AMOCO PRODUCTION COMPANY

MORGANZA FIELD CTB #1 AND SWEETENING FACILITY

MORGANZA, (POINTE COUPEE PARISH) LOUISIANA

# OXIDES OF NITROGEN, CARBON MONOXIDE and OPACITY

SOURCE # 87-4

JUNE 28, 1988

Submitted By :


EMISSION TESTING SERVICES, INC.

POST OFFICE BOX 15Ø75

BATON ROUGE, LOUISIANA 7Ø895


88Ø35


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AIR QUALITY DIVISION

**EMISSION TESTING SERVICES, INC.**

**POST OFFICE BOX 15Ø75**

**BATON ROUGE, LOUISIANA 7Ø895**

# CONFIRMATION OF INFORMATION

# EMISSION TEST REPORT

**FOR**

**AMOCO PRODUCTION COMPANY**

**MORGANZA CTB # 1 AND SWEETENING FACILITY**

**MORGANZA, (POINTE COUPEE PARISH) LOUISIANA**

**OXIDES OF NITROGEN, CARBON MONOXIDE and OPACITY**

**SOURCE # 87-4**

JUNE 28, 1988

I certify that I have personally examined and am familiar with the information submitted herein, and based on my inquiries of those individuals immediately responsible for obtaining the information, I believe the submitted information is true, accurate, and complete.

J. ANGELLOZ
Project Leader

Barry Gipson
Manager

OXIDES OF NITROGEN, CARBON MONOXIDE
and OPACITY

EMISSIONS TESTING

SOURCE # 87-4

for

AMOCO PRODUCTION COMPANY

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# I. INTRODUCTION

Emission Testing Services, Inc. was contracted by AMOCO Production Company to perform emissions testing on cogeneration Turbine 87-4 located at Morganza, Louisiana. This turbine is addressed in DEQ air permit No. 2260-00025-00. Testing was conducted for oxides of nitrogen, carbon monoxide emissions and opacity of emissions.

Turbine unit 87-4 consists of a natural gas fired turbine, an 800 kw/hour electric generator and a thermo flood heat recovery system. The turbine was manufactured by Solar turbines, Inc., model GCI-SB-KATO, serial no. SG87917.

Emissions were determined using EPA Method 9 for visible emissions, EPA Method 10 for carbon monoxide emissions, and EPA Method 20, as modified by Subpart GG, for Oxides of nitrogen emissions. The number of traverse points and the stack gas moisture, velocity and dry molecular weight were determined using EPA Methods 1-4. EPA Methods are found in Appendix A, Part 60, Title 40 of the Code of Federal Regulations.

The testing team consisting of John Angelloz, Troy LeSage, and Steven Schwartz arrived on June 27, 1988. All equipment was set-up and the instrumentation checked out. Testing began on the 28th with Steven Schwartz responsible for testing of oxides of nitrogen and carbon monoxide. John Angelloz was responsible for determining stack gas velocity, volumetric flow and opacity of emissions.

Three test runs were completed on the unit at maximum load conditions. During each test run, AMOCO personnel collected fuel gas samples for analysis and recorded turbine operational data. This analytical and operating data is included in the appendix.

Testing was coordinated through J.G. Lemaire of Amoco.

## II. SUMMARY

Emission testing results from Turbine 87-4 are tabulated below. Stack gas flow data follow on the next page.

Oxides of nitrogen (NOX) results have been reported as nitrogen dioxide. NOX emission rate data have been corrected to ISO standard day conditions. Concentration data reported as parts per million (PPM) have been corrected to 15 percent oxygen and ISO standard day conditions as outlined in Subpart GG of the regulations.

TURBINE 87-4

JUNE 28, 1988

| PARAMETER | RUN 1 | RUN 2 | RUN 3 | AVG. |
|---|---|---|---|---|
| TIME | 0845-0945 | 1100-1200 | 1300-1400 | |
| OXIDES OF NITROGEN | | | | |
| ( PPM ) | 52.416 | 52.856 | 49.124 | 51.465 |
| ( lb/ Hr ) | 2.576 | 2.491 | 2.468 | 2.512 |
| CARBON MONOXIDE | | | | |
| ( lb/ Hr ) | 1.987 | 1.932 | 1.960 | 1.960 |
| OPACITY ( % ) | | | | |
| maximum | 0 | 0 | 0 | 0 |
| minimum | 0 | 0 | 0 | 0 |
| average | 0 | 0 | 0 | 0 |
| FUEL FEED RATE (MCFD) | 279 | 260 | 260 | 266 |
| GENERATOR LOAD (kw) | 778 | 745 | 746 | 756 |

TURBINE 87-4

JUNE 28, 1988

PHYSICAL DATA ON STACK GAS

| RUN NO. | TEMPERATURE DEG. R | MOISTURE % | VELOCITY ft/ sec | VOLUMETRIC FLOW DSCFM |
|---|---|---|---|---|
| 1 | 1258 | 7.29 | 137.51 | 10112 |
| 2 | 1276 | 7.35 | 137.05 | 9945 |
| 3 | 1265 | 5.98 | 135.81 | 10084 |
| AVG. | 1266 | 6.87 | 136.79 | 10047 |

## III. PROCEDURE

Reference Methods 1 - 4 were followed to establish traverse points, stack gas velocity, dry gas molecular weight and moisture content of the gas stream. Method 20 was used to determine oxides of nitrogen concentration, Method 10 was used to determine carbon monoxide concentration and Method 9 was used to determine visible emissions. A brief description of each method used follows.

### METHOD 1: SAMPLE AND VELOCITY TRAVERSES FOR STATIONARY SOURCES

Sampling and velocity measurements were performed at a point meeting the "8 and 2" requirement.

### METHOD 2: DETERMINATION OF STACK GAS VELOCITY AND VOLUMETRIC FLOW RATE (TYPE S PITOT TUBE)

The average gas velocity in the stack was determined from the gas molecular weight, moisture content and the measurement of the average velocity head with a type "S" pitot tube. Dry volumetric flow rate was determined from the velocity and stack diameter.

### METHOD 3: GAS ANALYSIS FOR CARBON DIOXIDE, OXYGEN, EXCESS AIR, AND DRY MOLECULAR WEIGHT

The dry molecular weight of the stack gas was determined using an Orsat analyzer. The Orsat measures the concentration of oxygen, carbon monoxide and carbon dioxide. The remaining gas components are assumed to be nitrogen.

### METHOD 4: DETERMINATION OF MOISTURE CONTENT IN STACK GASES

A gas sample was extracted from the stack using a heated glass probe fitted with a particulate filter. The sample gas then passed through a series of four impingers immersed in an ice bath. The first two impingers contained measured volumes of water, the third was empty, and the fourth contained a known weight of silica gel. Any water vapor in the gas stream was condensed and trapped in the impingers. Moisture was determined gravimetrically.

METHOD 9: VISUAL DETERMINATION OF THE OPACITY OF EMISSIONS FROM STATIONARY SOURCES

Emissions opacity is determined visually by a certified observer. The method specifies procedures for observation of the visible plume emitted from the stack.

METHOD 10: DETERMINATION OF CARBON MONOXIDE EMISSIONS FROM STATIONARY SOURCES

An continuous gas sample was extracted from the stack at a centroidal sampling point. The sample was transferred through a heated sample line to a carbon dioxide scrubber and then to a Luft-type nondispersive infrared analyzer (NDIR) for analysis of carbon monoxide.

METHOD 20: DETERMINATION OF NITROGEN OXIDES, SULFUR DIOXIDE, AND OXYGEN EMISSIONS FROM STATIONARY GAS FIRED TURBINES

A continuous gas sample was extracted from the stack at a centroidal sampling point. The sample was transferred through a heated sample line to a chemiluminescence analyzer for analysis of nitrogen oxides concentration.

## IV. **ANALYTICAL TECHNIQUE**

All samples collected were analyzed in the field using continuous analyzers. Oxides of nitrogen concentration was determined using a chemiluminescence analyzer and carbon monoxide concentration was determined using a nondispersive infrared analyzer.

## V. CHAIN of CUSTODY

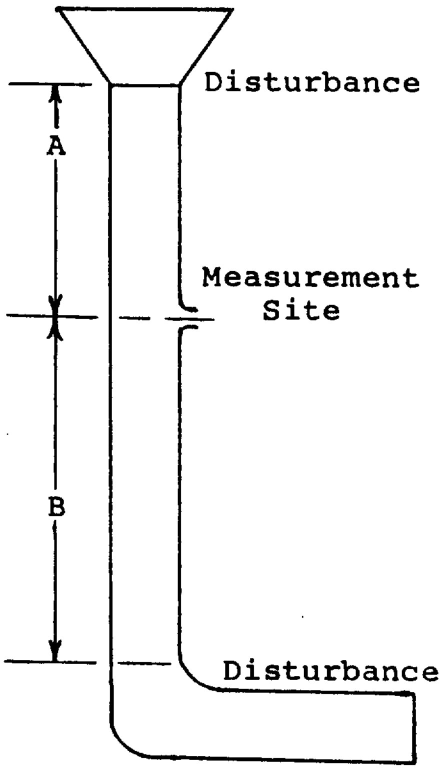
No samples were transported to the laboratory for analysis.

## VI. TEST DATA & CALCULATIONS

All data obtained during testing are contained in this section along with the associated data reduction calculations. Turbine operating data collected during testing and fuel gas analysis are also included at the end of this section.

# ETS
EMISSION TESTING SERVICES, INC.

## Traverse Point Layout




Client Amoco

Date 06-27-88

Unit Tested Turbine

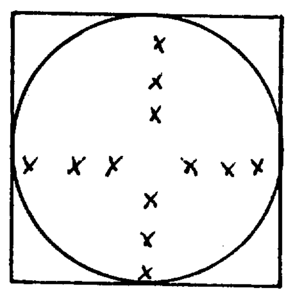
Location Morganza, LA.

Upstream Distance (A) ______

Downstream Distance (B) ______

Inside Diameter 24"

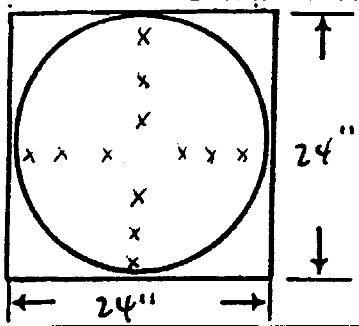
Coupling Length 8.5"

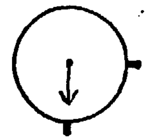


Cross Section Schematic of Stack

| Traverse Point | Distance % of Diameter | | Stack Diameter | | Coupling Length | | Traverse Points |
|---|---|---|---|---|---|---|---|
| 1 | .044 | x | 24" | + | 8.5" | = | 9.556 |
| 2 | .146 | | " | | " | | 12.004 |
| 3 | .296 | | " | | " | | 15.604 |
| 4 | .704 | | " | | " | | 25.396 |
| 5 | .854 | | " | | " | | 28.996 |
| 6 | .956 | | " | | " | | 31.444 |
| 7 | | | | | | | |
| 8 | | | | | | | |
| 9 | | | | | | | |
| 10 | | | | | | | |
| 11 | | | | | | | |

CROSS SECTIONAL SCHEMATIC OF STACK
TRAVERSE POINT LAYOUT



DRAW ARROW NORTH

# ETS FIELD DATA, METHOD(S) 1-4

| | | | | | |
|---|---|---|---|---|---|
| PLANT | Amoco | SAMPLE BOX NO. | 00 | STACK DIAMETER, In. | 24" |
| DATE | 06-28-88 | METER BOX NO. | 586 | PITOT TUBE NO. | P-3-3 |
| LOCATION | Morganza LA. | AMBIENT TEMPERATURE | 85°F | PITOT FACTOR | .800 |
| OPERATOR | K. Thibodeaux | BAROMETRIC PRESSURE | 29.96 | METER ΔHe | 1.844 |
| STACK NO. | Turbine | FILTER TARE wt mg | — | D.G.M.C. FACTOR | 1.037 |
| RUN NO. | 1 | PROBE LENGTH, In. | 3' | K FACTOR | — |

| TRAVERSE POINT NUMBER | SAMPLING TIME (Θ), min. | STATIC PRESSURE (In. $H_2O$) | STACK TEMP ($T_s$), °F | VELOCITY HEAD ($\Delta P_s$) | VELOCITY HEAD ($\sqrt{\Delta P_s}$) | PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) In., $H_2O$ ACTUAL | DESIRED | GAS SAMPLE VOLUME (Vm), ft3 | GAS SAMPLE TEMPERATURE AT DRY GAS METER INLET ($T_{min}$), °F | OUTLET ($T_{mout}$), °F | SAMPLE BOX TEMPERATURE °F | TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER F | PUMP VACUUM In. Hg gauge |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0845 | +0.605 | 723 | 2.250 | 1.500 | 1.500 | 1.500 | 180.501 | 77 | 81 | 226 | 63 | 7.0 |
| 2 | 0850 | off @ | 776 | 2.400 | 1.550 | \| | \| | 186.441 | 82 | 89 | 242 | 65 | 6.9 |
| 3 | 0900 | on @ | 808 | 2.700 | 1.643 | 1.500 | 1.500 | 201.643 | | | | | |
| 4 | 0923 | off @ | 813 | 3.000 | 1.732 | | | | | | | | |
| 5 | | 〃 | 808 | 3.100 | 1.760 | | | | | | | | |
| 6 | | | 814 | 3.050 | 1.746 | | | | | | | | |
| 7 | | | 791 | 2.150 | 1.470 | | | | | | | | |
| 8 | | | 804 | 2.650 | 1.630 | | | | | | | | |
| 9 | | | 812 | 3.000 | 1.732 | | | | | | | | |
| 10 | | | 811 | 2.850 | 1.690 | | | | | | | | |
| 11 | | | 809 | 3.100 | 1.760 | | | | | | | | |
| 12 | | | 811 | 2.550 | 1.600 | | | | | | | | |
| AVERAGE | 28 | +0.605 | 798 | | 1.651 | 1.5 | | 21.142 | 82 | | | | |

| VOLUME OF LIQUID WATER COLLECTED | IMPINGER WEIGHTS | | | |
|---|---|---|---|---|
| FINAL | 559.8 | 558.1 | 448.3 | 569.7 |
| INITIAL | 537.7 | 552.2 | 448.3 | 562.5 |
| WEIGHT COLLECTED | 22.1 | 5.9 | 0.4 | 7.2 |
| TOTAL WEIGHT | | | | 35.6 |

ORSAT MEASUREMENT

| | $CO_2$ | $O_2$ | CO | $N_2$ |
|---|---|---|---|---|
| 1 | 2.4 | 16.9 | 0.0 | 80.7 |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |

COMMENTS:

PRE-LEAK CHECK GOOD @ 9.9" H.G.
POST-LEAK CHECK GOOD @ 8.0" H.G.
Pitot tube Leak Check Wet-82°F
Good @ 6.2" $H_2O$
Dry-89°F

Emission Testing Services, Inc.
P.O. Box 15075
Baton Rouge, LA 70895
504-925-8405

Client : AMOCO
Source : TURBINE
Testing Date : 6-28-88
Run : 1

## DETERMINATION OF STACK GAS MOISTURE CONTENT

| | |
|---|---|
| Bws | - Moisture fraction content |
| Mw | - Molecular weight of water, 18.0 lb/ lb mole |
| Pm | - Absolute pressure at meter, in-Hg |
| Ps | - Standard absolute pressure, 29.92 in-Hg |
| R | - Ideal gas constant, 21.85 in-Hg ft3/ lb-mole deg R |
| Tm | - Absolute temperature at meter, deg R |
| Ts | - Standard absolute temperature, 528 deg R |
| Vm | - Dry gas volume measured by meter, DCF |
| Vms | - Dry gas volume at standard conditions, DSCF |
| Vwc | - Volume of water vapor collected by impingers, SCF |
| Vwsg | - Volume of water vapor collected by silica gel, SCF |
| Wc | - Total weight of impinger water, lb |
| Wsg | - Total weight of silica gel water, lb |
| Y | - Dry gas meter calibration factor |

$$Wc = (\ 22.1\ g)+(\ 5.9\ g)+(\ .4\ g)/(453.6\ g/lb) = .06261$$

$$Wsg = (\ 7.2\ g)/(453.6\ g/lb) = .01587$$

$$Vwc = \frac{Wc\ R\ Ts}{Ps\ Mw} = \frac{(\ .06261\ )(\ 21.85\ )(\ 528\ )}{(\ 29.92\ )(\ 18.0\ )} = 1.34121$$

$$Vwsg = \frac{Wsg\ R\ Ts}{Ps\ Mw} = \frac{(\ .01587\ )(\ 21.85\ )(\ 528\ )}{(\ 29.92\ )(\ 18.0\ )} = .34003$$

$$Vms = Vm\ Y\frac{Pm\ Ts}{Ps\ Tm} = (\ 21.142)(\ 1.037\ )\frac{(\ 29.96\ )(\ 528\ )}{(\ 29.92\ )(\ 542.)} = 21.37663$$

$$Bws = \frac{Vwc + Vwsg}{Vwc + Vwsg + Vms} =$$

$$= \frac{(\ 1.34121\ ) + (\ .34003\ )}{(\ 1.34121\ ) + (\ .34003\ ) + (\ 21.37663)} = .0729$$

Emission Testing Services, Inc.
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Baton Rouge, LA 70895
504-925-8405

Client : AMOCO
Source : TURBINE
Testing Date : 6-28-88
Run : 1

## DETERMINATION OF DRY MOLECULAR WEIGHT

Md - Dry molecular weight, lb/ lb-mole
%CO2 - Percent CO2 by volume ( dry basis )
%O2 - Percent O2 by volume ( dry basis )
%CO - Percent CO by volume ( dry basis )
%N2 - Percent N2 by volume ( dry basis )
0.280 - Molecular weight of N2 or CO, divided by 100
0.320 - Molecular weight of O2, divided by 100
0.440 - Molecular weight of CO2, divided by 100

$$Md = 0.440(\ \%CO2\ ) + 0.320(\ \%O2\ ) + 0.280(\ \%N2 + \%CO\ )$$

$$Md = 0.440(\ 2.4\ ) + 0.320(\ 16.9\ ) + 0.280(\ 80.7 + .0\ )$$

$$= 29.060$$

Emission Testing Services, Inc.
P.O. Box 15075
Baton Rouge, LA 70895
504-925-8405

Client : AMOCO
Source : TURBINE
Testing Date : 6-28-88
Run : 1

## DETERMINATION OF STACK GAS VELOCITY AND VOLUMETRIC FLOW RATE

- A - Cross-sectional area of stack, ft2
- Bws - Moisture fraction of stack gas
- Cp - Pitot tube coefficient
- dP - Average, square root of velocity head of stack gas
- Kp - Pitot tube constant, ft/sec ( lb in-Hg/ lb-mole deg R in Hg)¼0.5
- Md - Molecular weight of stack gas, dry basis, lb/ lb-mole
- Ms - Molecular weight of stack gas, wet basis, lb/ lb-mole
- Pbar - Barometric pressure at measurement site, in-Hg
- Pg - Static pressure of the stack gas, in H2O
- Ps - Absolute stack gas pressure, in-Hg
- Pstd - Standard absolute pressure, 29.92 in-Hg
- Qsd - Dry volumetric stack gas flow rate standard conditions, DSCF/Hr
- Ts - Average stack gas temperature, deg R
- Tstd - Standard absolute temperature, 528 deg R
- Vs - Average stack gas velocity, ft/sec
- 3600 - Conversion factor, sec to Hr
- 18.0 - Molecular weight of water, lb/lb-mole

$$Ms = Md\,(1 - Bws) + 18.0\,(Bws) =$$

$$= (29.060)(1 - .0729) + (18.0)(.0729) = 28.254$$

$$Vs = Kp\ Cp\ Dp \left(\frac{Ts}{Ps\ Ms}\right)^{0.5} =$$

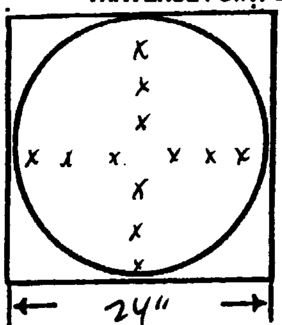
$$= (85.49)(.800)(1.650)\left(\frac{1258.}{[30.004][28.254]}\right)^{0.5} = 137.5098$$

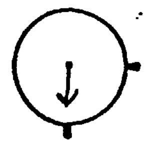
$$Qsd = 3600\,(1 - Bws)\ Vs\ A\ \frac{Tstd}{Ts}\ \frac{Ps}{Pstd} =$$

$$Qsd = 3600(1 - .0729)(137.5098)(3.1416)\frac{(528)(30.004)}{(1258.)(29.92)}$$

$$= 606692.7$$

CROSS SECTIONAL SCHEMATIC OF STACK TRAVERSE POINT LAYOUT





DRAW ARROW NORTH

# ETS FIELD DATA, METHOD(S) 1-4

| | | | |
|---|---|---|---|
| PLANT Amoco | SAMPLE BOX NO. EE | STACK DIAMETER, in. 24" |
| DATE 062888 | METER BOX NO. 586 | PITOT TUBE NO. P-3-3 |
| LOCATION Morganza LA. | AMBIENT TEMPERATURE 92°F | PITOT FACTOR .800 |
| OPERATOR K. Thibodeaux | BAROMETRIC PRESSURE 29.99 | METER Δ H@ 1.844 |
| STACK NO. Turbine | FILTER TARE wt mg — | D.G.M.C. FACTOR 1.037 |
| RUN NO. 2 | PROBE LENGTH, in. 3' | K FACTOR — |

| TRAVERSE POINT NUMBER | SAMPLING TIME (θ), min. | STATIC PRESSURE (in.H2O) | STACK TEMP (Ts), °F | VELOCITY HEAD (ΔPs) | VELOCITY HEAD (√ΔPs) | PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in., H2O ACTUAL | DESIRED | 223 GAS SAMPLE VOLUME (Vm), ft3 | GAS SAMPLE TEMPERATURE AT DRY GAS METER INLET (Tmin), °F | OUTLET (Tmout), °F | SAMPLE BOX TEMPERATURE °F | TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER F | PUMP VACUUM in. Hg gauge |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1100 | +0.650 | 793 | 2.150 | 1.470 | 1.500 | 1.500 | 202.047 | 97 | 100 | 242 | 66 | 2.0 |
| 2 | 1137 | off@ | 804 | 2.200 | 1.483 | \| | \| | 223.102 | 103 | 110 | 276 | 58 | 2.0 |
| 3 | | | 808 | 2.550 | 1.599 | 1.500 | 1.500 | | | | | | |
| 4 | | | 817 | 3.100 | 1.760 | | | | | | | | |
| 5 | | | 818 | 2.550 | 1.5[illegible] | | | | | | | | |
| 6 | | | 823 | 3.050 | 1.746 | | | | | | | | |
| 7 | | | 803 | 2.950 | 1.718 | | | | | | | | |
| 8 | | | 818 | 2.650 | 1.628 | | | | | | | | |
| 9 | | | 826 | 2.700 | 1.643 | | | | | | | | |
| 10 | | | 827 | 2.700 | 1.643 | | | | | | | | |
| 11 | | | 825 | 2.600 | 1.612 | | | | | | | | |
| 12 | | | 826 | 2.950 | 1.718 | | | | | | | | |
| AVERAGE | 32 min | +0.650 | 815.66 | | 1.635 | 1.500 | | 21.055 | 102.5 | | | | |

| VOLUME OF LIQUID WATER COLLECTED | IMPINGER WEIGHTS | | | |
|---|---|---|---|---|
| FINAL | 565.4 | 547.1 | 438.9 | 554.4 |
| INITIAL | 547.4 | 541.2 | 437.0 | 545.7 |
| WEIGHT COLLECTED | 18.0 | 5.9 | 1.9 | 8.7 |
| TOTAL WEIGHT | | | | 34.5 |

ORSAT MEASUREMENT

| | CO2 | O2 | CO | N2 |
|---|---|---|---|---|
| 1 | 2.4 | 17.0 | 0.0 | 80.6 |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |

COMMENTS: Dry - 103°F

PRE-LEAK CHECK GOOD @ 11" H.G.

