EVALUATOR CMC EVALUATION DATE 7/17/92

METHOD 5: SECONDARY EMISSIONS TEST REPORT EVALUATION

STATE: WY FACILITY: FMC - WYOMING CORP. TEST DATE: 10/9/90

PROCESS(ES) TESTED: MONO-5 calciner w/ 4 cyclones (dry) & venturi scrubber

SAMPLING DURATION 2
must have at least 3 runs, each ≥ 1 hour duration, with sampling ≥ 2 minutes at each traverse point, and total sampling volume ≥ 30 dscf
20 dscf each run. no

SAMPLING TEMPERATURE 2
both probe and filter must be maintained at 248 ± 25°F or other temperature specified in NSPS
vacuum steady

BACK-HALF 3
if any, what method was used to catch and recover condensible matter
WY. H_2O

PRODUCTION RATE 3
is process or production rate during testing representative of normal rates

CONTROL DEVICE(S) 3
are devices described, and their efficiencies given

METHOD 1 3
are calculations accurate, and is figure provided

METHODS 2,3 2
are data and calculations included for gas velocity, cyclonic flow, and molecular weight determination, and is source of barometric pressure noted
no

METHOD 4 3
are data and calculations included for moisture content determination, and is moisture content realistic [< saturation]

FIELD DATA is field data on standard forms, and does raw data correspond with printout 3

BOILER TESTS N/A
calculation of F_0 from Orsat accurate

EQUIPMENT were a borosilicate glass probe liner and a glass fiber filter used 2

CALIBRATION were both pre- and post-test calibrations performed for
meter box (cal against wet test) OK 3
pitot tube 2
temperature sensor 2 } no doc.
nozzle (3 #) 2

LEAK CHECKS both pre- and post-test 3

BLANKS were filter and reagent blanks analyzed, and were any problems addressed 3

SAMPLE PREP 3
filter desiccation and tare weights documented

ISOKINETICS within 100±10% for all runs 3

STACK EMISSIONS SURVEY
FMC WYOMING CORPORATION
GREEN RIVER, WYOMING

OCTOBER 1990

SOURCE MONO-5
(Mono 1 Calciner)

Certification of Report

The sampling and analysis represented by this report was performed under my direction and supervision.

Date: December 5 1997 Signature: Dale L Clark

Dale L. Clark
Sr. Environmental Engineer

I have reviewed all testing details and results in this report and hereby certify that the test report is authentic and accurate.

Date: Dec 5 1997 Signature: Wesley K. Nash

Wesley K. Nash
Environmental Manager

TABLE OF CONTENTS

Introduction

Compliance tests for particulate emissions were conducted on the Mono 1 Calciner (Source Mono-5) on October 9, 1990 at FMC Wyoming Corporation's plant located near Green River Wyoming.

In addition to the particulate tests, emissions of nitrogen oxides were also determined from this source.

The sampling followed the procedures set forth in Appendix II of the "Wyoming Air Quality Standards and Regulations", Wyoming Department of Environmental Quality, 1989.

FMC Wyoming Personnel taking part in the testwork were:

Dale Clark	Senior Environmental Engineer
Ted Brown	Environmental Engineer
Simon Lee	Environmental Engineering Aide
Ron McNalley	Environmental Engineering Aide

Summary of Results

This section summarizes the results of the particulate and nitrogen oxides emission tests performed on the Mono 1 Calciner (Source Mono-5). Table I is a summary of the results of the particulate tests performed on this unit and Table II is a summary of the nitrogen oxides tests. Details of the individual tests, including field data sheets, laboratory data sheets and calculation sheets can be found in the Appendix.

The data listed in Table I shows that the particulate emission from Source Mono-5 was 31.2 lb/hr, based on the average of the three tests.

The data listed in Table II shows that the emissions of oxides of nitrogen from the stack was 12.5 lb/hr, based on the average of the three tests.

Table I
FMC Wyoming Corporation
SUMMARY OF STACK SAMPLING CALCULATIONS

Stack: Mono 5 (Mono 1)	TEST 1	TEST 2	TEST 3
Test Code Number	90-1	90-2	90-3
Ambient Barometric Pressure, (in Hg)	24.25	24.25	24.25
Absolute stack gas pressure., (in. Hg)	24.25	24.25	24.25
Absolute average stack gas temp., (R)	632.1	624.2	628.7
Absolute average dry gas meter temp., (R)	548.9	552	554.8
Total volume of water collected, (ml)	273.4	246.2	260.8
Volume of gas through dry gas meter, (ft3)	25.744	24.638	25.37
Average pressure drop across orifice, (in. H2O)	0.518	0.483	0.476
Pitot tube coefficient	0.84	0.84	0.84
Average velocity head of stack gas, (in. H2O)	1.104	1.063	1.063
Cross sectional area of stack, (ft2)	19.63	19.63	19.63
Front half particulate collected, (gm)	0.1232	0.1259	0.0975
Back half particulate collected, (gm)	0.0074	0.0044	0.0037
Total particulate collected, (gm)	0.1306	0.1303	0.1012
Total sampling time, (min)	60	60	60
Cross sectional area of nozzle, (ft2*10-4)	1.767	1.767	1.767
Gas volume, (acfm)	94,289	89,778	90,074
Gas volume, (scfm)	64,077	61,783	61,544
Percent isokinetic	96.16	92.91	96.78
Emission rate, (lb/hr)	33.4	34.49	25.72

Table II
FMC Wyoming Corporation
SUMMARY OF NITROGEN OXIDE SAMPLING RESULTS

Stack: Mono-5 (Mono 1)	TEST 1	TEST 2	TEST 3
Test Code Number	90-1 NOx	90-2 NOx	90-3 NOx
Ambient Barometric Pressure, (in Hg)	24.25	24.25	24.25
Absolute stack gas pressure., (in. Hg)	24.25	24.25	24.25
Absolute average stack gas temp., (F)	632.1	624.2	628.7
Average velocity head of stack gas, (in. H2O)	1.104	1.063	1.063
Cross sectional area of stack, (ft2)	19.63	19.63	19.63
Concentration of NOx in stack gas (ppm)	44	45	47
Concentration of NOx in stack gas (lb./dscf)	5.28E-06	5.40E-06	5.64E-06
Total sampling time, (min)	60	60	60
Percent moisture by volume in stack	39.112	37.807	38.596
Gas volume, (acfm)	94,269	89,778	90,074
Gas volume, (scfm)	64,077	61,783	61,544
Dry gas volume, (dscfm)	39,015	38,424	37,790
Calciner feed rate (tons/hour)	89	89	89
Calciner heat input rate (mm Btu/hr)	101.9	101.9	101.9
Emission rate, (lb(NOx)/hr)	12.4	12.4	12.8
Emission rate, (lb(NOx)/ton)	0.139	0.14	0.144
Emission rate, (lb(NOx)/mmBtu)	0.122	0.123	0.126

Discussion of Results

The three particulate tests taken on the stack appeared to be valid representations of the actual emissions during the tests. The indicative parameters calculated from the field data are in close agreement. The moisture percentages were within 1.8% of the mean value. The measured flow rates (Qs) were within 1.6% of the mean value. Isokinetic sampling rates on all three tests were maintained well within the 90% to 110% allowable range.

Description of Process Operation

Crushed Trona ore (sodium sesquicarbonate) is fed into the gas fired rotary calciner where the trona is converted to impure soda ash (sodium carbonate) by heat.

The exhaust gases from the calciner pass through two sets of four dry cyclones and a high pressure drop wet venturi scrubber for particulate removal before emission to the atmosphere.

Description of Sampling Location

The sampling ports are located on the circular stack approximately 80 feet above the ground. The sampling was performed from two ports on the stack located 44 feet (8.8 stack diameters) downstream of the stack inlet, and 24 feet (4.8 stack diameters) upstream of the stack outlet. The area of the stack is 19.63 square feet. Port and wall thickness is 7 inches.

