APPENDIX A-I
(*Appendix I to Exhibit A*)

Surrogate Parameter Emission Monitoring
Development and Implementation

Asarco Incorporated
East Helena, Montana

The purpose of this Appendix A-I (to Exhibit A entitled "EMISSION LIMITATIONS AND CONDITIONS - Asarco Incorporated) is to identify the surrogate parameters that may be used to calculate Surrogate Hourly Emission Rates for the Blast Furnace Stack and the Sinter Plant Stack for those hours when CEMS data is unavailable during Operating Hours, to outline how the surrogate parameters are to be monitored, and to describe the relationship between the surrogate parameters and emission levels. Asarco has identified surrogate parameters to the department in a letter dated January 24, 1994 (received February 2, 1994).

Emission data provided by the operation of a continuous emission monitoring system ("CEMS") is the primary basis for monitoring and determining compliance with emission limits for the Blast Furnace Stack and the Sinter Plant Stack at the Asarco primary lead smelter in East Helena, Montana. As provided in Exhibit A, Surrogate Hourly Emission Rates will be substituted for CEMS-Derived Hourly Emissions Rates when less than 20 CEMS-Derived Hourly Emission Rates are available in a Calendar Day. However, Surrogate Hourly Emission Rates shall not be used to satisfy Asarco's Quarterly Data Recovery Rate requirements.

1) Use of Surrogate Emission Rates to Determine Compliance with Daily Emission Limits

When, for a Calendar Day, less than 20 hours of CEMS-Derived Hourly Emission Rates are available for the Sinter Plant Stack or Blast Furnace Stack, or both, Surrogate Hourly Emission Rates, determined in accordance with surrogate equations 1 and 2 of this Appendix, shall be substituted for all Operating Hours when CEMS-Derived Hourly Emission Rates are unavailable, for the purpose of calculating Daily Emissions and determining compliance with the emission limitations in Exhibit A, PART I, Section 3.

2) Surrogate Equations

When required, and for all Operating Hours when CEMS-Derived Hourly Emission Rates are unavailable, a Surrogate Hourly Emission Rate shall be determined by the use of the following equations:

Sinter Plant Stack Surrogate Hourly Emission Rate

(Equation 1 of A-I)

$$\text{Hourly Emission Rate (Tons } SO_2\text{/Hour)} = \frac{\text{Sulfur In New Material Feed to Sinter Plant (Tons Sulfur/Day)} \cdot (0.242) + 11.542}{\text{Total Operating Hours in Calendar Day}}$$

Blast Furnace Stack Surrogate Hourly Emission Rate

(Equation 2 of A-I)

$$\text{Hourly Emission Rate (Tons } SO_2\text{/Hour)} = \frac{\text{Sulfur In Sinter Charged to Blast Furnace (Tons Sulfur/Day)} \cdot (0.643) + 3.837}{\text{Total Operating Hours in Calendar Day}}$$

The department has reviewed the data submitted by Asarco to verify equations 1 and 2 above. Equations 1 and 2 above reflect a 95% Confidence, using the Student's 1-tailed T-test, that the *actual* emissions of the source will be less than or equal to the values determined by the equations.

3) Correlation Between Actual Emissions and Surrogate Emission Values

The correlation coefficient for the Sinter Plant surrogate parameter (sulfur in the new material feed to the Sinter Plant) is 0.696. The correlation coefficient for the Blast Furnace surrogate parameter (sulfur in the sinter charge to the Blast Furnace) is 0.573. Although these correlations may be less than optimal, the use of an equation reflecting a 95% confidence level provides a conservative measure of compliance with emission limits. Asarco shall continue to gather data regarding SO_2 emissions, sulfur in new material feed to the Sinter Plant, and sulfur in sinter charged to the Blast Furnace.

The department and Asarco agree that the continuing validity and accuracy of the current surrogate equations for the Blast Furnace and Sinter Plant Stacks must be reviewed after additional operational data has been acquired. Not later than September 1, 1995, Asarco shall provide to the department for its review a report that addresses the continuing validity and accuracy of the current surrogate equations, possible improvements that could be made to the current equations, and the availability of other parameters that might provide a better correlation. If requested by the department, Asarco

shall make available all underlying data and analyses used in preparing this report.

