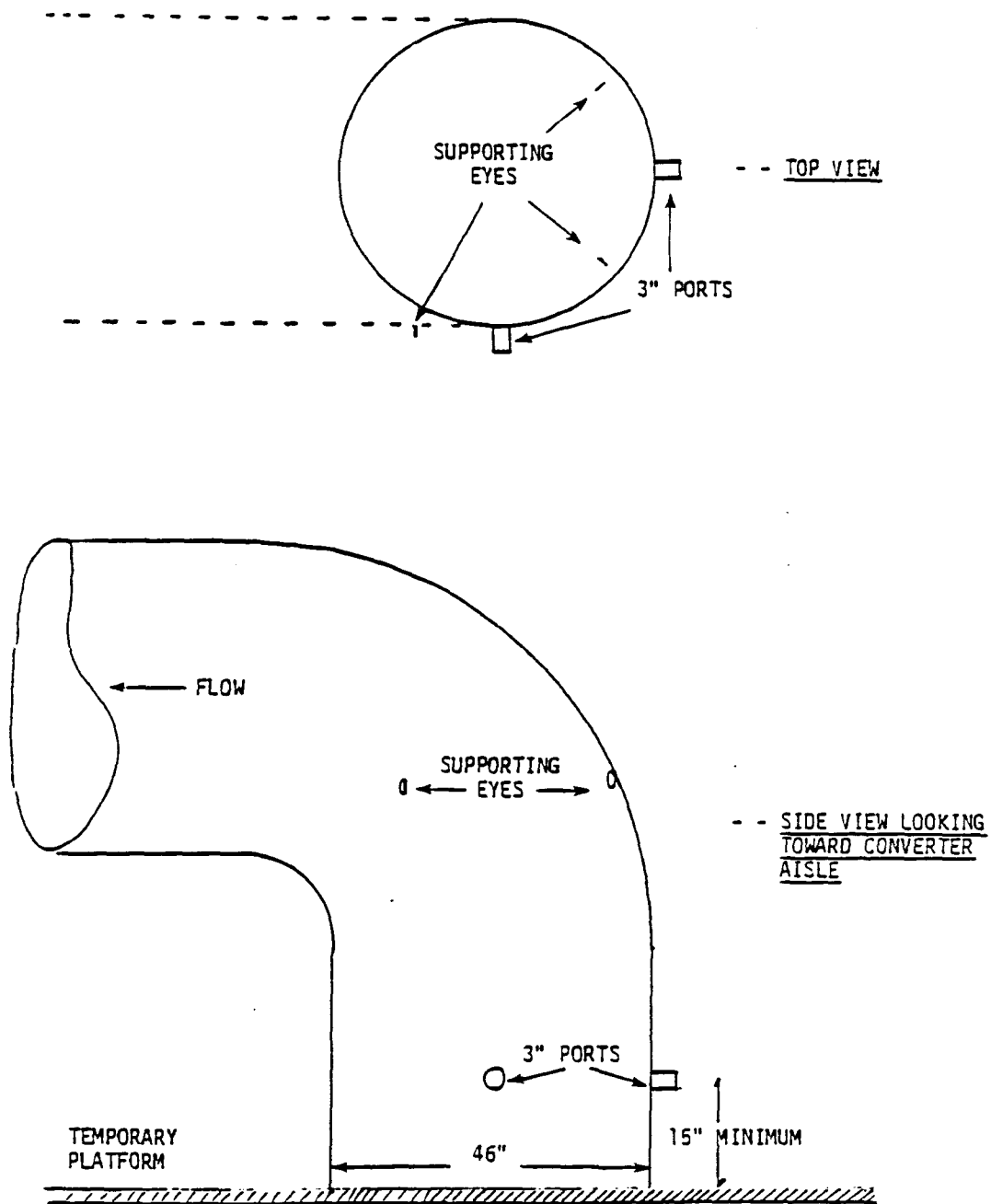


Figure 4-2. Sampling port location for the flash furnace matte tapping launder and launder to ladle transfer point hooping .

angles to the duct axis and to each other. The axis of one nipple was in the same plane as the center line of the downstream elbow.

ESCF Slag Skimming Hooding

All hooding collecting emissions from the slag skimming for the ESCF is ducted into in a common duct. This duct runs roughly parallel to the converter aisle, then through a series of compound bends, and becomes vertical as it passes upward through the second floor. The location for the sampling ports was approximately six feet above the third floor. A sketch of the port locations is given in Figure 4-3. The ports were three inch pipe nipples, six inches in length. The axis of each nipple was perpendicular to the duct axis, and to each other. One nipple was welded on the side of the duct opposite the converter aisle; the other was located with its axis parallel to the converter aisle.

Electric Slag Cleaning Furnace Scrubber Inlet

The ports for the sampling of off gases from the ESCF entering the scrubber were located on the cylindrical inlet duct to the scrubber just downstream (below) the sleeved bellows expansion joint. A sketch showing the location of the ports is given in Figure 4-4. The ports were three inch pipe nipples, six inches in length and welded to the duct. The axis of each nipple was at right angles to the duct axis, at right angles to each other and in the same plane.

Electric Slag Cleaning Furnace Scrubber Outlet

The gases exiting the ESCF scrubber are directed up through a 18" diameter duct which runs parallel and outside the ESCF building. Existing sampling ports in the duct at the fourth level were used to sample this stream. This test plane is used by Phelps Dodge during compliance sampling.

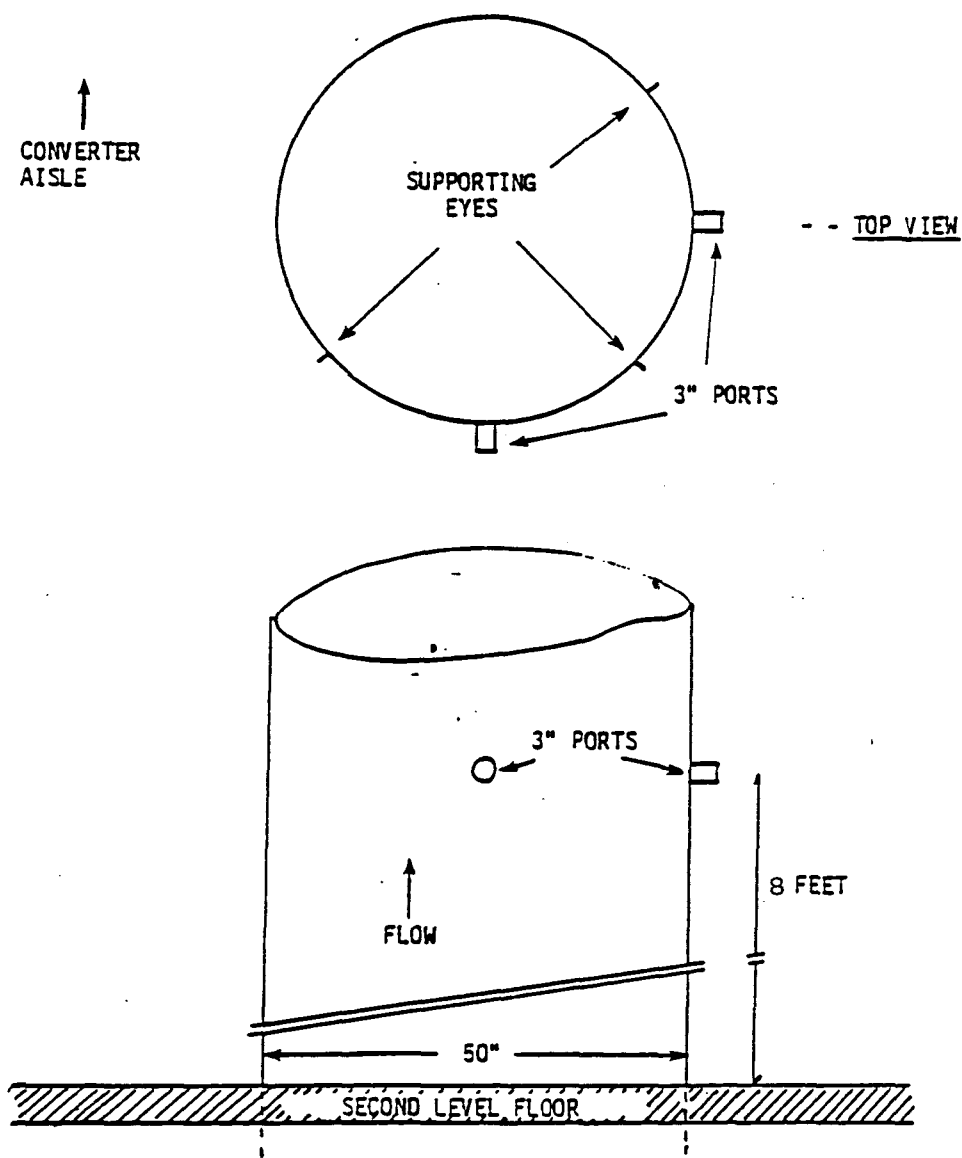


Figure 4-3. Sampling port location for the ESCF matte tapping and slag skimming emissions