Sampling and Analysis Procedures

Particulate

Testing for particulate emissions was conducted on October 9 using Reference Method 5 from Appendix II of the "Wyoming Air Quality Standards and Regulations" - 1989. Each test consisted of traversing both sample diameters, with six points being sampled on each diameter. Sample points were determined by Reference Method 1. Each point was sampled for five minutes for a total sample time of sixty minutes. The testwork was completed without incident and the samples were returned to the FMC Environmental Department work area for recovery and analysis.

Operational parameters that were logged during the testwork can be found in the logsheets in the Appendix.

Nitrogen Oxides

Nitrogen oxide testing was conducted concurrently with the particulate testing using Reference Method 7E from Appendix II of the "Wyoming Air Quality Standards and Regulations" - 1989. Each test consisted of drawing a sample for one hour and integrating the voltage output (concentration) of the NOx monitor for the hour period by use of a calibrated signal averager. The concentration values recorded were then adjusted for instrument drift. Calibration gases used during the test were EPA Protocol 1 certified.

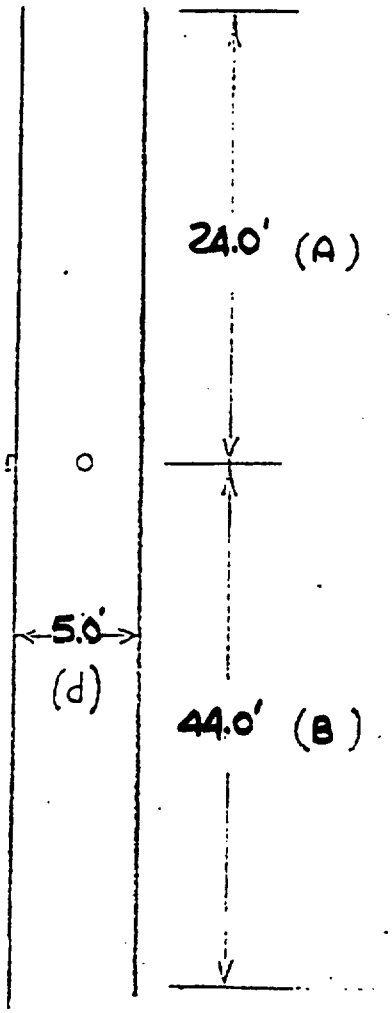
APPENDIX A

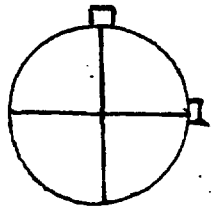
Location of Sample Points

FMC Corporation

Industrial Chemical Division
Box 872
Green River Wyoming 82935
(307) 875 2580

MONO-5





$\frac{B}{d} = 8.8$

NO. OF POINTS PER TRAVERSE = 12
NO. OF POINTS PER DIAMETER = 6
NO. OF DIAMETERS PER RUN = 2
SAMPLE TIME PER POINT = 5 MINUTES

TRAVERSE POINTS ON EACH DIAMETE.

	% OF DIAMETER	DISTANCE FROM INSIDE WALL (IN.)	DISTANCE COUPLING (IN
1.	4.4	2.64	9.64
2.	14.7	8.82	15.82
3.	29.5	17.70	24.70
4.	70.5	42.30	49.30
5.	85.3	51.18	58.18
6.	95.6	57.36	64.36

APPENDIX B

Source Emission Calculations

TEST NO. 90-1 DATE 10-09-90

VELOCITY AND VOLUME DETERMINATION

****

DRY GAS VOLUME

Vmstd=(17.71 deg R/in. Hg)*Vm*(Pbar+deltaH/13.6)/Tm)

Where Vmstd=Volume(ft3) of gas sample at 70F and 29.92 in. Hg
Vm=Volume (ft3) of gas at meter conditions
Tm=Average dry gas meter temperature (R)
Pbar=Barometric pressure (in. Hg)
deltaH=Pressure drop across orifice (in. WG)

Vmstd=17.71* 25.74*(24.25+0.518/13.6)/548.9 = 20.174 ft3

VOLUME OF WATER VAPOR

Where Vwstd=Volume (ft3) of water vapor
Vlc=Total volume of water collected (ml)

Vwstd = .00474* 273.4 = 12.959 ft3

MOISTURE CONTENT

Bwo=Vwstd*100/(Vwstd+Vmstd)

Where Bwo=Percent moisture

Bwo = 12.96*100/(12.96+ 20.17) = 39.112 percent

CONCENTRATION 0

Cs'=(15.43 grains/gm)*Mn/(Vmstd+Vwstd)

Where Cs'=Concentration (grains/scf)
Mn=Total particulate collected (gm)

Cs' = 15.43*0.1306/(20.17+ 12.96) = 0.0608 grains/scf

STACK VELOCITY

V=Kp*85.48*SQR(delta P)*SQR(Ts/(Mw*Ps))

Where V=Stack velocity (ft/sec)
Ts=Stack absolute temperature (R)
deltaP=Average pitot reading (in. WG)
Mw=Molecular wt. of stack gas (lb/lb mole)
Kp=Pitot tube coefficient

Mw=0.18*39.11+0.44* 7.85+0.32* 5.30+0.28*47.74 = 25.557 lb/mole

V=0.84*85.48*1.104*SQR(632.1/(25.56*24.25)) = 80.056 ft/sec

STACK VOLUME

ACFM=V*A*60 AND SCFM=ACFM*530*Ps/(Ts*29.92)

Where ACFM=Actual cubic Ft per minute at stack conditions
A=Stack area (ft2)
SCFM=Standard cubic ft. per min. (29.92 in. Hg & 530 R)

ACFM = 80.06* 19.630*60 = 94289 acfm

SCFM = 94289*530*24.25/(632.1*29.92) = 64077 scfm

CALCULATED DUST LOAD

lb/hr=Cs'*SCFM*60/7000 grains/lb

DUST LOAD= 0.0608* 64077*60/7000 = 33.40 Lb/Hr

ISOKINETIC RATE

I = 96.15714 %

TEST NO. 90-2 DATE 10-09-90

VELOCITY AND VOLUME DETERMINATION

****

DRY GAS VOLUME

Vmstd=(17.71 deg R/in. Hg)*Vm*(Pbar+deltaH/13.6)/Tm)

Where Vmstd=Volume(ft3) of gas sample at 70F and 29.92 in. Hg
Vm=Volume (ft3) of gas at meter conditions
Tm=Average dry gas meter temperature (R)
Pbar=Barometric pressure (in. Hg)
deltaH=Pressure drop across orifice (in. WG)

Vmstd=17.71* 24.64*(24.25+0.483/13.6)/552.0 = 19.197 ft3

VOLUME OF WATER VAPOR

Where Vwstd=Volume (ft3) of water vapor
Vlc=Total volume of water collected (ml)

Vwstd = .00474* 246.2 = 11.670 ft3

MOISTURE CONTENT

Bwo=Vwstd*100/(Vwstd+Vmstd)

Where Bwo=Percent moisture

Bwo = 11.67*100/(11.67+ 19.20) = 37.807 percent

CONCENTRATION 0

Cs'=(15.43 grains/gm)*Mn/(Vmstd+Vwstd)

Where Cs'=Concentration (grains/scf)
Mn=Total particulate collected (gm)

Cs' = 15.43*0.1303/(19.20+ 11.67) = 0.0651 grains/scf

STACK VELOCITY

V=Kp*85.48*SQR(delta P)*SQR(Ts/(Mw*Ps))

Where V=Stack velocity (ft/sec)
Ts=Stack absolute temperature (R)
deltaP=Average pitot reading (in. WG)
Mw=Molecular wt. of stack gas (lb/lb mole)
Kp=Pitot tube coefficient