POST-LEAK CHECK GOOD @ Wet - 88°F

Pitot tube Check Good @ 4.5" H2O

Emission Testing Services, Inc.
P.O. Box 15075
Baton Rouge, LA 70895
504-925-8405

Client : AMOCO
Source : TURBINE
Testing Date : 6-28-88
Run : 2

## DETERMINATION OF STACK GAS MOISTURE CONTENT

- Bws - Moisture fraction content
- Mw - Molecular weight of water, 18.0 lb/ lb mole
- Pm - Absolute pressure at meter, in-Hg
- Ps - Standard absolute pressure, 29.92 in-Hg
- R - Ideal gas constant, 21.85 in-Hg ft3/ lb-mole deg R
- Tm - Absolute temperature at meter, deg R
- Ts - Standard absolute temperature, 528 deg R
- Vm - Dry gas volume measured by meter, DCF
- Vms - Dry gas volume at standard conditions, DSCF
- Vwc - Volume of water vapor collected by impingers, SCF
- Vwsg - Volume of water vapor collected by silica gel, SCF
- Wc - Total weight of impinger water, lb
- Wsg - Total weight of silica gel water, lb
- Y - Dry gas meter calibration factor

$$Wc = (18.0\ g)+(5.9\ g)+(1.9\ g)/(453.6\ g/lb) = .05688$$

$$Wsg = (8.7\ g)/(453.6\ g/lb) = .01918$$

$$Vwc = \frac{Wc\ R\ Ts}{Ps\ Mw} = \frac{(.05688)(21.85)(528)}{(29.92)(18.0)} = 1.21842$$

$$Vwsg = \frac{Wsg\ R\ Ts}{Ps\ Mw} = \frac{(.01918)(21.85)(528)}{(29.92)(18.0)} = .41086$$

$$Vms = Vm\ Y\frac{Pm\ Ts}{Ps\ Tm} = (21.055)(1.037)\frac{(29.99)(528)}{(29.92)(563.)} = 20.54284$$

$$Bws = \frac{Vwc + Vwsg}{Vwc + Vwsg + Vms} =$$

$$= \frac{(1.21842) + (.41086)}{(1.21842) + (.41086) + (20.54284)} = .0735$$

Emission Testing Services, Inc.
P.O. Box 15075
Baton Rouge, LA 70895
504-925-8405

Client : AMOCO
Source : TURBINE
Testing Date : 6-28-88
Run : 2

DETERMINATION OF DRY MOLECULAR WEIGHT

| | |
|---|---|
| Md | - Dry molecular weight, lb/ lb-mole |
| %CO2 | - Percent CO2 by volume ( dry basis ) |
| %O2 | - Percent O2 by volume ( dry basis ) |
| %CO | - Percent CO by volume ( dry basis ) |
| %N2 | - Percent N2 by volume ( dry basis ) |
| 0.280 | - Molecular weight of N2 or CO, divided by 100 |
| 0.320 | - Molecular weight of O2, divided by 100 |
| 0.440 | - Molecular weight of CO2, divided by 100 |

$$Md = 0.440( \%CO2 ) + 0.320( \%O2 ) + 0.280( \%N2 + \%CO )$$

$$Md = 0.440( 2.4 ) + 0.320( 17.0 ) + 0.280( 80.6 + .0 )$$

$$= 29.064$$

Emission Testing Services, Inc.
P.O. Box 15075
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Client : AMOCO
Source : TURBINE
Testing Date : 6-28-88
Run : 2

## DETERMINATION OF STACK GAS VELOCITY AND VOLUMETRIC FLOW RATE

- A - Cross-sectional area of stack, ft2
- Bws - Moisture fraction of stack gas
- Cp - Pitot tube coefficient
- dP - Average, square root of velocity head of stack gas
- Kp - Pitot tube constant, ft/sec ( lb in-Hg/ lb-mole deg R in Hg)¼0.5
- Md - Molecular weight of stack gas, dry basis, lb/ lb-mole
- Ms - Molecular weight of stack gas, wet basis, lb/ lb-mole
- Pbar - Barometric pressure at measurement site, in-Hg
- Pg - Static pressure of the stack gas, in H2O
- Ps - Absolute stack gas pressure, in-Hg
- Pstd - Standard absolute pressure, 29.92 in-Hg
- Qsd - Dry volumetric stack gas flow rate standard conditions, DSCF/Hr
- Ts - Average stack gas temperature, deg R
- Tstd - Standard absolute temperature, 528 deg R
- Vs - Average stack gas velocity, ft/sec
- 3600 - Conversion factor, sec to Hr
- 18.0 - Molecular weight of water, lb/lb-mole

$$Ms = Md ( 1 - Bws ) + 18.0 ( Bws ) =$$

$$= ( 29.064 )( 1 - .0735 ) + ( 18.0 )( .0735 ) = 28.251$$

$$Vs = Kp\ Cp\ Dp \left( \frac{Ts}{Ps\ Ms} \right)^{0.5} =$$

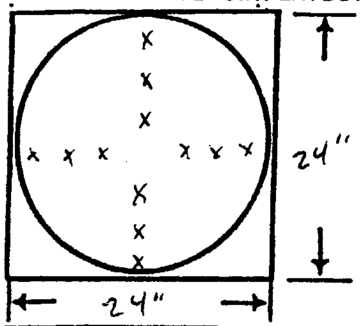
$$=( 85.49 )( .800 )( 1.634 )\left( \frac{1276.}{[ 30.038 ][ 28.251 ]} \right)^{0.5} =137.0463$$

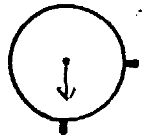
$$Qsd = 3600 ( 1 - Bws )\ Vs\ A\ \frac{Tstd}{Ts}\ \frac{Ps}{Pstd} =$$

$$Qsd = 3600( 1 - .0735 )( 137.0463 )( 3.1416 )\frac{( 528 )( 30.038 )}{( 1276. )( 29.92 )}$$

$$= 596727.0$$

CROSS SECTIONAL SCHEMATIC OF STACK
TRAVERSE POINT LAYOUT



DRAW ARROW NORTH

# ETS FIELD DATA, METHOD(S) 1-4

PLANT Amoco
DATE 0628-88
LOCATION Morganza LA
OPERATOR K. Thibodeaux
STACK NO. Turbine
RUN NO. 3

SAMPLE BOX NO. OO
METER BOX NO. 586
AMBIENT TEMPERATURE 98°F
BAROMETRIC PRESSURE 29.98
FILTER TARE wt mg —
PROBE LENGTH, in. 3'

STACK DIAMETER, in. 24"
PITOT TUBE NO. P-3-3
PITOT FACTOR .800
METER ΔH@ 1.844
D.G.M.C. FACTOR 1.037
K FACTOR —

| TRAVERSE POINT NUMBER | SAMPLING TIME (Θ), min. | STATIC PRESSURE (in.H₂O) | STACK TEMP (Ts), °F | VELOCITY HEAD (ΔPs) | VELOCITY HEAD (√ΔPs) | PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in., H₂O ACTUAL | DESIRED | 744 GAS SAMPLE VOLUME (Vm), ft³ | GAS SAMPLE TEMPERATURE AT DRY GAS METER INLET (Tmin), °F | OUTLET (Tmout), °F | SAMPLE BOX TEMPERATURE °F | TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER F | PUMP VACUUM in. Hg gauge |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1307 | +0.650 | 677 | 1.850 | 1.360 | 1.500 | 1.500 | 223.259 | 113 | 115 | 250 | 62 | 6.2 |
| 2 | 1339 | off @ | 805 | 2.200 | 1.483 | \| | \| | 244.444 | 110 | 116 | 246 | 60 | 6.5 |
| 3 | | | 821 | 2.800 | 1.673 | 1.500 | 1.500 | | | | | | |
| 4 | | | 824 | 3.150 | 1.775 | | | | | | | | |
| 5 | | | 811 | 2.550 | 1.597 | | | | | | | | |
| 6 | | | 819 | 3.050 | 1.746 | | | | | | | | |
| 7 | | | 799 | 2.500 | 1.581 | | | | | | | | |
| 8 | | | 814 | 2.700 | 1.643 | | | | | | | | |
| 9 | | | 816 | 2.700 | 1.643 | | | | | | | | |
| 10 | | | 827 | 2.800 | 1.673 | | | | | | | | |
| 11 | | | 826 | 3.050 | 1.746 | | | | | | | | |
| 12 | | | 817 | 2.700 | 1.643 | | | | | | | | |
| AVERAGE | 32 min | +0.650 | 804.7 | | 1.636 | 1.500 | | 21.185 | 113.5 | | | | |

| VOLUME OF LIQUID WATER COLLECTED | IMPINGER WEIGHTS | | | |
|---|---|---|---|---|
| FINAL | 583.9 | 560.4 | 448.9 | 570.4 |
| INITIAL | 559.8 | 558.1 | 448.7 | 569.7 |
| WEIGHT COLLECTED | 24.1 | 2.3 | 0.2 | 0.7 |
| TOTAL WEIGHT | | | | 27.3 |

ORSAT MEASUREMENT

| | $CO_2$ | $O_2$ | CO | $N_2$ |
|---|---|---|---|---|
| 1 | 2.4 | 16.8 | 0.0 | 80.8 |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |

COMMENTS:

Wet - 86°F

PRE-LEAK CHECK GOOD @ 10.1" H.G

POST-LEAK CHECK GOOD @ 7.1" H.G. Dry - 103°F

Pitot tube Check Good @ 7.2" H₂O

Emission Testing Services, Inc.
P.O. Box 15075
Baton Rouge, LA 70895
504-925-8405

Client : AMOCO
Source : TURBINE
Testing Date : 6-28-88
Run : 3

## DETERMINATION OF STACK GAS MOISTURE CONTENT

| | |
|---|---|
| Bws | - Moisture fraction content |
| Mw | - Molecular weight of water, 18.0 lb/ lb mole |
| Pm | - Absolute pressure at meter, in-Hg |
| Ps | - Standard absolute pressure, 29.92 in-Hg |
| R | - Ideal gas constant, 21.85 in-Hg ft3/ lb-mole deg R |
| Tm | - Absolute temperature at meter, deg R |
| Ts | - Standard absolute temperature, 528 deg R |
| Vm | - Dry gas volume measured by meter, DCF |
| Vms | - Dry gas volume at standard conditions, DSCF |
| Vwc | - Volume of water vapor collected by impingers, SCF |
| Vwsg | - Volume of water vapor collected by silica gel, SCF |
| Wc | - Total weight of impinger water, lb |
| Wsg | - Total weight of silica gel water, lb |
| Y | - Dry gas meter calibration factor |

$$Wc = (24.1\ g)+(2.3\ g)+(.2\ g)/(453.6\ g/lb) = .05864$$

$$Wsg = (.7\ g)/(453.6\ g/lb) = .00154$$

$$Vwc = \frac{Wc\ R\ Ts}{Ps\ Mw} = \frac{(.05864)(21.85)(528)}{(29.92)(18.0)} = 1.25621$$

$$Vwsg = \frac{Wsg\ R\ Ts}{Ps\ Mw} = \frac{(.00154)(21.85)(528)}{(29.92)(18.0)} = .03306$$

$$Vms = Vm\ Y\frac{Pm\ Ts}{Ps\ Tm} = (21.185)(1.037)\frac{(29.98)(528)}{(29.92)(574.)} = 20.26645$$

$$Bws = \frac{Vwc + Vwsg}{Vwc + Vwsg + Vms} =$$

$$= \frac{(1.25621) + (.03306)}{(1.25621) + (.03306) + (20.26645)} = .0598$$

Emission Testing Services, Inc.
P.O. Box 15075
Baton Rouge, LA 70895
504-925-8405

Client : AMOCO
Source : TURBINE
Testing Date : 6-28-88
Run : 3

## DETERMINATION OF DRY MOLECULAR WEIGHT

Md - Dry molecular weight, lb/ lb-mole
%CO2 - Percent CO2 by volume ( dry basis )
%O2 - Percent O2 by volume ( dry basis )
%CO - Percent CO by volume ( dry basis )
%N2 - Percent N2 by volume ( dry basis )
0.280 - Molecular weight of N2 or CO, divided by 100
0.320 - Molecular weight of O2, divided by 100
0.440 - Molecular weight of CO2, divided by 100

$$Md = 0.440( \%CO2 ) + 0.320( \%O2 ) + 0.280( \%N2 + \%CO )$$

$$Md = 0.440( 2.4 ) + 0.320( 16.8 ) + 0.280( 80.8 + .0 )$$

$$= 29.056$$

Emission Testing Services, Inc.
P.O. Box 15075
Baton Rouge, LA 70895
504-925-8405

Client : AMOCO
Source : TURBINE
Testing Date : 6-28-88
Run : 3

## DETERMINATION OF STACK GAS VELOCITY AND VOLUMETRIC FLOW RATE

A - Cross-sectional area of stack, ft2
Bws - Moisture fraction of stack gas
Cp - Pitot tube coefficient
dP - Average, square root of velocity head of stack gas
Kp - Pitot tube constant, ft/sec ( lb in-Hg/ lb-mole deg R in Hg)¼0.5
Md - Molecular weight of stack gas, dry basis, lb/ lb-mole
Ms - Molecular weight of stack gas, wet basis, lb/ lb-mole
Pbar - Barometric pressure at measurement site, in-Hg
Pg - Static pressure of the stack gas, in H2O
Ps - Absolute stack gas pressure, in-Hg
Pstd - Standard absolute pressure, 29.92 in-Hg
Qsd - Dry volumetric stack gas flow rate standard conditions, DSCF/Hr
Ts - Average stack gas temperature, deg R
Tstd - Standard absolute temperature, 528 deg R
Vs - Average stack gas velocity, ft/sec
3600 - Conversion factor, sec to Hr
18.0 - Molecular weight of water, lb/lb-mole

$$Ms = Md ( 1 - Bws ) + 18.0 ( Bws ) =$$

$$= ( 29.056 )( 1 - .0598 ) + ( 18.0 )( .0598 ) = 28.395$$

$$Vs = Kp\ Cp\ Dp \left( \frac{Ts}{Ps\ Ms} \right)^{0.5} =$$

$$=( 85.49 )( .800 )( 1.630 )\left( \frac{1265.}{[ 30.028 ][ 28.395 ]} \right)^{0.5} =135.8051$$

$$Qsd = 3600 ( 1 - Bws )\ Vs\ A\ \frac{Tstd}{Ts}\ \frac{Ps}{Pstd} =$$

$$Qsd = 3600( 1 - .0598 )( 135.8051 )( 3.1416 )\frac{( 528 )( 30.028 )}{( 1265. )( 29.92 )}$$

$$= 605066.4$$

# ETS

## METHOD 1Ø DATA SHEET

COMPANY Amoco Production SOURCE # 874 DATE 6/20/88

PARAMETER CO LOAD% MAX RUN NUMBER 1

## CALIBRATION STATISTICS

| | Cylinder Value | Initial Analyzer Response mv | Initial Analyzer Response ppm | Final Analyzer Response mv | Final Analyzer Response ppm | %Drift |
|---|---|---|---|---|---|---|
| Zero | N2 | -20 | 1.54 | -21 | 1.44 | -0.1 |
| Low | 29.34 | 230 | 27.48 | 227 ~~232~~ | 27.17 | -0.3 |
| Mid | 59.76 | 535 | 59.14 | 535 | 59.14 | 0 |
| High | 89.85 | 840 | 90.8 | 842 | 91.0 | 0.2 |

Calibration curve: ppm = (response mv)(slope) + intercept

Slope 0.10378 Intercept 3.61 Span Range 107.39

$$\%Drift = \frac{\text{Final response (ppm)} - \text{Initial response (ppm)}}{\text{Span (ppm)}} \times 100$$

## TEST DATA

Start time 8:45 Finish time 9:45 Minutes per point 7

Sample port A & B

| Test Point | mv | Test Point | mv | Test Point | mv |
|---|---|---|---|---|---|
| 1 | 408 | 11 | | 21 | |
| 2 | 411 | 12 | | 22 | |
| 3 | 421 | 13 | | 23 | |
| 4 | 414 | 14 | | 24 | |
| 5 | 401 | 15 | | 25 | |
| 6 | 408 | 16 | | 26 | |
| 7 | 406 | 17 | | 27 | |
| 8 | 407 | 18 | | 28 | |
| 9 | | 19 | | 29 | |
| 1Ø | | 2Ø | | 3Ø | |

Ave. mv 409.75

Ave. conc. 46.139 ppm

COMMENTS:

# ETS

## METHOD 10 DATA SHEET

COMPANY Amoco Production SOURCE # 87-4 DATE 6/28/88

PARAMETER CO LOAD% MAX RUN NUMBER 2

## CALIBRATION STATISTICS

| | Cylinder Value | Initial Analyzer Response mv | Initial Analyzer Response ppm | Final Analyzer Response mv | Final Analyzer Response ppm | %Drift |
|---|---|---|---|---|---|---|
| Zero | N2 | -21 | 1.68 | -18 | 1.99 | 0.3 |
| Low | 29.34 | 227 | 27.30 | 230 | 27.62 | 0.3 |
| Mid | 59.76 | 535 | 59.13 | 535 | 59.13 | 0 |
| High | 89.85 | 842 | 90.8 | 849 | 91.6 | 0.7 |

Calibration curve: ppm = (response mv)(slope) + intercept

Slope 0.10332 Intercept 3.85 Span Range 107.17

$$\%Drift = \frac{\text{Final response (ppm)} - \text{Initial response (ppm)}}{\text{Span (ppm)}} \times 100$$

## TEST DATA

Start time 11:00 Finish time 12:00 Minutes per point 7

Test Point mv Sample port ________

| Test Point | mv | Test Point | mv | Test Point | mv |
|---|---|---|---|---|---|
| 1 | 411 | 11 | | 21 | |
| 2 | 405 | 12 | | 22 | |
| 3 | 401 | 13 | | 23 | |
| 4 | 401 | 14 | | 24 | |
| 5 | 402 | 15 | | 25 | |
| 6 | 405 | 16 | | 26 | |
| 7 | 405 | 17 | | 27 | |
| 8 | 404 | 18 | | 28 | |
| 9 | | 19 | | 29 | |
| 10 | | 20 | | 30 | |

Ave. mv 404.25

Ave. conc. 45.616 ppm

COMMENTS:

# ETS

## METHOD 10 DATA SHEET

COMPANY Amoco Production SOURCE # 87-4 DATE 6/28/88

PARAMETER CO LOAD% ~~[illegible]~~ MAX RUN NUMBER 3

### CALIBRATION STATISTICS

| | Cylinder Value | Initial Analyzer Response mv | Initial Analyzer Response ppm | Final Analyzer Response mv | Final Analyzer Response ppm | %Drift |
|---|---|---|---|---|---|---|
| Zero | N2 | -18 | 1.80 | -20 | 1.59 | -0.2 |
| Low | 29.34 | 230 | 23.5 | 228 | 23.3 | -0.2 |
| Mid | 59.76 | 535 | 57.6 | 540 | 58.2 | 0.5 |
| High | 89.85 | 849 | 92.7 | 852 | 92.8 | 0.1 |

Calibration curve: ppm = (response mv)(slope) + intercept

Slope 0.102968 Intercept 3.65 Span Range 106.618

$$\%Drift = \frac{\text{Final response (ppm)} - \text{Initial response (ppm)}}{\text{Span (ppm)}} \times 100$$

### TEST DATA

Start time 13:00 Finish time 14:00 Minutes per point 7

Test Point mv Sample port ____________

| Test Point | mv | Test Point | mv | Test Point | mv |
|---|---|---|---|---|---|
| 1 | 422 | 11 | | 21 | |
| 2 | 416 | 12 | | 22 | |
| 3 | 418 | 13 | | 23 | |
| 4 | 410 | 14 | | 24 | |
| 5 | 401 | 15 | | 25 | |
| 6 | 391 | 16 | | 26 | |
| 7 | 404 | 17 | | 27 | |
| 8 | 399 | 18 | | 28 | |
| 9 | | 19 | | 29 | |
| 10 | | 20 | | 30 | |

Ave. mv 407.625

Ave. conc. 45.626 ppm

COMMENTS:

Emission Testing Services, Inc.
P.O. Box 15075
Baton Rouge, LA 70895
504-925-8405

Client : AMOCO
Source : TURBINE
Testing Date : 6-28-88

## CARBON MONOXIDE EMISSION RATE

ECO - Carbon Monoxide emission rate, lb/Hr
F - Conversion factor for carbon monoxide, ( $lb/ft^3$ )/( PPM )
( $M_{co}$/385 )/1,000,000 = 7.2727 X 10-8
385 - Volume of an ideal gas, $ft^3$, at 528 deg R, 29.92 in-Hg
$M_{co}$ - Molecular weight of carbon monoxide, 28.00 lb/lb-mole
COms - Concentration of CO as measured after scrubbing CO2 - PPM
CO2f - Concentration of CO2 scrubbed from sample, %/100
$CO_{vv}$ - Concentration of carbon monoxide, corr. for CO2 - PPM
$CO_{wv}$ - Concentration of carbon monoxide - $lb/ft^3$
$Q_{sd}$ - Dry volumetric stack gas flow rate, DSCF/Hr

### CORRECTED CO CONCENTRATION FOR CO2 SCRUBBED

COvv = COms ( 1 - CO2f )

------ RUN # 1 ------

COvv = ( 46.139 )( 1 - 0.024 ) = 45.032

$CO_{wv}$ = $CO_{vv}$ F = ( 45.032 )( 7.2727 X 10-8 ) = 3.275 X 10-6

ECO = $Q_{sd}$ $CO_{wv}$ = ( 606692.7 )( 3.275 X 10-6 ) = 1.987

------ RUN # 2 ------

COvv = ( 45.616 )( 1 - 0.024 ) = 44.521

$CO_{wv}$ = $CO_{vv}$ F = ( 44.521 )( 7.2727 X 10-8 ) = 3.237 X 10-6

ECO = $Q_{sd}$ $CO_{wv}$ = ( 596727.0 )( 3.237 X 10-6 ) = 1.932

------ RUN # 3 ------

COvv = ( 45.626 )( 1 - 0.024 ) = 44.531

$CO_{wv}$ = $CO_{vv}$ F = ( 44.531 )( 7.2727 X 10-8 ) = 3.238 X 10-6

ECO = $Q_{sd}$ $CO_{wv}$ = ( 605066.4 )( 3.238 X 10-6 ) = 1.960

**METHOD 20**

**OXYGEN TRAVERSE DATA SHEET**

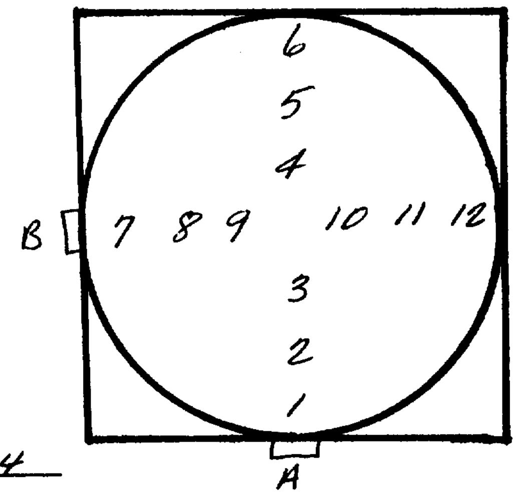
COMPANY: Amoco Production SOURCE: Turbine #874

DATE: June 27, 1988

OPERATOR: [illegible]

NUMBER OF PORTS: 2

STACK TYPE: Circular




LEAST SQUARES CURVE:

% OXYGEN = (mv reading)(2.6006) - 0.644

| PORT/TRAVERSE POINT | OXYGEN READING (mv) | OXYGEN CONCENTRATAION (%) |
|---|---|---|
| A1 | 6.93 | 17.378 |
| A2 | 6.93 | 17.378 |
| A3 | 6.91 | 17.326 |
| A4 | 6.93 | 17.378 |
| A5 | 6.89 | 17.274 |
| A6 | 6.90 | 17.300 |
| | | |
| B7 | 6.90 | 17.300 |
| B8 | 6.91 | 17.326 |
| B9 | 6.91 | 17.326 |
| B10 | 6.87 | 17.222 |
| B11 | 6.90 | 17.300 |
| B12 | 6.90 | 17.300 |
| | 6.92 | 17.352 |

METHOD 20 DATA SHEET

RESPONSE TIME TEST

COMPANY: Amoco Production SOURCE: Turbine #87-4

DATE: June 27, 1988 ANALYZER: Thermox

OPERATOR: [signature] SPAN GAS: 13.13%

| UPSCALE TIME | | | DOWNSCALE TIME | | |
|---|---|---|---|---|---|
| 1) | 70 | sec. | 1) | 58 | sec. |
| 2) ✓ | 52 | sec. | 2) ✓ | 50 | sec. |
| 3) ✓ | 52 | sec. | 3) ✓ | 54 | sec. |
| 4) ✓ | 54 | sec. | 4) ✓ | 57 | sec. |
| 5) | | sec. | 5) | | sec. |
| 6) | | sec. | 6) | | sec. |
| AVG. | 52.67 | sec. | AVG. | 53.67 | sec. |

Greater Avg. = 53.67 sec.

Analyzer responce time = 60 + avg.

ART = 114 sec.

# ETS
EMISSION TESTING SERVICES, INC.

## STATIONARY GAS TURBINE DATA SHEET

COMPANY Amoco Production SOURCE # 874 DATE 6/28/88

PARAMETER NOx LOAD% MAX RUN NUMBER 1

## CALIBRATION STATISTICS

| | Cylinder Value | Initial Analyzer Response mv | Initial Analyzer Response ppm | Final Analyzer Response mv | Final Analyzer Response ppm | %Drift |
|---|---|---|---|---|---|---|
| Zero | N2 | 4 | 1.5 | 6 | 1.9 | 0.2 |
| Low | 40.82 | 182 | 40.6 | 186 | 41.5 | 0.4 |
| Mid | 79.81 | 351 | 77.7 | 349 | 77.3 | -0.2 |
| High | 198.93 | 906 | 199.8 | ~~899~~ 902 | 198.9 | -0.4 |

Calibration curve: ppm = (response mv)(slope) + intercept

Slope 0.21986 Intercept 0.58 Span Range 220.44

%Drift = (Final response (ppm) - Initial response (ppm)) / Initial response (ppm) X 100

## TEST DATA

Temperature: WB 82 DB 89 BP ______

Start time 8:45 Finish time 9:45 Minutes per point 7

Sample port "A" : "B"

| Test Point | mv |
|---|---|
| 1 | 128 |
| 2 | 128 |
| 3 | 130 |
| 4 | 131 |
| 5 | 129 |
| 6 | 133 |
| 7 | 134 |
| 8 | 126 |
| average | 129.875 |

ppm 29.130

R.H. = 74%

S.H. = 0.02225

COMMENTS:

ETS
EMISSION TESTING SERVICES, INC.