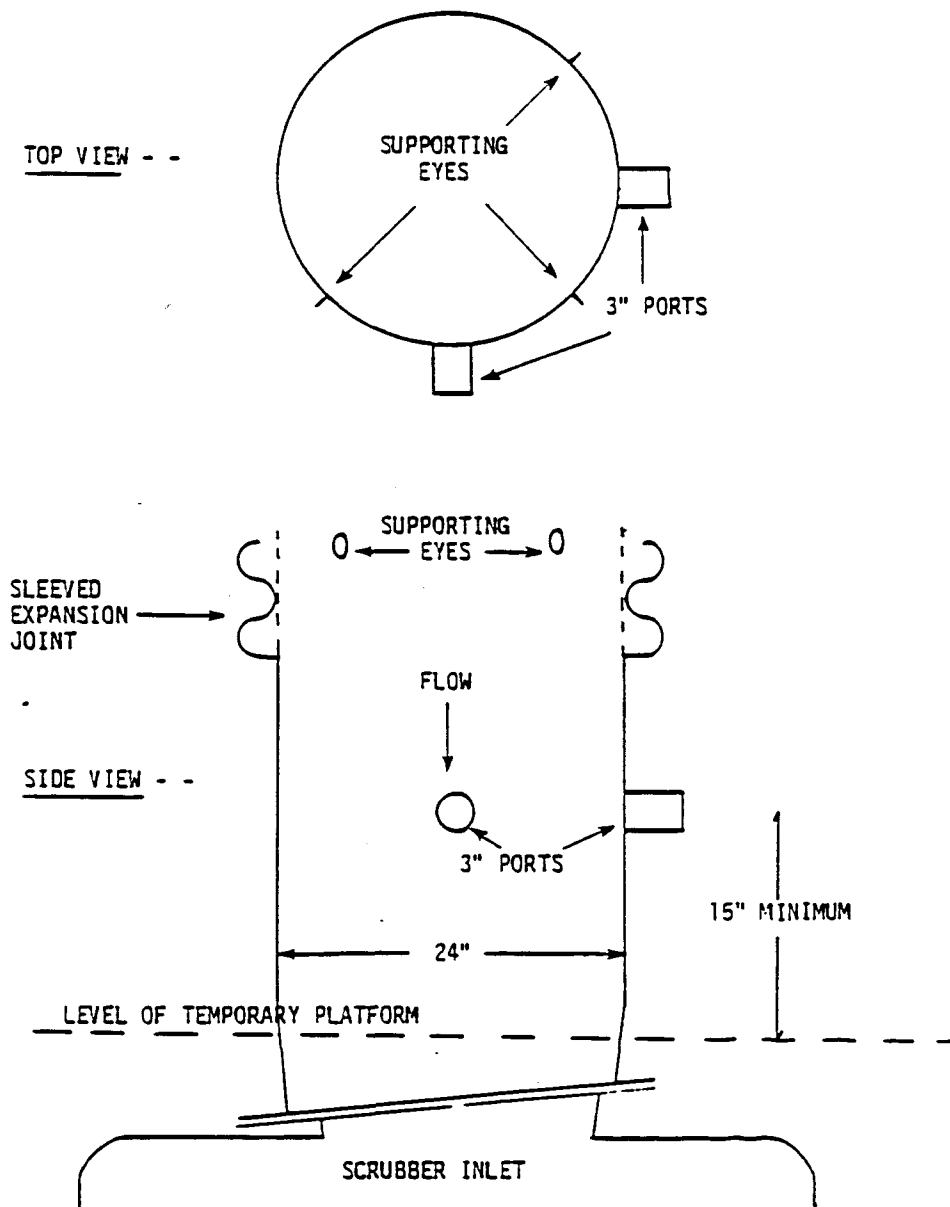


Figure 4-4. Sampling port location for the ESCF scrubber inlet

4.2 SAMPLING

In order to determine the desired emission rates, at various times during this project, Radian employed EPA Reference Methods 1, 2, 3, 4, 5, 6, and 8 (Code of Federal Regulations, 40, Protection of the Environment, Parts 53 to 80, Revised as of July 1, 1980). The use of 12 sampling points at each test plane was directed by the EPA Project Officer.

In the determination of mass loading and sulfur dioxide concentration, EPA Reference Methods 5 and 6 were combined within a single sampling test. A vital aspect of this testing was the sequencing and communication involved to coordinate the sampling with the plant operations. Walkie-talkies, provided by the U.S. EPA, were the main means of communication. RTI officials observed when the slag was being skimmed and the matte being tapped. This information was relayed to the sampling team and the sampling commenced. If the plant operations ceased, the sampling was terminated. The U.S. EPA requested that Radian traverse each diameter twice, sampling each of the six points twice for 2-1/2 minutes. The reasoning was that since each tap had a duration of only a few minutes, the sampling would be biased if only one point was sampled per tap (5 minute sampling point). With 2-1/2 minute sampling points, at least two points across the duct would be sampled during each tap.

A schematic drawing of the sampling train and related equipment is shown in Figure 4-5. Gas volume was measured with a dry gas meter calibrated against a standardized dry gas meter. Stack temperature was measured by Type K, chrome-alumel thermocouple calibrated against a mercury thermometer. Velocity pressure and pressure drop across the orifice were measured using Magnehelic® gauges having ranges from 0-1 and 0-3 inches H₂O, respectively.