Mw=0.18*37.81+0.44* 8.71+0.32* 4.91+0.28*48.57 = 25.809 lb/mole

V=0.84*85.48*1.063*SQR(624.2/(25.81*24.25)) = 76.225 ft/sec

STACK VOLUME

ACFM=V*A*60 AND SCFM=ACFM*530*Ps/(Ts*29.92)

Where ACFM=Actual cubic Ft per minute at stack conditions
A=Stack area (ft2)
SCFM=Standard cubic ft. per min. (29.92 in. Hg & 530 R)

ACFM = 76.23* 19.630*60 = 89778 acfm

SCFM = 89778*530*24.25/(624.2*29.92) = 61783 scfm

CALCULATED DUST LOAD

lb/hr=Cs'*SCFM*60/7000 grains/lb

DUST LOAD= 0.0651* 61783*60/7000 = 34.49 Lb/Hr

ISOKINETIC RATE

I = 92.90534 %

TEST NO. 30-3 DATE 10-09-90

VELOCITY AND VOLUME DETERMINATION

****

DRY GAS VOLUME

Vmstd=(17.71 deg R/in. Hg)*Vm*(Pbar+deltaH/13.6)/Tm)

Where Vmstd=Volume(ft3) of gas sample at 70F and 29.92 in. Hg
Vm=Volume (ft3) of gas at meter conditions
Tm=Average dry gas meter temperature (R)
Pbar=Barometric pressure (in. Hg)
deltaH=Pressure drop across orifice (in. WG)

Vmstd=17.71* 25.37*(24.25+0.476/13.6)/554.8 = 19.667 ft3

VOLUME OF WATER VAPOR

Where Vwstd=Volume (ft3) of water vapor
Vlc=Total volume of water collected (ml)

Vwstd = .00474* 260.8 = 12.362 ft3

MOISTURE CONTENT

Bwo=Vwstd*100/(Vwstd+Vmstd)

Where Bwo=Percent moisture

Bwo = 12.36*100/(12.36+ 19.67) = 38.596 percent

CONCENTRATION

Cs'=(15.43 grains/gm)*Mn/(Vmstd+Vwstd)

Where Cs'=Concentration (grains/scf)
Mn=Total particulate collected (gm)

Cs' = 15.43*0.1012/(19.67+ 12.36) = 0.0488 grains/scf

STACK VELOCITY

V=Kp*85.48*SQR(delta P)*SQR(Ts/(Mw*Ps))

Where V=Stack velocity (ft/sec)
Ts=Stack absolute temperature (R)
deltaP=Average pitot reading (in. WG)
Mw=Molecular wt. of stack gas (lb/lb mole)
Kp=Pitot tube coefficient

Mw=0.18*38.60+0.44* 9.36+0.32* 4.64+0.28*47.40 = 25.824 lb/mole

V=0.84*85.48*1.063*SQR(628.7/(25.82*24.25)) = 76.477 ft/sec

STACK VOLUME

ACFM=V*A*60 AND SCFM=ACFM*530*Ps/(Ts*29.92)

Where ACFM=Actual cubic Ft per minute at stack conditions
A=Stack area (ft2)
SCFM=Standard cubic ft. per min. (29.92 in. Hg & 530 R)

ACFM = 76.48* 19.630*60 = 90074 acfm

SCFM = 90074*530*24.25/(628.7*29.92) = 61544 scfm

CALCULATED DUST LOAD

lb/hr=Cs'*SCFM*60/7000 grains/lb

DUST LOAD= 0.0488* 61544*60/7000 = 25.72 Lb/Hr

ISOKINETIC RATE

I = 96.77875 %

FMC WYOMING CORPORATION

Green River Wyoming

Nitrogen Oxides Report

Date of test: 10-09-90

Nitrogen Oxides

Test Location: Mono 1 (Mono-5) Calibration Gas: 230

Span: 0-500ppm

Calibration Drift Corrections

Run Number	Initial Zero	Final Zero	Initial Cal.	Final Cal.	Measured Conc.	Corrected* Conc.
1	1	2	228	222	44	44
2	2	2	222	223	45	45
3	2	1	223	221	47	47

$$* \quad C_{dms} = (\bar{C} - C_o) \frac{C_{ma}}{C_m - C_o}$$

Where:

C_{dms} = Effluent gas concentration dry basis, ppm

$\bar{C}$ = Average gas concentration indicated by gas analyzer, dry basis, ppm

C_o = Average of initial and final system calibration bias check responses for zero gas, ppm.

C_m = Average of initial and final system calibration bias check responses for the upscale calibratrion gas, ppm.

C_{ma} = Actual concentration of the upscale calibration gas, ppm.

Nitrogen Oxides Calculations

To determine the mass emissions (lb/hr) from concentration (ppmv) in air determined from monitors on a dry basis.

---

1. The Ideal Gas Law determines the density of 100% pure pollutant at standard conditions.

   Ideal Gas Law: 359.05 ft^3 of ideal gas contains 1 mole of atoms (at 0°C, 1 atm.).

   Correct to EPA Standard conditions (20°C, 1 atm.):

$$359.05 * \frac{(273+20)}{273} = 385.35 \frac{ft^3}{lb.-mole}$$

   Determine the molecular weight of pollutant (NO_x)

$$MW\ (NO_x) = 46.01\ lb/lb\text{-}mole$$

   The density of 100% NO_x at STP is:

$$46.01 \frac{lb.}{lb.-mole} \div 385.35 \frac{ft^3}{lb.-mole} = 0.120 \frac{lb.}{dsft^3}$$

2. The ratio of pollutant (ppm) to air is:

$$\frac{1}{1,000,000} = 1.0 * 10^{-6}$$

$$\frac{lb.(NO_x)}{dsft^3} = (ppm\ NO_x) * 1.20 * 10^{-7}$$

   And:

$$\frac{lb.(NO_x)}{hr.} = \frac{lb.(NO_x)}{dsft^3} * \frac{dsft^3}{min.}(exhaust) * \frac{60\ min.}{hour}$$

APPENDIX C

Calibration of Equipment

FMC, WYOMING CORPORATION
GREEN RIVER, WYOMING

METER BOX CALIBRATION DATA AND CALCULATION FORM

DATE: 3/29/90
Pb: 23.83

METER BOX NUMBER: NAPP, D514
CALIBRATED BY: SCOT ALER

DH (IWC)	Vw (FT3)	Vd (FT3)	Tw (F)	Td (F)	DP (IWC)	TIME (MIN)	Yd	DH@	Q
0.5	6.159	6.555	73	96	-0.3	15.00	0.9777	2.016	0.324
0.5	6.177	6.495	73	93	-0.3	15.00	0.9843	2.015	0.325
1.5	6.806	7.298	73	100	-0.5	10.00	0.9738	2.185	0.537
1.5	6.815	7.230	73	94	-0.5	10.00	0.9737	2.203	0.537
3.0	10.004	10.440	73	98	-1.0	10.33	0.9909	2.168	0.764
3.0	10.001	10.490	73	100	-1.0	10.31	0.9894	2.151	0.765
						AVERAGES:	0.9816	2.123	

METER BOX NUMBER: Napp DS14 CALIBRATED BY: Scot Allen

DATE: 3/29/90 BAROMETRIC: 23.83

VOLUME WET TEST METER	VOLUME DRY GAS METER	DH	TEMP WET TEST METER	TEMP DRY GAS METER	DP	TIME
0 6.159 6.159	423.227 429.782 6.555	0.5	73	96 93 97 94 99 94 (96)	-0.3	15
0 6.177 6.177	442.359 448.854 6.495	0.5	73	95 88 97 89 98 90 (93)	-0.3	15
0 6.806 6.806	433.70 440.998 7.298	1.5	73	102 95 105 96 105 96 (100)	-0.5	10
0 6.815 6.815	462.02 469.25 7.230	1.5	73	95 88 99 85 100 90 (94)	-0.5	10
0 10.004 10.004	471.01 481.45 10.44	3.0	73	103 91 105 92 106 93 (98)	-1.0	10.333
0 10.001 10.001	481.45 491.94 10.49	3.0	73	104 93 107 94 108 95 (100)	-1.0	10.308