# STATIONARY GAS TURBINE DATA SHEET

COMPANY Amoco Production SOURCE # 87-4 DATE 6/28/88

PARAMETER NOx LOAD% MAX RUN NUMBER 2

## CALIBRATION STATISTICS

| | Cylinder Value | Initial Analyzer Response mv | Initial Analyzer Response ppm | Final Analyzer Response mv | Final Analyzer Response ppm | %Drift |
|---|---|---|---|---|---|---|
| Zero | N2 | 6 | 1.28 | 9 | 1.95 | 0.3 |
| Low | 40.82 | 186 | 41.2 | 188 | 41.6 | 0.2 |
| Mid | 79.81 | 349 | 77.3 | 348 | 77.1 | -0.1 |
| High | 198.93 | 902 | 199.82 | 899 | 199.16 | -0.3 |

Calibration curve: ppm = (response mv)(slope) + intercept

Slope 0.22159 Intercept -0.049 Span Range 221.541

$$\%Drift = \frac{\text{Final response (ppm) - Initial response (ppm)}}{\text{Initial response (ppm)}} \times 100$$

## TEST DATA

Temperature: WB 85 DB 101 BP ______

Start time 11:00 Finish time 12:00 Minutes per point 7

Sample port ______

| Test Point | mv |
|---|---|
| 1 | 127 |
| 2 | 125 |
| 3 | 128 |
| 4 | 131 |
| 5 | 129 |
| 6 | 126 |
| 7 | 132 |
| 8 | 131 |
| average | |

ppm 28.453

R.H = 52%

S.H = 0.0226

COMMENTS: 128.625

**ETS**
**EMISSION TESTING SERVICES, INC.**

# STATIONARY GAS TURBINE DATA SHEET

COMPANY *Amoco Production* SOURCE # *92-4* DATE *6/28/88*

PARAMETER *NOx* LOAD% *MAX* RUN NUMBER *3*

## CALIBRATION STATISTICS

| | Cylinder Value | Initial Analyzer Response mv | Initial Analyzer Response ppm | Final Analyzer Response mv | Final Analyzer Response ppm | %Drift |
|---|---|---|---|---|---|---|
| Zero | $N_2$ | 9 | 1.366 | 10 | 1.588 | 0.1 |
| Low | 40.82 | 188 | 42.20 | 188 | 42.20 | 0 |
| Mid | 79.81 | 348 | 77.59 | 347 | 77.37 | -0.1 |
| High | 198.93 | 899 | 199.5 | 896 | 198.8 | -0.3 |

Calibration curve: ppm = (response mv)(slope) + intercept

Slope *0.22308* Intercept *-0.643* Span Range *222.437*

$$\%Drift = \frac{\text{Final response (ppm)} - \text{Initial response (ppm)}}{\text{Initial response (ppm)}} \times 100$$

## TEST DATA

Temperature: WB *86* DB *103* BP ________

Start time *13:00* Finish time *14:00* Minutes per point *7*

Sample port ________

| Test Point | mv |
|---|---|
| 1 | 132 |
| 2 | 131 |
| 3 | 133 |
| 4 | 128 |
| 5 | 126 |
| 6 | 131 |
| 7 | 128 |
| 8 | 127 |
| average | 129.5 |

ppm *28.246*

COMMENTS:

Emission Testing Services, Inc.
P.O. Box 15075
Baton Rouge, LA 70895
504-925-8405

Client : AMOCO
Source : TURBINE
Testing Date : 6-28-88

## OXIDES OF NITROGEN EMISSION RATE - SUBPART GG

ENOX - Oxides of nitrogen as NO2, emission rate, lb/Hr
F - Conversion factor for NO2, 1.1948 X 10-7 ( $lb/ft^3$ )/(PPM)
$NOX_{vv}$ - NOX Conc. as NO2, ISO conditions, PPM
$NOX_{wv}$ - NOX Conc. as NO2, ISO conditions, $lb/ ft^3$
$Q_{sd}$ - Dry volumetric stack gas flow rate, DSCF/Hr
$CONC_c$ - NOX conc. as measured, PPM
$P_{ref}$ - Reference combuster inlet pressure, at ISO conditions, supplied by Turbine manufacturer, Kilopascals absolute
$P_{obs}$ - Measured combuster inlet pressure, Kilopascals absolute
$H_{obs}$ - Specific humidity of ambient air, lb H2O/ lb dry air
$T_{amb}$ - Measured ambient temperature, DEG. K

### CORRECTION TO ISO STANDARD DAY CONDITIONS

$$NOX_{vv} = CONC_c \left( \frac{P_{ref}}{P_{obs}} \right)^{0.5} \left( e^{19(H_{obs} - 0.00633)} \right) \left( \frac{288}{T_{amb}} \right)^{1.53}$$

------ RUN # 1 ------

$$NOX_{vv} = (29.130) \left( \frac{496.4}{464.2} \right)^{0.5} \left( e^{19(0.0222 - 0.00633)} \right) \left( \frac{288}{304.7} \right)^{1.53} =$$

$NOX_{wv}$ = $NOX_{vv}$ F = ( 35.536 )( 1.1948 X $10^{-7}$ ) = 4.245 X 10-6

ENOX = $Q_{sd}$ $NOX_{wv}$ = (606692.7 )( 4.245 X 10-6 ) = 2.576

------ RUN # 2 ------

$$NOX_{vv} = (28.453) \left( \frac{496.4}{455.1} \right)^{0.5} \left( e^{19(0.0244 - 0.00633)} \right) \left( \frac{288}{312.4} \right)^{1.53} =$$

$NOX_{wv}$ = $NOX_{vv}$ F = ( 34.939 )( 1.1948 X $10^{-7}$ ) = 4.174 X 10-6

ENOX = $Q_{sd}$ $NOX_{wv}$ = (596727.0 )( 4.174 X 10-6 ) = 2.491

------ RUN # 3 ------

$$NOX_{vv} = (28.246) \left( \frac{496.4}{452.3} \right)^{0.5} \left( e^{19(0.0232 - 0.00633)} \right) \left( \frac{288}{312.4} \right)^{1.53} =$$

$NOX_{wv}$ = $NOX_{vv}$ F = ( 34.137 )( 1.1948 X $10^{-7}$ ) = 4.078 X 10-6

ENOX = $Q_{sd}$ $NOX_{wv}$ = (605066.4 )( 4.078 X 10-6 ) = 2.468

Emission Testing Services, Inc.
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Baton Rouge, LA 70895
504-925-8405

Client : AMOCO
Source : TURBINE
Testing Date : 6-28-88

# OXIDES OF NITROGEN CONCENTRATION

## CORRECTED TO 15 % OXYGEN - ISO STANDARD DAY CONDITIONS

### CORRECTION TO 15 % OXYGEN

$CONC_{meas}$ - NOX concentration as measured, Corr. to ISO, PPM
$CONC_c$ - NOX concentration corrected to 15% OXYGEN, PPM
$O2_{conc}$ - Measured oxygen concentration, %

$$CONC_c = CONC_{meas} \frac{5.9}{20.9 - O2_{conc}}$$

------ RUN # 1 ------

$$CONC_c = ( 35.536 ) \frac{5.9}{20.9 - ( 16.9 )} = 52.416$$

------ RUN # 2 ------

$$CONC_c = ( 34.939 ) \frac{5.9}{20.9 - ( 17.0 )} = 52.856$$

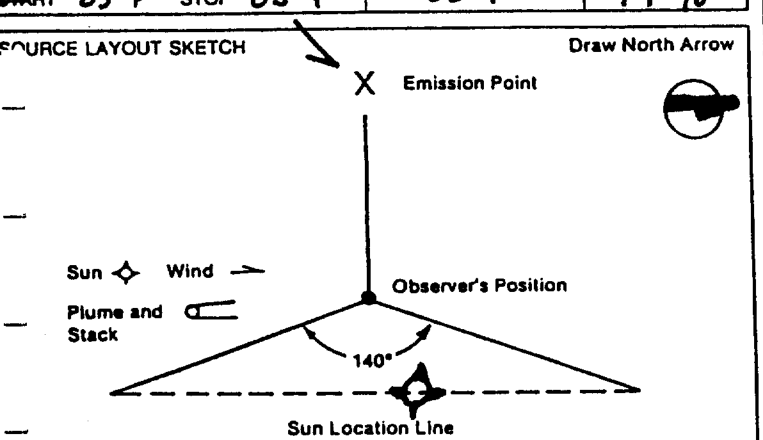
------ RUN # 3 ------

$$CONC_c = ( 34.137 ) \frac{5.9}{20.9 - ( 16.8 )} = 49.124$$

# VISIBLE EMISSION OBSERVATION FORM

| | |
|---|---|
| RCE NAME | Co-Generation Turbine |
| RESS | AMOCO PRODUCTION COMPANY |
| | Rt 1A Box 42 |
| (city) | Morganza |
| STATE | LA |
| ZIP | 70759 |
| ONE | 04) 694-3630 |
| SOURCE ID NUMBER | 87-4 |
| CESS EQUIPMENT | Turbine Generator |
| OPERATING MODE | MAX |
| ITROL EQUIPMENT | N/A |
| OPERATING MODE | N/A |
| ESCRIBE EMISSION POINT — RT | 1' Above Stack |
| STOP | SAME |
| GHT ABOVE GROUND LEVEL — TART | 30' |
| STOP | SAME |
| HEIGHT RELATIVE TO OBSERVER — START | 24.2' |
| STOP | SAME |
| TANCE FROM OBSERVER — RT | 200' |
| STOP | 200' |
| DIRECTION FROM OBSERVER — START | WEST |
| STOP | SAME |
| ESCRIBE EMISSIONS — RT | NONE |
| STOP | NONE |
| SSION COLOR — TART | N/A |
| STOP | SAME |
| PLUME TYPE | CONTINUOUS ☐ FUGITIVE ☐ INTERMITTENT ☐ |
| TER DROPLETS PRESENT | NO ☒ YES ☐ |
| IS WATER DROPLET PLUME | ATTACHED ☐ DETACHED ☐ |
| OINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED — TART | N/A |
| STOP | SAME |
| SCRIBE BACKGROUND — START | HAZY |
| STOP | SAME |
| CKGROUND COLOR — ART | Gray |
| STOP | SAME |
| SKY CONDITIONS — START | CLEAR |
| STOP | SAME |
| WIND SPEED — START | 3MPH |
| STOP | 5MPH |
| WIND DIRECTION — START | WSW |
| STOP | SAME |
| BIENT TEMP — ART | 83°F |
| STOP | 85°F |
| WET BULB TEMP | 82°F |
| RH, percent | 74% |

SOURCE LAYOUT SKETCH




OMMENTS

AVE RECEIVED A COPY OF THESE OPACITY OBSERVATIONS

SIGNATURE

TITLE

DATE

| OBSERVATION DATE | START TIME | STOP TIME |
|---|---|---|
| 062888 | 0845 | 0905 |

| MIN \ SEC | 0 | 15 | 30 | 45 | MIN \ SEC | 0 | 15 | 30 | 45 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 | 31 | | | | |
| 2 | 0 | 0 | 0 | 0 | 32 | | | | |
| 3 | 0 | 0 | 0 | 0 | 33 | | | | |
| 4 | 0 | 0 | 0 | 0 | 34 | | | | |
| 5 | 0 | 0 | 0 | 0 | 35 | | | | |
| 6 | 0 | 0 | 0 | 0 | 36 | | | | |
| 7 | 0 | 0 | 0 | 0 | 37 | | | | |
| 8 | 0 | 0 | 0 | 0 | 38 | | | | |
| 9 | 0 | 0 | 0 | 0 | 39 | | | | |
| 10 | 0 | 0 | 0 | 0 | 40 | | | | |
| 11 | 0 | 0 | 0 | 0 | 41 | | | | |
| 12 | 0 | 0 | 0 | 0 | 42 | | | | |
| 13 | 0 | 0 | 0 | 0 | 43 | | | | |
| 14 | 0 | 0 | 0 | 0 | 44 | | | | |
| 15 | 0 | 0 | 0 | 0 | 45 | | | | |
| 16 | 0 | 0 | 0 | 0 | 46 | | | | |
| 17 | 0 | 0 | 0 | 0 | 47 | | | | |
| 18 | 0 | 0 | 0 | 0 | 48 | | | | |
| 19 | 0 | 0 | 0 | 0 | 49 | | | | |
| 20 | 0 | 0 | 0 | 0 | 50 | | | | |
| 21 | | | | | 51 | | | | |
| 22 | | | | | 52 | | | | |
| 23 | | | | | 53 | | | | |
| 24 | | | | | 54 | | | | |
| 25 | | | | | 55 | | | | |
| 26 | | | | | 56 | | | | |
| 27 | | | | | 57 | | | | |
| 28 | | | | | 58 | | | | |
| 29 | | | | | 59 | | | | |
| 30 | | | | | 60 | | | | |

AVERAGE OPACITY FOR HIGHEST PERIOD: 0

NUMBER OF READINGS ABOVE 0 % WERE 0

RANGE OF OPACITY READINGS: 0 MINIMUM 0 MAXIMUM

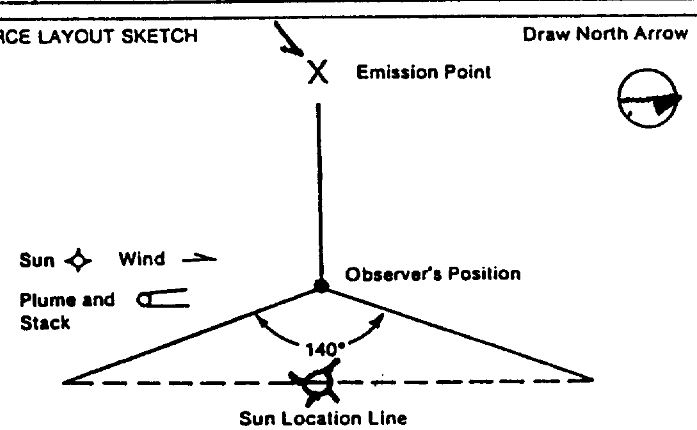
| | | DATE |
|---|---|---|
| OBSERVER'S NAME (PRINT) | JOHN R. ANGELLOZ, JR. | |
| OBSERVER'S SIGNATURE | John R. Angelloz, Jr. | 062888 |
| ORGANIZATION | EMISSIONS TESTING SERVICES | |
| CERTIFIED BY | Louisiana D.E.Q. | 042188 |
| VERIFIED BY | J. GIPSON | 042188 |

# VISIBLE EMISSION OBSERVATION FORM

| | |
|---|---|
| ...RCE NAME | Co-Generation Turbine |
| ...DRESS | AMOCO PRODUCTION COMPANY |
| | Rt 1A Box 42 |
| ... | Morganza |
| STATE | LA |
| ZIP | 70759 |
| ...ONE | (504) 694-3630 |
| SOURCE ID NUMBER | 87-4 |
| ...CESS EQUIPMENT | Turbine Generator |
| OPERATING MODE | MAX |
| ...TROL EQUIPMENT | N/A |
| OPERATING MODE | N/A |
| ...ESCRIBE EMISSION POINT | ...RT 1' Above Stack STOP SAME |
| ...GHT ABOVE GROUND LEVEL | ...TART 30' STOP SAME |
| HEIGHT RELATIVE TO OBSERVER | START 24.2' STOP SAME |
| ...TANCE FROM OBSERVER | ...RT 200' STOP 200' |
| DIRECTION FROM OBSERVER | START WEST STOP SAME |
| ...ESCRIBE EMISSIONS | ...RT NONE STOP NONE |
| ...SSION COLOR | ...TART N/A STOP SAME |
| PLUME TYPE | CONTINUOUS ☐ FUGITIVE ☐ INTERMITTENT ☐ |
| ...TER DROPLETS PRESENT | NO ☒ YES ☐ |
| IS WATER DROPLET PLUME | ATTACHED ☐ DETACHED ☐ |
| ...OINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED | ...TART N/A STOP SAME |
| ...SCRIBE BACKGROUND | ...TART HAZY STOP SAME |
| ...ACKGROUND COLOR | ...RT Gray STOP SAME |
| SKY CONDITIONS | START Clear STOP SAME |
| ...ND SPEED | ...TART 3 MPH STOP SAME |
| WIND DIRECTION | START SW STOP SAME |
| ...BIENT TEMP | ...RT 90°F STOP 92°F |
| WET BULB TEMP | 85°F |
| RH, percent | 52 |

SOURCE LAYOUT SKETCH

Draw North Arrow




...OMMENTS

...AVE RECEIVED A COPY OF THESE OPACITY OBSERVATIONS

SIGNATURE

TITLE

DATE

| OBSERVATION DATE | START TIME | STOP TIME |
|---|---|---|
| 062888 | 1100 | 1120 |

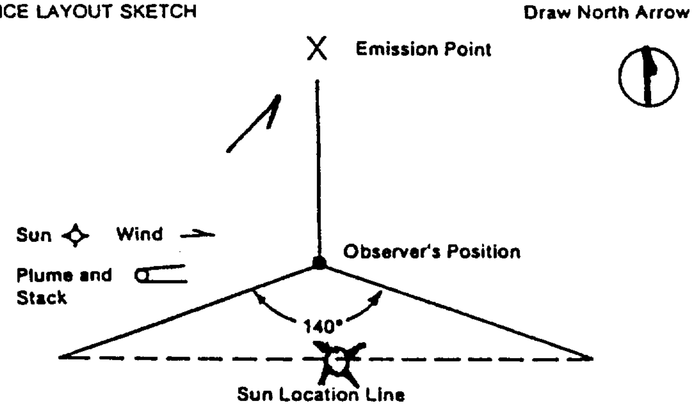
| MIN \ SEC | 0 | 15 | 30 | 45 | MIN \ SEC | 0 | 15 | 30 | 45 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 | 31 | | | | |
| 2 | 0 | 0 | 0 | 0 | 32 | | | | |
| 3 | 0 | 0 | 0 | 0 | 33 | | | | |
| 4 | 0 | 0 | 0 | 0 | 34 | | | | |
| 5 | 0 | 0 | 0 | 0 | 35 | | | | |
| 6 | 0 | 0 | 0 | 0 | 36 | | | | |
| 7 | 0 | 0 | 0 | 0 | 37 | | | | |
| 8 | 0 | 0 | 0 | 0 | 38 | | | | |
| 9 | 0 | 0 | 0 | 0 | 39 | | | | |
| 10 | 0 | 0 | 0 | 0 | 40 | | | | |
| 11 | 0 | 0 | 0 | 0 | 41 | | | | |
| 12 | 0 | 0 | 0 | 0 | 42 | | | | |
| 13 | 0 | 0 | 0 | 0 | 43 | | | | |
| 14 | 0 | 0 | 0 | 0 | 44 | | | | |
| 15 | 0 | 0 | 0 | 0 | 45 | | | | |
| 16 | 0 | 0 | 0 | 0 | 46 | | | | |
| 17 | 0 | 0 | 0 | 0 | 47 | | | | |
| 18 | 0 | 0 | 0 | 0 | 48 | | | | |
| 19 | 0 | 0 | 0 | 0 | 49 | | | | |
| 20 | 0 | 0 | 0 | 0 | 50 | | | | |
| 21 | | | | | 51 | | | | |
| 22 | | | | | 52 | | | | |
| 23 | | | | | 53 | | | | |
| 24 | | | | | 54 | | | | |
| 25 | | | | | 55 | | | | |
| 26 | | | | | 56 | | | | |
| 27 | | | | | 57 | | | | |
| 28 | | | | | 58 | | | | |
| 29 | | | | | 59 | | | | |
| 30 | | | | | 60 | | | | |

| | |
|---|---|
| AVERAGE OPACITY FOR HIGHEST PERIOD | 0 |
| NUMBER OF READINGS ABOVE 0 % WERE | 0 |
| RANGE OF OPACITY READINGS | MINIMUM 0 MAXIMUM 0 |
| OBSERVER'S NAME (PRINT) | JOHN R. ANGELLOZ, JR. |
| OBSERVER'S SIGNATURE | John R. Angelloz, Jr. |
| DATE | 062888 |
| ORGANIZATION | EMISSIONS TESTING SERVICES |
| CERTIFIED BY | Louisiana D. E. Q. |
| DATE | 042188 |
| VERIFIED BY | J. GIPSON |
| DATE | 042188 |

# VISIBLE EMISSION OBSERVATION FORM

| | |
|---|---|
| SOURCE NAME | Co-Generation Turbine |
| ADDRESS | Amoco Production Company, Rt 1A Box 42 |
| CITY | Morganza |
| STATE | LA |
| ZIP | 70759 |
| PHONE | (504) 694-3630 |
| SOURCE ID NUMBER | 87-4 |
| PROCESS EQUIPMENT | Turbine Generator |
| OPERATING MODE | MAX |
| CONTROL EQUIPMENT | N/A |
| OPERATING MODE | N/A |
| DESCRIBE EMISSION POINT | START 1' Above Stack STOP SAME |
| HEIGHT ABOVE GROUND LEVEL | START 30' STOP SAME |
| HEIGHT RELATIVE TO OBSERVER | START 24.2' STOP SAME |
| DISTANCE FROM OBSERVER | START 200' STOP 200' |
| DIRECTION FROM OBSERVER | START STOP SAME |
| DESCRIBE EMISSIONS | START NONE STOP NONE |
| EMISSION COLOR | START N/A STOP SAME |
| PLUME TYPE | CONTINUOUS ☐ FUGITIVE ☐ INTERMITTENT ☐ |
| WATER DROPLETS PRESENT | NO ☒ YES ☐ |
| IS WATER DROPLET PLUME | ATTACHED ☐ DETACHED ☐ |
| POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED | START N/A STOP SAME |
| DESCRIBE BACKGROUND | START BLUE SKY STOP SAME |
| BACKGROUND COLOR | START BLUE STOP SAME |
| SKY CONDITIONS | START clear STOP SAME |
| WIND SPEED | START 3 MPH STOP SAME |
| WIND DIRECTION | START WSW STOP SAME |
| AMBIENT TEMP | START 96°F STOP 98°F |
| WET BULB TEMP | 86°F |
| RH, percent | 50 |

SOURCE LAYOUT SKETCH — Draw North Arrow




COMMENTS

I HAVE RECEIVED A COPY OF THESE OPACITY OBSERVATIONS

SIGNATURE

TITLE

DATE

| OBSERVATION DATE | START TIME | STOP TIME |
|---|---|---|
| 062888 | 1300 | 1320 |

| MIN \ SEC | 0 | 15 | 30 | 45 | MIN \ SEC | 0 | 15 | 30 | 45 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 | 31 | | | | |
| 2 | 0 | 0 | 0 | 0 | 32 | | | | |
| 3 | 0 | 0 | 0 | 0 | 33 | | | | |
| 4 | 0 | 0 | 0 | 0 | 34 | | | | |
| 5 | 0 | 0 | 0 | 0 | 35 | | | | |
| 6 | 0 | 0 | 0 | 0 | 36 | | | | |
| 7 | 0 | 0 | 0 | 0 | 37 | | | | |
| 8 | 0 | 0 | 0 | 0 | 38 | | | | |
| 9 | 0 | 0 | 0 | 0 | 39 | | | | |
| 10 | 0 | 0 | 0 | 0 | 40 | | | | |
| 11 | 0 | 0 | 0 | 0 | 41 | | | | |
| 12 | 0 | 0 | 0 | 0 | 42 | | | | |
| 13 | 0 | 0 | 0 | 0 | 43 | | | | |
| 14 | 0 | 0 | 0 | 0 | 44 | | | | |
| 15 | 0 | 0 | 0 | 0 | 45 | | | | |
| 16 | 0 | 0 | 0 | 0 | 46 | | | | |
| 17 | 0 | 0 | 0 | 0 | 47 | | | | |
| 18 | 0 | 0 | 0 | 0 | 48 | | | | |
| 19 | 0 | 0 | 0 | 0 | 49 | | | | |
| 20 | 0 | 0 | 0 | 0 | 50 | | | | |
| 21 | | | | | 51 | | | | |
| 22 | | | | | 52 | | | | |
| 23 | | | | | 53 | | | | |
| 24 | | | | | 54 | | | | |
| 25 | | | | | 55 | | | | |
| 26 | | | | | 56 | | | | |
| 27 | | | | | 57 | | | | |
| 28 | | | | | 58 | | | | |
| 29 | | | | | 59 | | | | |
| 30 | | | | | 60 | | | | |

| | |
|---|---|
| AVERAGE OPACITY FOR HIGHEST PERIOD | 0 |
| NUMBER OF READINGS ABOVE 0 % WERE | 0 |
| RANGE OF OPACITY READINGS | 0 MINIMUM, 0 MAXIMUM |
| OBSERVER'S NAME (PRINT) | JOHN R. ANGELLOZ, JR. |
| OBSERVER'S SIGNATURE | John R. Angelloz, Jr. |
| DATE | 062888 |
| ORGANIZATION | EMISSIONS TESTING SERVICES |
| CERTIFIED BY | Louisiana D.E.Q. |
| DATE | 042188 |
| VERIFIED BY | J. GIPSON |
| DATE | 042188 |

ETS

# METHOD 6C&7E DATA SHEET

COMPANY Amoco Production SOURCE # 874 DATE 6/28/88

PARAMETER $O_2$ LOAD% MAX RUN NUMBER 1

## CALIBRATION STATISTICS

| Cylinder | Value | Analyzer Response mv | Analyzer Response ppm | Absolute Difference mv | Absolute Difference ppm | % Span ±2% |
|---|---|---|---|---|---|---|
| Zero | N2 | 0.23 | 0.003 | 0.23 | 0.063 | 0 |
| Mid | 13.13 | 5.38 | 13.12 | 5.36 | 13.07 | -0.2 |
| High | 19.89 | 8.04 | 19.90 | 8.04 | 19.90 | 0 |

Calibration curve: ppm = (response mv)(slope) + intercept

Slope 2.5471 Intercept -0.583 Span Range 24.888

| Analyzer Cal | Init. Analyzer Resp. mv | Init. Analyzer Resp. ppm | Bias ±5 | Final Analyzer Resp. mv | Final Analyzer Resp. ppm | Bias ±5 | Span Drift ±3 |
|---|---|---|---|---|---|---|---|
| Conc. N/A | | | | | | | |

Sys. Cal. Bias = $\frac{\text{Sys. cal. (ppm) - analyzer cal. (ppm)}}{\text{Span (ppm)}}$ X 100