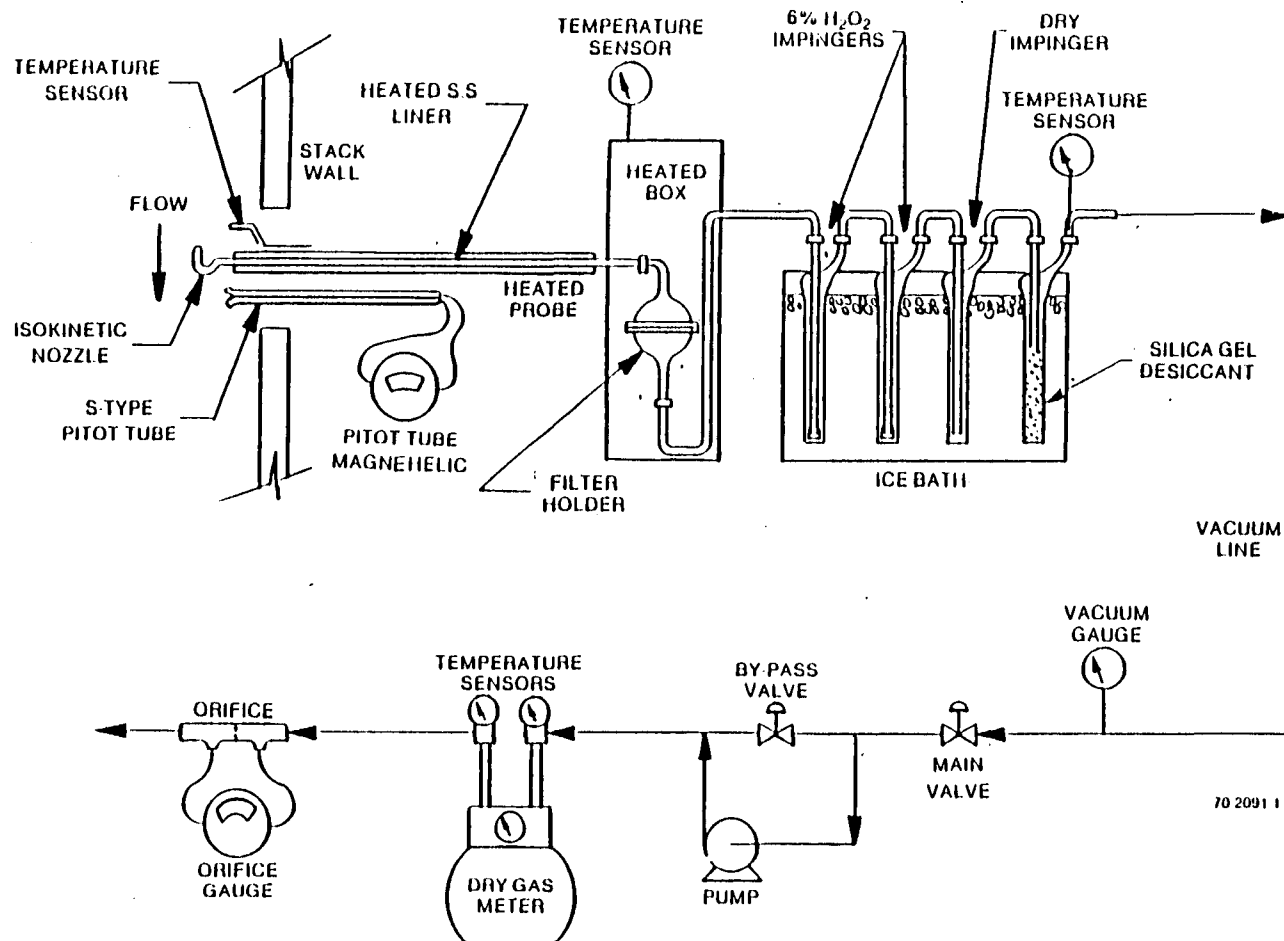


Figure 4-5. A schematic of the combined EPA Method 5 and 6 sampling apparatus

A leak check of the entire train was conducted before and after each run and the leak rate noted. The leak check was performed at either 15" Hg vacuum or the highest vacuum obtained during the run. Pitot lines were leak checked at 3" H₂O before and after each run to insure proper velocity pressure measurements. The barometric pressure was read daily from an aneroid barometer. The measured static pressure of the stack gas was added to this atmospheric pressure to obtain the actual stack pressure.

Dry gas meter volume was noted at the beginning of sampling for each point. The velocity pressure (ΔP) was read and the sampling rate (ΔH) adjusted by a predetermined factor to obtain an isokinetic sample. Stack temperature, hot box temperature, gas temperature at the exit of the final impinger, dry gas meter inlet and outlet temperature, and the vacuum on the train were all recorded at each sample point. Processed data forms containing the above information for each run are included in Appendix C.

Immediately following a run, both the probe liner and nozzle were brushed and rinsed with acetone to collect all particles. The hot box/cold box assembly was taken to the mobile lab for the remaining portion of the sample recovery. All glassware upstream of the filter and the front half of the glass filter holder were rinsed and the wash, containing particles which had attached to the tubing walls, was combined with the probe rinse. This mixture was eventually taken to dryness and the mass of the particulate material determined. The filter itself was replaced in its original, individual petri dish and the weight gain subsequently determined. Care was taken to recover all fragments of the filter. Impingers were weighed to determine the amount of water collected and the moisture content of the gas calculated. The contents of the H₂O₂ impingers were quantitatively transferred to polyethylene containers, marked, and sealed for storage and shipment.

4.3 VISUAL EMISSIONS OBSERVATIONS

Visual emissions observations were made to evaluate various hood capture systems and pollution control equipment. The testing was performed using visible emissions observations of fugitive particulate matter as an indicator of fugitive sulfur dioxide emissions. Results from these observations, along with simultaneous sulfur dioxide and particulate measurements, will provide input for revision of the New Source Performance Standards (NSPS) for the primary copper industry.

4.3.1 Observation Sites - Hidalgo Smelter

Five streams from the Phelps Dodge Hidalgo smelter were visually evaluated, as follows:

- the fugitive emissions escaping collection by the doghouse style hoods at the flash furnace matte tapping ports,
- the fugitive emissions escaping collection by the hoods serving the flash furnace matte launders and launder-to-ladle transfer points,
- the ESCF scrubber outlet,
- the fugitive emissions escaping collection by the hoods serving the ESCF matte tapping port and launders, and
- the fugitive emissions escaping collection by the hoods serving the ESCF slag tapping ports and launders.

Figures 4-6 and 4-7 show the position of the observer for each launder on the flash furnace and ESF, respectively.

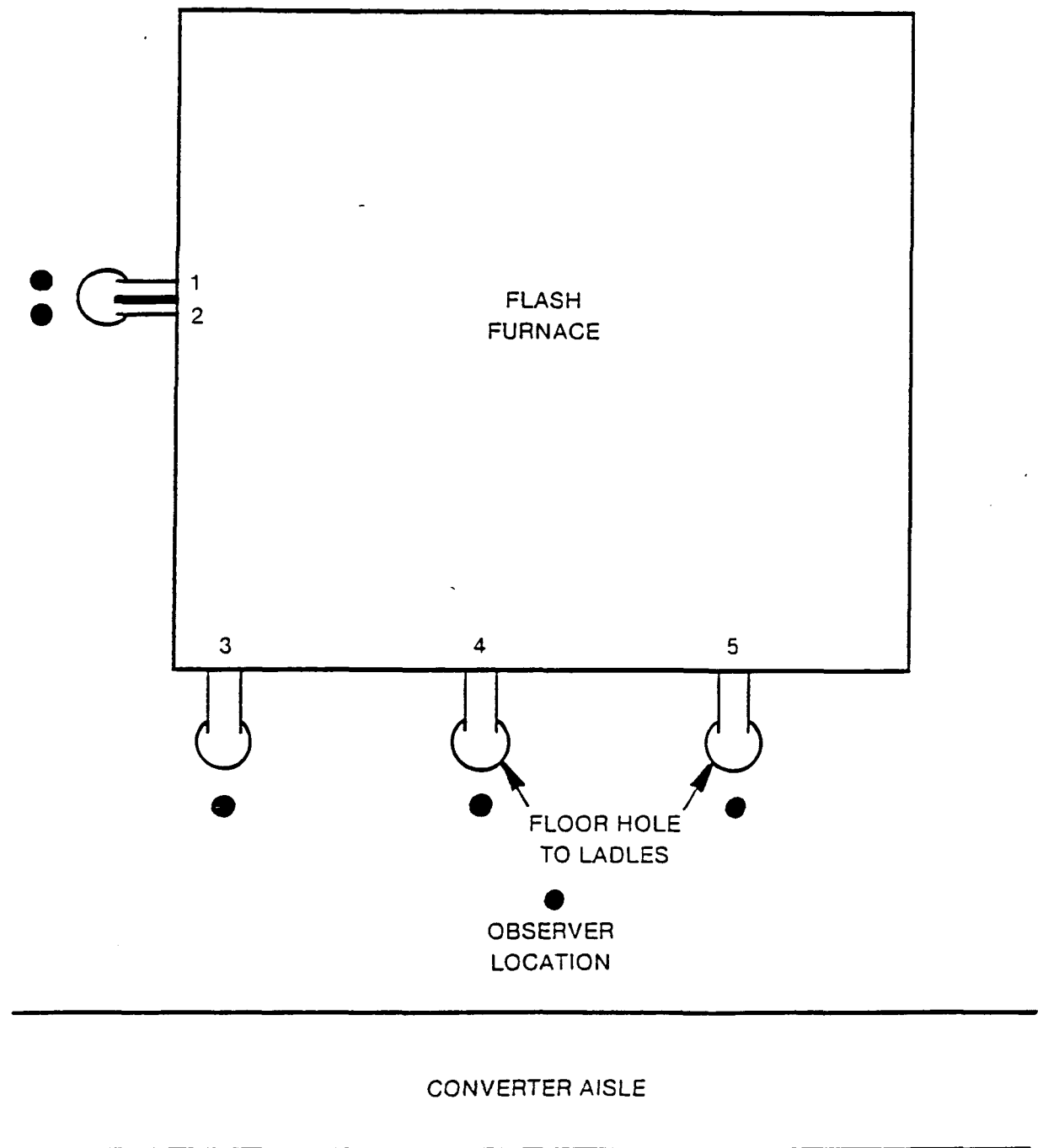
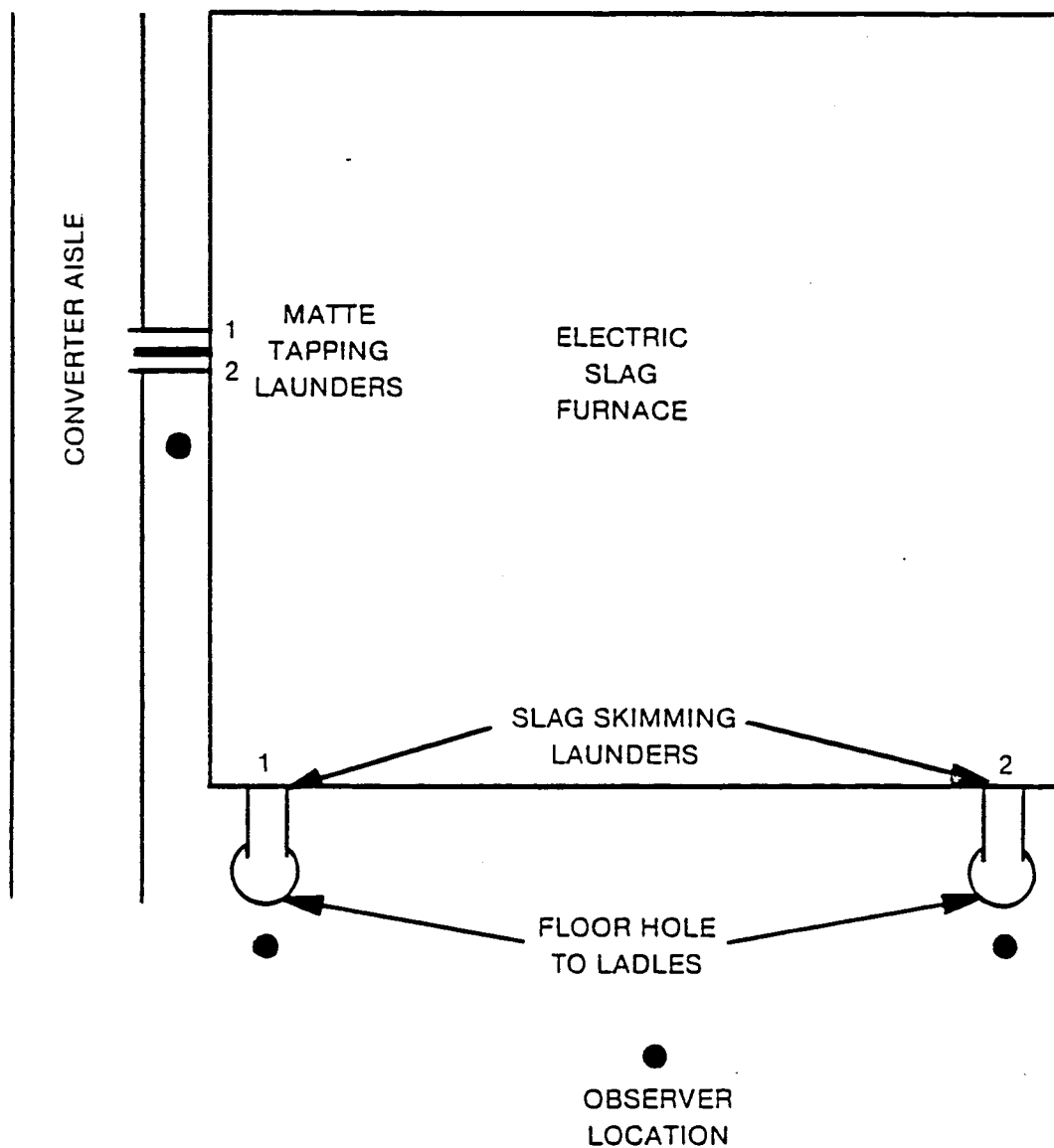