TELEX: 510-100-8831 (ScotGas)
FAX: 714-887-0549
PHONE: 714-887-2571

Scott Specialty Gases a division of

Scott Environmental Technology Inc. 2600 CAJON BLVD., SAN BERNARDINO, CA 92405

Shipped From: Scott SAN BERNARDINO, CA
Date Shipped 5/23/90
Our Project No: 6635
Your P.O. No: GR90020685
Page 1 of 1
Expiration Date: 11/90

FMC CORPORATION
P.O. BOX 872
GREEN RIVER, WY 82935

CERTIFICATE OF ANALYSIS--EPA PROTOCOL GASES*

Certified Per Traceability Protocol No. 1 Procedure No. G1 Cylinder No. ALM-12582 Cylinder Pressure 1900 psig Certified Accuracy ±1% % NBS Traceable

REFERENCE STD

COMPONENTS	CERTIFIED CONC	SRM/CRM NO.	CYL. NO.	CONC.
NITRIC OXIDE	390.4 ppm	- CRM1687	AAL-19336	966 ppm
NOX	390.6 ppm			
SULFUR DIOXIDE	400.0 ppm	GMIS TRACEABLE TO CRM166IA	AAL-18160	496.2 ppm

GAS ANALYZER

MAKE/MODEL/SERIAL NO.	LAST CAL. DATE	ANALYTICAL PRINCIPLE
THERMO-ELECTRON 10 AR 14853-150	2/15/90	CHEMI-LUMINENSCENT
HORIBA AIA 23 56174104	4/30/90	INFRA-RED

BALANCE GAS NITROGEN

ANALYZER READINGS: Z = Zero Gas T = Test Gas R = Reference Gas

Component NITRIC OXIDE
First Analysis Date 5/8/90 Units ppm

Z	0.00	R	96.58	T	39.04
R	96.62	Z	0.02	T	39.04
Z	0.01	T	39.02	R	96.50

Mean Test Assay 390.4 ppm

Second Analysis Date 5/15/90 Units ppm

Z	0.00	R	96.58	T	39.00
R	96.43	Z	0.00	T	39.00
Z	-0.01	T	39.03	R	96.60

Mean Test Assay 390.4 ppm

Component SULFUR DIOXIDE
Date 5/10/90 Units ppm

Z	00.0	R	99.0	T	82.4
R	99.0	Z	00.0	T	82.4
Z	00.0	T	82.4	R	99.0

Mean Test Assay 400.5 ppm

Date 5/21/90 Units ppm

Z	00.0	R	99.0	T	82.3
R	99.0	Z	00.0	T	82.3
Z	00.0	T	82.3	R	99.0

Mean Test Assay 400.0 ppm

Component _____
Date _____ Units _____

Z		R		T	
R		Z		T	
Z		T		R	

Mean Test Assay _____

Date _____ Units _____

Z		R		T	
R		Z		T	
Z		T		R	

Mean Test Assay _____

Chronology: Date _____
Assay _____

Analyst L. OLDHAM/P. VILIMAS

Approved By: _____

TELEX: 510-100-8831 (ScotGas)
FAX: 714-887-0549
PHONE: 714-887-2571

Scott Specialty Gases a division of

Scott Environmental Technology Inc. 2600 CAJON BLVD., SAN BERNARDINO, CA 92405

Shipped From: Scott SAN BERNARDINO, CA
Date Shipped 5/23/90
Our Project No: 6635
Your P.O. No: GR90020685
Page 1 of 1
Expiration Date: 11/90

FMC CORPORATION
P.O. BOX 872
GREEN RIVER, WY 82935

CERTIFICATE OF ANALYSIS – EPA PROTOCOL GASES*

Certified Per Traceability Protocol No. 1 Procedure No. G1 Cylinder No. AAL-4639 Cylinder Pressure 1900 psig Certified Accuracy ±1% % NBS Traceable

REFERENCE STD

COMPONENTS	CERTIFIED CONC	SRM/CRM NO.	CYL. NO.	CONC.
NITRIC OXIDE	230.1 ppm	CRM1685B	CAL-5817	236 ppm
NOX	230.7 ppm			
SULFUR DIOXIDE	234.5 ppm	GMIS TRACEABLE TO CRM1661A	AAL-18160	496.2 ppm

GAS ANALYZER

MAKE/MODEL/SERIAL NO.	LAST CAL. DATE	ANALYTICAL PRINCIPLE
THERMO-ELECTRON 10 AR 14853-150	2/15/90	CHEMI-LUMINENSCENT
HORIBA AIA 23 56174104	4/30/90	INFRA RED

BALANCE GAS NITROGEN

ANALYZER READINGS: Z = Zero Gas T = Test Gas R = Reference Gas

Component NITRIC OXIDE
First Analysis Date 5/8/90 Units ppm

Z 0.00	R 94.40	T 92.18
R 94.50	Z 0.03	T 92.40
Z 0.01	T 92.10	R 94.30

Mean Test Assay 230.6 ppm

Second Analysis Date 5/15/90 Units ppm

Z 0.00	R 94.42	T 92.00
R 94.20	Z 0.00	T 91.90
Z 0.00	T 91.95	R 94.31

Mean Test Assay 230.1 ppm

Component SULFUR DIOXIDE
Date 5/13/90 Units ppm

Z 00.0	R 99.0	T 51.0
R 99.0	Z 00.0	T 51.0
Z 00.0	T 51.0	R 99.0

Mean Test Assay 233.5 ppm

Date 5/21/90 Units ppm

Z 00.0	R 99.0	T 51.2
R 99.0	Z 00.0	T 51.2
Z 00.0	T 51.2	R 99.0

Mean Test Assay 234.5 ppm

Component _____
Date _____ Units _____

Z	R	T
R	Z	T
Z	T	R

Mean Test Assay _____

Date _____ Units _____

Z	R	T
R	Z	T
Z	T	R

Mean Test Assay _____

Chronology: Date _____
Assay _____

Analyst L. OLDHAM/M. JOHNSON

Approved By: _____

APPENDIX D

Field Testing and Analytical Data

FMC STACK SAMPLING FIELD DATA

Company [illegible] Assumed Moisture % 5.5

Plant Location [illegible] Probe Tip Diameter, in. [illegible]

Run No. 90-2 Probe Length, ft. 6

Sampling Location [illegible] Ambient Temperature, °F

Date 10-9-90 Bar. Pressure, in. Hg. 24.25

Start Time 11:59 - 12.57 Initial Leak Check, CFM 0.002 at 6 in. H

Finish Time 12:29 ? - 13:27 Final Leak Check, CFM 0.006 at 4 in. H

Unit # D-514 Meter Correction 0.9816 Orsat, %CO_2 14.0

% O_2 7.9

Stack Area 19.63 % CO -0-

Point No.	Time (min)	Dry Gas Meter FT^3	Pitot in. H_2O P	Pitot in. H_2O $\sqrt{P}$	Orifice ΔH in H_2O Desired	Orifice ΔH in H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Pump Vacuum in. Hg Gauge	Sample Box Temp. °F	Impinger Temp. °F	Stack Press. in Hg	Sta Tem °F
1	0	815.118	1.22	1.104	0.51	0.51	91	89	1.8	229	45		16
2	5	815.2	1.24	1.113	0.53	0.53	94	90	2.0	247	44		16
3	10	817.3	1.28	1.131	0.55	0.55	95	89	3.1	232	44		16
4	15	819.5	1.20	1.095	0.51	0.51	96	89	3.1	222	46		16
5	20	821.6	1.10	1.049	0.47	0.47	96	88	2.3	244	45		17
6	25	823.7	1.00	1.000	0.43	0.43	95	88	2.0	276	45		16
	30	825.6											1
1	0	825.6	.95	0.975	0.40	0.40	89	88	1.9	215	52		16
2	5	827.5	1.0	1.000	0.43	0.43	93	88	2.0	259	46		16
3	0	829.5	1.0	1.000	0.43	0.43	94	88	2.0	281	44		16
4	5	831.6	1.2	1.095	0.51	0.51	96	88	2.3	283	44		16
5	20	833.8	1.2	1.095	0.51	0.51	97	89	2.3	275	43		15
6	25	836.0	1.2	1.095	0.51	0.51	98	89	2.5	273	43		15
	30	838.218											
(0.9816)(25.1)=24.638													
							2206						19
TOTAL	Vm	24.638	12.752		5.79		92°F						16
AVG.			1.063		0.483		552°R						16