%Drift = $\frac{\text{Final sys. resp. (ppm) - Initial sys. resp. (ppm)}}{\text{span (ppm)}}$ X 100

## TEST DATA

Start time 8:45 Finish time 9:45 Minutes per point 7

Test Point mv Sample port A & B

| Test Point | mv | Test Point | mv | Test Point | mv |
|---|---|---|---|---|---|
| 1 | 6.84 | 11 | | 21 | |
| 2 | 6.81 | 12 | | 22 | |
| 3 | 6.80 | 13 | | 23 | |
| 4 | 6.79 | 14 | | 24 | |
| 5 | 6.77 | 15 | | 25 | |
| 6 | 6.74 | 16 | | 26 | |
| 7 | 6.78 | 17 | | 27 | |
| 8 | 6.79 | 18 | | 28 | |
| 9 | | 19 | | 29 | |
| 10 | | 20 | | 30 | |

Ave. mv 6.79

Ave. conc. 16.712 ~~ppm~~ %

COMMENTS:

# ETS

## METHOD 6C&7E DATA SHEET

COMPANY Amoco Production SOURCE # 87-4 DATE 6/28/88

PARAMETER $O_2$ LOAD% max RUN NUMBER 2

### CALIBRATION STATISTICS

| Cylinder | Value | Analyzer Response mv | Analyzer Response ppm | Absolute Difference mv | Absolute Difference ppm | % Span ±2% |
|---|---|---|---|---|---|---|
| Zero | $N_2$ | 0.23 | .014 | 0.23 | .014 | 0 |
| Mid | 13.13 | 5.36 | 13.09 | 5.37 | 13.11 | 0.1 |
| High | 19.89 | 8.04 | 19.92 | 8.04 | 19.92 | 0 |

Calibration curve: ppm = (response mv)(slope) + intercept

Slope 2.5484 Intercept -0.572 Span Range 24.912

| Analyzer Cal | Init. Analyzer Resp. mv | Init. Analyzer Resp. ppm | Bias ±5 | Final Analyzer Resp. mv | Final Analyzer Resp. ppm | Bias ±5 | Span Drift ±3 |
|---|---|---|---|---|---|---|---|
| Conc. N/A | | | | | | | |

Sys. Cal. Bias = $\frac{\text{Sys. cal. (ppm) - analyzer cal. (ppm)}}{\text{Span (ppm)}}$ X 100

%Drift = $\frac{\text{Final sys. resp. (ppm) - Initial sys. resp. (ppm)}}{\text{span (ppm)}}$ X 100

### TEST DATA

Start time 11:00 Finish time 12:00 Minutes per point 7

Sample port ______

| Test Point | mv | Test Point | mv | Test Point | mv |
|---|---|---|---|---|---|
| 1 | 6.80 | 11 | | 21 | |
| 2 | 6.81 | 12 | | 22 | |
| 3 | 6.79 | 13 | | 23 | |
| 4 | 6.82 | 14 | | 24 | |
| 5 | 6.80 | 15 | | 25 | |
| 6 | 6.84 | 16 | | 26 | |
| 7 | 6.75 | 17 | | 27 | |
| 8 | 6.79 | 18 | | 28 | |
| 9 | | 19 | | 29 | |
| 10 | | 20 | | 30 | |

Ave. mv 6.800

Ave. conc. 16.758 ppm

COMMENTS:

# ETS

## METHOD 6C&7E DATA SHEET

COMPANY Amoco Production SOURCE # 87-4 DATE 6/28/88

PARAMETER $O_2$ LOAD% ______ RUN NUMBER 3

## CALIBRATION STATISTICS

| Cylinder | Value | Analyzer Response mv | Analyzer Response ppm | Absolute Difference mv | Absolute Difference ppm | % Span ±2% |
|---|---|---|---|---|---|---|
| Zero | $N_2$ | 0.23 | .009 | 0.23 | .009 | 0 |
| Mid | 13.13 | 5.37 | 13.10 | 5.35 | 13.05 | -0.2 |
| High | 19.89 | 8.04 | 19.76 | 8.05 | 19.78 | ~~.001~~ 0.1 |

Calibration curve: ppm = (response mv)(slope) + intercept

Slope 2.5478 Intercept -0.577 Span Range 24.901

| Analyzer Cal | Init. Analyzer Resp. mv | ppm | Bias ±5 | Final Analyzer Resp. mv | ppm | Bias ±5 | Span Drift ±3 |
|---|---|---|---|---|---|---|---|
| Conc. | ______ | ______ | ______ | ______ | ______ | ______ | ______ |

Sys. Cal. Bias = $\frac{\text{Sys. cal. (ppm) - analyzer cal. (ppm)}}{\text{Span (ppm)}}$ X 100

%Drift = $\frac{\text{Final sys. resp. (ppm) - Initial sys. resp. (ppm)}}{\text{span (ppm)}}$ X 100

## TEST DATA

Start time 13:00 Finish time 14:00 Minutes per point 7

Sample port ______

| Test Point | mv | Test Point | mv | Test Point | mv |
|---|---|---|---|---|---|
| 1 | 6.77 | 11 | ____ | 21 | ____ |
| 2 | 6.74 | 12 | ____ | 22 | ____ |
| 3 | 6.77 | 13 | ____ | 23 | ____ |
| 4 | 6.76 | 14 | ____ | 24 | ____ |
| 5 | 6.74 | 15 | ____ | 25 | ____ |
| 6 | 6.76 | 16 | ____ | 26 | ____ |
| 7 | 6.76 | 17 | ____ | 27 | ____ |
| 8 | 6.81 | 18 | ____ | 28 | ____ |
| 9 | ____ | 19 | ____ | 29 | ____ |
| 10 | ____ | 20 | ____ | 30 | ____ |

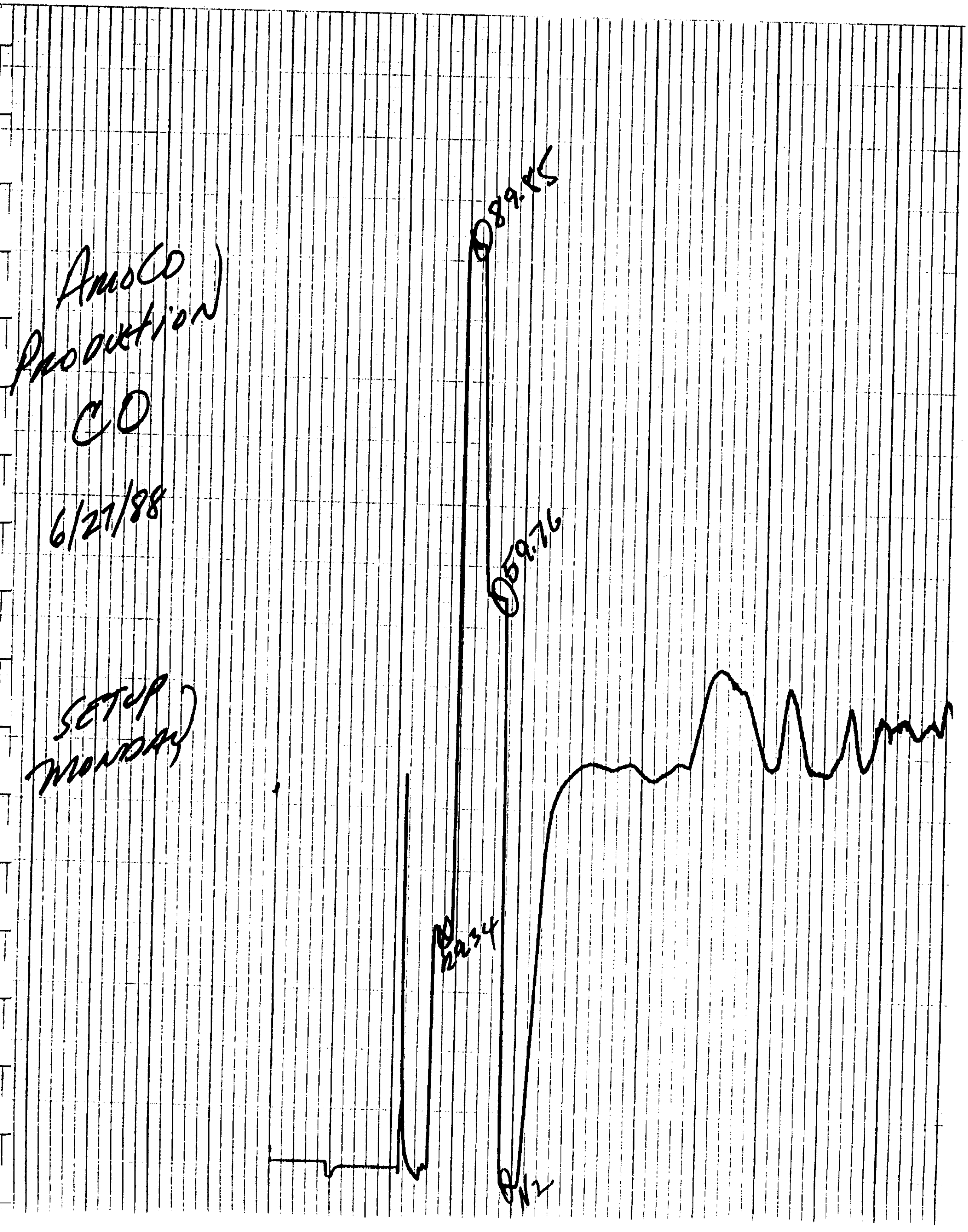
Ave. mv 6.7638

Ave. conc. 16.655 ~~ppm~~ %

COMMENTS:

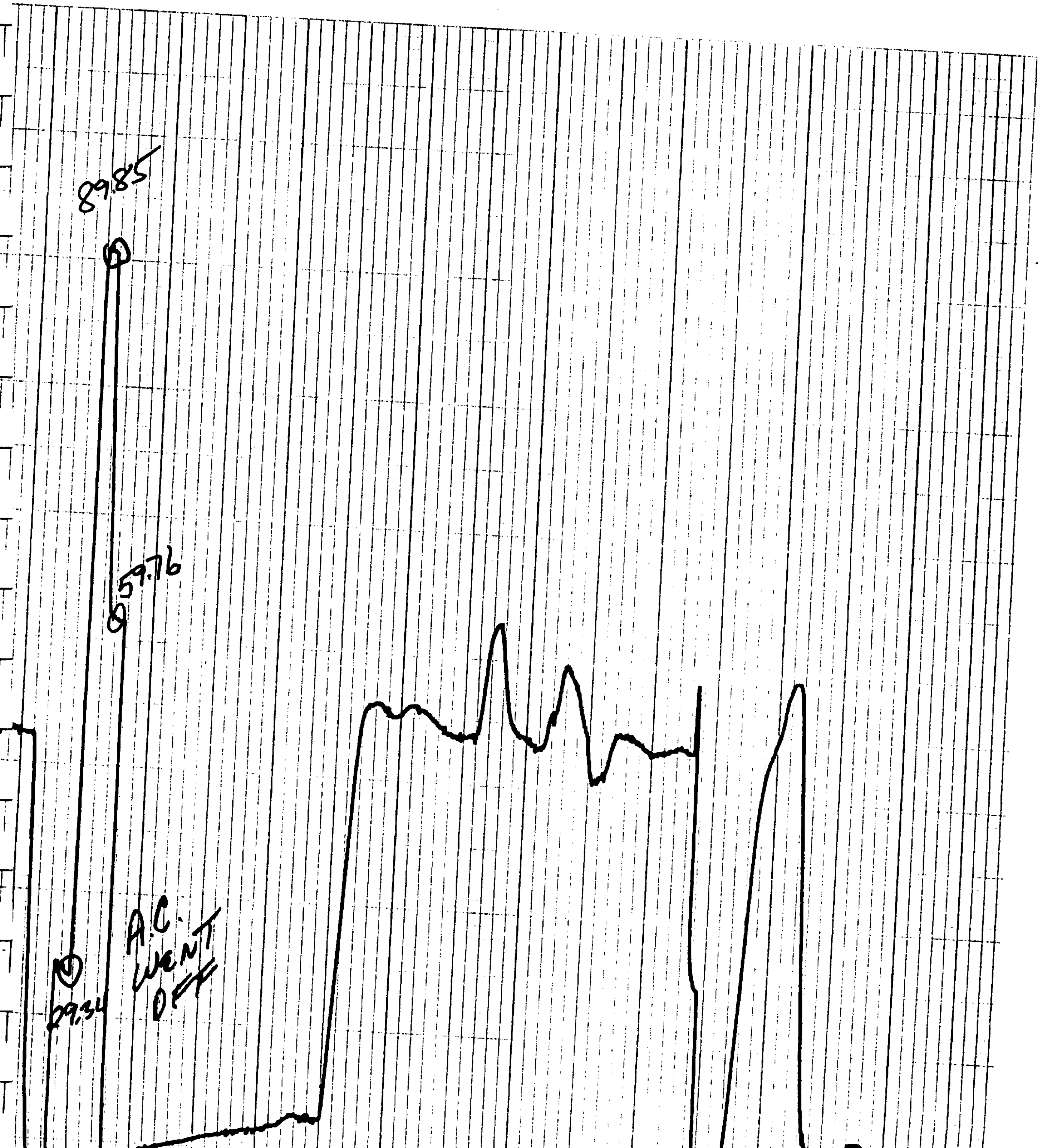
No. RC-109

RECORDING CHARTS GRAPHI

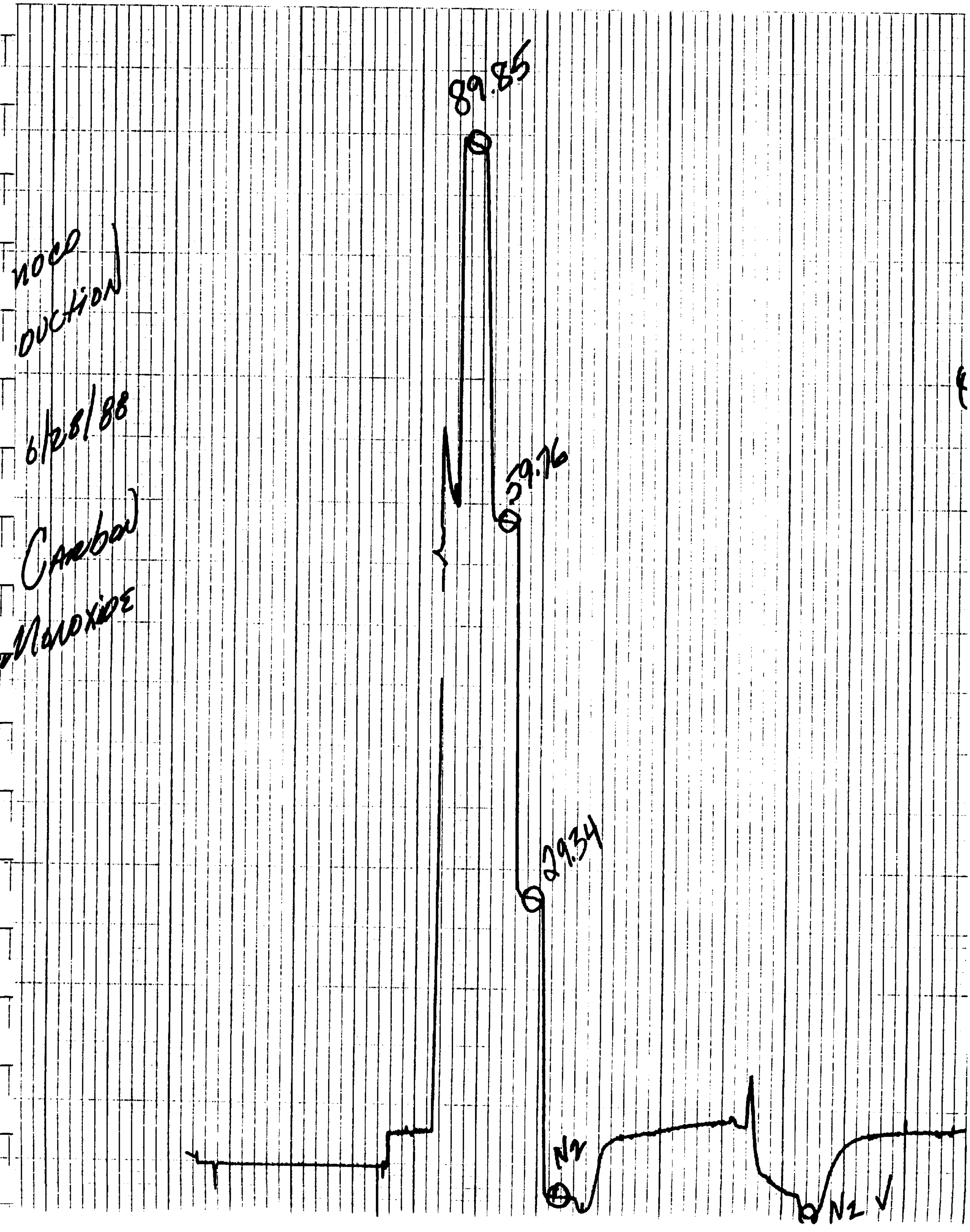


CONTROLS CORPORATION BUFFALO, NEW YORK

PRINTED IN U.S.A.

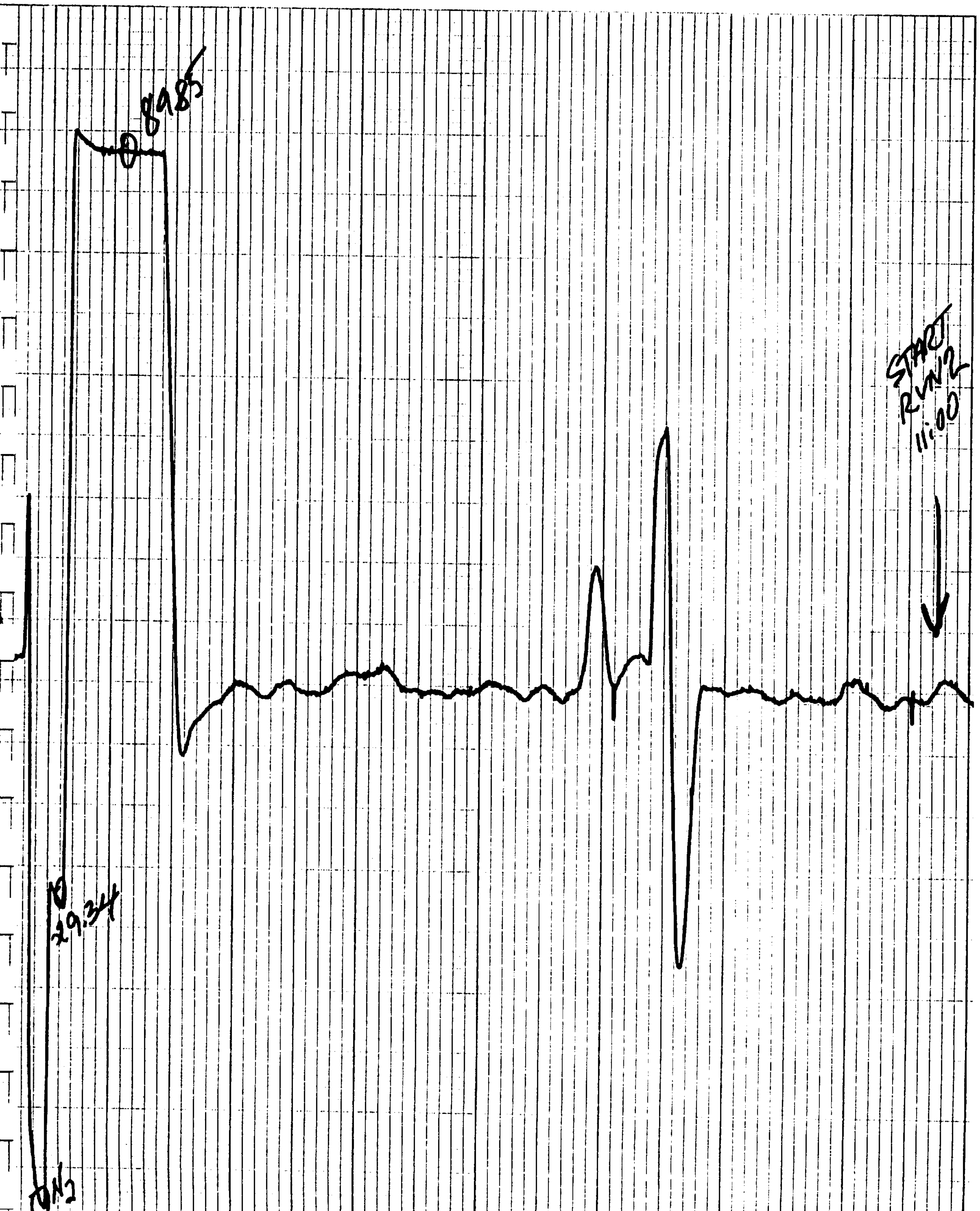


CHARTS GRAPHIC CONTROLS CORPORATION BUFFALO, NEW YORK PRINTED IN U.S.A.



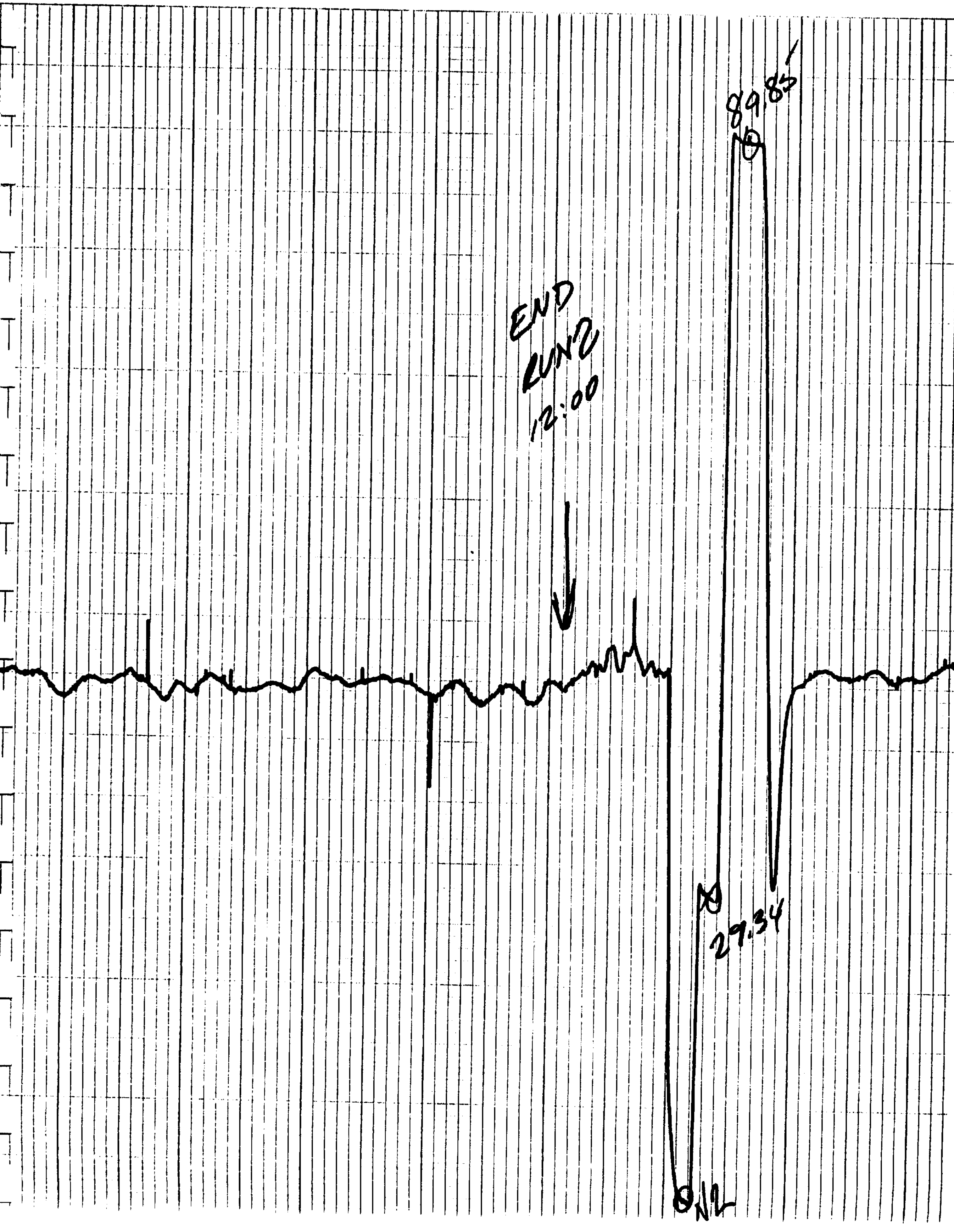

START RUN # 1
8:46
END RUN 1
9:45

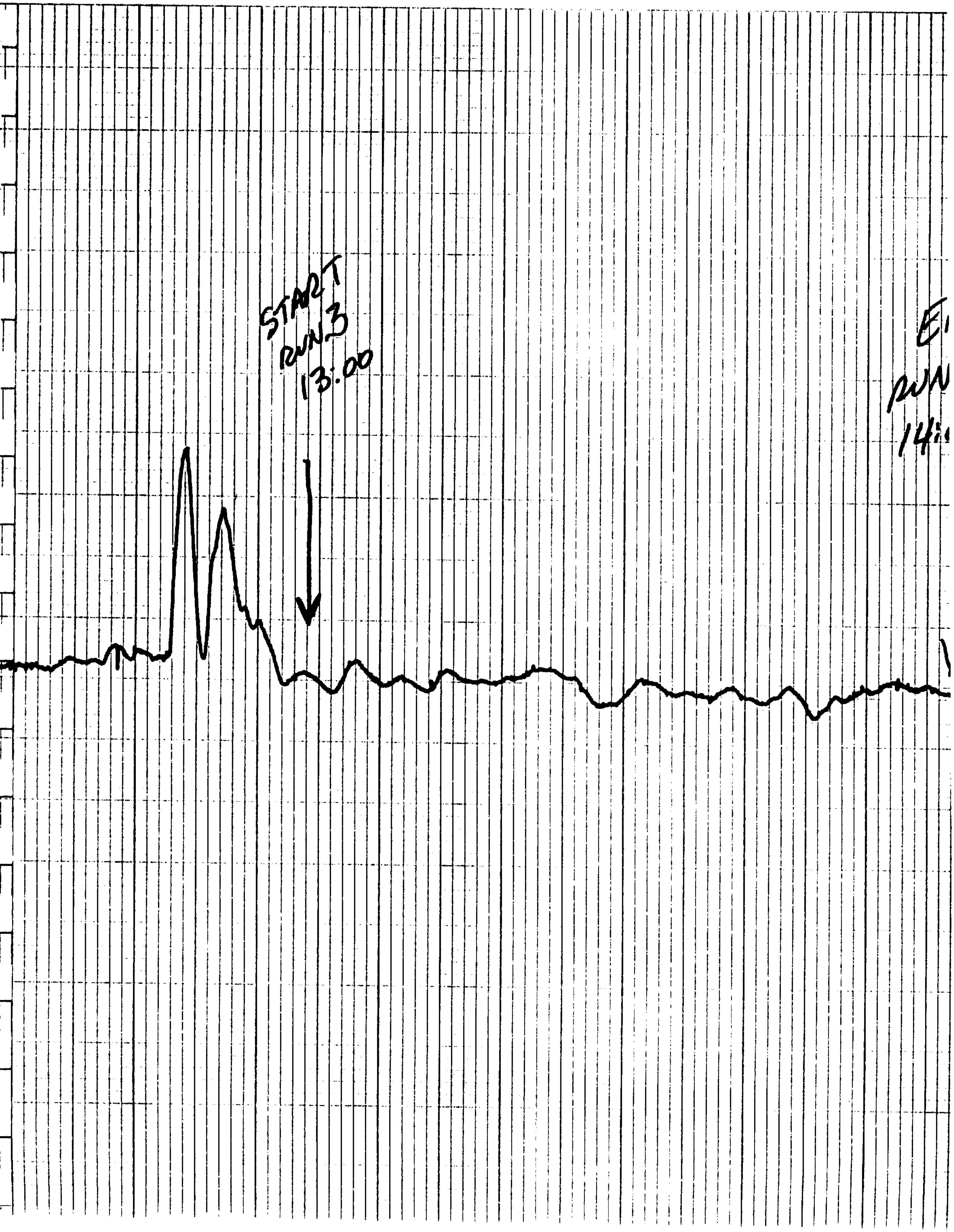
RECORDING CHARTS GRAPHIC CONTROLS CORPORATION BUFFALO, NEW YORK



PRINTED IN U.S.A.