Figure 4-6. Hidalgo smelter flash furnace visible emissions observer position during matte tapping



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Figure 4-7. Hidalgo smelter electric slag furnace visible emissions observer position during slag skimming and matte tapping

4.3.2 Methodology

Two visible emissions methods were employed in the testing. The technique of EPA Method 9, "Visual Determination of the Opacity of Emissions from Stationary Sources" was used to determine the opacity of fugitive hood emissions and scrubber stack emissions. The proposed EPA Method 22, "Visual Determination of Fugitive Emissions from Material Processing Sources" was used to determine the accumulated time that fugitive emissions were observed escaping each hooding system evaluated. All in-plant observations were made from a position approximately 15 feet directly in front of each launder.

Method 9

A certified observer is generally used by control agencies to evaluate the opacity of an emission source. The observers are instructed at opacity training schools. In order to become certified, observers must evaluate plume opacity with 7.5 percent accuracies relative to transmissometer measurement of plume opacity. Upon passing the course, they are certified by the school for six months as capable of evaluating plume opacity by visual inspection. Mr. Craig Beskid of Radian Corporation, who was a certified visible emissions observer at the time, performed all Method 9 and Method 22 testing.

When observing a plume, Method 9 requires that the observer stand:

- at a distance from the plume sufficient to provide a clear view of the emissions,
- with his line of vision approximately perpendicular to the plume direction, and
- with the sun oriented in the quadrant to his back.

The method also requires that readings be made at 15-second intervals over a minimum six-minute period at the point of greatest opacity in the plume. The average of these minimum 24 readings is reported as the average visual opacity. Data forms with these recorded readings are contained in Appendix D.

For the purpose of this study, modifications to Method 9 were necessary. First, Method 9 was performed indoors at the Hidalgo smelter flash furnace and electric slag cleaning furnace. This was an improper position relative to the emissions, the light source, and the background. The emissions were read most often with light from above the emissions as the emissions escaped the hooding system. All opacity observations used the furnace facing, approximately two feet above the launders, as background. Most observations were performed during a simultaneous stack test. Also, all observations were halted during excessive visual interferences caused by fugitives from other nearby sources.

Method 22

This method is used to determine the amount of time that any visible fugitive emissions occur during the observation period. Fugitive emissions include emissions that:

- escape capture by process equipment exhaust hoods,
- are emitted during material transfer, or handling, and
- are emitted directly from process equipment.

Method 9 procedures implicitly include provisions for a cyclic process such as a varying process load. However, for characterization of intermittent fugitive emissions, where there are periods of no emissions, Method 9 is not adequate. Method 22, which does not require a certified observer, is intended to make up this shortcoming. Method 22 essentially monitors the percentage of time that fugitive emissions were observed.

In addition to the modifications described above for the Method 9 testing, the most significant modifications and limitations to the Method 22 observations in this application are listed below:

- visible emissions interference due to hood leaks and nearby processes (increased recorded emission time).
- Less than an adequate amount of light (<100 lux)
- Inability to attain proper observer position relative to light source (may increase or decrease visibility of emissions which are highly dependent on position of light source).

4.4 PROCESS OBSERVATIONS

The matte tapping from the flash furnace and the slag skimming from the ESCF were observed from the furnace-level floor during sampling. The observers also coordinated the sampling with the plant operation. Communications were made via two way radios.

During the sampling of the matte tapping, the observer gave instructions to the teams to begin sampling when metal flow began and recorded the time. Upon completion, or at the start of lancing for another tap, the sampling was stopped and the time recorded. If a second tap was lanced while metal was flowing from another tap, the sampling was halted during the lancing. Sampling was resumed as soon as metal flow from the second port began. Sampling continued as long as one of the taps was active.

The observer's task at the ESCF skim bays was essentially the same as above. The sampling team sampled only when metal was flowing from the port. The observer noted the extent that each ladle was filled and any other information which was thought to be pertinent.

At the request of the RTI personnel on site and with the approval of EPA, a single run for the flash furnace matte tapping and all of the runs for the ESCF skimming were made with the lancing emission included.

Sulfuric acid mist determinations were made at the ESCF scrubber inlet and outlet only. At the request of the EPA, modifications were made in Method 8. The train used is shown schematically in Figure 4-8. The filter oven was held at 350-380°F to avoid the condensation of sulfuric mist. The outlet, the sampling apparatus was as specified, including an unheated glass fiber filter for the collection of sulfuric acid mist between the 80% isopropanol and hydrogen peroxide impingers. At the scrubber inlet, a stainless steel probe line was used due to the high temperature (800°F-1200°F) at that location.

The process observations at Hidalgo were performed primarily by RTI with support from Radian. Coordination of the sampling activities was the responsibility of Radian. The process documentation provided by RTI is reproduced in Appendix A of this report. Some of the operating logs from Hidalgo have been requested by RTI which will augment the process observations appendix. This information will be used to corroborate the data collected and, where possible, confirm some of the assumptions which were made for matte and slag production rates and schedules.