FMC Wyoming Corporation
Emission Testing
Laboratory Data

Date: 10-9-20 Run No.: 90-2

Location: MONO-5

MOISTURE COLLECTED

			GM/ML
Impinger 1	Final Weight	719.5	
	Initial Weight	530.7	
		178.8	Increase 178.8
Impinger 2	Final Weight	594.2	
	Initial Weight	537.7	
		56.5	Increase 56.5
Impinger 3	Final Weight	441.2	
	Initial Weight	437.0	
		4.2	Increase 4.2
Impinger 4	Final Weight	645.2	
	Initial Weight	638.5	
		6.7	Increase 6.7

Total Moisture Catch 246.2

PARTICULATE COLLECTED

FRONT HALF WASH
Beaker (Gross Weight) 74.0935
Beaker (Tare Weight) 74.0706 B-1

TOTAL WASH CATCH 0.0229

ACETONE BLANK
Beaker (Gross Weight) 74.9925
Beaker (Tare Weight) 74.9713

TOTAL BLANK 0.0012

FRONT HALF ANALYSIS
(Nozzle, Probe, Cyclone, Filter)

Filter (Gross Weight) 0.6415
Filter (Tare Weight) 0.5373
Filter Catch 0.1042

Washings 0.0229
Total Catch 0.1271
Acetone Blank 0.0012

TOTAL FRONT CATCH 0.1259

BACK HALF ANALYSIS
(Impingers, Filter Back-Half)

Beaker (Gross Weight) 74.9964
Beaker (Tare Weight) 74.9920

TOTAL BACK HALF CATCH 0.0044

TOTAL TRAIN CATCH 0.1303

FMC

STACK SAMPLING FIELD DATA

A"

Company [illegible]

Plant Location [illegible]

Run No. 90-1

Sampling Location [illegible]

Date 10-9-70

Start Time 10:20 11:08

Finish Time 10:50 11:38

Meter Correction 0.9816

Stack Area 19.63

Assumed Moisture % 3 5

Probe Tip Diameter, in. [illegible]

Probe Length, ft. 6

Ambient Temperature, °F

Bar. Pressure, in. Hg. 24.25

Initial Leak Check, CFM .02 at 9 in. H

Final Leak Check, CFM <.01 at 3 in. H

*Orsat, %CO_2 12.9

% O_2 8.1

% CO -0-

S. Lee

Point No.	Time (min)	Dry Gas Meter FT 3	Pitot in. H_2O P	Pitot in. H_2O $\sqrt{P}$	Orifice ΔH in H_2O Desired*	Orifice ΔH in H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Pump Vacuum in. Hg Gauge	Sample Box Temp. °F	Impinger Temp. °F	Stack Press. in Hg	Sta Tem °F
					*								
1	0	786.720	1.3	1.140	0.55	0.55	91	78	1.5	293	31		17
2	5	789.0	1.3	1.140	0.55	0.55	85	78	1.5	283	34		17
3	10	791.2	1.2	1.095	0.51	0.51	88	79	2.0	283	33		17
* 4	15	793.4	1.2	1.095	0.51	0.51	90	81	2.0	288	32		17
	20	795.5	1.1	1.049	0.47	0.47	92	82	1.9	287	33		17
6	25	797.7	1.1	1.049	0.47	0.47	94	84	2.0	295	35		17
	30	799.7											
1	0	799.7	1.18	1.086	0.50	0.50	92	89	1.9	276	39		17
2	5	802.0	1.20	1.095	0.51	0.51	96	90	2.0	289	39		17
3	10	804.1	1.25	1.118	0.53	0.53	98	91	2.3	282	41		17
4	15	806.2	1.30	1.140	0.55	0.55	98	91	2.8	276	43		17
5	20	808.5	1.32	1.149	0.56	0.56	98	90	3.0	271	44		17
6	25	810.8	1.20	1.095	0.51	0.51	98	90	3.0	277	42		17
	30	812.947											
(0.9816)(26.257) =													
							2133						
TOTAL	Vm	25.744	13.251		6.22		88.9°F						70
AVG.			1.104		0.518		548.9°R						17
													63

FMC Wyoming Corporation
Emission Testing
Laboratory Data

Date: 10-9-90 Run No.: 90-1

Location: MONO-5

MOISTURE COLLECTED

			GM/ML
Impinger 1	Final Weight	734.4	
	Initial Weight	541.6	
		192.8	Increase 192.8
Impinger 2	Final Weight	638.6	
	Initial Weight	571.2	
		67.4	Increase 67.4
Impinger 3	Final Weight	425.5	
	Initial Weight	419.4	
		6.1	Increase 6.1
Impinger 4	Final Weight	624.4	
	Initial Weight	617.3	
		7.1	Increase 7.1

Total Moisture Catch 93.4

PARTICULATE COLLECTED

FRONT HALF WASH
Beaker (Gross Weight) 73.5432
Beaker (Tare Weight) 73.5035

TOTAL WASH CATCH 0.0397

ACETONE BLANK
Beaker (Gross Weight) 74.9025
Beaker (Tare Weight) 74.9013

TOTAL BLANK 0.0012

FRONT HALF ANALYSIS
(Nozzle, Probe, Cyclone, Filter)

Filter (Gross Weight) 0.6226
Filter (Tare Weight) 0.5379
Filter Catch 0.0847

Washings 0.0397
Total Catch 0.1244
Acetone Blank 0.0012

TOTAL FRONT CATCH 0.1232

BACK HALF ANALYSIS
(Impingers, Filter Back-Half)