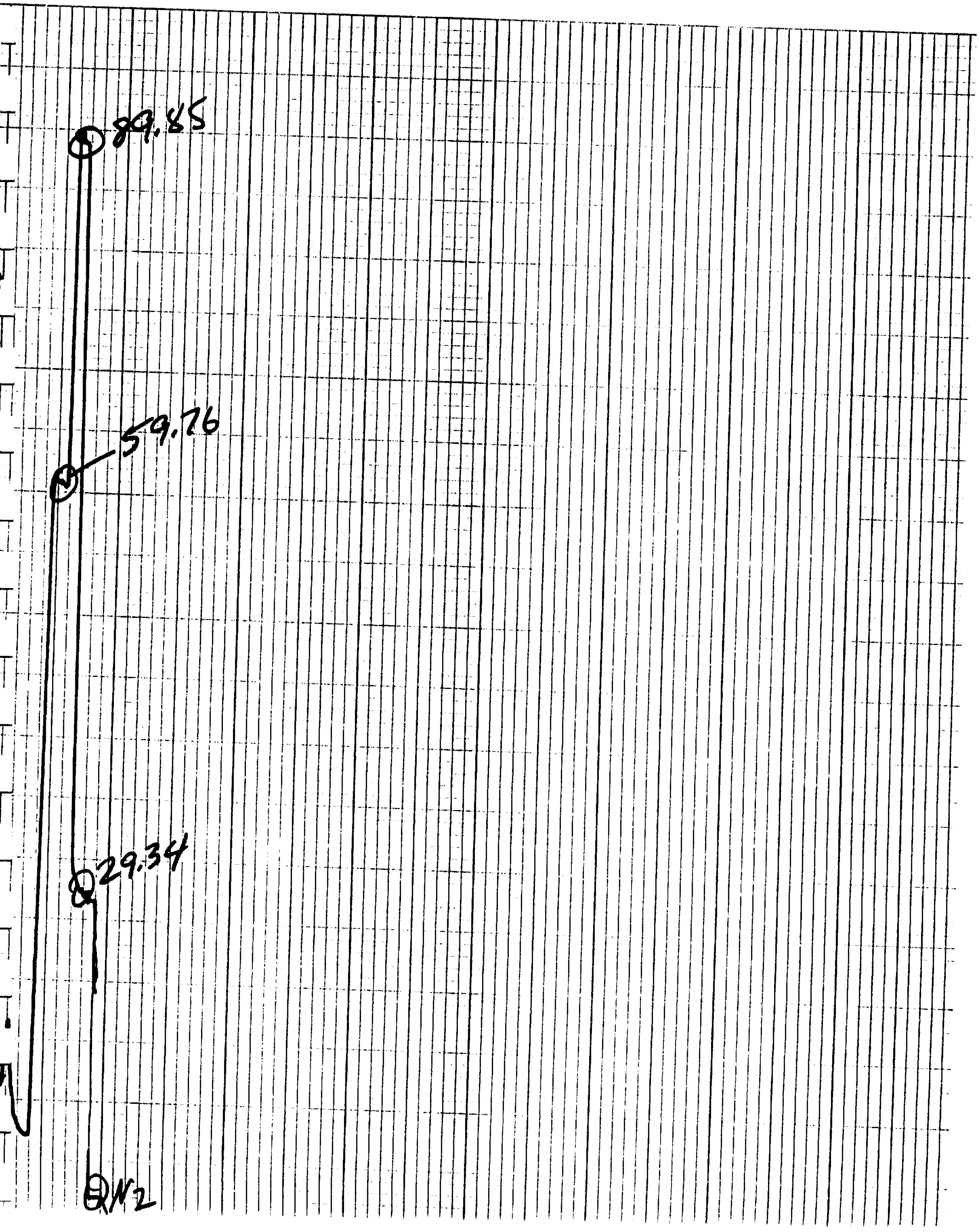
No. RC-109



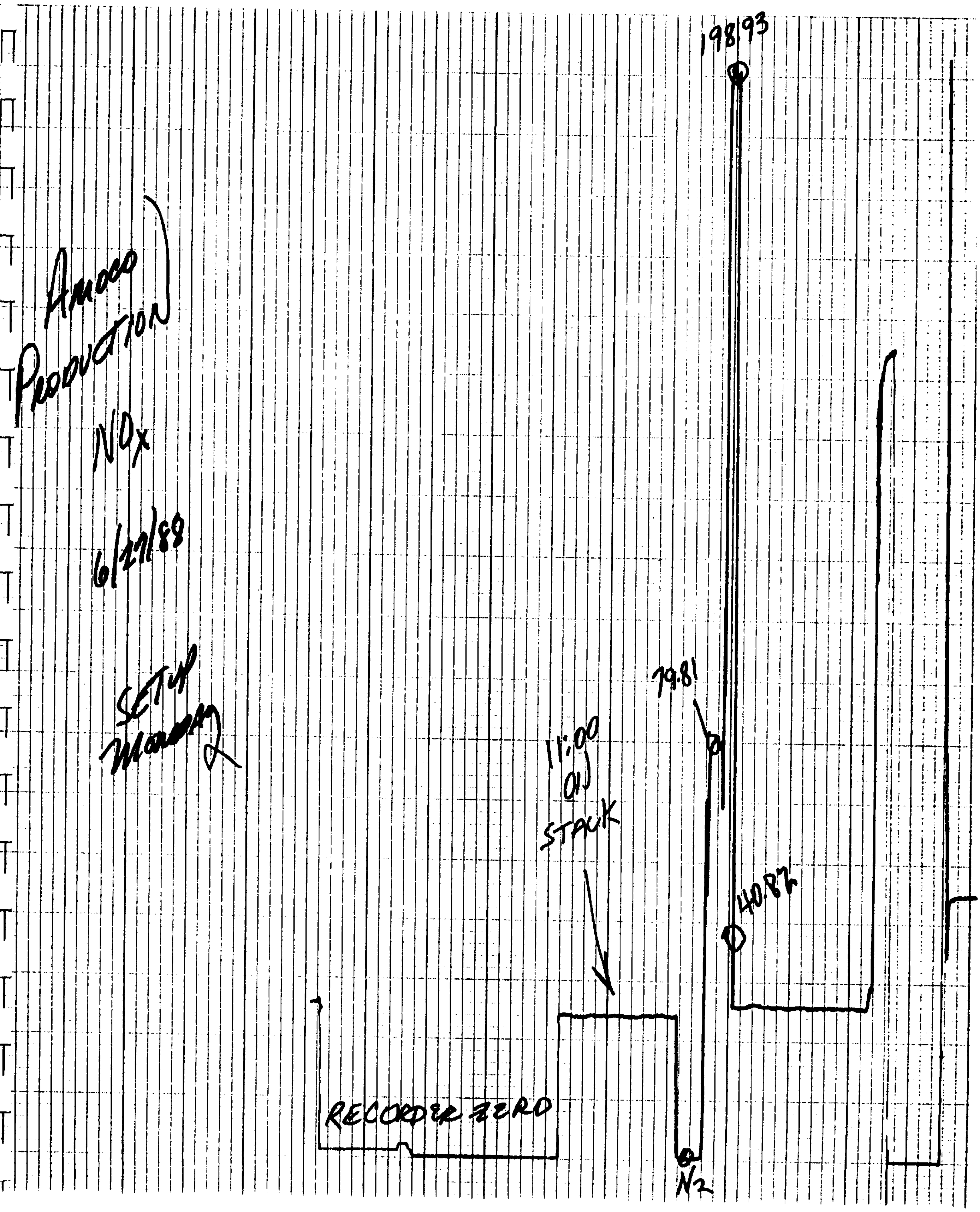

START
RUN 3
13:00
RUN
14:

PRINTED IN U.S.A.

No. F

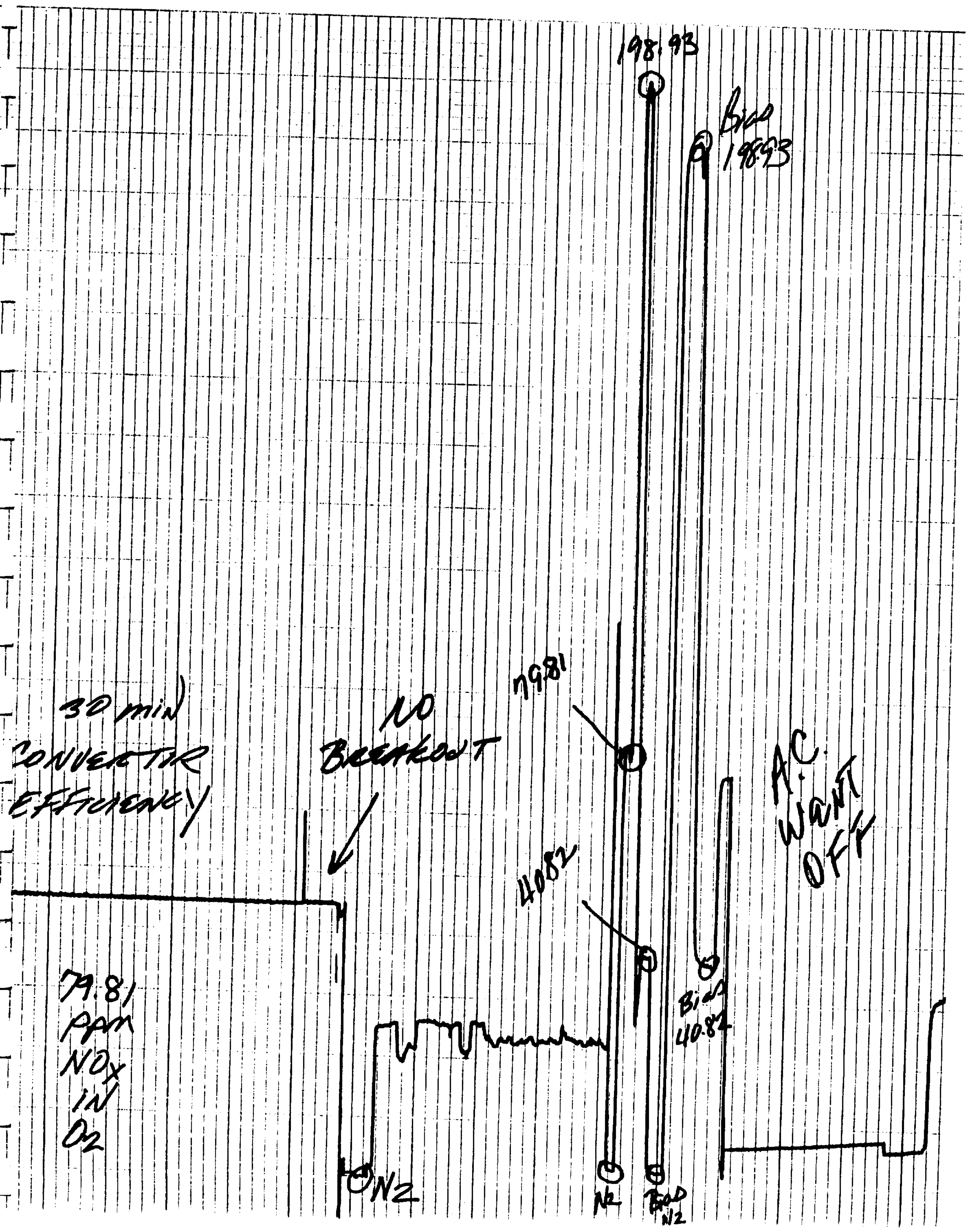


RECORDING CHARTS | GRAPHIC CONTROLS CORPORATION BUFFALO, NEW YORK

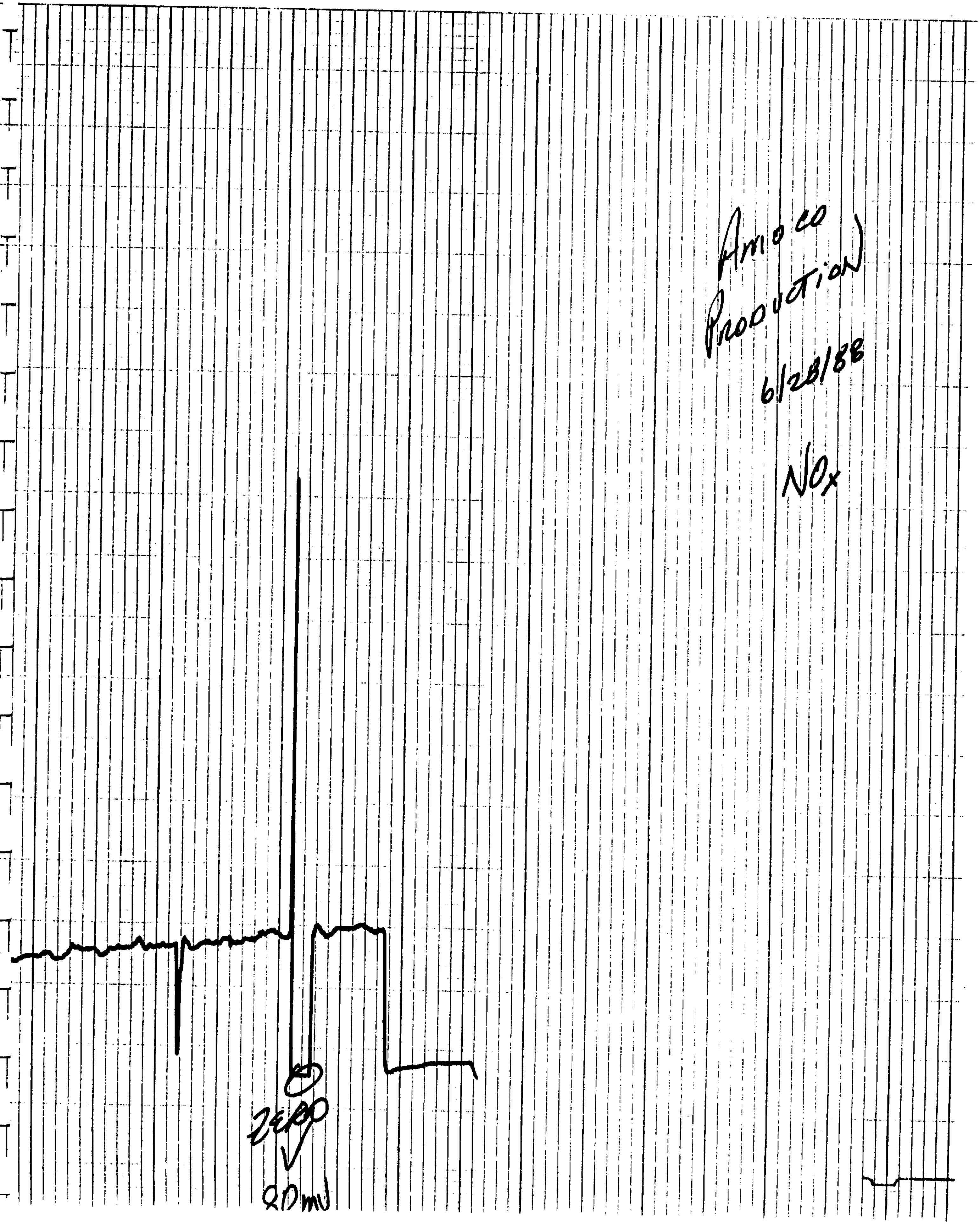


PRINTED IN U.S.A.

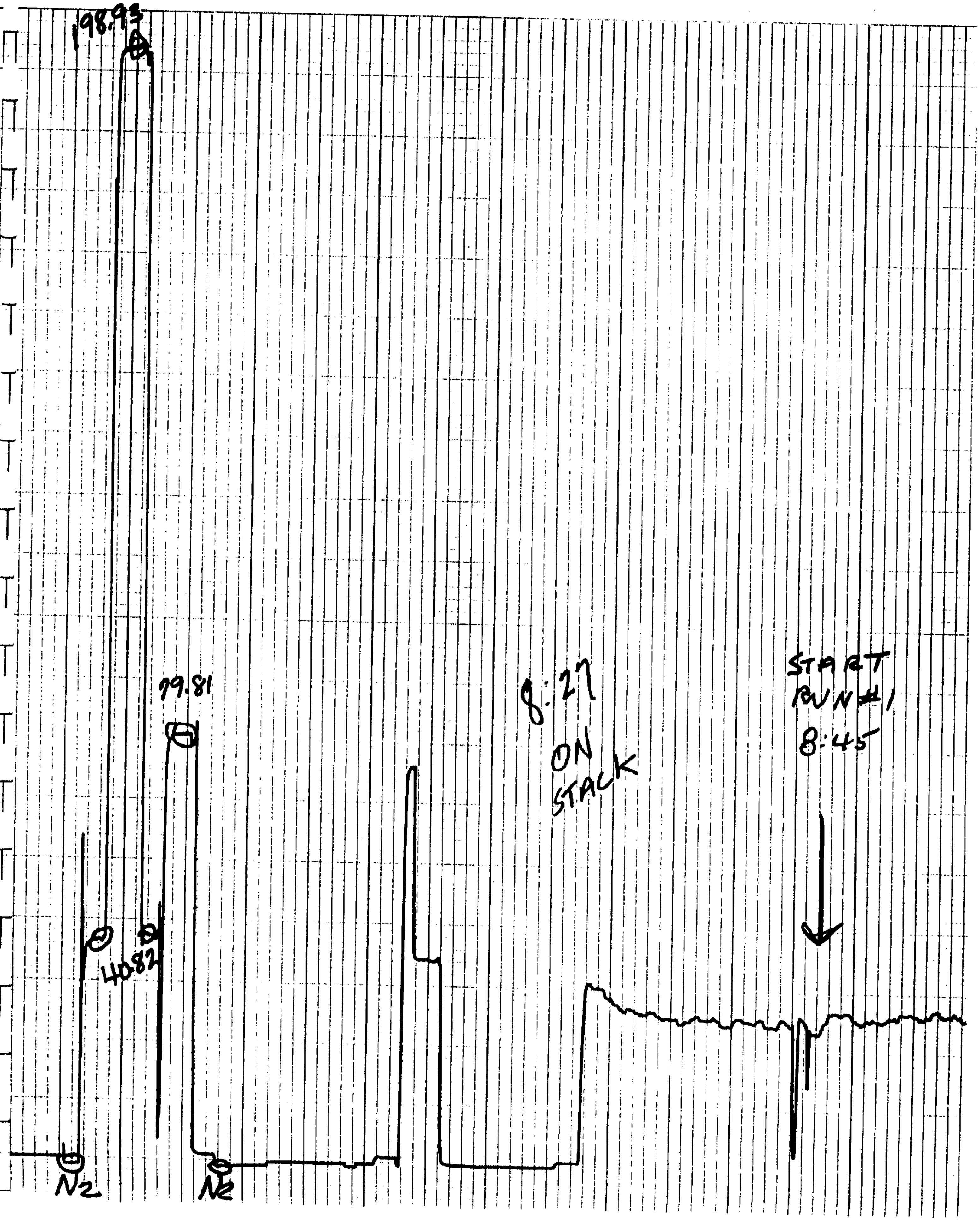




RECORDING CHARTS  GRAPHIC CONTROLS CORPORATION  BUFFALO, NEW YORK

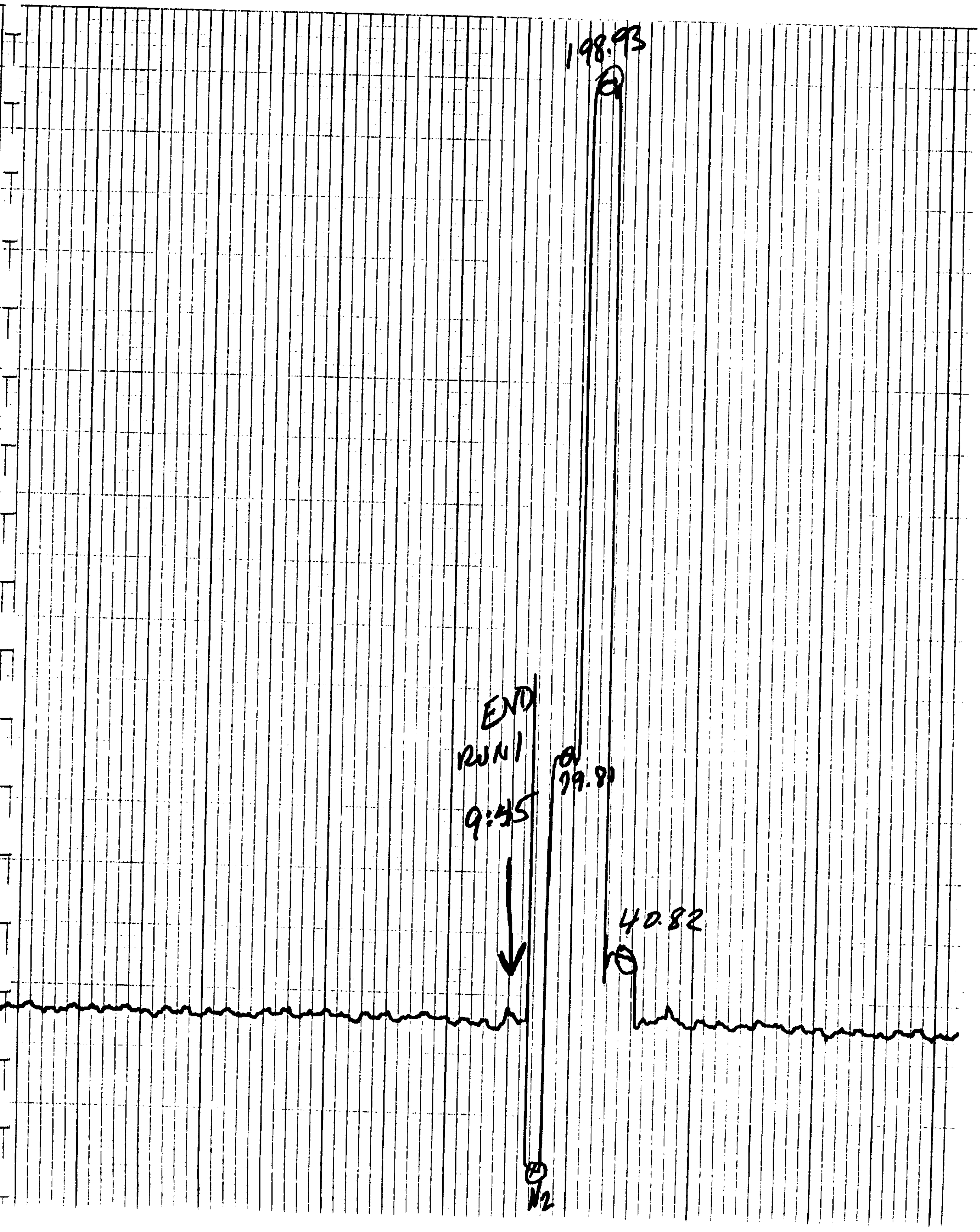


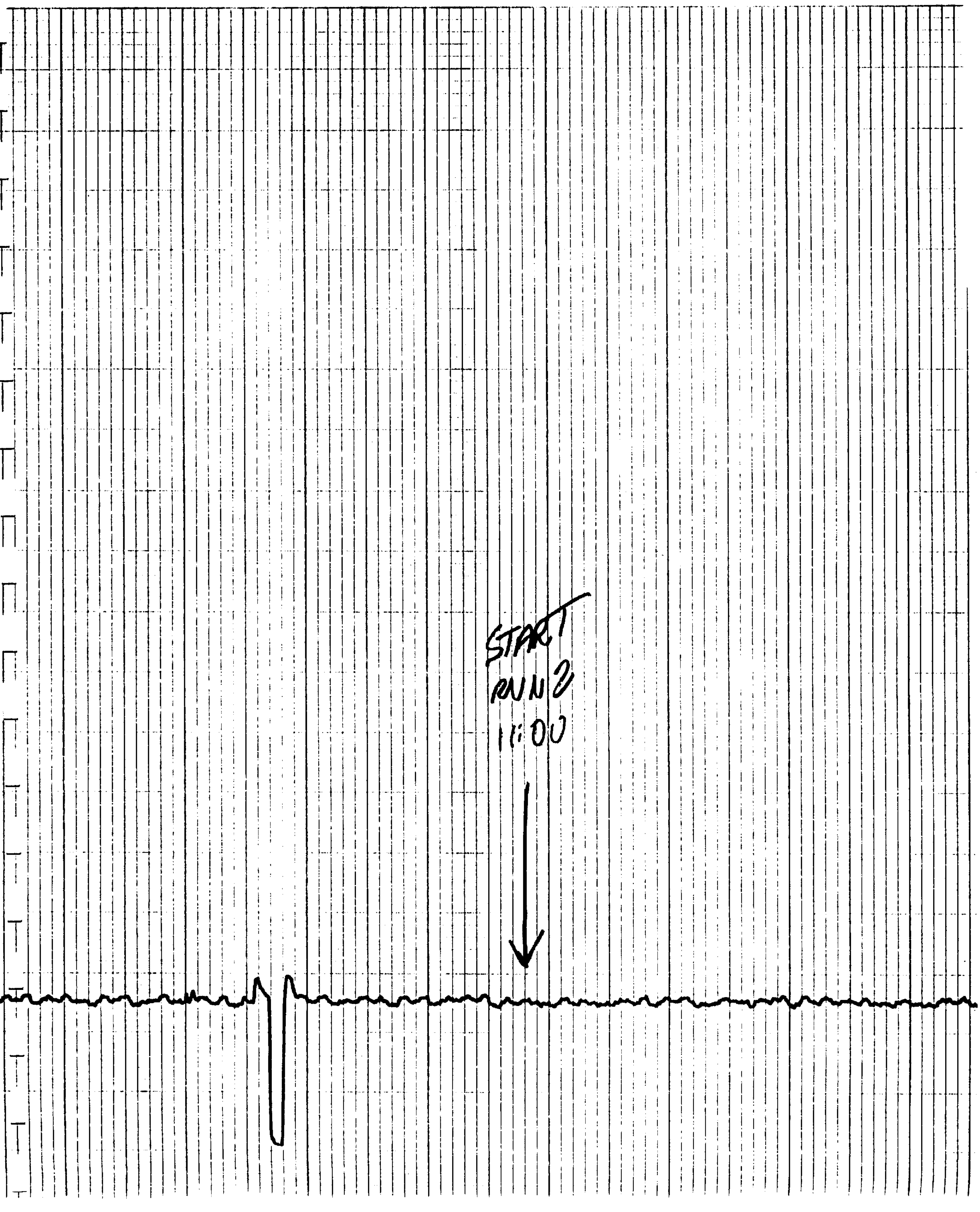
PRINTED IN U.S.A.