4) Surrogate Parameter Monitoring Requirements

A) Sulfur Content Determination

Sampling

Asarco shall sample the new material feed to the Sinter Plant, and the sinter charged to Blast Furnace at least once every 8 hours (once per shift is acceptable) for each Calendar Day when the respective processes are in operation.

Analysis

Asarco is not required to immediately analyze (perform a sulfur content determination) all samples taken, but may choose to archive the samples for future analysis. When the calculation of a Surrogate Hourly Emission Rate is required pursuant to Exhibit A and this Appendix A-I, Asarco shall analyze the appropriate archived samples. Asarco shall analyze the samples for each Calendar Day by taking a composite of the samples and conducting one analysis, or analyzing each sample separately and taking the mean of the analyses. Such analysis shall be conducted in a manner that is consistent with the QA/QC Plan and SOP adopted pursuant to this Appendix.

B) Process Rate Determination

Asarco shall monitor and record the process rates (feed rates on a Calendar Day basis) for the new material feed to the Sinter Plant and the sinter charged to the Blast Furnace. Such process rate determination shall be conducted in a manner that is consistent with the QA/QC Plan and SOP adopted pursuant to this Appendix.

5) Surrogate Emission Rate Reporting Requirements

Within 7 days after the specific Calendar Day for which Surrogate Hourly Emission Rates are required to determine Daily Emissions, Asarco shall determine the Surrogate Hourly Emission Rates for all Operating Hours when CEMS-Derived Hourly Emission Rates are unavailable. In the quarterly reports submitted to the department pursuant to Exhibit A, PART I, Section 7, subsection (B), Asarco shall include the following information:

(A) sulfur content of sample(s) used to determine the Surrogate Hourly Emission Rate(s); and

(B) process rate(s) used to calculate Surrogate Hourly Emission Rate(s).

6) Quality Assurance/Quality Control & Standard Operating Procedures

Asarco shall develop, maintain, and utilize a general Quality Assurance/Quality Control Plan and Standard Operating Procedure (QA/QC Plan and SOP) for monitoring process rates and sulfur content of material used to determine Surrogate Hourly Emission Rates. The QA/QC Plan and SOP, and any modifications thereto, are subject to review and approval by the department, as described below.

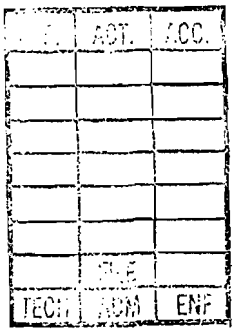
(1) Asarco shall submit the QA/QC Plan and SOP for the current surrogate parameters to the department for review prior to implementation. Any modifications to the QA/QC Plan and SOP shall be submitted to the department within 60 days after implementation. The department shall approve, require revision, or disapprove the QA/QC Plan and SOP, or any modifications thereto, within 90 days after submittal by Asarco.

(2) Asarco shall implement the QA/QC Plan and SOP for the current surrogate parameters no later than July 1, 1994, and for any modification when the modification is installed or implemented. Asarco shall continue to implement the QA/QC Plan and SOP or any modification until the receipt of a written notice of revision or disapproval from the department. Pending the department's action on any submitted QA/QC Plan and SOP or modification, Surrogate Hourly Emission Rates based upon parameters determined in accordance with the submitted QA/QC Plan and SOP or modification will be considered valid.

(3) Upon receipt of a written notice of revision or disapproval from the department, Asarco may continue to implement the QA/QC Plan and SOP or any modification, but shall seek to correct any identified deficiencies and obtain department approval of a revised or new QA/QC Plan and SOP within 30 days. During this 30-day period, Surrogate Hourly Emission Rates based upon parameters determined in accordance with the submitted QA/QC Plan and SOP or modification will be considered valid. Surrogate Hourly Emission Rates determined from samples taken after this 30-day period shall not be considered valid unless they are determined in accordance with an approved QA/QC Plan and SOP.