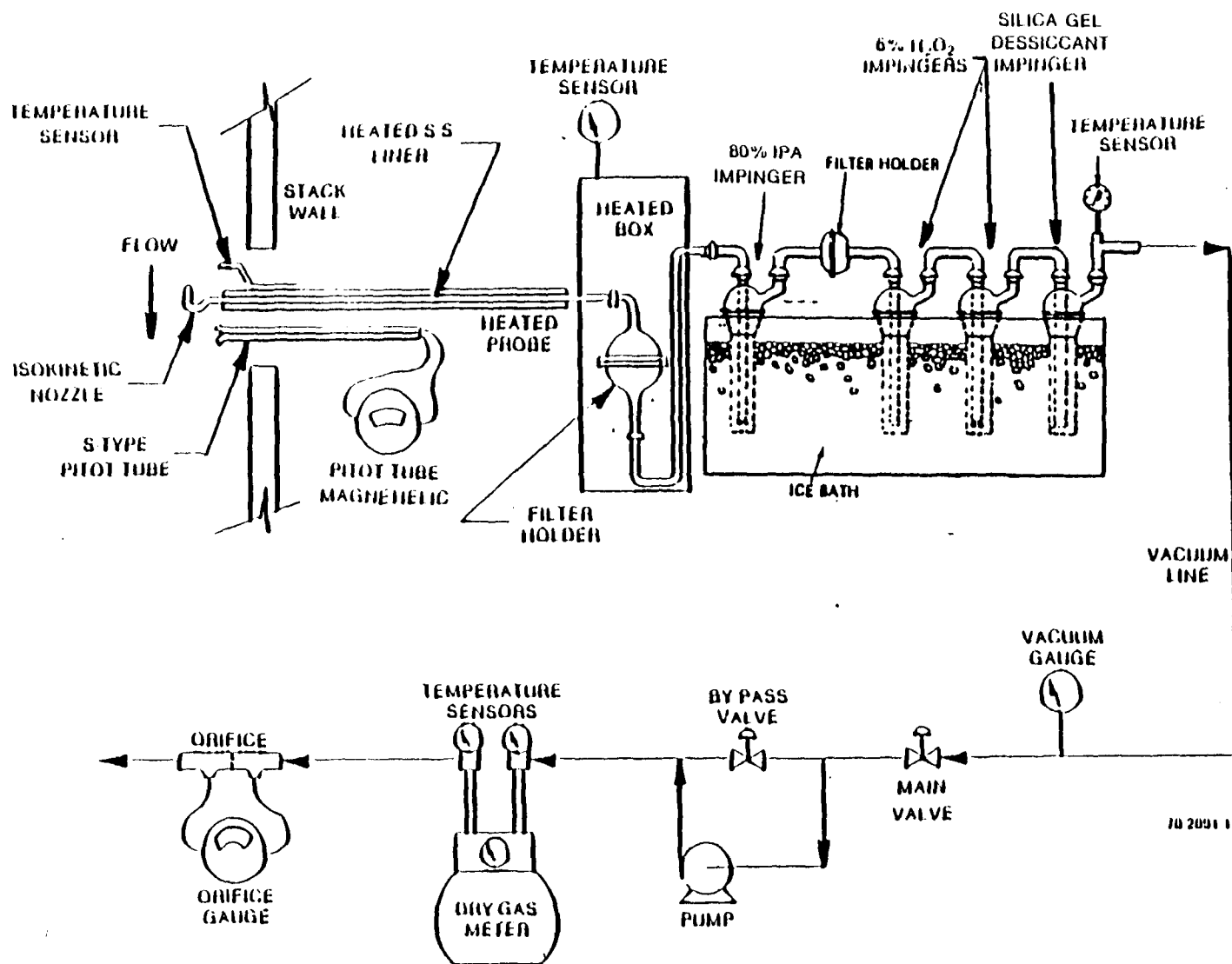


Figure 4-8. A schematic of the combined EPA Method 5, 6, and 8 sampling apparatus

SECTION 5

ANALYTICAL METHODOLOGY

This section deals with the handling, preparation and analysis of all the recovered samples. EPA Reference methods 3, 5, 6, and 8 were used where applicable (see reference in Section 4.2).

For determination of the dry molecular weight of the flue gas, the EPA's Reference method 3 was used. Radian used a Fyrite® apparatus during each test. During mid-run, the flue gas was hand pumped through a pitot line into a sealed container holding either CO₂ or O₂ absorbing solution. The gas was thoroughly mixed with the solution and the CO₂ or O₂ percentile was read off the scale on the container. This procedure was done at least twice. Once both CO₂ and O₂ percentages were established, the balance of the gas was assumed to be composed of nitrogen.

Upon return to Radian's Austin laboratories, final weights were obtained for all filters and the acetone/deionized water wash residues in compliance with EPA Reference Method 5. Filters were desiccated for 24 hours and weighed to a constant weight. Initial and final weighing was performed on a Mettler semi-micro balance. The acetone/deionized water washes were quantitatively transferred to tared glass beakers and taken to dryness. These samples were then desiccated 24 hours and weighed to a constant weight. Acetone and deionized water blanks, 100 mL, were treated in this same manner, and the samples corrected for these blanks.

Using EPA Reference Method 6, the H_2O_2 samples containing the SO_2 were diluted up to 500, 1000, or 2000 mL in volumetric flasks depending on the SO_2 concentration. A 5 mL aliquot was pipetted into a 250 mL Erlenmeyer flask and 20 mL of 100% isopropanol added. Two to four drops of thorin indicator were added and the sample titrated to a pinkish-orange endpoint with .01 N $\text{Ba}(\text{ClO}_4)_2$. The equation in Method 6 for calculation of SO_2 concentration was followed. The $\text{Ba}(\text{ClO}_4)_2$ was standardized daily against 0.01 N H_2SO_4 prepared from a purchased analytical concentrate. Blanks, QA audit samples, and duplicates were titrated every tenth sample.

Samples containing the glass fiber filters in an 80% isopropanol slurry and were treated as above, except dilutions were made with 80% isopropanol. Calculations were carried out as specified in Method 8.

SECTION 6

QUALITY ASSURANCE

The work performed at the Phelps Dodge Hidalgo smelter incorporated a comprehensive quality assurance/quality control (QA/QC) program as an integral part of the overall sampling and analytical effort. The major objective of the QA/QC program was to provide data of known quality with respect to:

- completeness,
- accuracy,
- precision,
- representativeness, and
- comparability.

The quality assurance function was organized to provide independent review and assessment of project activities and their ability to achieve the stated data quality objectives. The QA coordinator for the project had the responsibility of evaluating the adequacy and effectiveness of the QC system and providing assurance that it was, in fact, responsive to the specific needs of the program.

While the system of QA activities was necessarily independent of the technical effort per se, the QC system was an integral part of the daily technical effort. It was designed to provide an overall system for generating data of a specified quality. This section provides an assessment of the QC program and a summary of resulting data quality as determined by the QA audit.

6.1 Source Sampling Audit Results

As part of the quality assurance program for this project a performance and systems audit was performed during the period 13 November to 14 November 1981 while the Morenci sampling effort was under way. Audit activities, results and conclusions are presented below. The same sampling crew and equipment and identical procedures were used at the Hidalgo smelter.

6.1.1 Systems Audit

A systems audit is an on-site qualitative review of various aspects of a total sampling and/or analytical system to assess its overall effectiveness. The systems audit results represent a subjective evaluation of a set of interactive systems with respect to strengths, weaknesses and potential problem areas. The audit was designed to evaluate the following:

- Adherence to accepted procedures in performing reference method source sampling,
- Adequacy of internal quality control procedures,
- Equipment and facilities,
- Qualification and training of personnel,
- Calibration procedures and documentation,
- Sample handling, custody and storage, and
- Data recording, review and handling.

The systems audit checklists, which were presented in Appendix B of the Morenci report, delineate the specific aspects of the sampling/analytical system which are deemed to be especially important in obtaining quality data. The activities which were obtained during the audit included determinations of:

- Velocity and volumetric gas flow rate (EPA Method 2)
- Gas phase molecular weight (EPA Method 3),
- Gas phase moisture (EPA Method 4),
- Particulate concentration (EPA Method 5),
- Gas phase (SO₂) concentration (EPA Method 6), and
- Visible fugitive emissions (EPA Method 9 and proposed Method 22).

Equipment calibration data sheets were also given in Appendix B of the Morenci Report. After the equipment was used at both sites, the equipment was post-calibrated, and those data forms are reproduced in Appendix B of this report.

As indicated on the audit checklists, careful compliance with accepted sampling procedures was observed for all sampling activities. The sampling crew exhibited an obvious familiarity with the equipment and methods used. Internal QC checks such as pre- and post-test leak checks of sampling train, intermediate calculation of isokinetics, replicate Fyrite® analyses, etc., were carefully followed. The facilities and procedures used in sample handling and storage were judged to be quite adequate. All data records were well organized and utilized preformatted data sheets in most instances. All equipment calibration data was complete and similarly well organized. Overall, the systems audit indicated an efficient, well orchestrated sampling effort which was judged to be adequate for achieving the data quality for each of the EPA Methods as shown in Table 6-1.