No. RC-109

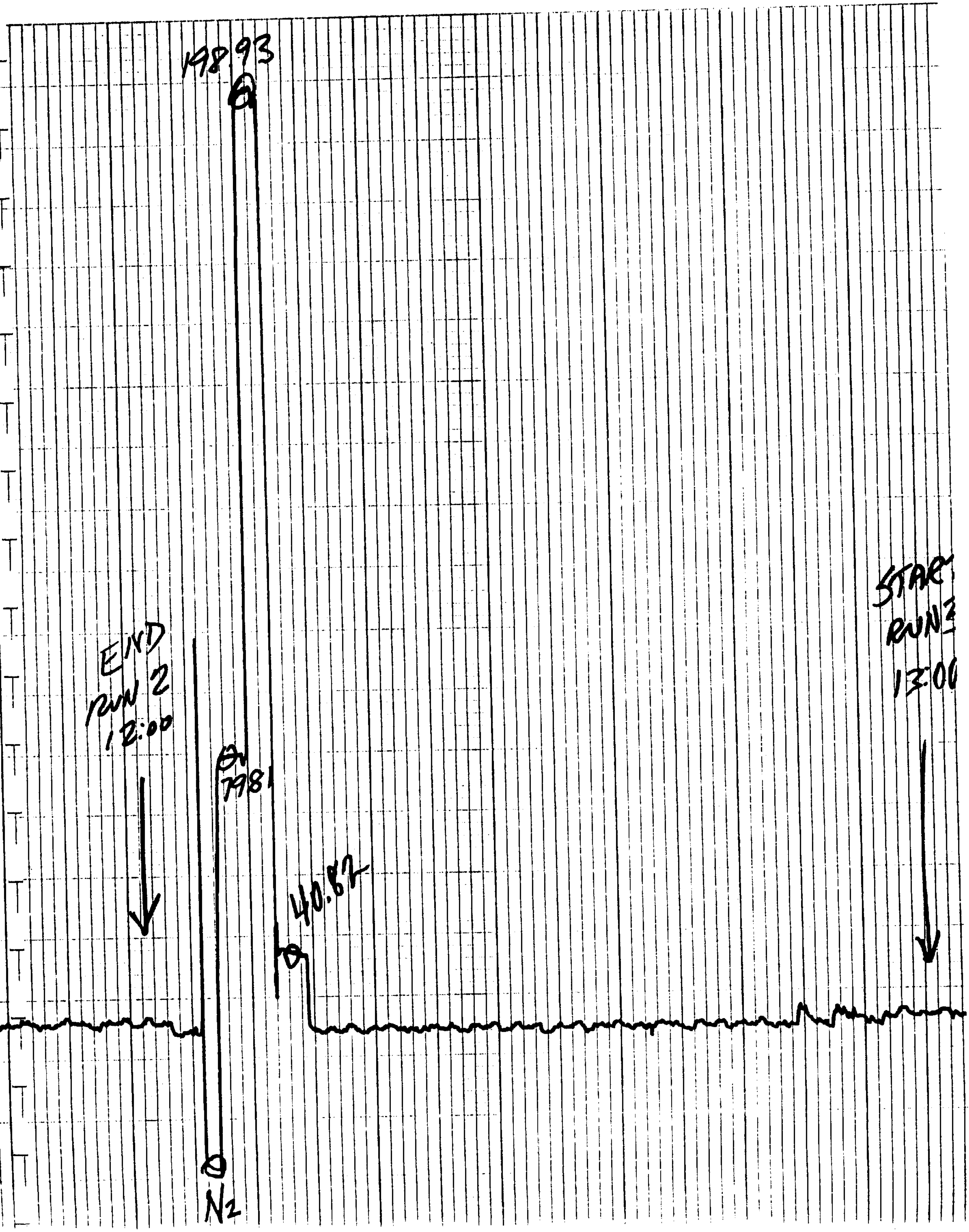
RECORDING CHARTS GRAPHIC CONTROLS CORPORATION

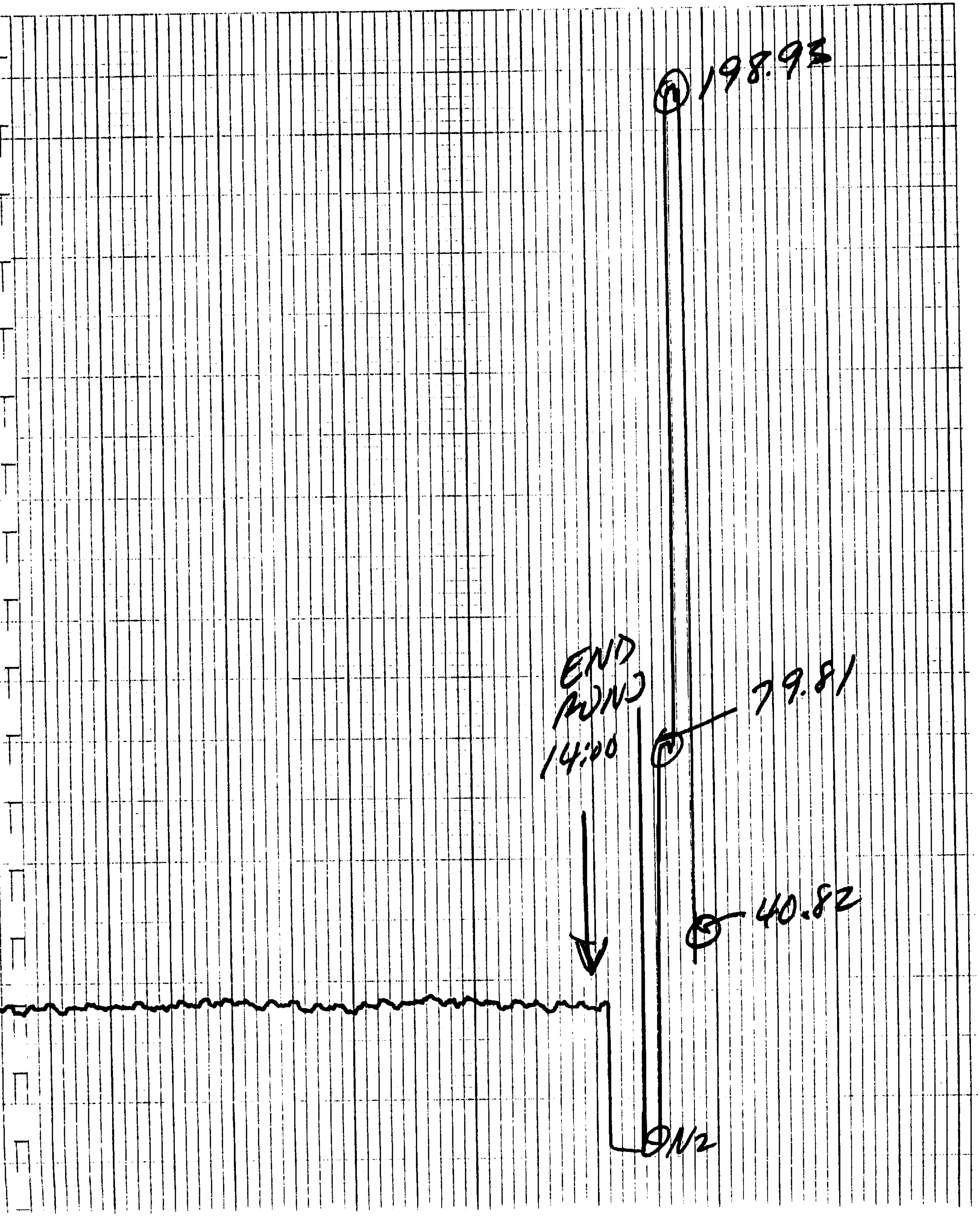


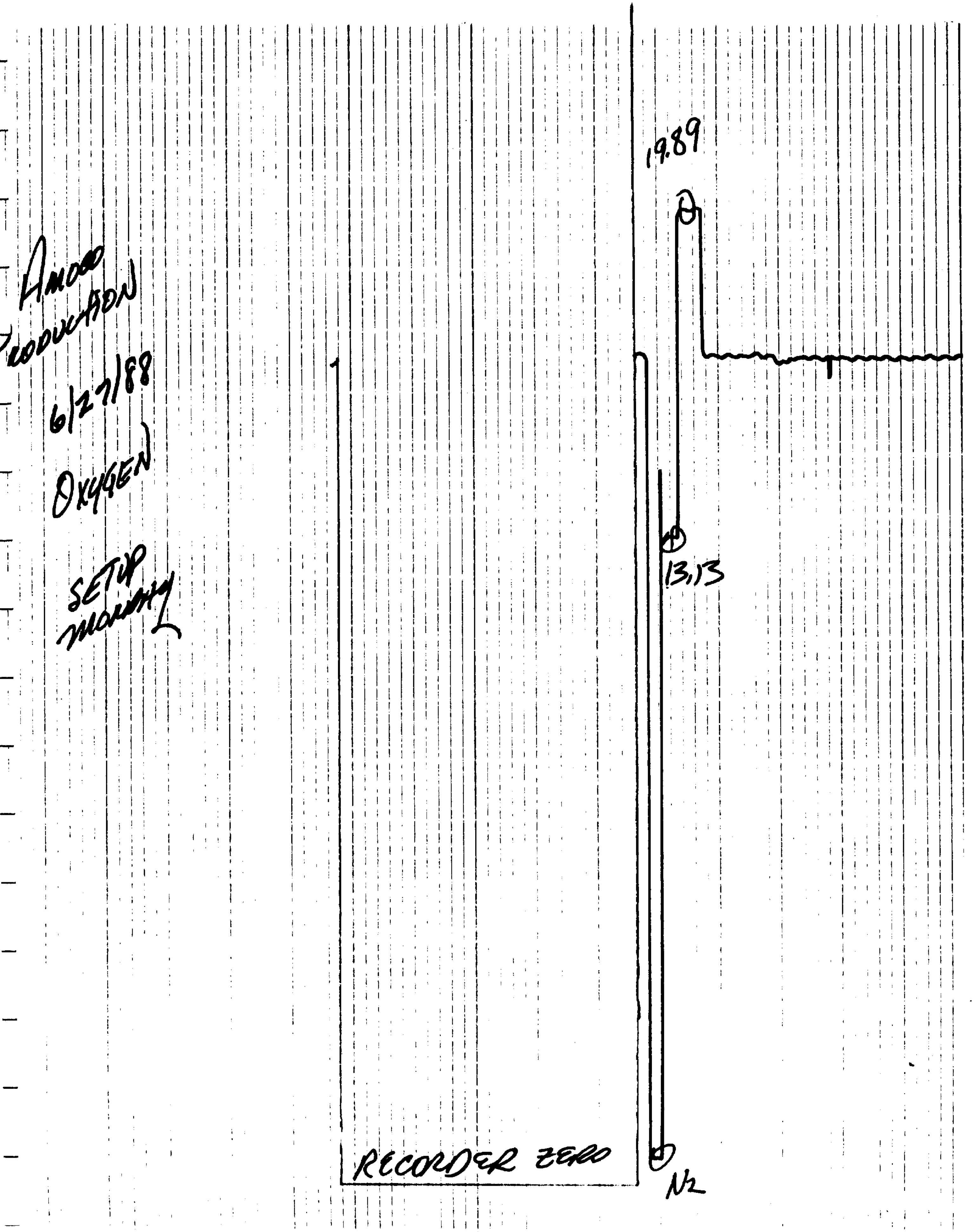

START
RUN 2
11:00

No. RC-109

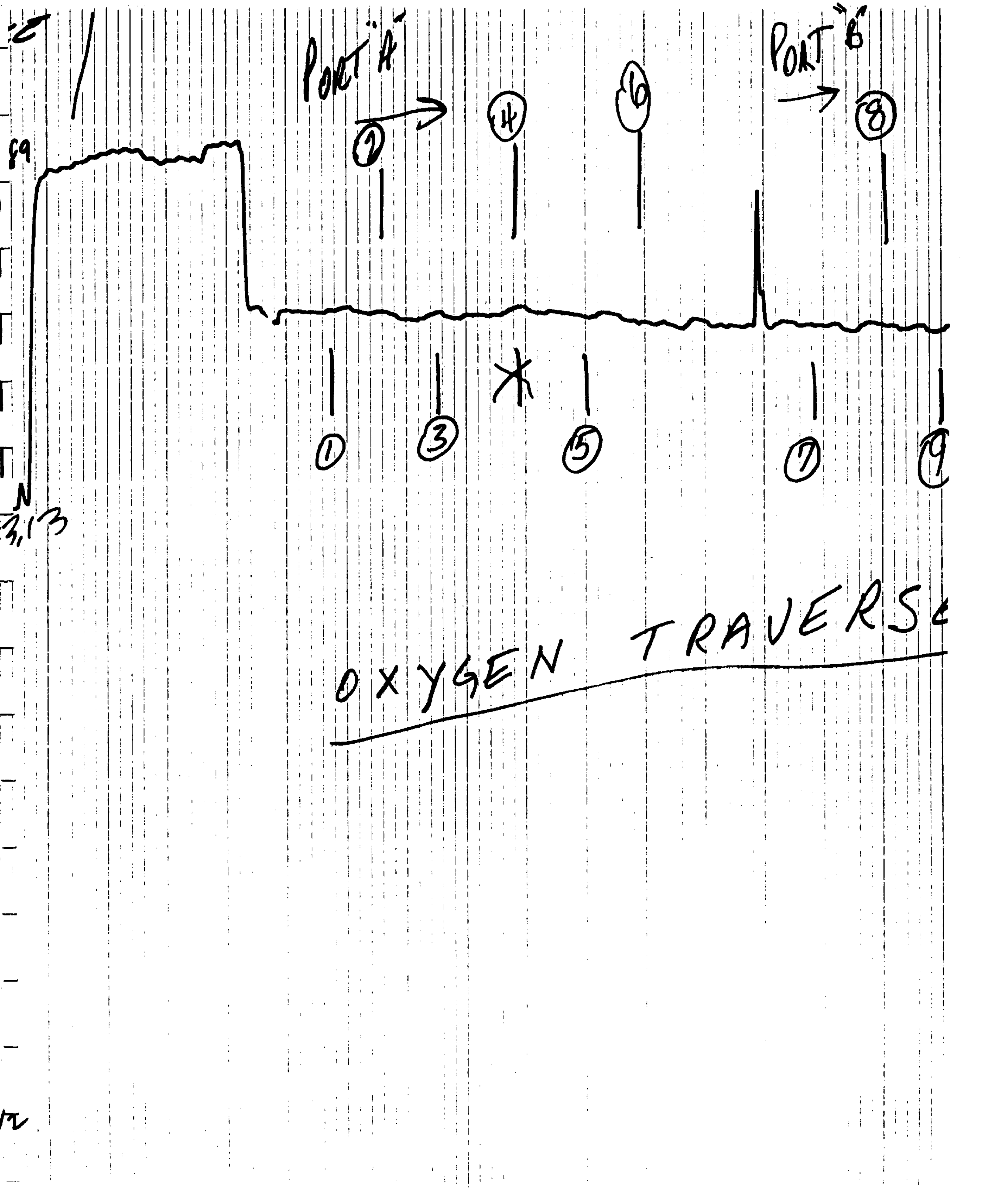
RECORDING CHARTS GRAPHIC CC

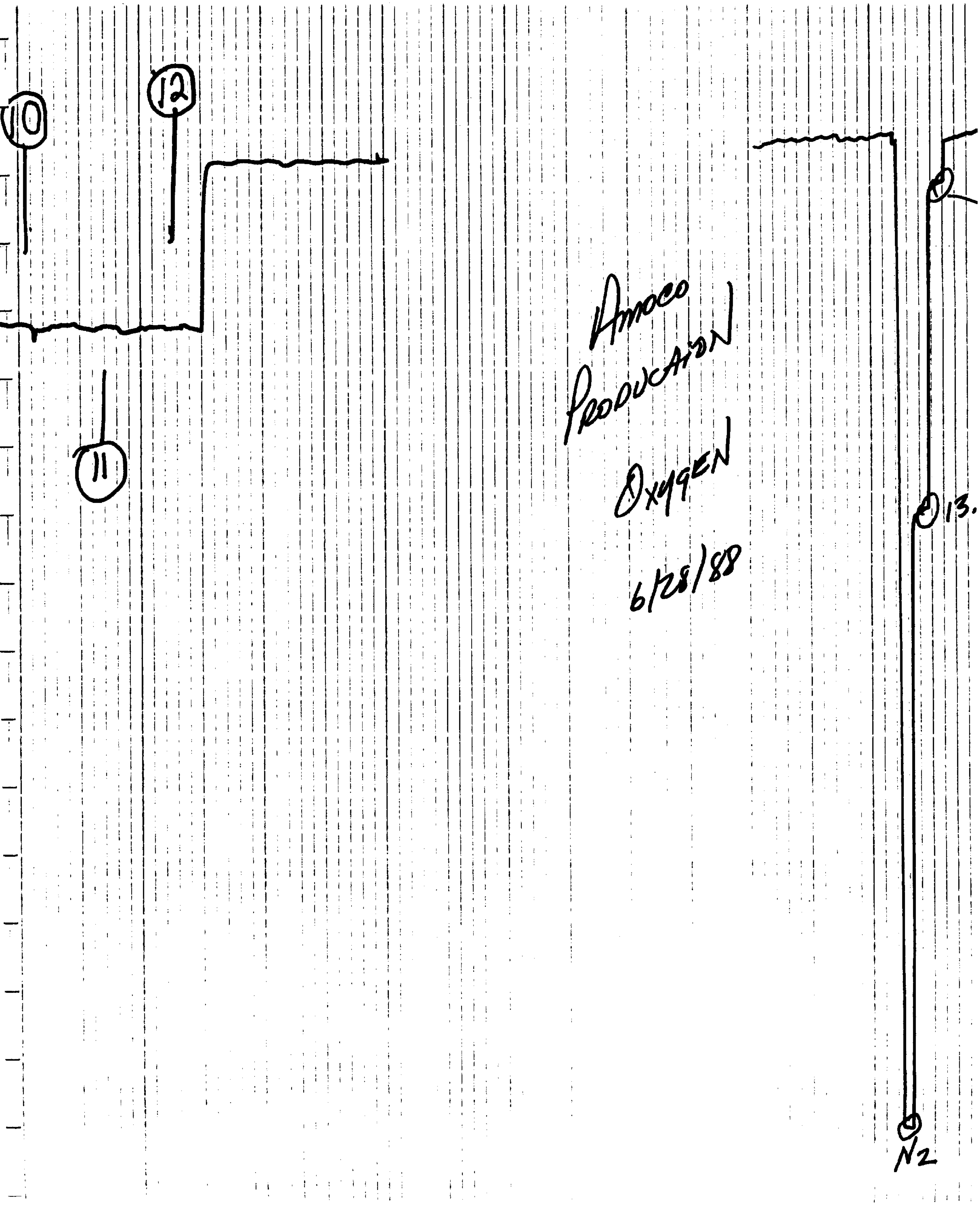


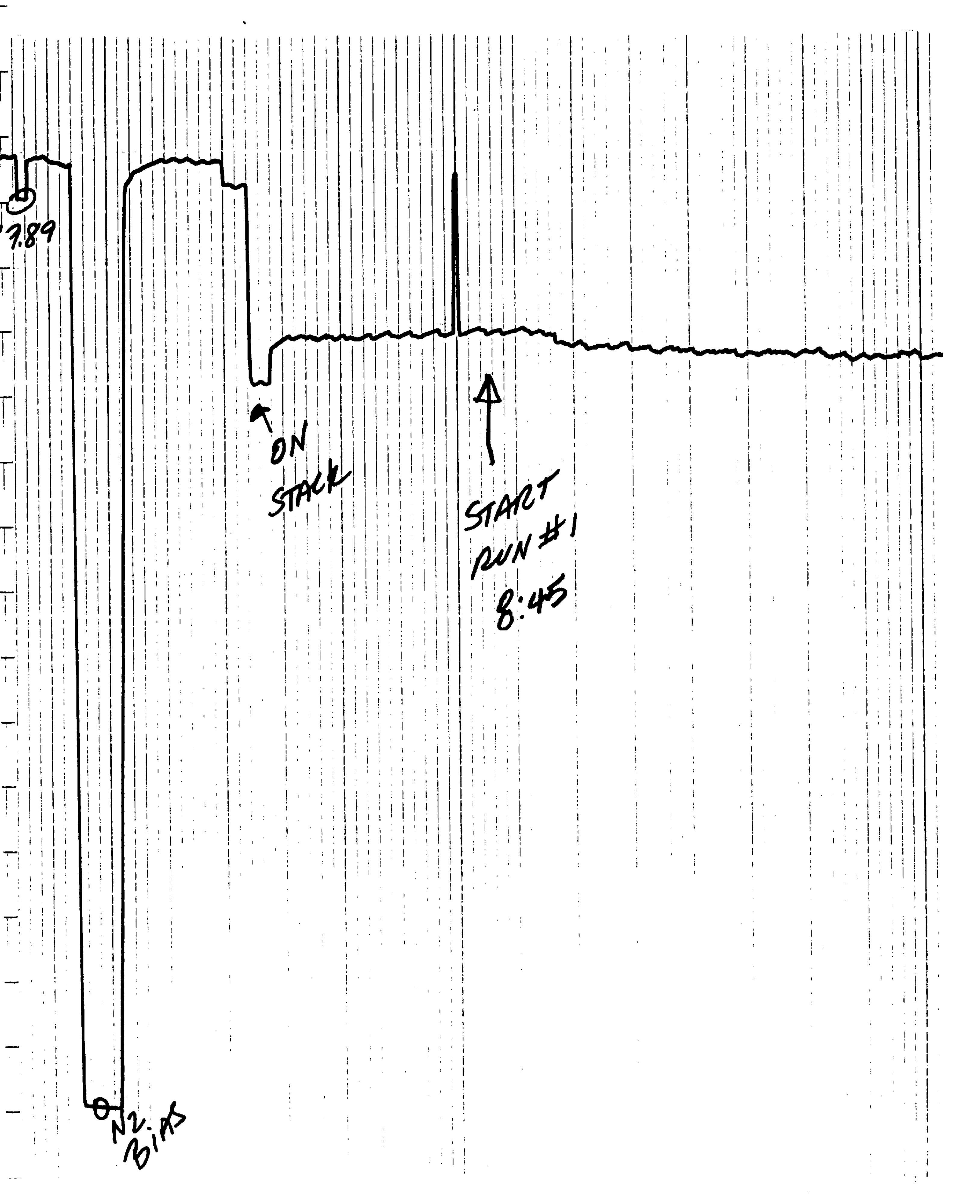

198.93
END RUN
14:00
79.81
40.82
N2


AMOCO PRODUCTION
6/27/88
OXYGEN
SETUP
19.89
13.13
RECORDER ZERO
N2

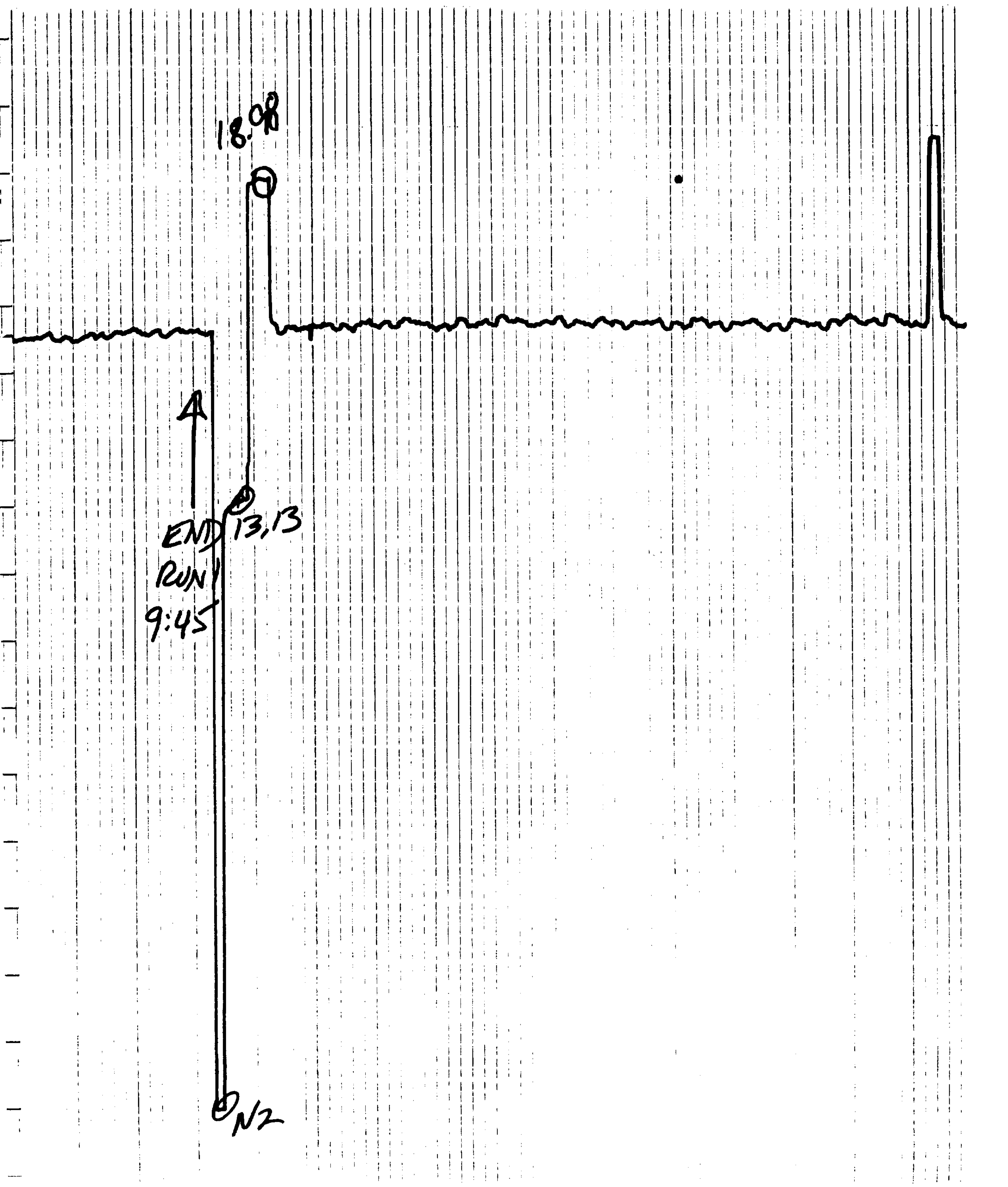

RESPO
TES


PORT "A"
PORT "B"
89
1
2
3
4
5
6
7
8
9
OXYGEN TRAVERSE

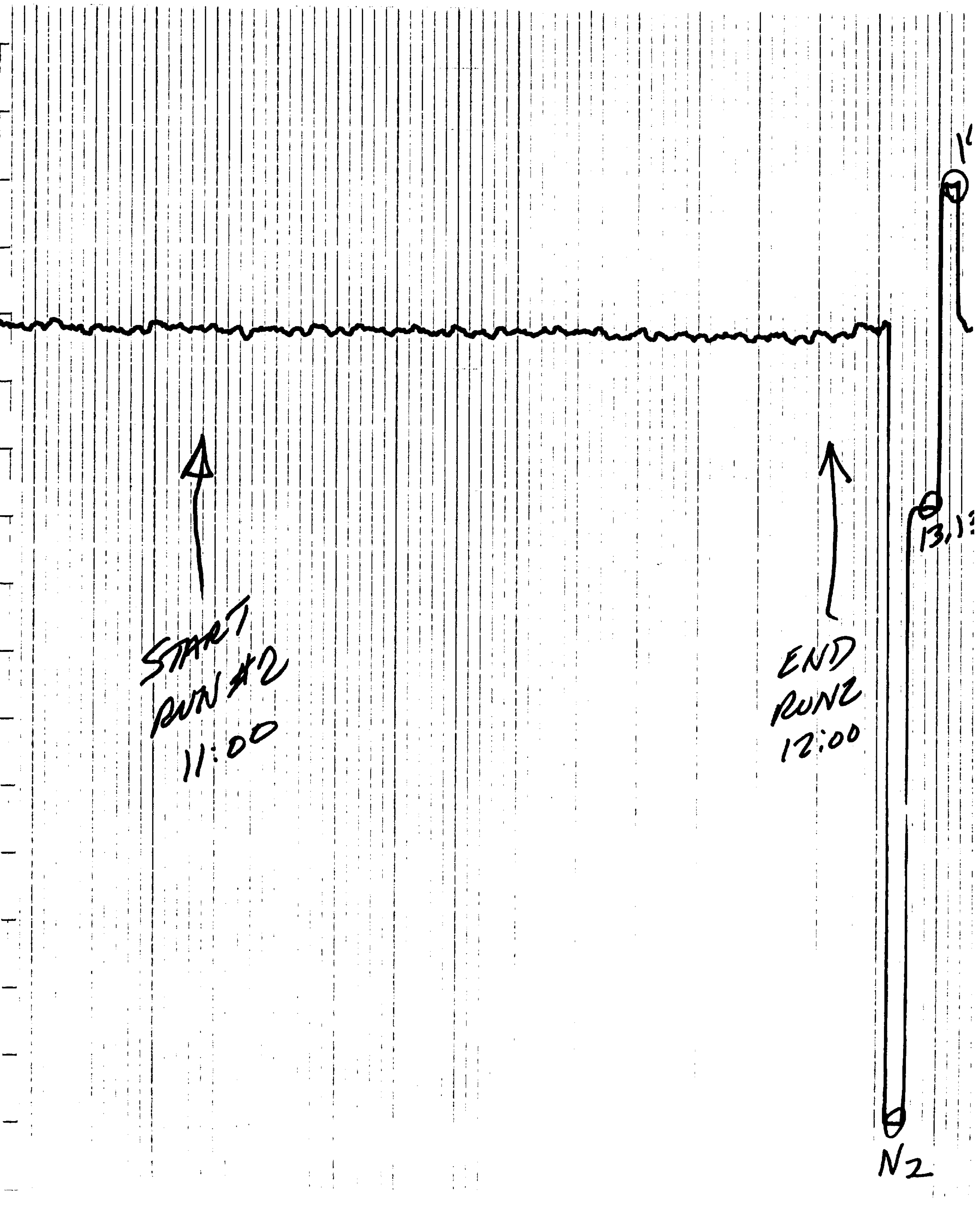

10
12
11
Amoco
Production
Oxygen
6/28/88
13.
N2



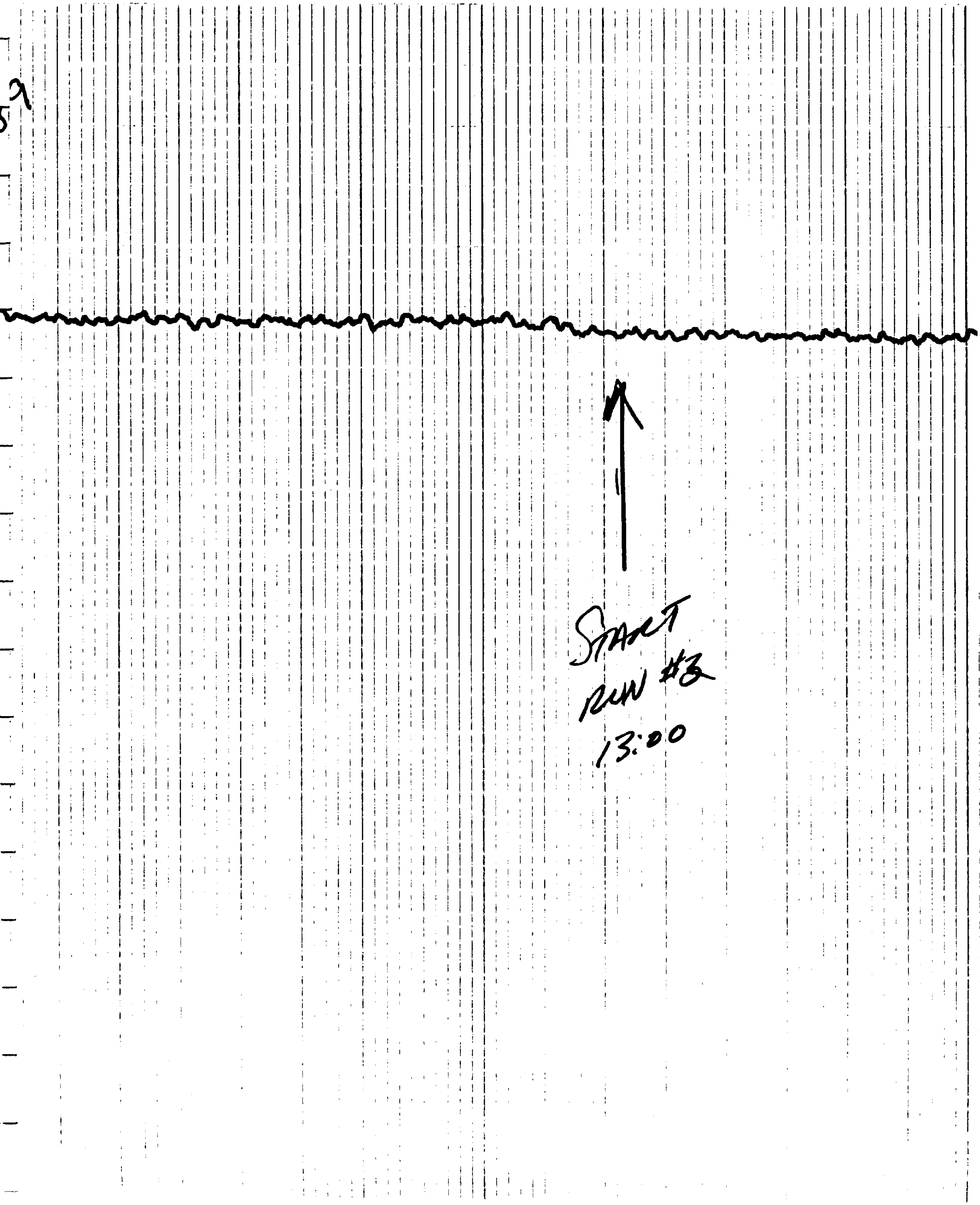
7.89
ON STACK
START RUN #1 8:45
N2 BIAS

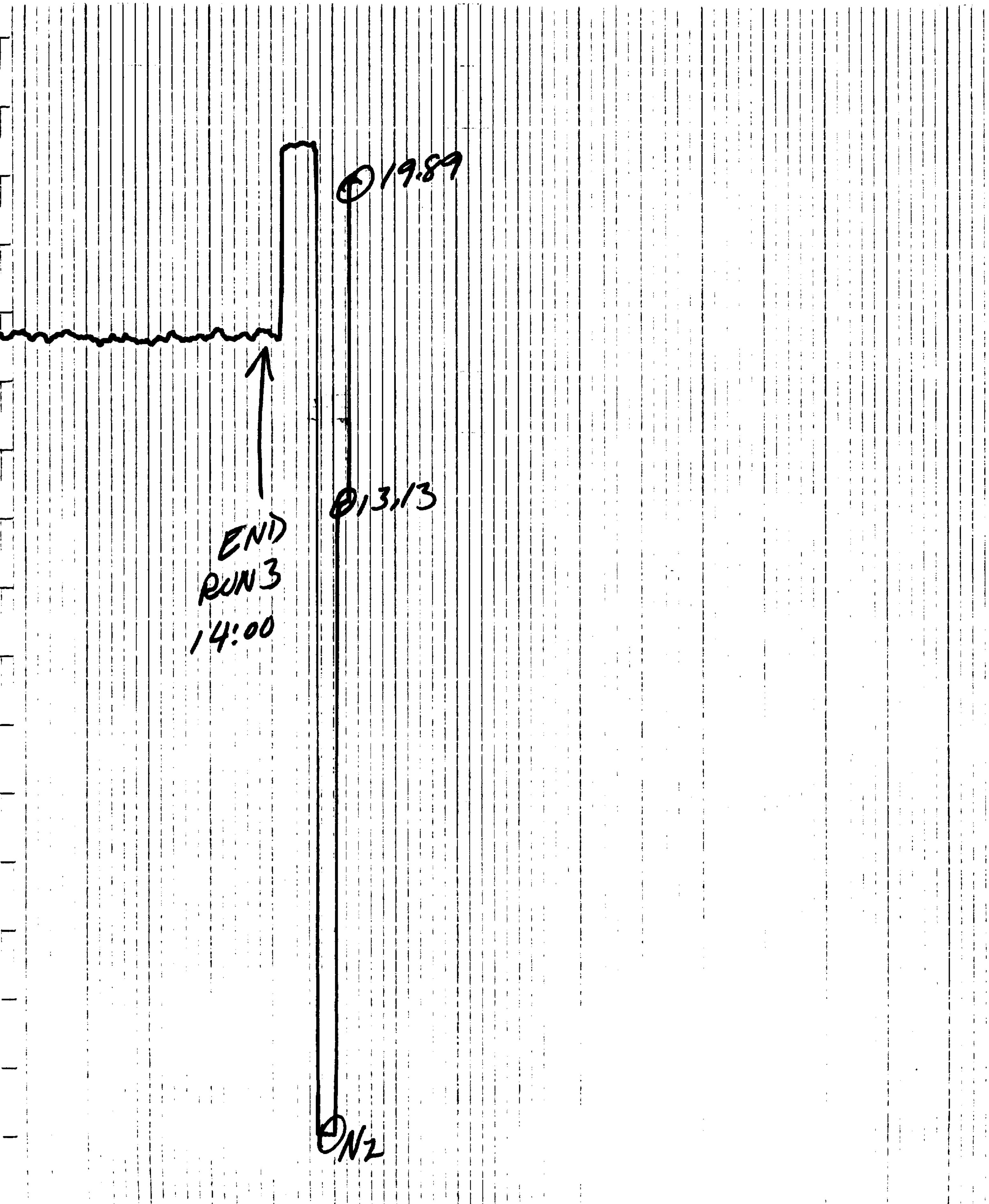


18.98
13,13
END RUN
9:45
N2



START
RUN #2
11:00
END
RUN2
12:00
N2


START
RUN #2
13:00


19.89
13.13
END
RUN 3
14:00
N2

# TURBINE OPERATIONAL RECORD

Company Name AMOCO PRODUCTION COMPANY

Company Location MORGANZA SWT PLT

Turbine Name SATURN (SINGLE SHAFT)

Turbine Source I. D. No. 87-4

## Design Specifications

Manufacturer's Name SOLAR TURBINES INCORPORATED

Model No. GC1-SB-KATO

Serial No. SG 87917

## Parameter Specifications

A. Fuel Type NATURAL GAS B. Fuel Supplier AMOCO

C. Fuel Flow Units MMCFD Meas. Method ORFICE PLATE & METER

D. Is unit equipped for waste heat recovery? YES

Describe THERMO-FLOOD

E. Does unit use water or steam injection? NO

Describe measurement method (continuous flow, start-finish volumes, etc) N/A

F. Combustor Inlet Pressure units (psia, kpa, etc.) 67 PSI

G. Combustor Inlet Temperature units N/A

## Ultimate Fuel Analysis

C _____ S _____ H _____ Ash _____

O _____ $H_2O$ _____ N _____

Trace Metals: Na _____ Va _____ K _____

Fuel elements added _____

Fuel elements added for smoke suppression _____

# TURBINE TEST RUN LOG 1st run

Turbine Operator Daniel K Dendy

Date 6-28-88 ~~Time:~~ Start 0835 End 0935

Ambient Temperature, at time of test 97°F

Turbine Load Condition % 100%

| DATA LOG TIME (15 minute ~~intervals~~) | 0835 | 0850 | 0905 | 0920 |
|---|---|---|---|---|
| Fuel Feed (flow) MCFD | 281 | 281 | 278 | 278 |
| ~~Steam to Turbine (flow)~~ | | | | |
| ~~ENGINE Exhaust Temp~~ | | | | |
| Turbine Speed (rpm) | 22,300 | 22,300 | 22,300 | 22,300 |
| Combustor Inlet Temperature | N/A | N/A | N/A | N/A |
| ok Combustor Inlet Pressure | 68 psi | 68 psi | 67 psi | 67 psi |
| Generator Load (Kw)/Temp Exh | 800/880°F | 790/875°F | 780/870 | 775/870 |
| Combustor Chamber Pressure | N/A | N/A | N/A | N/A |

Run Conditions:

Remarks:



operator log

TURBINE TEST RUN LOG 1st run

Turbine Operator Daniel K. Denly

Date 6-28-99 ~~Time:~~ Start 0935 End

Ambient Temperature, at time of test

Turbine Load Condition % 100%

| | | | | |
|---|---|---|---|---|
| DATA LOG TIME (15 minute ~~intervals~~) | 0935 | 0950 | | |
| Fuel Feed (flow) MCFD | 278 | 278 | | |
| ~~Steam to Turbine (flow)~~ | | | | |
| ~~Engine Exhaust Temp~~ | | | | |
| Turbine Speed (rpm) | 22,300 | | | |
| Combustor Inlet Temperature | N/A | N/A | | |
| Combustor Inlet Pressure | 67 psi. | 67 | | |
| Generator Load (Kw)/Engine Exh. | 780/775 | 745/765 | | |
| Combustor Chamber Pressure | N/A | N/A | | |

Run Conditions:

Remarks:



Operator Log

# TURBINE TEST RUN LOG 2nd run

Turbine Operator David K. Dendy

Date 6-28-88 ~~Time:~~ Start 1100 End 1200

Ambient Temperature, at time of test 102

Turbine Load Condition % 100%

| | | | | |
|---|---|---|---|---|
| DATA LOG TIME (15 minute intervals) | 1100 | 1115 | 1130 | 1145 |
| Fuel Feed (flow) MCFD | 260 | 260 | 260 | 260 |
| ~~Steam to Turbine (flow)~~ | | | | |