APPENDIX A-1

ASARCO



January 28, 1994

Mr. Jack Dartman
Department of Health and
Environmental Sciences
Air Quality Bureau
Cogswell Building
Helena, Montana 59620

Re: Asarco East Helena Plant: SO_2 SIP Surrogate Data Information

Dear Jack:

In accordance with your telephone discussion with Jon Nickel; on January 21, 1994, I write to provide you with a brief explanation of how the proposed surrogate measurements were developed, and the specific equation that defines the surrogate for CEM data and provide a 95% confidence level for the sinter stack and the blast furnace stack emissions.

SINTER PLANT

We began by statistically testing each of the following sinter plant parameters for correlation with sinter stack SO_2 emissions:

1. Total sulfur in new material to the sinter plant (tons/day).
2. Total sulfur reporting to the acid plant (tons/day).
3. Total sulfur left in the sinter (tons/day).
4. Estimated sulfur available to the sinter plant stack by sulfur balance (Item 1 minus Item 2 minus Item 3 above) (tons/day).
5. Total sulfur returns (tons/day).
6. Total sulfur in the sinter plant feed (new + returns) (tons/day).
7. Sulfate in sinter plant feed (tons/day).

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8. Sulfide in sinter plant feed (tons/Day).

Based on this analysis, we determined that the parameter exhibiting the best correlation with sinter stack SO_2 emissions is the total sulfur in new material introduced to the sinter plant. The total sulfur in new material is determined by multiplying each day the percent sulfur in the new material by the total tons of new material feed. Percent sulfur is determined by daily analysis at Asarco's laboratory of a composite sample of new material. Tons of new material feed are monitored daily by means of scale weights and transfer belt speed, both of which are tracked by computer and monitored by the sinter plant operator.

Based on the available data, Asarco then derived a linear regression equation and a 95% tolerance equation to be used to create surrogate data for the CEM data. The 95% tolerance limit for the sinter plant is expressed as follows:

$$Z = 1.660 + .242\ W + 1.645\ \sqrt{.00035\ W^2 - .0479\ W + 37.927}$$

Where:

W is the total sulfur in tons per day in new material feed to the sinter plant.

Z is the 95% tolerance limit for sulfur dioxide emissions in tons per day in the sinter plant stack.

For actual operating application, this can be simplified to:

$$Z = 11.542 + .242\ W$$

The database on which the correlations and calculations are based was previously provided to Mr. Bruce Bradshaw, and is included in Attachment A.

BLAST FURNACE STACK

We began with an initial assessment of parameters which might possibly correlate with blast furnace stack SO_2 emissions, and identified the following:

1. Total sulfur in sinter material fed to the blast furnace.

2. Gasses from the dross plant.

3. Direct feed material.

4. Coke.

5. Scrap iron.

It was determined that parameters 2 through 5 either have such low sulfur content or such insignificant impact on SO_2 emissions that they were unsatisfactory candidates. We examined the statistical correlation between total sulfur in the sinter and SO_2 emissions from the blast furnace stack, the result of which has been provided to you.

Total sulfur in the sinter is determined by multiplying each day the percentage sulfur content of the sinter by the tons of sinter introduced to the blast furnace. Sulfur content is measured daily by taking three composite samples from the No. 4 pan in the sinter plant and analyzing it in Asarco's laboratory. The tons of sinter is monitored closely by the feed floor operator, who reports this data to the blast furnace supervisor.

Based on available data Asarco then derived a linear regression equation and a 95% tolerance equation to be used to create surrogate data for the CEM data. The 95% tolerance limit for the blast furnace stack is expressed as follows:

$$Y = .234 + .643\,X + 1.645\,\sqrt{.00426\,X^2 - .08744\,X + 5.269}$$

Where:

X is the total in tons per day in sinter charged to the blast furnace.

Y is the 95% tolerance limit for sulfur dioxide in tons per day in the blast furnace stack.

For actual operating application, this could be simplified to:

$$Y = 3.837 + .643\,X$$

The database on which the correlation and calculations are based was previously provided to Mr. Bruce Bradshaw, and is also included in Attachment A.