Beaker (Gross Weight) 75.5555
Beaker (Tare Weight) 75.5481

TOTAL BACK HALF CATCH 0.0074

TOTAL TRAIN CATCH 0.1306

STACK SAMPLING FIELD DATA

Company [redacted] Assumed Moisture % 35

Plant Location GRAND Probe Tip Diameter, in. 0.18

Run No. 90-3 Probe Length, ft. 6

Sampling Location Mono 5 Ambient Temperature, °F

Date 10-9-90 Bar. Pressure, in. Hg. 24.25

Start Time 13:48 2.53 Initial Leak Check, CFM 0.010 at 7 in. H

Finish Time 14:24 3.23 Final Leak Check, CFM 0.008 at 4 in. H

Unit #D-514 Meter Correction 0.9816 Orsat, %CO_2 15.25 S. Lee

% O_2 7.55

Stack Area 19.63 % CO -0-

Point No.	Time (min)	Dry Gas Meter FT³	Pitot in. H_2O P	Pitot $\sqrt{P}$	Orifice ΔH in H_2O Desired	Orifice ΔH Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Pump Vacuum in. Hg Gauge	Sample Box Temp. °F	Impinger Temp. °F	Stack Press. in Hg	Sta Tem °F
1	0	[redacted]	1.02	1.010	0.44	0.44	92	90	2.1	224	52		17
2	5	840.6	1.05	1.025	0.45	0.45	96	91	2.5	251	47		16
3	10	842.7	1.08	1.039	0.46	0.467	93	90	2.9	265	42		16
4	15	844.8	1.05	1.025	0.45	0.45	97	91	2.3	240	45		17
5	20	846.9	1.00	1.000	0.43	0.43	98	91	2.5	263	49		17
6	25	848.9	0.90	0.949	0.38	0.38	98	92	2.5	265	51		17
	30	850.77											
1	0	850.77	1.2	1.095	0.51	0.51	94	92	2.9	258	54		16
2	5	853.1	1.2	1.095	0.51	0.51	98	93	2.9	257	51		16
3	10	855.4	1.2	1.095	0.51	0.51	100	92	3.0	256	51		16
4	15	857.6	1.3	1.140	0.55	0.55	101	93	3.1	264	49		16
5	20	859.9	1.2	1.096	0.51	0.51	102	93	3.1	263	49		16
6	25	862.1	1.2	1.095	0.51	0.51	103	94	3.2	263	49		16
	30	[redacted]											
							3274						2
TOTAL	Vm	25.37	12.753		5.71		94.8°F						16
AVG.			1.063		0.476		554.8°R						62

(0.9816)(25.846) 25.37

FMC Wyoming Corporation
Emission Testing
Laboratory Data

Date: 10-7-90 Run No.: 90-3

Location: MONO-5

MOISTURE COLLECTED

			GM/ML
Impinger 1	Final Weight	736.1	
	Initial Weight	531.5	
		204.6	Increase 204.6
Impinger 2	Final Weight	602.4	
	Initial Weight	556.4	
		46.0	Increase 46.0
Impinger 3	Final Weight	453.5	
	Initial Weight	449.8	
		3.7	Increase 3.7
Impinger 4	Final Weight	602.2	
	Initial Weight	595.7	
		6.5	Increase 6.5

Total Moisture Catch 260.8

PARTICULATE COLLECTED

FRONT HALF WASH
Beaker (Gross Weight) 75.5862
Beaker (Tare Weight) 75.5480

TOTAL WASH CATCH 0.0382

ACETONE BLANK
Beaker (Gross Weight) 74.9925
Beaker (Tare Weight) 74.9913

TOTAL BLANK 0.0012

FRONT HALF ANALYSIS
(Nozzle, Probe, Cyclone, Filter)

Filter (Gross Weight) 0.6018
Filter (Tare Weight) 0.5413
Filter Catch 0.0605

Washings 0.0382
Total Catch 0.0987
Acetone Blank 0.0012

TOTAL FRONT CATCH 0.0975

BACK HALF ANALYSIS
(Impingers, Filter Back-Half)

Beaker (Gross Weight) 74.0750
Beaker (Tare Weight) 74.0713

TOTAL BACK HALF CATCH 0.0037

TOTAL TRAIN CATCH 0.1012

we 45 10m

Start. 11:59:00
12:57:00

System calibration bias

Test number: 90-2 NOx

	Initial Values			Final Values		
	Analyzer calibration response	System calib. response	System calib. bias (% of span)	System calib. response	System cal.bias (±5%)	Drif (±3%
Zero gas	0	2	.4%	2	.4%	.0
Mid-range	229	222	-1.4%	223	-1.2%	-.2

System Cal. Bias = $\frac{\text{Sys. Cal. Response - Analyzer Cal. Response}}{\text{Span}} \times 100$

Drift = $\frac{\text{Final Sys. Cal. Response - Initial Sys. Cal. Response}}{\text{Span}} \times 100$

System calibration bias

Start ~~1155~~ 2:05

47ppm

Test number: 90-3 NOx

	Initial Values			Final Values		
	Analyzer calibration response	System calib. response	System calib. bias (% of span)	System calib. response	System cal.bias (±5%)	Drif (±3%
Zero gas	0	2	0.4%	1	0.2%	0.2
Mid-range	229	223	-1.2%	221	1.6%	0.4

System Cal. Bias = $\frac{\text{Sys. Cal. Response - Analyzer Cal. Response}}{\text{Span}} \times 100$

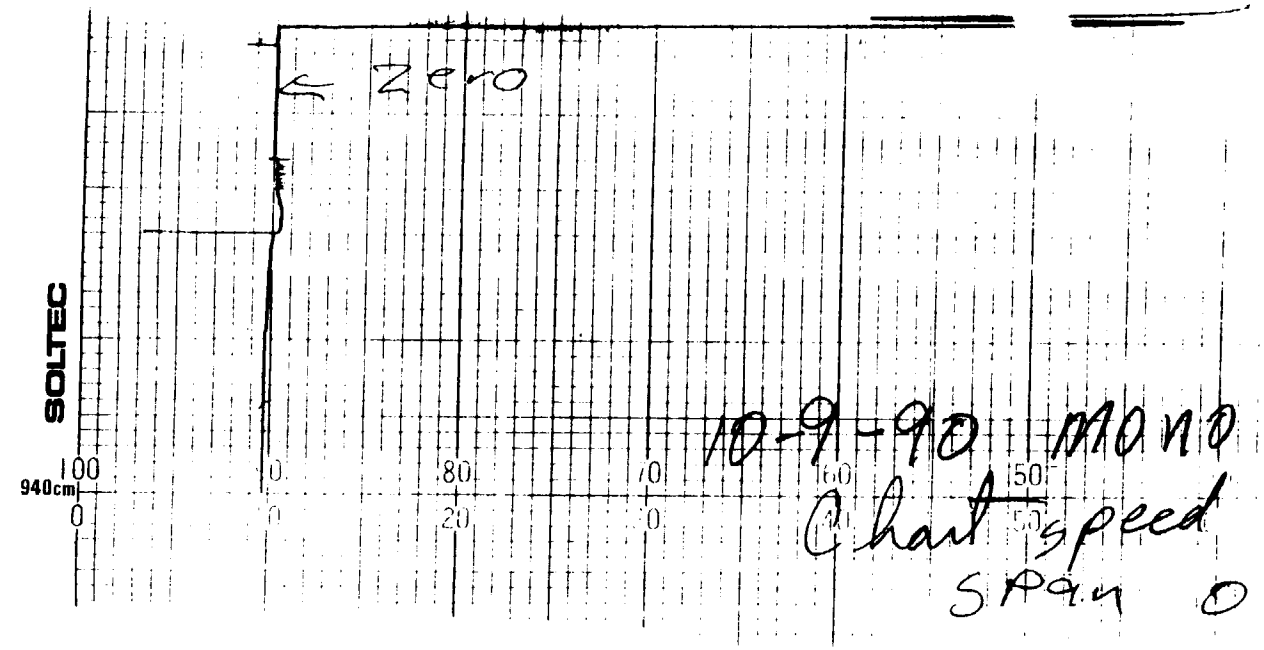
Drift = $\frac{\text{Final Sys. Cal. Response - Initial Sys. Cal. Response}}{\text{Span}} \times 100$

Leak @ 25" Hg ϕ Flow OK

Response time check

Upscale response time: 1:10 min/sec.