| ~~Engine Exhaust Temp~~ | | | | |
| Turbine Speed (rpm) | 22,300 | 22,300 | 22300 | 22,300 |
| Combustor Inlet Temperature | N/A | N/A | N/A | N/A |
| Combustor Inlet Pressure | 66 psi. | 66 psi | 66 psi. | 66 psi. |
| Generator Load (Kw)/ Exhaust Temp. | 740/870°F | 750/880°F | 750/870°F | 750/880°F |
| Combustor Chamber Pressure | N/A | N/A | N/A | N/A |

Run Conditions: ______

Remarks: ______

Operator log

TURBINE TEST RUN LOG 2nd. Run

Turbine Operator Daniel K. Dendy

Date 6-28-88 ~~Time:~~ Start 1100 End 1200

Ambient Temperature, at time of test 102°F

Turbine Load Condition % 100%

| | | | | |
|---|---|---|---|---|
| DATA LOG TIME (15 minute ~~intervals)~~ | 1200 | | | |
| Fuel Feed (flow) | 260 | | | |
| ~~Steam to Turbine (flow)~~ | | | | |
| ENGINE Exhaust Temp | | | | |
| Turbine Speed (rpm) | 22,300 | | | |
| Combustor Inlet Temperature | N/A | | | |
| Combustor Inlet Pressure | 66 psi. | | | |
| Generator Load (Kw)/Exhaust Temp | 735/820°F | | | |
| Combustor Chamber Pressure | N/A | | | |

Run Conditions:

Remarks:



Operator Log

TURBINE TEST RUN LOG 3rd Run

Turbine Operator Daniel K. Dendy

Date 6-28-88 ~~Time:~~ Start 1200 End 1300

Ambient Temperature, at time of test 97°

Turbine Load Condition % 100%

| DATA LOG TIME (15 minute ~~intervals~~) | 1200 | 1215 | 1230 | 1245 |
|---|---|---|---|---|
| Fuel Feed (flow) MCFD | 260 | 260 | 260 | 260 |
| ~~Steam to Turbine (flow)~~ | | | | |
| ENGINE Exhaust Temp | | | | |
| Turbine Speed (rpm) | 22,300 | 22,300 | 22,300 | 22,300 |
| Combustor Inlet Temperature | N/A | N/A | N/A | N/A |
| Combustor Inlet Pressure | 66 psi | 66 psi | 66 psi | 65 psi |
| Generator Load (Kw) / Exhaust Temp. | 750/885 | 750/880 | 740/865 | 750/880 |
| Combustor Chamber Pressure | N/A | N/A | N/A | N/A |

Run Conditions:

Remarks:



Operator Log

TURBINE TEST RUN LOG

3rd run

Turbine Operator Daniel K. Dendy

Date 6-28-88 ~~Time:~~ Start 1300 End

Ambient Temperature, at time of test 97°

Turbine Load Condition % 100%

| | | | | |
|---|---|---|---|---|
| DATA LOG TIME (15 minute ~~intervals~~) | 1300 | | | |
| Fuel Feed (flow) MCFD | 260 | | | |
| ~~Steam to Turbine (flow)~~ | | | | |
| ENGINE Exhaust Temp | | | | |
| Turbine Speed (rpm) | 22300 | | | |
| Combustor Inlet Temperature | N/A | | | |
| Combustor Inlet Pressure | 65 | | | |
| Generator Load (Kw)/ Exhaust Temp | 740/850 | | | |
| Combustor Chamber Pressure | N/A | | | |

Run Conditions:

Remarks:



operator log

PETROLEUM ANALYST INC.

ANALYTICAL CONSULTANTS

GAS ANALYSIS REPORT NO: 013-062988-01 DATE: 06-29-88

| | | | |
|---|---|---|---|
| FOR: | AMOCO PRODUCTION COMPANY | SAMPLE IDENTIFICATION: | |
| | ATTN: GAS MEAS. SEC. | COMPANY: | AMOCO PRODUCTION JB |
| | P.O. BOX 39500 | FIELD: | MORGANZA CF#1 40-665 |
| | LAFAYETTE LA 70593 | LEASE: | TURBINE FUEL |

SAMPLE DATA: DATE: 06-28-88 BY: J. BENDILY
PSIG: 146 TEMP: 106 DEG.F. GRAV: .612
MCF/D: 250 DIF: 34 IN. DF: LBS H2O

REMARKS: H2S (FIELD TEST) = 2.5 PPM
TIME 9:05 AM

CYL # 413

COMPONENT ANALYSIS

| COMPONENT | | MOL PERCENT | GPM @ 15.025 PSIA |
|---|---|---|---|
| CARBON DIOXIDE | (CO2) | 1.30 | |
| NITROGEN | ( N2) | 0.18 | |
| METHANE | ( C1) | 92.79 | |
| ETHANE | ( C2) | 3.67 | 1.001 |
| PROPANE | ( C3) | 0.80 | 0.225 |
| ISO-BUTANE | (IC4) | 0.25 | 0.083 |
| N-BUTANE | (NC4) | 0.20 | 0.064 |
| ISO-PENTANE | (IC5) | 0.13 | 0.049 |
| N-PENTANE | (NC5) | 0.07 | 0.026 |
| HEXANES | ( C6) | 0.17 | 0.071 |
| HEPTANES PLUS | (C7+) | 0.44 | 0.207 |
| TOTAL | | 100.00 | |

ETHANE + GPM 1.726
ISO-PENTANE + GPM 0.353

COMPRESSIBILITY FACTOR 0.9975

SPECIFIC GRAVITY @ 60 DEG. F. (AIR = 1) 0.622

BTU/CU. FT. @ 60 DEG. F.. 15.025 PSIA DRY 1104.1
WET 1085.3

PETROLEUM ANALYST INC.