If you have any questions regarding this information, please do not hesitate to contact me.

Sincerely,

Terry D. Coble
Environmental Engineer

cc: RALitle
RCMarcus
JCNickel
RWatson
LEVolmert

Attachment "A"

SINTER PLANT DATA

	Measured SO2 in stack	Tons sulphur to D&L
05/02/93	17.31	33.3
05/03/93	18.20	45.5
05/04/93	13.15	39.3
05/05/93	9.66	31.7
05/06/93	12.71	34.5
05/09/93	11.33	42.8
05/10/93	11.53	34.3
05/11/93	11.00	49.2
05/12/93	13.51	38.2
05/13/93	7.98	48.2
05/14/93	9.05	35.9
05/17/93	10.01	44.5
05/18/93	11.16	43.4
05/19/93	6.30	28.0
05/20/93	10.45	38.3
05/21/93	12.83	49.7
05/23/93	13.61	41.4
05/24/93	15.58	46.7
'25/93	17.04	54.9
26/93	12.88	39.8
05/27/93	26.35	46.6
05/29/93	17.77	47.4
05/31/93	10.58	37.4
06/01/93	11.13	61.4
06/02/93	11.43	38.4
06/03/93	13.83	74.4
06/04/93	10.83	75.9
06/06/93	25.83	79.0
06/07/93	24.34	88.4
06/08/93	23.98	95.9
06/09/93	8.73	36.7
06/10/93	23.16	94.6
06/11/93	28.17	73.7
06/13/93	26.55	92.6
06/14/93	21.35	68.5
06/15/93	15.32	59.0
06/16/93	31.32	93.2
06/17/93	16.34	57.8
06/18/93	14.81	68.7
06/21/93	10.38	66.7
'22/93	12.94	59.7
/23/93	12.75	91.0
06/24/93	15.08	72.6

BLAST FURNACE DATA

	Sulfur in charge	Measured SO2 in stack
5/1	0	0
5/2	10.98	5.44
5/3	14.4	8.96
5/4	14.49	9.21
5/5	11.18	5.34
5/6	10.8	4.97
5/7	12.42	5.04
5/8	11.97	4.31
5/9	11.81	5.42
5/10	6	2.87
5/11	7.65	5.27
5/12	8.51	3.9
5/13	9.12	5.11
5/14	11.75	7.24
5/15	11.07	5.18
5/16	10.26	6.46
5/17	9.96	4.88
5/18	11.28	4.86
5/19	10.84	3.33
5/20	9.45	3.15
5/21	7.65	4.08
5/22	12.83	5.07
5/23	11.97	7.32
5/24	9.95	7.88
5/25	10.33	6.42
5/26	10.08	5.13
5/27	9.84	5.67
5/28	9.34	6.84
5/29	8.78	6.39
5/30	11.83	9.45
5/31	10.55	9.01
6/1	7.67	7.28
6/2	9.69	6.74
6/3	9.11	9.42
6/4	9.24	9.9
6/5	9.36	9.01
6/6	10.08	9.4
6/7	10.53	10.77
6/8	10.67	11.14
6/9	9.86	10.27
6/10	12.15	9.41
6/11	9.95	9.02
6/12	9.24	8.28

Attachment "A"

SINTER PLANT DATA

	Measured SO2 in stack	Tons sulphur to D&L
06/25/93	12.59	58.3
06/27/93	9.31	69.0
06/28/93	7.86	50.7
06/29/93	9.51	59.5
06/30/93	6.17	42.2
07/01/93	12.63	56.7
07/05/93	11.09	62.5
07/06/93	11.98	73.8
07/07/93	11.32	44.6
07/09/93	12.37	87.0
07/11/93	12.27	62.7
07/12/93	10.81	65.4
07/13/93	12.01	82.3
07/14/93	9.13	45.6
07/18/93	16.80	68.7
07/19/93	16.01	66.0
07/20/93	9.86	67.9
07/21/93	9.84	45.5
[illegible]/22/93	17.67	68.9
[illegible]3/93	20.22	63.7
07/25/93	24.69	64.0
07/26/93	24.33	83.9
07/27/93	27.09	74.2
07/28/93	19.64	69.5
07/29/93	21.81	95.6
07/30/93	24.50	84.9
08/01/93	20.07	76.1
08/02/93	19.73	77.8
08/03/93	16.46	72.7
08/04/93	8.72	42.3
08/05/93	11.70	57.4
08/06/93	12.77	86.2
08/08/93	20.33	68.9
08/09/93	38.59	68.9
08/18/93	13.75	42.3
08/19/93	17.78	19.7
08/23/93	11.27	65.6
08/24/93	13.63	70.0
08/26/93	15.80	72.0
08/27/93	14.15	62.0
[illegible]29/93	10.78	58.1
[illegible]30/93	12.14	68.2
08/31/93	15.34	69.5