Downscale response time: 2:10



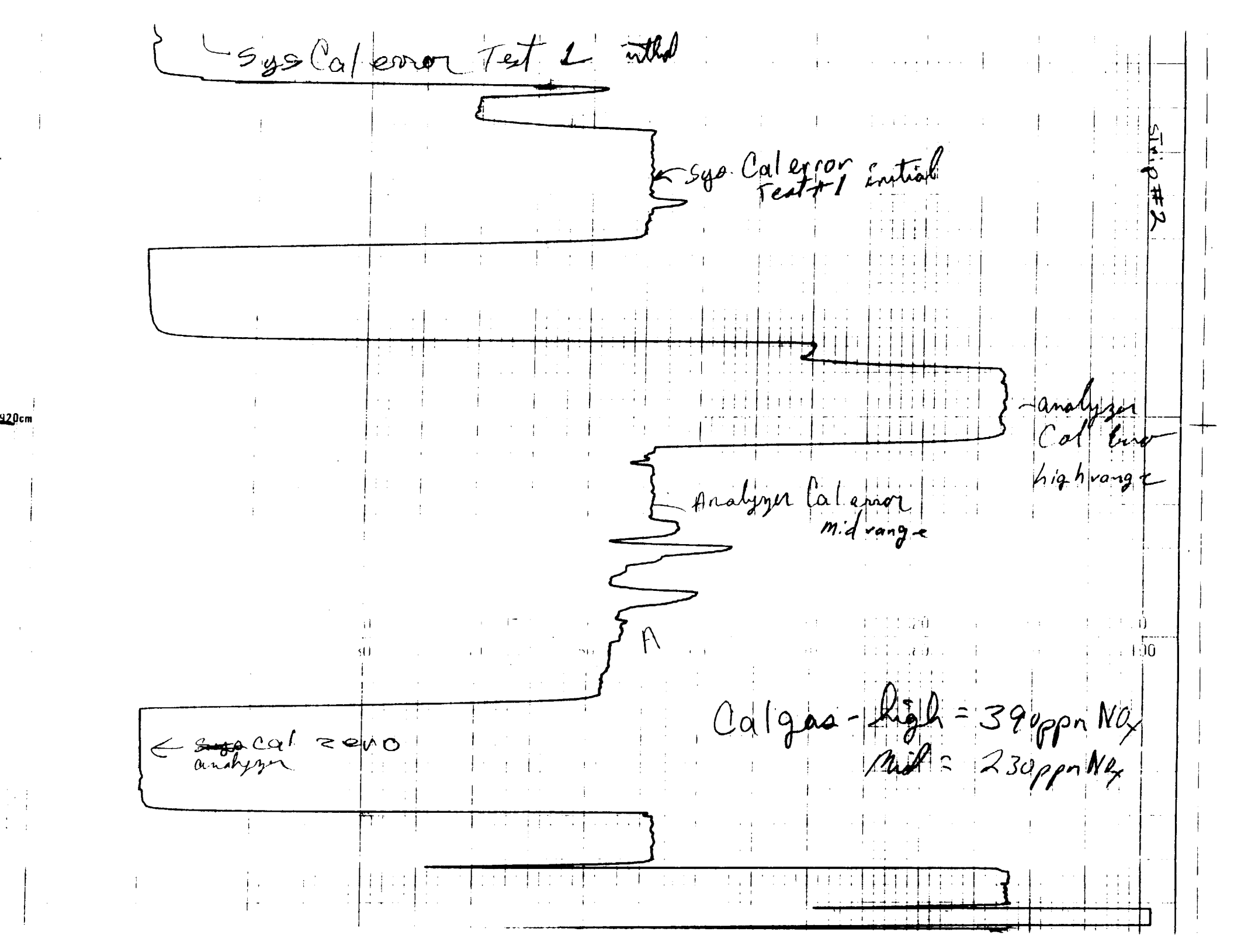
Strip #1

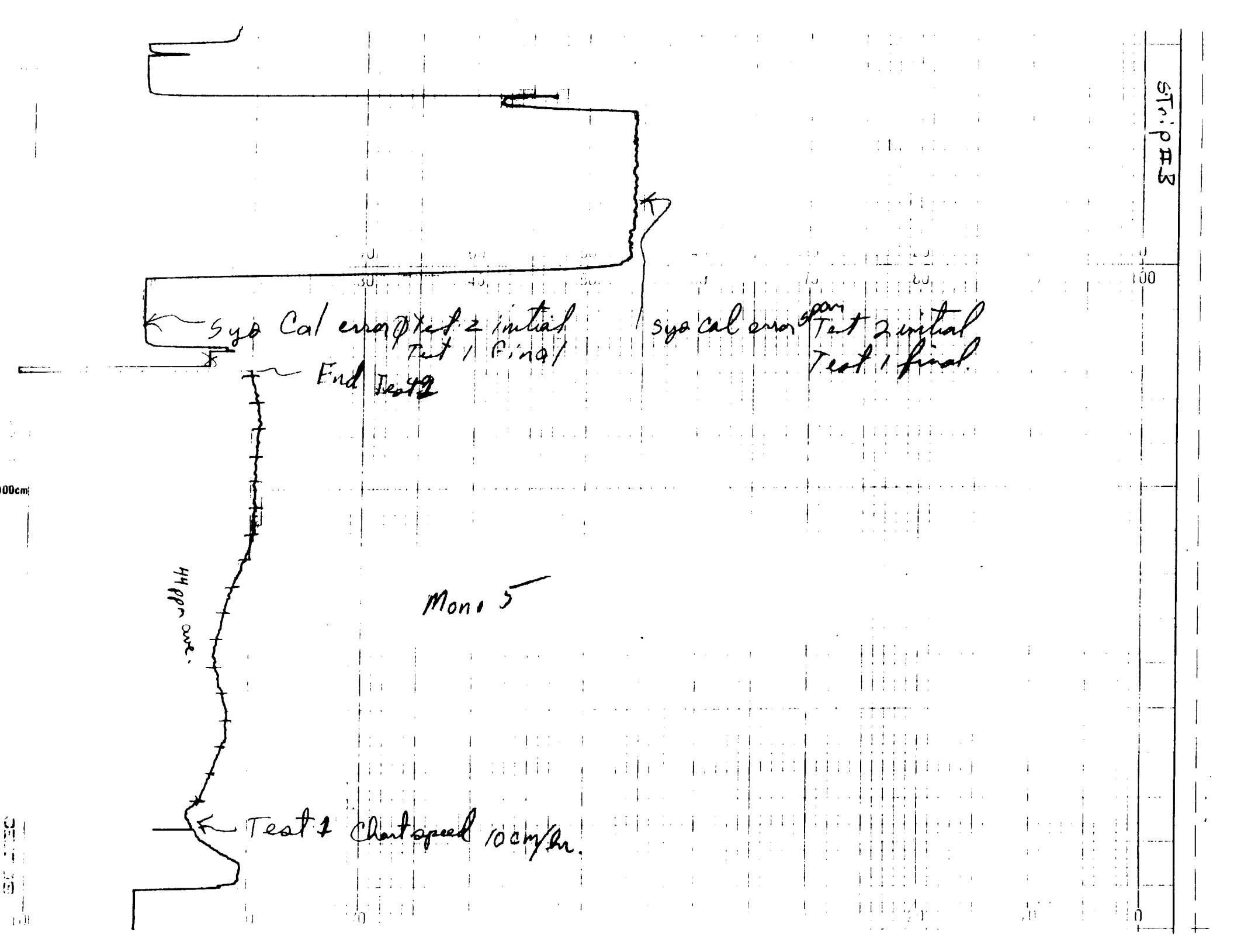
Dr Clark

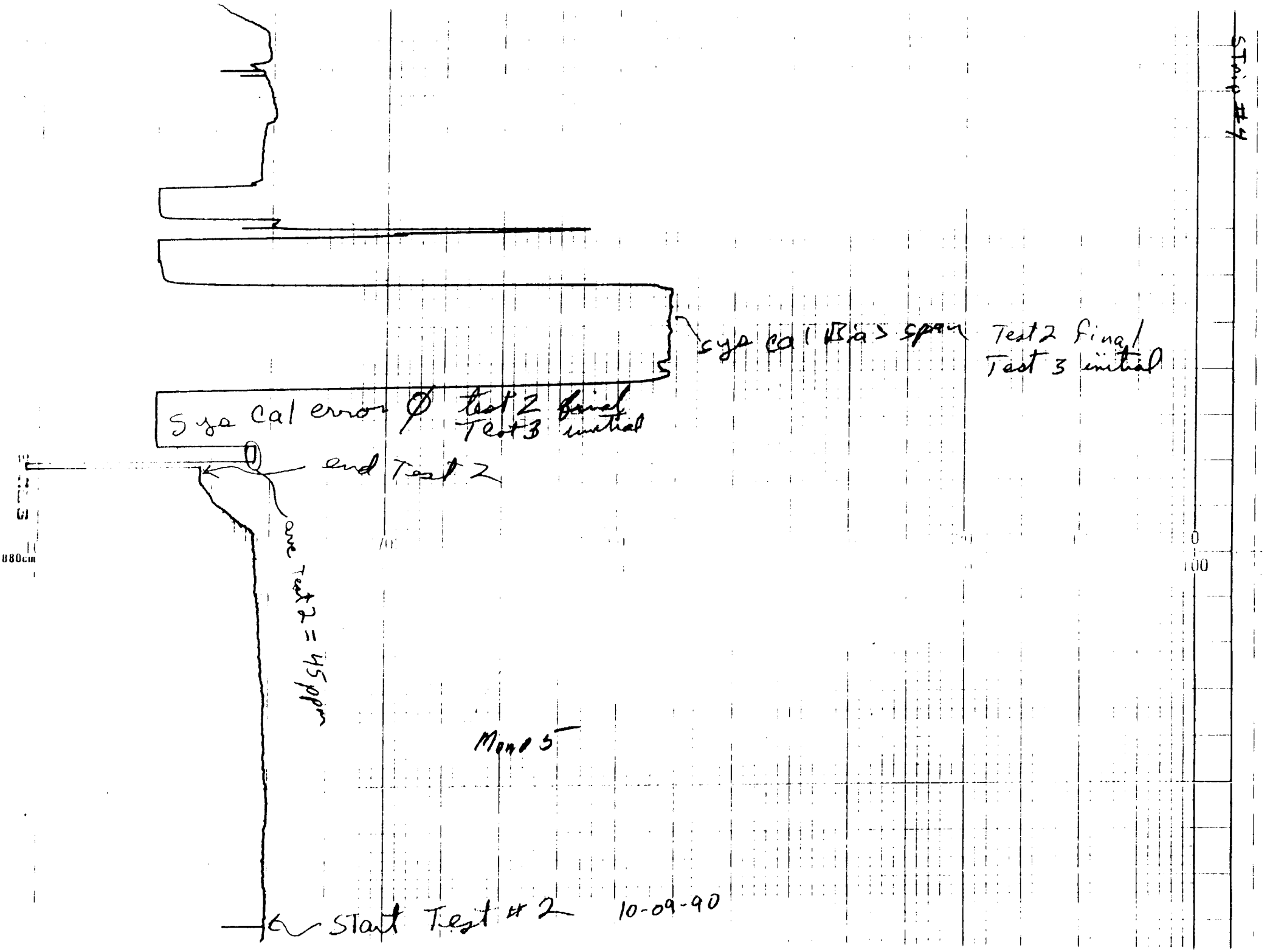
10-9-90 mono 1 Calciner

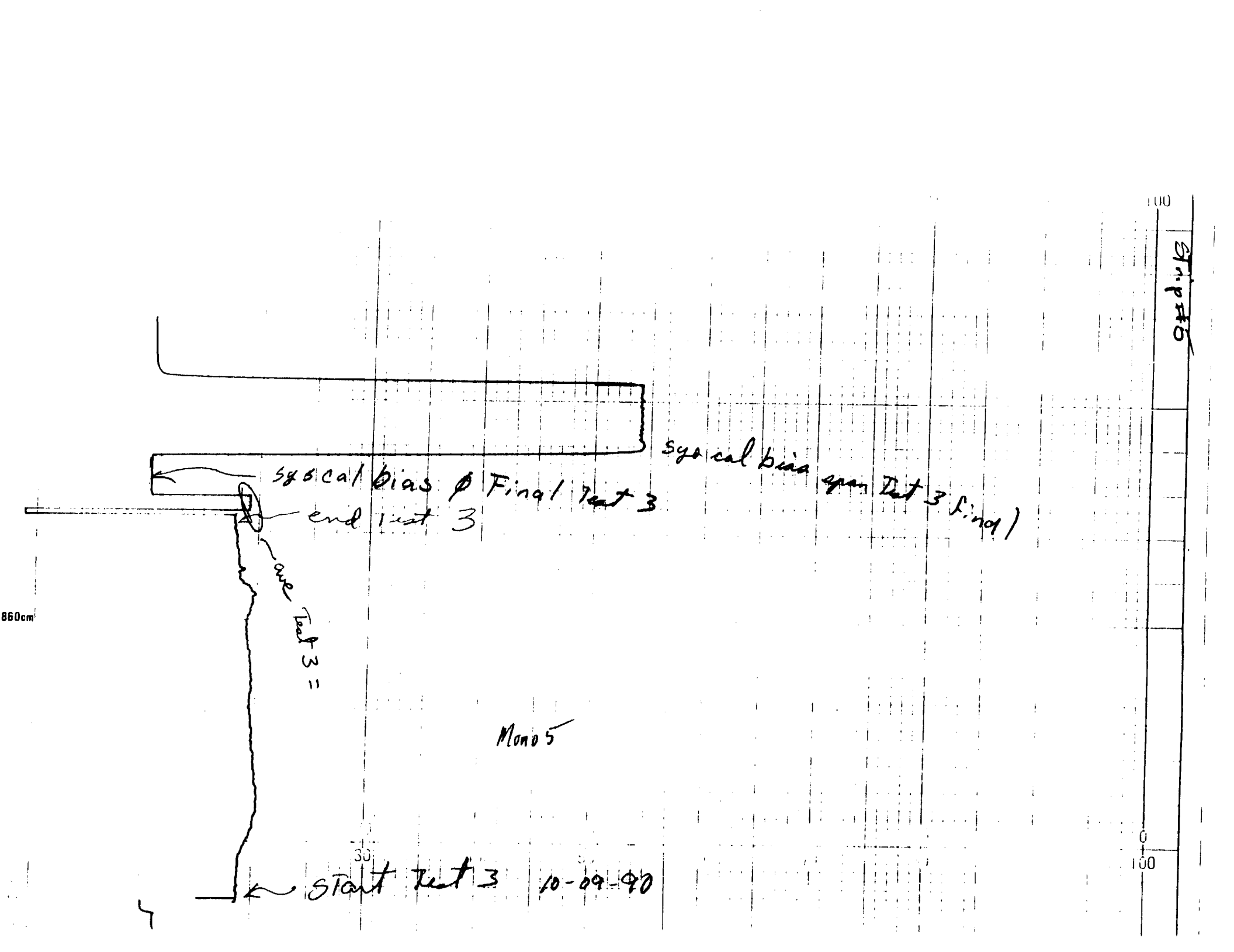
Chart speed 20cm/hr.

Span 0-500 ppm


Sys Cal error Test 2 with
Sys. Cal error Test #1 initial
analyzer Cal error high range
Analyzer Cal error mid range
A
Sys cal zero analyzer
Calgas - high = 390 ppm NOx
mid = 230 ppm NOx
Strip #2


Sys Cal error Test 2 initial
Test 1 Final
End Test 2
Sys cal error Test 2 initial
Test 1 final
Mon. 5
Test 1 Chart speed 10 cm/hr.


Strip #4
Sys cal bias span Test 2 final
Test 3 initial
Sys cal error Ø Test 2 final
Test 3 initial
and Test 2
Error Test 2 = 45 ppm
Mono 5
Start Test # 2 10-09-90
0
100
880cm


Strip #6
100
0
100
sys cal bias @ Final Test 3
sys cal bias @ Final Test 3
end test 3
ave Test 3 =
860cm
Mono 5
30
Start Test 3 10-09-90