ANALYTICAL CONSULTANTS

GAS ANALYSIS REPORT NO: 014-062988-01 DATE: 06-29-88

FOR: AMOCO PRODUCTION COMPANY
ATTN: GAS MEAS. SEC.
P.O. BOX 39500
LAFAYETTE LA 70593

SAMPLE IDENTIFICATION:
COMPANY: AMOCO PRODUCTION JB
FIELD: MORGANZA CF#1 40-665
LEASE: TURBINE FUEL

SAMPLE DATA: DATE: 06-28-88 BY: J. BENDILY
PSIG: 147 TEMP: 116 DEG.F. GRAV: .618
MCF/D: 250 DIF: 33 IN. DP: LBS H2O

REMARKS: H2S (FIELD TEST) = 2.5 PPM
TIME 11:20 AM

CYL. # 310

COMPONENT ANALYSIS

| COMPONENT | | MOL PERCENT | GPM @ 15.025 PSIA |
|---|---|---|---|
| CARBON DIOXIDE | (CO2) | 1.37 | |
| NITROGEN | ( N2) | 0.15 | |
| METHANE | ( C1) | 92.97 | |
| ETHANE | ( C2) | 3.64 | 0.993 |
| PROPANE | ( C3) | 0.78 | 0.219 |
| ISO-BUTANE | (IC4) | 0.23 | 0.077 |
| N-BUTANE | (NC4) | 0.16 | 0.051 |
| ISO-PENTANE | (IC5) | 0.13 | 0.049 |
| N-PENTANE | (NC5) | 0.07 | 0.026 |
| HEXANES | ( C6) | 0.15 | 0.063 |
| HEPTANES PLUS | (C7+) | 0.35 | 0.165 |
| TOTAL | | 100.00 | |

ETHANE + GPM 1.643
ISO-PENTANE + GPM 0.303

COMPRESSIBILITY FACTOR 0.9975

SPECIFIC GRAVITY @ 60 DEG. F. (AIR = 1) 0.618

BTU/CU. FT. @ 60 DEG. F., 15.025 PSIA DRY 1096.8
WET 1078.1

(3)

# PETROLEUM ANALYST INC.

ANALYTICAL CONSULTANTS

GAS ANALYSIS REPORT NO: 015-062988-01 DATE: 06-29-88

FOR: AMOCO PRODUCTION COMPANY
ATTN: GAS MEAS. SEC.
P.O. BOX 39500
LAFAYETTE LA 70593

SAMPLE IDENTIFICATION:
COMPANY: AMOCO PRODUCTION JB
FIELD: MORGANZA CF#1 40-665
LEASE: TURBINE FUEL

---

SAMPLE DATA: DATE: 06-28-88 BY: J. BENDILY
PSIG: 148 TEMP: 108 DEG.F. GRAV: .615
MCF/D: 250 DIF: 35 IN. DP: LBS H2O

REMARKS: H2S (FIELD TEST) = 2.5 PPM
TIME 1:30 PM

CYL # 208

---

## COMPONENT ANALYSIS

| COMPONENT | | MOL PERCENT | GPM @ 15.025 PSIA |
|---|---|---|---|
| CARBON DIOXIDE | (CO2) | 1.38 | |
| NITROGEN | ( N2) | 0.15 | |
| METHANE | ( C1) | 92.90 | |
| ETHANE | ( C2) | 3.64 | 0.993 |
| PROPANE | ( C3) | 0.78 | 0.219 |
| ISO-BUTANE | (IC4) | 0.23 | 0.077 |
| N-BUTANE | (NC4) | 0.16 | 0.051 |
| ISO-PENTANE | (IC5) | 0.13 | 0.049 |
| N-PENTANE | (NC5) | 0.07 | 0.026 |
| HEXANES | ( C6) | 0.15 | 0.063 |
| HEPTANES PLUS | (C7+) | 0.41 | 0.193 |
| TOTAL | | 100.00 | |

ETHANE + GPM 1.671
ISO-PENTANE + GPM 0.331

COMPRESSIBILITY FACTOR 0.9975

SPECIFIC GRAVITY @ 60 DEG. F. (AIR = 1) 0.620

BTU/CU. FT. @ 60 DEG. F.. 15.025 PSIA DRY 1099.5
WET 1080.8

## VII. APPENDIX

Contained in this section are the dry gas meter calibration, wet test meter calibration, pitot tube calibration, gas standard certifications and resumes of the persons performing the testing. Also included are excerpts from the instrument operations manuals for all analytical instruments used, showing the principle of operation, performance specifications, flow diagrams, etc..

John R. Angelloz, Jr.
Sampling Specialist
ETS Incorporated
Baton Rouge, Louisiana

EDUCATION

B.S., Engineering Technology
Louisiana State University

Engineer Officer Advanced Course, 1988
Fort Belvoir, Virginia

Engineer Officer Basic Course, 1983
Fort Belvoir, Virginia

EXPERIENCE

1984 to Present - Transferred to ETS from Kemron when ETS purchased assets. Testing Team Leader experienced in emission testing, fugitive emissions, continuous emissions and ambient air monitoring. Familiar with all routine US EPA New Source Performance Test procedures. Routinely performs source sampling and testing using Reference Method test as well as non-standard testing procedures. Conducts calibration, repair and routine maintenance of source sampling and continuous emission monitoring equipment. Responsible for equipment and crew preparation, calibration and logistics for sampling and testing projects.

1984 - Ashton and Associates - Computer Plotter Operator for engineering drawings and prints. Responsible for current materials inventory control.

1975 to 1984 - St. Alphonsus Church. Maintenance Supervisor of maintenance personnel. Responsible for scheduling work, ordering materials, quality control, maintenance safety, and time motion sequences.

MILITARY

Louisiana National Guard - CPT. - Active duty

Troy W. LeSage
Sampling Specialist
ETS Incorporated
Baton Rouge, Louisiana

EDUCATION

Central High School

EXPERIENCE

1987 to Present - Emission testing specialist for ETS. Performs EPA reference methods for compliance testing as well as other non-routine source evaluations. Responsibilities also include job preparation, equipment calibration, and equipment maintenance.

1985 to 1987 - Industrial Hygiene Technican for an environmental firm, performing metal analysis with atomic adsorption spectophotometer, fiber analysis for asbestos and overseeing asbestos abatement projects.

EPA - Sampling and evaluation of Airborn Asbestos Temple University

Air pollution control orientation course

Certified Emissions Opacity Reader.

Niosh - Supervision of Asbestos Abatement Projects, Texas A&M

Steven J. Schwartz
Instrumentation Engineer
ETS Incorporated
Baton Rouge, Louisiana

EDUCATION

A.A., Engineering
Palm Beach Junior College

B.S., Chemical Engineering
University of Southwestern Louisiana

B.S., Chemistry
University of Southwestern Louisiana

EXPERIENCE

1987 to present - Emission Testing Services, Inc. Field testing of stack gases and parameters governing the performance of stationary sources. Knowledgeable with the EPA Reference Methods 1-11, 20 and 25A compliance tests and analysis.

1985 to 1987 - University of Southwestern Louisiana. Student stockroom assistant. Responsibilities include the standardization and quality control of all research and classroom reagents and chemicals. Coordinated the calibration and maintenance of laboratory instruments and analyzers.

1982 to 1985 - Service Lab Analysis, Inc., Laboratory Manager. Involved in all phases of wastewater, ground water and soil analysis as proposed by the Louisiana Department of Natural Resources, 29-B. Detailed laboratory investigations of EPA methodology analysis of pesticides, organic and inorganic matter according to SW-846. Group leader and oversaw the proposals and technical reports to clients.

# METER BOX CALIBRATION DATA AND CALCULATION FORM

(English Units)

Date 4-7-88 Meter box number 586

Barometric pressure, $P_b$ 30.82 in. Hg Calibrated by Troy LeSage

| Orifice manometer setting ($\Delta H$), in. $H_2O$ | Wet test meter ($V_w$), $ft^3$ | Dry gas meter ($V_d$), $ft^3$ | Wet test meter ($t_w$), °F | Dry gas meter Inlet ($t_{d_i}$), °F | Dry gas meter Outlet ($t_{d_o}$), °F | Dry gas meter Avg[a] ($t_d$), °F | Time (θ), min. |
|---|---|---|---|---|---|---|---|
| 0.5 | 5 | 812.000 | 63° | 79 / 75 | 74 / 72 | | 12.97 |
| 1.0 | 5 | 816.963 | 64° | 83 / 79 | 76 / 74 | | 9.24 |
| 1.5 | 10 | 821.917 | 65° | 86 / 82 | 78 / 75 | | 15.25 |
| 2.0 | 10 | 831.805 | 65° | 90 / 84 | 79 / 77 | | 12.96 |
| 3.0 | 10 | 841.676 | 66° | 93 / 88 | 82 / 78 | | 11.05 |
| 4.0 | 10 | 851.549 | | | | | |

| $\Delta H$, in. $H_2O$ | $\frac{\Delta H}{13.6}$ | $Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6})(t_w + 460)}$ | $\Delta H@_i = \frac{0.0317 H}{P_b (t_d + 460)} \left[\frac{(t_w + 460) \theta}{V_w}\right]^2$ |
|---|---|---|---|
| 0.5 | 0.0368 | 1.029 | 1.763 |
| 1.0 | 0.0737 | 1.034 | 1.783 |
| 1.5 | 0.110 | 1.037 | 1.818 |
| 2.0 | 0.147 | 1.042 | 1.963 |
| 3.0 | 0.221 | 1.042 | 1.894 |
| 4.0 | 0.294 | | |
| Average | | 1.037 | 1.844 |

Y = Ratio of reading of wet test meter to dry test meter; tolerance for individual values ± 0.02 from average.

$H_@$ = Orifice pressure differential that equates to 0.75 cfm of air @ 68 F and 29.92 inches of mercury, in. $H_2O$; tolerance for individual values ± 0.20 from average.

Calibrated by Troy S. LeSage

Wet test meter serial number P-1388 Date 03-04-88

Range of wet test meter flow rate 0-50 ft³/hr

Volume of test flask $V_s$ = 0-20 ft³/hr wet ~~test~~ Mether

Satisfactory leak check? Yes

Ambient temperature of equilibrate liquid in wet test meter and reservoir 77.8°F

| Test number | Manometer reading,[a] mm $H_2O$ | Final volume ($V_f$), ℓ | Initial volume ($V_i$), ℓ | Total volume ($V_m$)[b], ℓ | Flask volume ($V_s$), ℓ | Percent error,[c] % |
|---|---|---|---|---|---|---|
| 1 | 0.01 | 282.9035 | 0.0 | 282.9035 | 283.1017 | -0.001 |
| 2 | 0.01 | 565.9535 | 282.9035 | 283.0500 | 286.0277 | - 0.010 |
| 3 | 0.01 | 849.5430 | 565.9535 | 283.5895 | 287.8433 | - 0.015 |

[a] Must be less than 10 mm (0.4 in.) $H_2O$.

Calculations:

[b] $V_m = V_f - V_i$.

[c] % error = $100 (V_m - V_s)/V_s$ = - 0.009 (±1%).

Bead Hathan Signature of calibration person

Wet test meter calibration log.

# PITOT TUBE CALIBRATION

Pitot Tube Number P-3-3 　　　 $Cp_{(std)}$ 0.99

Calibrated By T. LeSage 　　　 Date 2-2-88

| Point Number | Standard Pitot $\Delta p$ (in. $H_2O$) | "S" Type Pitot $\Delta p$ (in. $H_2O$) "A" Side | "B" Side |
|---|---|---|---|
| 1 | 0.110 | 0.170 | 0.170 |
| 2 | 0.545 | 0.820 | 0.815 |
| 3 | 0.845 | 1.35 | 1.30 |

Calculations:

$$Cp_{(s)} = Cp_{(std)} \times \sqrt{\frac{\Delta p\ (std)}{\Delta p\ (s)}}$$

Deviation $= Cp_{(s)} - \overline{Cp}$ (Side A or B)

Avg. Dev. $= \dfrac{\sum_{1}^{3} \left| Cp_{(s)} - \overline{Cp} \right|}{3}$ (Side A or B)

| "A" Side $Cp_{(s)}$ | "A" Side Deviation | "B" Side $Cp_{(s)}$ | "B" Side Deviation |
|---|---|---|---|
| 0.796 | 0.003 | 0.796 | 0.005 |
| 0.807 | 0.008 | 0.810 | 0.009 |
| 0.783 | 0.016 | 0.798 | 0.003 |

$\overline{Cp}$ = 0.799 　　　 = 0.801

$\left| \overline{Cp}\ (\text{Side A}) - \overline{Cp}\ (\text{Side B}) \right|$ = 0.002 (must be $\leq$ 0.01)

Avg. Dev. (Side A) = 0.009 (must be $\leq$ 0.01)

(Side B) = 0.006 (must be $\leq$ 0.01)

$Cp = \dfrac{\overline{Cp}\ (\text{Side A}) + \overline{Cp}\ (\text{Side B})}{2}$ (should be $0.80 \leq Cp \leq 0.85$) = 0.80

Scott Specialty Gases
TROY, MI. 48083 PHONE: 313-589-2950 FAX NO: 313-589-2134

Date Shipped 10/23/87
Our Project No: 924300
Your P.O. No: VERBAL
Page ____ of ____

## CERTIFICATE OF ANALYSIS – EPA PROTOCOL GASES*
(Concentrations are in mole % or ppm)

Cylinder Number AAL-4812 Certified Accuracy ±1% % NBS Traceable Analysis Dates: First 10/12/87 Last 10/21/87

P-0783 CYLINDER PRESSURE 1900 PSIG

| COMPONENTS | CERTIFIED CONC | EXPIRATION DATE | ANALYTICAL PRINCIPLE | PRIMARY STANDARD NBS/SRM's | REPLICATE CONCENTRATIONS FIRST | REPLICATE CONCENTRATIONS SECOND |
|---|---|---|---|---|---|---|
| NITRIC OXIDE | 197.08 PPM | 3/21/89 | HORIBA CHEMILUMINESCENCE | | 196.20 PPM | 197.32 PPM |
| NITROGEN DIOXIDE | 1.85 PPM (NOT PROTOCOLED) | | | 1687 B CAL-9063 951 PPM | 197.95 PPM | 196.97 PPM |
| | | | | | 197.95 PPM | 196.97 PPM |
| NITROGEN | BALANCE | | | 1658B 243 PPM FF-19356 | | |

Cylinder Number ____ Certified Accuracy ____ % NBS Traceable Analysis Dates: First ____ Last ____

| COMPONENTS | CERTIFIED CONC | EXPIRATION DATE | ANALYTICAL PRINCIPLE | PRIMARY STANDARD NBS/SRM's | REPLICATE CONCENTRATIONS FIRST | REPLICATE CONCENTRATIONS SECOND |
|---|---|---|---|---|---|---|
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*We hereby certify the cylinder gas has been analyzed according to EPA Protocol No:

Analyst [signature] Approved By [signature: J. Shapiro]

The only liability of this Company for gas which fails to comply with this analysis shall be replacement thereof by the Company without extra cost.

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Scott Specialty Gases
TROY, MI. 48083 PHONE: 313-589-2950 FAX NO: 313-589-2134

Date Shipped 10/23/87
Our Project No: 924300
Your P.O. No: VERBAL
Page ____ of ____

## CERTIFICATE OF ANALYSIS – EPA PROTOCOL GASES*
(Concentrations are in mole % or ppm)

Cylinder Number AAL-13230 Certified Accuracy ±1% % NBS Traceable Analysis Dates: First 10/12/87 Last 10/22/87

P-0787 CYLINDER PRESSURE 2200 PSIG

| COMPONENTS | CERTIFIED CONC | EXPIRATION DATE | ANALYTICAL PRINCIPLE | PRIMARY STANDARD NBS/SRM's | REPLICATE CONCENTRATIONS FIRST | REPLICATE CONCENTRATIONS SECOND |
|---|---|---|---|---|---|---|
| NITRIC OXIDE | 77.30 PPM | 3/21/89 | HORIBA | 1684B FF24138 | 76.87 PPM | 77.20 PPM |
| NITROGEN DIOXIDE | 2.51 PPM (NOT | PROTOCOLED) | CHEMILUMINESCENCE | 93.7 PPM | 77.43 PPM | 77.10 PPM |
| | | | | 1638B FF26385 | 77.33 PPM | 77.60 PPM |
| NITROGEN | BALANCE | | | 49.5 PPM | | |

Cylinder Number ______ Certified Accuracy ______ % NBS Traceable Analysis Dates: First ______ Last ______

| COMPONENTS | CERTIFIED CONC | EXPIRATION DATE | ANALYTICAL PRINCIPLE | PRIMARY STANDARD NBS/SRM's | REPLICATE CONCENTRATIONS FIRST | REPLICATE CONCENTRATIONS SECOND |
|---|---|---|---|---|---|---|
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*We hereby certify the cylinder gas has been analyzed according to EPA Protocol No:

Analyst [signature] Approved By [signature: Shapiro]

The only liability of this Company for gas which fails to comply with this analysis shall be replacement thereof by the Company without extra cost.

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Scott Specialty Gases
TROY, MI. 48083 PHONE: 313-589-2950 FAX NO: 313-589-2134

Date Shipped 10/23/87
Our Project No: 924300
Your P.O. No: VERBAL
Page ____ of ____

# CERTIFICATE OF ANALYSIS – EPA PROTOCOL GASES*

(Concentrations are in mole % or ppm)

Cylinder Number AAL-2683 Certified Accuracy ±1% % NBS Traceable Analysis Dates: First 10/12/87 Last 10/22/87

P-0786 CYLINDER PRESSURE 2200 PSIG

| COMPONENTS | CERTIFIED CONC | EXPIRATION DATE | ANALYTICAL PRINCIPLE | PRIMARY STANDARD NBS/SRM's | REPLICATE CONCENTRATIONS FIRST | REPLICATE CONCENTRATIONS SECOND |
|---|---|---|---|---|---|---|
| NITRIC OXIDE | 40.32 PPM | 3/21/89 | HORIBA | 1684B FF24138 | 40.39 PPM | 40.32 PPM |
| ~~NITROGEN DIOXIDE~~ | 0.50 PPM (NOT | PROTOCOLED) | CHEMILUMINESCENCE | 93.7 PPM | 40.63 PPM | 40.22 PPM |
| | | | | 1638B FF26385 | 40.73 PPM | 40.42 PPM |
| NITROGEN | BALANCE | | | 49.5 PPM | | |

Cylinder Number ____ Certified Accuracy ____ % NBS Traceable Analysis Dates: First ____ Last ____

| COMPONENTS | CERTIFIED CONC | EXPIRATION DATE | ANALYTICAL PRINCIPLE | PRIMARY STANDARD NBS/SRM's | REPLICATE CONCENTRATIONS FIRST | REPLICATE CONCENTRATIONS SECOND |
|---|---|---|---|---|---|---|
| | | | | | | |
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*We hereby certify the cylinder gas has been analyzed according to EPA Protocol No:

Analyst [signature] Approved By [signature: S. Shapiro]

The only liability of this Company for gas which fails to comply with this analysis shall be replacement thereof by the Company without extra cost.

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Scott Specialty Gases
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Date Shipped 9/2/87
Our Project No: 923910
Your P.O. No: VERBAL
Page 1 of 1

## CERTIFICATE OF ANALYSIS – EPA PROTOCOL GASES*
(Concentrations are in mole % or ppm)

Cylinder Number AAL-18938 Certified Accuracy 1 % NBS Traceable Analysis Dates: First 8/21/87 Last 8/31/87

P0702 CYLINDER PRESSURE 2000 PSIG

| COMPONENTS | CERTIFIED CONC | EXPIRATION DATE | ANALYTICAL PRINCIPLE | PRIMARY STANDARD NBS/SRM's | REPLICATE CONCENTRATIONS FIRST | REPLICATE CONCENTRATIONS SECOND |
|---|---|---|---|---|---|---|
| Carbon Monoxide | 89.85 ppm | 2/28/89 | Beckman NDIR | 1680B | 89.58 ppm | 89.99 ppm |
| | | | | CAL2284 475 ppm | 89.99 ppm | 89.58 ppm |
| Nitrogen | Balance | | | 1679C | 89.58 ppm | 89.99 ppm |
| | | | | CAL5168 97.10 ppm | | |

Cylinder Number AAL-7912 Certified Accuracy 1 % NBS Traceable Analysis Dates: First 8/24/87 Last 8/31/87

P0703 CYLINDER PRESSURE 2000 PSIG

| COMPONENTS | CERTIFIED CONC | EXPIRATION DATE | ANALYTICAL PRINCIPLE | PRIMARY STANDARD NBS/SRM's | REPLICATE CONCENTRATIONS FIRST | REPLICATE CONCENTRATIONS SECOND |
|---|---|---|---|---|---|---|
| Carbon Monoxide | 59.76 ppm | 2/28/89 | Beckman NDIR | 1680B | 60.16 ppm | 59.76 ppm |
| | | | | CAL2284 475 ppm | 60.16 ppm | 59.76 ppm |
| Nitrogen | Balance | | | 1679C | 60.16 ppm | 59.76 ppm |
| | | | | CAL5168 97.10 ppm | | |

*We hereby certify the cylinder gas has been analyzed according to EPA Protocol No:

Analyst Bob Pritz Approved By J. Shapiro

The only liability of this Company for gas which fails to comply with this analysis shall be replacement thereof by the Company without extra cost.

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**Scott Specialty Gases** a division of Scott Environmental Technology, Inc.
PLUMSTEADVILLE, PA 18949 PHONE: 215-766-8861 TWX: 510-665-9344

Shipped From: Scott TROY, MICHIGAN
Date Shipped 10/30/87
Our Project No: 924300
Your P.O. No: VERBAL
Page 1 of 1
Expiration Date: 4/29/89

## CERTIFICATE OF ANALYSIS—EPA PROTOCOL GASES*

Certified Per Traceability Protocol No. 1 Procedure No. ____ Cylinder No. AAL-16677 Cylinder Pressure 1900 psig Certified Accuracy 1 % NBS Traceable

PO 300

| COMPONENTS | CERTIFIED CONC | REFERENCE STD: SRM/CRM NO. | CYL. NO. | CONC. | GAS ANALYZER: MAKE/MODEL/SERIAL NO. | LAST CAL. DATE | ANALYTICAL PRINCIPLE |
|---|---|---|---|---|---|---|---|
| CARBON MONOXIDE | 29.34 PPM | 1678C | FF-19750 | 45.60 PPM | HORIBA | 10/23/87 | NDIR |
| | | 1677 | AAL-7314 | 9.90 PPM | | | |

**BALANCE GAS:** NITROGEN

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

Component CARBON MONOXIDE
First Analysis Date 10/23/87 Units Milli-Volts

| | | |
|---|---|---|
| Z 0 | R 98.4 | T 58.3 |
| R 98.5 | Z 0 | T 58.0 |
| Z 0 | T 58.0 | R 98.5 |

Mean Test Assay 29.39 PPM

Second Analysis Date 10/29/87 Units Milli-Volts

| | | |
|---|---|---|
| Z 0 | R 98.4 | T 58.0 |
| R 98.4 | Z 0 | T 58.0 |
| Z 0 | T 57.9 | R 98.4 |

Mean Test Assay 29.34 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 ____

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 10/29/87
Assay 29.34 PPM

Analyst Bob Pastoff

Approved By: J. Shapiro

Scott Specialty Gases
TROY, MI. 48083 PHONE: 313-589-2950 FAX NO: 313-589-2134

Date Shipped 10/23/87
Our Project No: 924300
Your P.O. No: VERBAL
Page ____ of ____

## CERTIFICATE OF ANALYSIS – EPA PROTOCOL GASES*
(Concentrations are in mole % or ppm)

Cylinder Number AAL-16113 Certified Accuracy ±1% % NBS Traceable Analysis Dates: First ____ Last 9/18/87

P-0724 CYLINDER PRESSURE 2000 PSIG

| COMPONENTS | CERTIFIED CONC | EXPIRATION DATE | ANALYTICAL PRINCIPLE | PRIMARY STANDARD NBS/SRM's | REPLICATE CONCENTRATIONS FIRST | REPLICATE CONCENTRATIONS SECOND |
|---|---|---|---|---|---|---|
| OXYGEN | 13.13% | 3/18/89 | BECKMAN PARAMAGNETIC | 2659 CAL-5911 | | 13.12% |
| | | | | 20.66% | | 13.12% |
| NITROGEN | BALANCE | | | 2651 CAL4155 | | 13.14% |
| | | | | 5.07% | | |

Cylinder Number ____ Certified Accuracy ____ % NBS Traceable Analysis Dates: First ____ Last ____

| COMPONENTS | CERTIFIED CONC | EXPIRATION DATE | ANALYTICAL PRINCIPLE | PRIMARY STANDARD NBS/SRM's | REPLICATE CONCENTRATIONS FIRST | REPLICATE CONCENTRATIONS SECOND |
|---|---|---|---|---|---|---|
| | | | | | | |

*We hereby certify the cylinder gas has been analyzed according to EPA Protocol No:

Analyst [signature] Approved By [signature] Shapiro

The only liability of this Company for gas which fails to comply with this analysis shall be replacement thereof by the Company without extra cost.

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## OXYGEN CYLINDER CERTIFICATION

Company: Liquid Carbonic

Analyst: Troy LeSage

Cylindar # SGAL 2875

Date: 6/22/88

Instrument: Orsat Analysis

| Trial | | $O_2$ | $CO_2$ |
|---|---|---|---|
| 1 | | 19.7 | Ø.Ø |
| 2 | | 19.8 | Ø.Ø |
| 3 | | 29.9 | Ø.Ø |
| 4 | | 19.9 | Ø.Ø |
| 5 | | 19.9 | Ø.Ø |
| 6 | | 2Ø.Ø | Ø.Ø |
| 7 | | 2Ø.Ø | Ø.Ø |
| 8 | | 19.8 | Ø.Ø |
| 9 | | 19.9 | Ø.Ø |
| 1Ø | | 19.9 | Ø.Ø |
| 11 | | 2Ø.Ø | Ø.Ø |
| 12 | | 19.9 | Ø.Ø |
| | Total | 238.7 | Ø.Ø |

Mean $Ø_2$ = 19.89%