BLAST FURNACE DATA

	Sulfur in charge	Measured SO2 in stack
6/13	8.52	7.52
6/14	9.31	8.21
6/15	10.26	8.39
6/16	10.4	9.81
6/20	0	0
6/22	12.71	6.36
6/23	8.8	7.6
6/24	10.97	5.44
6/25	12.11	5.49
6/26	9.14	5.98
6/27	8.82	5.37
6/28	10.44	5.15
6/29	11.25	5.65
6/30	12	6.27
7/1	10.97	5.71
7/2	8.4	6.63
7/3	9	6.52
7/4	9.72	7
7/5	10.53	8.66
7/6	7.01	5.69
7/7	12	7.16
7/8	13.37	10.77
7/9	11.55	11.48
7/10	9.69	7.34
7/11	9.69	10.01
7/12	11.4	9.29
7/13	11.4	8.04
7/14	12.76	8.91
7/15	11.88	6.63
7/16	11.55	3.96
7/17	12.045	5.87
7/18	12.87	8.25
7/19	11.34	7.16
7/20	9.48	7.64
7/21	12.68	7.94
7/22	11.26	7.77
7/23	8.82	6.65
7/24	9.11	5.32
7/25	9.23	6.37
7/26	9	8.12
7/27	10.94	8.45
7/28	11.69	6.68
7/29	10.97	4.49

Attachment "A"

SINTER PLANT DATA

	Measured SO2 in stack	Tons sulphur to D&L
09/01/93	24.69	80.5
09/02/93	11.81	39.7
09/03/93	18.15	91.2
09/07/93	19.64	76.9
09/08/93	14.39	44.3
09/10/93	23.51	77.8
09/13/93	22.74	71.6
09/14/93	20.18	81.6
09/15/93	17.64	55.9
09/16/93	22.79	74.0
09/17/93	23.51	74.5
09/19/93	34.86	100.7
09/21/93	23.48	92.6
09/22/93	28.13	90.1
09/23/93	23.04	91.0
09/24/93	5.41	0.0
09/25/93	0.14	0.0
09/26/93	0.29	0.0
[illegible]/27/93	0.19	0.0
[illegible]28/93	0.36	0.0
09/29/93	0.15	0.0
09/30/93	7.88	32.7
10/01/93	20.91	78.7
10/03/93	16.51	102.2
10/04/93	18.71	95.0
10/06/93	20.29	87.1
10/07/93	20.61	72.5
10/08/93	19.71	67.0
10/10/93	26.74	60.9
10/11/93	15.42	54.2
10/12/93	28.17	81.7
10/13/93	31.39	82.8
10/14/93	30.76	85.9
10/17/93	26.41	60.0
10/18/93	22.79	88.8
10/19/93	26.33	88.7
10/20/93	27.15	80.2
10/21/93	25.16	89.6
10/22/93	14.99	79.2
10/24/93	12.41	73.8
[illegible]25/93	13.42	102.3
[illegible]/26/93	14.34	78.2
10/27/93	11.88	48.0