TABLE 6-1. ATTAINABLE ACCURACY AND PRECISION OF TEST RESULTS BASED
ON THE EPA COLLABORATIVE TESTS OF STATIONARY SOURCE
METHODS**

Parameter	Method	Accuracy (%)	Precision (Standard Deviation) (%)
Volumetric Gas Flow Rate	2	±11	20
Molecular Weight	3	±25	10
Moisture	4	±10	11
Particulate Mass	5	±20	10
SO ₂	6	±20	10
Emissions Opacity	9	±7.5	5
Emissions Visibility*	22	±10	10

*Radian estimate

**Midgett, M. Rodney, Environmental Science and Technology, 11, No. 7,
pp. 655-659.

6.1.2 Performance Audit

A performance audit is a quantitative assessment of the data quality of a sampling and/or analytical system. Both field and laboratory (analytical) operations were addressed in the performance audit for this program. Audit activities included:

- field checks of dry gas meter/control console calibration,
- field check of the laboratory balance (Mettler PC4400),
- field checks of the Fyrite® analyses,
- checks of field calculations,
- check of the data reduction program used for the sampling data reduction, and
- analysis of SO₂ audit samples.

Results of the performance audit supported the results of the systems audit, indicating that the test data quality should be as shown in Table 6-1.

Performance audit results presented below are expressed in terms of relative accuracy. The relative accuracy for each parameter is calculated as:

$$\% A = \frac{(M-T)}{T} \times 100$$

where,

% A = relative accuracy, percent

M = measured value

T = true value of reference standard

100 = factor for conversion to percentage basis

Dry Gas Meter/Control Console

Field checks of the dry gas meters/control consoles were performed using a Kurz Model 543 flow calibrator (Serial No. 769). The Kurz instrument had recently been calibrated by the manufacturer using an NBS traceable mass flow meter (NBS test numbers 213-21/190522). The calibration factor, was determined by averaging triplicate measurements at each of three meter rates (nominally 0.25, 0.50 and 0.75 ACFM).

A second calibration indicated that the dry gas meter correction factors had changed by less than five percent of their original calibration value. Thus, the use of the original calibration factor was appropriate for further data reduction.

Laboratory Balance

The accuracy of the laboratory balance (Mettler PC4400) was checked using a set of NBS traceable Class S weights. Replicate weighings were made on weights ranging from 0.01 g to 100 g. The greatest difference between balance reading and actual weight was observed with the 0.5 g weight. This difference was 0.01 g or 2.0 percent.

Fyrite® Analyses

Ambient air was analyzed during the performance audit using the Fyrite® gas analyzer for carbon dioxide and oxygen. The precision and accuracy for these determinations were within the readability of the analyzers (± 0.5 percent). Based on this data and the systems audit results, the gas composition determinations should be within the precision and accuracy ranges estimated for this method (Table 6-1).

Field Calculations and Computerized Data Reduction

A check of field measurements and calculations used for determining the location of sampling traverse points (EPA Method 1) indicated that the points were correctly located. Radian's computerized Source Sampling Data Reduction Program was used to reduce all velocity, flow rate, molecular weight, particulate mass and SO₂ data. Example data sets for Methods 2, 3, 4, 5 and 6 were submitted for reduction using this program and the results compared to those obtained by hand calculation using the equations and procedure specified in the Reference Methods. The comparison of results indicated excellent agreement between the two procedures with the magnitude of the difference attributable to rounding differences. The results of this comparison are summarized in Table 6-2.

Sulfur Dioxide Determinations

The sulfate content of the impinger solutions resulting from the adsorption of sulfur dioxide were analyzed per EPA Reference Method 6 using the barium perchlorate-thorin titration method. The data quality for these determinations were assessed by submitting blind EPA Stationary Source Quality Assurance SO₂ Reference Standards. These audit standards were analyzed with the impinger samples. The results for these determinations are summarized in Table 6-3. The percent accuracy for these analyses is within the 7.0 percent control limit.

Four of the thirteen Method 5 and 6 tests incorporated a third hydrogen peroxide impinger to document the SO₂ collection efficiency of the impinger train. As shown in Table 6-4, the results from the analyses of these additional impinger solutions indicate the collection efficiency using two impingers was greater than 99 percent.

TABLE 6-2. SUMMARY OF DATA REDUCTION CHECK

Parameter	Data Reduction Program Results	Hand Calculated Results	Accuracy (%)
Velocity (ft/sec)	15.3505	15.3657	-0.04
Volumetric Flow Rate (dscf/min)	24184	24203	-0.08
Molecular Weight (lbs/lb-mole)	28.85	28.85	0.0
Particulate Concentration (gr/dscf)	0.637	0.639	-0.3

TABLE 6-3. SUMMARY OF EPA AUDIT SAMPLE ANALYSES

Sample Number	Measured ng SO ₂ /dscf	Actual ng SO ₂ /dscf	Accuracy (%)	Control Limit
8136	805	762.6	+5.6	±7.0
6065	1317	1334.6	-1.3	±7.0

TABLE 6-4. SUMMARY OF EPA METHOD 5/6 IMPINGER COLLECTION EFFICIENCY RESULTS

Sample Number	MM SO ₂ in Impingers 1 and 2	MM SO ₂ in Impinger 3	Collection Efficiency (%)
EMB-013HMT	99.2	0.8	>99
EMB-015HDH	99.4	0.6	>99
EMB-021HSO	99.9	0.1	>99
EMB-022HSI	99.9	0.1	>99

SECTION 7

CHAIN-OF-CUSTODY

While in the field, all samples were under the care of Michael J. Krall during the periods of November 17 through November 24, 1981, and January 12 through January 15, 1982. Throughout these periods, all samples were processed for transport back to Radian's Austin laboratories within 24 hours after collection. This involved placing filters in petri dishes and sealing them with tape. Probe washes and SO₂ samples were kept in polyethylene bottles, their lids taped shut, and the initial volume noted. All samples were logged and stored in the Radian mobile lab on site.

On November 24, the first set of samples was transported by automobile from Deming, New Mexico, to El Paso, Texas. The samples were placed in the custody of Continental Airlines aboard Flight No. 75. Upon arrival in San Antonio, Michael J. Krall transported the samples by automobile to Radian's Austin laboratories where they remained overnight. Final processing of the samples was completed on December 7, and the samples were placed in storage.

The second set of samples was taken from January 12-15, 1982 and processed in the identical manner as the first set. On January 15, Michael J. Krall turned over custody of the samples to Robert V. Collins who transported the samples back to Radian's Austin laboratories via the mobile laboratory where they remained over the weekend. On January 18, Robert V. Collins turned custody back over to Michael J. Krall who processed the samples through their final stage on January 20. The samples were then placed in storage. At no time during the process of collection, storage on

site, transport, or final analysis was there any evidence that these samples were tampered with.

However, one set of samples taken between December 1-4 from the ESCF slag skimming and scrubber operations was lost by Radian at their Austin laboratories. This loss necessitated another trip to Hidalgo during the period January 12-15 to acquire similar samples from the ESCF slag skimming and scrubber operations. Although these samples were successfully returned to Radian's Austin laboratories, the scrubber samples were later judged to be non-representative due to abnormal operation of the ESCF during the scrubber sampling.

SECTION 8

RESULTS OF PHYSICAL MEASUREMENTS

A summary of particulate and sulfur dioxide sampling results of the matte tapping and slag skimming are presented in Tables 8-1, 8-2, 8-3 and 8-4. The summary of particulate, sulfur dioxide, and sulfuric acid mist sampling results from the ESCF scrubber inlet and outlet are presented in Tables 8-5 and 8-6.

The matte tapping and slag skimming particulate and sulfur dioxide results from the computerized data reduction are in units of mass of pollutants per hour (of sampling). These results were converted to mass of pollutants per ton of matte or slag produced (during sampling) using the following equation:

$$\frac{\text{Mass of Pollutant}}{\text{Ton of Production}} = \frac{\text{PMR} \times \theta}{(60 \text{ min/hr}) \sum_{i=1}^n M_i T_i L}$$

where: PMR, in pounds per hour, is the pollutant mass rate of particulate or sulfur dioxide as calculated through the computerized data reduction.

θ , in minutes, is the sampling time.

TABLE 8-1. RESULTS OF SAMPLING CONDUCTED DURING MATTE TAPPING OPERATIONS
 AT THE FLASH FURNACE LAUNDER (WITHOUT LANCING).

Run	EMB-009HMT	EMB-011HMT	EMB-013HMT	Average
Date	11/17-18/81	11/18/81	11/18/81	—
Time	1123-0859	1045-1817	1914-2330	—
Lbs Particulate/hr	51	48	35	45
Lbs Particulate/Ton	0.25	0.23	0.19	0.23
Lbs SO ₂ /hr	320	360	270	320
Lbs SO ₂ /Ton	1.6	1.7	1.5	1.6
Matte Production, Tons	200	208	183	197
Episodes	9	9	8	—
Gas Flow, DSCFM	26,000	32,400	29,600	—

TABLE 8-2. RESULTS OF SAMPLING CONDUCTED DURING MATTE TAPPING OPERATIONS AT THE FLASH FURNACE DOGHOUSE HOODING (WITHOUT LANCING).

Run	EMB-010HDH	EMB-012HDH	EMB-015HDH	Average
Date	11/17-18/81	11/18/81	11/18/81	--
Time	1123-0900	1045-1816	1914-2330	--
Lbs Particulate/hr	6.2	9.9	3.1	6.4
Lbs Particulate/Ton	0.031	0.048	0.017	0.032
Lbs SO ₂ /hr	16	37	33	29
Lbs SO ₂ /Ton	0.081	0.18	0.18	0.15
Matte Production, Tons	200	208	183	197
Episodes	9	9	8	--
Gas Flow, DSCFM	10,500	10,900	10,600	--

TABLE 8-3. RESULTS OF SAMLING CONDUCTED DURING MATTE TAPPING OPERATIONS
AT THE FLASH FURNACE DOGHOUSE HOODING (INCLUDING LANCING).

Run	EMB-023HDHL
Date	11/24/81
Time	0901-1221
Lbs Particulate/hr	8.6
Lbs Particulate/Ton	0.060
Lbs SO ₂ /hr	24
Lbs SO ₂ /Ton	0.16
Matte Production, Tons	144
Episodes	7
Gas Flow, DSCFM	10,700

TABLE 8-4. RESULTS OF SAMPLING CONDUCTED DURING SLAG SKIMMING OPERATIONS
OF THE ELECTRIC SLAG CLEANING FURNACE

Run	EMB-054HSS	EMB-055HSS	EMB-056HSS	Average
Date	1/14/82	1/14/82	1/14-15/82	—
Time	1316-1433	1509-1944	1957-0750	—
Lbs Particulate/hr	11	10	12	11
Lbs Particulate/Ton	0.075	0.073	0.069	0.072
Lbs SO ₂ /hr	120	150	120	130
Lbs SO ₂ /Ton	0.86	1.1	0.68	0.88
Slag Production, Tons	142	140	180	154
Episodes	3	4	6	—
Gas Flow, DSCFM	28,800	29,600	30,000	—

TABLE 8-5. RESULTS OF SAMPLING AT THE ELECTRIC SLAG CLEANING FURNACE SCRUBBER INLET

<u>Run</u>	<u>EMB-016HSI</u>	<u>EMB-020HSI</u>	<u>EMB-022HSI</u>	<u>EMB-050HSI8†</u>	<u>EMB-052HSI8†</u>	<u>Average</u>
Date	11/20/81	11/22/81	11/23/81	1/12/82	1/12/82	--
Time	1430-1603	0910-1141	0940-1144	0956-1300	1604-1759	--
Lbs/Particulate/hr	100	110	120	100	83	100
Lbs/SO ₂ /Hr	200	150	280	170	110	180
Lbs H ₂ SO ₄ /hr	*	*	*	0.06	0.00	0.03
Gas Flow, DSCFM	5700	4900	4600	5000	5900	--

*Did not sample for sulfuric acid mist.

†Results are to be considered only appropriately representative of the scrubber conditions due to abnormal operation of the ESCF during the sampling period.

TABLE 8-6. RESULTS OF SAMPLING AT THE ELECTRIC SLAG CLEANING FURNACE SCRUBBER OUTLET

<u>Run</u>	<u>EMB-017HSO</u>	<u>EMB-019HSO</u>	<u>EMB-021HSO</u>	<u>EMB-051HSO8†</u>	<u>EMB-053HSO8†</u>	<u>Average</u>
Date	11/20/81	11/22/81	11/23/81	1/12/82	1/12/82	--
Time	1430-1603	0910-1141	0940-1144	0905-1310	1605-1800	--
Lbs/Particulate/hr	1.3	0.98	1.4	19	1.9	4.9
Lbs SO ₂ /hr	160	63	17	70	31	99
Lbs H ₂ SO ₄ /hHr	*	*	*	0.10	0.04	0.07
Gas Flow, DSCFM	8900	7400	6800	5300	5900	--

*Did not sample for sulfuric acid mist.

†Results are to be considered only approximately representative of the scrubber conditions due to abnormal operation of the ESCF during the sampling period.

n is the number of trapping or skimming operations which were sampled. (Note: more than one operation may be in progress during sampling.)

T_i is the fraction of the tapping or skimming time that the i th tap or skim was in use during the observing period.

M_i is the fraction of the normal ladle which was removed from the furnace during the observed i th tap or skim.

L , in tons, is the weight of a normal ladle of matte or slag as specified by the plant personnel.

The T_i , M_i , and L terms are presented in Tables 8-7, 8-8, 8-9, and 8-10. These were derived from correlating the start and stop times on the data sheets with the process observations. The test results are expressed in units of mass of pollutants per unit sampling time (not clock time).

Examination of the data in Tables 8-1, 8-2, 8-3, and 8-4 shows that the emission rates of both particulate matter and SO_2 per ton of matte or slag vary some, but no larger consistent differences or trends are apparent. It was the observation of the samplers that the emission rate was strongly dependent upon the time and surface area of exposed molten material. Thus, a faster flow would lead to fewer emissions, but since sampling was stopped when the flow stopped, emissions from the open surface in the ladle, waiting for transfer, which may be significant, were not addressed by this testing protocol.

It should be noted that the particulate emission factor for the single matte tap run that included lancing was significantly higher than the previous runs at the same sampling location. This lends credence to the notion that perhaps lancing will increase the particulate rate and should be dealt with as a contributing source of pollution. The limitation, of course, is that no concrete conclusion can be drawn from only one data point.

TABLE 8-7. SAMPLING SEQUENCING--PHELPS DODGE HIDALGO, NM COPPER SMELTER
 MATTE TAPPING--FLASH FURNACE LAUNDER

Date	Episode	EMB-009HMT			EMB-011HMT			EMB-013HMT		
		T _i	M _i	L	T _i	M _i	L	T _i	M _i	L
11/17/81	1123-1132	1	1	25						
	1210-1217	1	1	25						
	1303-1309	1	1	25						
	1313-1318	1	1	25						
	1326-1329	.5	1	25						
	1528-1539	1	1	25						
	1546-1551	1	1	25						
	1612-1621	1	1	25						
11/18/81	0854-0869	.5	1	25						
	1045-1052				1	1	25			
	1058-1103				1	1	25			
	1109-1116				1	1	25			
	1217-1224				1	1	25			
	1301-1305				.3	1	25			
	1348-1356				1	1	25			
	1739-1743				1	1	25			
	1753-1802				1	1	25			
	1808-1817				1	1	25			
	1914-1920							1	1	25
	1924-1931							1	1	25
	1956-2006							1	1	25
	2008-2015							.9	1	25
	2029-2015							1	1	25
	2221-2228							1	1	25
	2236-2247							1	1	25
	2327-2330							.4	1	25

T_i is the fraction of the total duration of the ith tap or skim which was sampled.
 M_i is the fraction of the normal ladle which was removed from the furnace during the observed ith tap or skim.
 L, in tons, is the weight of a normal ladle of matte or slag as specified by the plant personnel.

TABLE 8-8. SAMPLING SEQUENCING--PHELPS DODGE HIDALGO, NM COPPER SMELTER
 MATTE TAPPING--FLASH FURNACE DOGHOUSE HOODING

Date	Episode	EMB-010HDE			EMB-012HDE			EMB-015HDE		
		T _i	M _i	L	T _i	M _i	L	T _i	M _i	L
11/17/81	1123-1132	1	1	25						
	1209-1217	1	1	25						
	1303-1309	1	1	25						
	1313-1318	1	1	25						
	1326-1328	.5	1	25						
	1527-1539	1	1	25						
	1547-1551	1	1	25						
	1612-1621	1	1	25						
11/18/81	0853-0900	.5	1	25						
	1045-1051				1	1	25			
	1057-1103				1	1	25			
	1107-1115				1	1	25			
	1216-1223				1	1	25			
	1258-1303				.3	1	25			
	1347-1356				1	1	25			
	1738-1743				1	1	25			
	1752-1801				1	1	25			
	1807-1816				1	1	25			
	1914-1920							1	1	25
	1923-1930							1	1	25
	1955-2005							1	1	25
	2008-2015							.9	1	25
	2028-2037							1	1	25
	2220-2228							1	1	25
	2236-2247							1	1	25
	2326-2330							.4	1	25

T_i is the fraction of the total duration of the ith tap or skim which was sampled.