BLAST FURNACE DATA

	Sulfur in charge	Measured SO2 in stack
7/30	8.91	6.12
7/31	9.45	6.42
8/3	9	6.05
8/4	7.2	5.06
8/5	5.17	3.93
8/6	8.58	8.15
8/7	8	6.51
8/8	8.48	7.33
8/9	7.83	6.27
8/10	11.35	5.39
8/11	9.68	5.72
8/12	8.51	5.71
8/13	8.82	5.59
8/14	11.73	6.29
8/15	10.58	5.8
8/16	10.56	6.07
8/17	11.35	7.15
8/18	10.2	5.05
8/19	8.88	4.81
8/23	8.89	4.51
8/24	7.38	4.18
8/25	7.2	3.91
8/26	6.68	3.47
8/27	12.26	2.8
8/28	7.76	4.21
8/29	8.5	4.71
8/30	8.28	4.85
8/31	7.84	5.77
9/1	10.4	5.62
9/2	9.46	6
9/3	10.01	5.71
9/4	1.02	6.57
9/5	11.22	7.93
9/6	11.99	11.41
9/7	10.08	7.11
9/8	13.8	8.83
9/9	11.73	9.27
9/10	10.71	8.92
9/11	17.25	10.42
9/12	16.73	10.69
9/13	12.83	10.64
9/14	13.54	10.46
9/15	13.05	8.31

Attachment "A"

SINTER PLANT DATA

	Measured SO2 in stack	Tons sulphur to D&L
10/28/93	14.19	72.2
10/29/93	10.19	94.2
10/31/93	7.77	77.3
11/01/93	6.63	84.5
11/02/93	6.92	79.0
11/03/93	7.69	74.3
11/04/93	9.41	54.6
11/05/93	19.96	102.1
11/07/93	27.79	93.7
11/08/93	24.80	95.3
11/09/93	21.63	75.8
11/11/93	27.49	77.1
11/14/93	21.18	66.4
11/15/93	25.59	88.5
11/16/93	20.59	87.1
11/17/93	12.79	45.7
11/18/93	21.78	89.3
11/19/93	14.47	63.5
'21/93	20.76	90.1
22/93	17.61	76.2
11/23/93	18.92	103.1
11/26/93	19.47	107.5
11/28/93	21.46	93.4
11/29/93	21.53	74.8
11/30/93	28.73	104.7
12/01/93	38.26	87.1
12/02/93	19.51	54.0
12/03/93	24.21	84.2
12/05/93	30.27	95.1
12/06/93	36.91	91.3
12/07/93	35.13	84.5
12/08/93	9.04	21.4
12/10/93	34.38	112.7
12/12/93	34.02	96.8
12/13/93	31.30	83.4
12/14/93	32.02	88.3
12/15/93	16.10	52.2
12/16/93	30.37	91.0
12/17/93	29.72	99.1
12/19/93	33.40	102.5
'20/93	35.90	90.9
21/93	25.95	91.3
12/22/93	28.10	93.5

BLAST FURNACE DATA

	Sulfur in charge	Measured SO2 in stack
9/16	13.54	10.51
9/17	13.65	12.23
9/18	12.11	10.62
9/19	13.11	12.3
9/20	2.17	3.48
9/21	16.83	20.65
9/22	12.97	9.9
9/23	9.99	7.71
9/24	11.12	5.17
9/25	10.69	2.43
9/26	10.97	3.31
9/27	10.12	1.77
9/28	10.4	1.78
9/29	10.55	1.14
9/30	8.55	1.28
10/1	10.65	5.42
10/2	10.2	8.91
10/3	12.94	10.07
10/4	10.73	11.57
10/5	9.6	7.69
10/6	9.32	6.77
10/7	12.6	6.71
10/8	9.45	7.66
10/9	10.24	8.45
10/10	10.8	7.38
10/11	10.2	9.88
10/12	11.48	6.41
10/13	10.68	6.33
10/14	12.83	6.51
10/15	8.61	5.52
10/16	8.66	3.42
10/17	9.45	4.22
10/18	10.68	5.59
10/19	8.61	4.19
10/20	8.4	4.14
10/21	7.8	3.98
10/22	9.03	4.35
10/23	8.78	5.27
10/24	8.21	5.94
10/25	9.95	6
10/26	4.94	5
10/27	9.34	6.35
10/28	10.92	12.54