M_i is the fraction of the normal ladle which was removed from the furnace during the observed ith tap or skim.

L, in tons, is the weight of a normal ladle of matte or slag as specified by the plant personnel.

TABLE 8-9. SAMPLING SEQUENCING--PHELPS DODGE HIDALGO, NM COPPER SMELTER
 MATTE TAPPING--FLASH FURNACE DOGHOUSE HOODING WITH LANCING

Date	Episode	EMB-0123HDHLH		
		T_i	M_i	L
11/24/81	0901-0912	.7	1	25
		.5	1	25
	0922-0936	1	1	25
	1045-1049	.4	1	25
	1123-1134	1	1	25
	1152-1207	1	1	25
		1	1	25
	1217-1221	.2	1	25

T_i is the fraction of the total duration of the i th tap or skim which was sampled.

M_i is the fraction of the normal ladle which was removed from the furnace during the observed i th tap or skim.

L, in tons, is the weight of a normal ladle of matte or slag as specified by the plant personnel.

TABLE 8-10. SAMPLING SEQUENCING--PHELPS DODGE HIDALGO, NM COPPER SMELTER
 SLAG SKIMMING--ELECTRIC SLAG CLEANING FURNACE

Date	Episode	EMB-054HSS			EMB-055HSS			EMB-056HSS		
		T _i	M _i	L	T _i	M _i	L	T _i	M _i	L
1/14/82	1316-1346	1	.8	40						
		1	.8	40						
		1	.8	40						
	1349-1407	1	.9	40						
	1422-1433	.6	.5	40						
	5109-1528				1	.8	40			
	1530-1541				.6	1	40			
	1543-1548				.3	1	40			
	1918-1944				1	1	40			
					.8	1	40			
	1957-2007							.8	.9	40
	2007-2019							1	.9	40
	2023-2032							.7	.9	40
	2034-2035							.1	.9	40
	2038-2052							1	1	40
								.9	.8	40
								.5	1	40
1/15/82	0735-0750									

T_i is the fraction of the total duration of the ith tap or skim which was sampled.

M_i is the fraction of the normal ladle which was removed from the furnace during the observed ith tap or skim.

L, in tons, is the weight of a normal ladle of matte or slag as specified by the plant personnel.

Using the averages of the data from the scrubber inlet and outlet (Tables 8-5 and 8-6), a scrubber efficiency of approximately 95% particulate removal and 45% SO₂ removal may be calculated. There appeared to be a small increase in sulfuric acid mist across the scrubber.

8.1 Results of Visible Emissions

Two types of visible emission testing were performed: Method 9 which yields results that are a time weighted opacity and Method 22 which indicates the fraction of time visible emissions were present. A lower opacity reported for Method 9 indicates a greater capture efficiency for the hooding system being evaluated, if all other factors are constant.

Six process points were visually evaluated at the Hidalgo smelter. The processes evaluated were:

- flash furnace matte tapping (lancing emissions not included),
- flash furnace matte tapping (lancing emissions included),
- scrubber stack (11/20 - 11/23 operating conditons),
- scrubber stack (12/3 operating conditions),
- electric slag cleaning furnace slag skimming (lancing emissions included), and
- electric slag cleaning furnace matte tapping (lancing emissions included).

These processes were evaluated using the techniques of Methods 9 and 22, where applicable. This section presents the results of those observations.

8.1.1 Flash Furnace Matte Tapping (Lancing Emissions Not Included)

Method 9. The launder No. 2 hood system was observed most often. Based on approximately one hour of observations, the average opacity of fugitive emissions escaping capture by the launder No. 2 hood system was 20 percent. The fugitive emissions around the hooding systems for both launder No. 1 and No.3 also showed average opacities of 20 percent. Fugitive emissions around the hooding systems for launders No. 4 and No. 5 were observed to have average opacities of 40 percent and 30 percent, respectively. Table 8-11 summarizes the Method 9 data.

TABLE 8-11. FLASH FURNACE METHOD 9 OBSERVATIONS
(Lancing emissions not included.)

Process Observed	Launder Number	Number of Events Observed	Average Opacity (%)	Total Observation Time (min/sec)
Matte tapping	1	3	20	32:00
Matte tapping	2	8	20	55:00
Matte tapping	3	1	20	21:00
Matte tapping	4	6	40	30:00
Matte tapping	5	1	30	4:00

Method 22. During matte tapping, fugitive emissions were observed escaping continually from each launder hood system observed. The results of these observations are shown in Table 8-12.

TABLE 8-12. METHOD 22 OBSERVATIONS DURING FLASH FURNACE MATTE TAPPING

<u>Percent Observed</u>	<u>Launder Number</u>	<u>Number of Events Observed</u>	<u>Percent Time Emissions Observed (%)</u>	<u>Total Observation Time (min/sec)</u>
Matte tapping	1	1	100	9:36
Matte tapping	2	1	100	7:27
Matte tapping	3	1	100	11:15
Matte tapping	5	2	100	12:08

8.1.2 Flash Furnace Matte Tapping (Lancing Emissions Included)

Method 9. Based on approximately 20 minutes of observations, launder No. 5 hood system fugitive emissions had an average opacity of 40 percent. Fugitive emissions around hooding systems for launders No. 1, No. 3, and No. 4 had average opacities of 30, 35, and 45 percent respectively. Average opacities from matte tapping, including lancing emissions, are shown in Table 8-13. It may be noted that the lancing operation increased the average opacity about 10% (compare Tables 8-11 and 8-13).

TABLE 8-13. METHOD 9 OBSERVATIONS DURING FLASH FURNACE MATTE TAPPING
(Including lancing emissions.)

<u>Process Observed</u>	<u>Launder Number</u>	<u>Number of Events Observed</u>	<u>Average Opacity (%)</u>	<u>Total Observation Time (min/sec)</u>
Matte tapping	1	1	30	13:00
Matte tapping	3	1	35	10:00
Matte tapping	4	1	45	9:00
Matte tapping	5	2	40	23:00

Method 22. A total of 29 minutes of observations were made on hooding systems for launder No. 2, No. 3, and No. 4 using the techniques of Method 22. Each hooding system was observed constantly during the test period. Table 8-14 lists the observation time for each launder hooding system. During the matte tapping, both with and without lancing, some fugitive emissions were always observed.

TABLE 8-14. METHOD 22 OBSERVATIONS DURING FLASH FURNACE MATTE TAPPING
(Lancing emissions included.)

Process Observed	Launder Number	Number of Events Observed	Percent Time Emissions Observed (%)	Total Observation Time (min/sec)
Matte tapping	2	1	100	7:42
Matte tapping	3	1	100	10:20
Matte tapping	4	1	100	11:05

8.1.3 Scrubber Stack

The scrubber stack is not a source of fugitive emissions, therefore, no Method 22 observations were performed. Method 9 observations were performed for two sets of scrubber operating conditions.

Based on approximately 6.5 hours of observations for the November scrubber operating conditions (11/20-11/23), the average scrubber opacity was less than five percent. For the December scrubber operating conditions (12/3), approximately two hours of observations were made. The average opacity was less than five percent.

8.1.4 Electric Slag Cleaning Furnace Slag Skimming (Lancing Included)

Method 9. Approximately 1.5 hours of opacity observations were made for launders No. 1 and No. 2. The average opacity of fugitive emissions escaping capture by the launder No. 1 hooding system was 40 percent. For launder No. 2 the average opacity was 35 percent.

Lancing emissions contributing to opacity were included in these observations. However, the duration of lancing emissions was approximately three minutes per skim. Two skims were observed for approximately 1.5 hours. Therefore, the inclusion of lancing emissions did not significantly effect the reported average opacity of 40 percent.

Method 22. Slag skimming launders No. 1 and No. 2 were observed for a total of 108 minutes. Fugitive emissions escaped capture by the hooding systems at launder No. 1 and No. 2, 99 percent and 81 percent of the time, respectively.

Electric Slag Cleaning Furnace Matte Tapping

Source sampling of the off gases from this process was not performed. Only visual observations were made.

Method 9. Based on 24 minutes of observation of launder No. 1, the fugitive emissions escaping capture by the hooding system had an average opacity of 45 percent.

Method 22. Launder No. 1 was observed for approximately 11 minutes. During this time, fugitive emissions were observed escaping 82 percent of the time.