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R.F. MACDONALD
SOURCE EMISSIONS TESTING AT TOMATEK INC.

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REPORT #1251
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INTRODUCTION

On October 19, 1989, Ecoserve, Inc. performed emissions compliance testing on two boilers located at Tomatek, Inc. Firebaugh, CA. Ecoserve measured the following parameters at the boiler exhaust stack: Nitrogen Oxides (NO_x), Carbon Monoxide (CO), Non-Methane Hydrocarbons (NMHC), Oxygen (O_2), and Carbon Dioxide (CO_2). Emission rates were calculated based on the F factor method. The Ecoserve test team was comprised of Michael Bell (team leader) and Art Hernandez.

The results of the sampling runs, as well as all test methods with pertinent data and equipment calibration information are included in this report.

DISCUSSION OF RESULTS

Process Data

Since the F factor method was used to determine emission rates, the process data collection/interpretation is worthy of discussion.

#1 - From 40 CFR Part 60.45, an F_d of 8740 DSCF/MMBtu was used as the F factor for all emission rate calculations.

#2 - The fuel consumption (SCF/Hr) was calculated from a fuel meter located on site. A meter reading and time value were recorded at the start and end of testing on each unit. The total gas volume was divided by the total time to give the fuel consumption rate for each unit.

#3 - The Gross Calorific Value (GCV) was obtained from a telephone conversation with Davis Flattenfalltrick at the Yosemite Division of PG&E. He stated that the GCV was averaging 1044 Btu/SCF for the last four weeks.

Constant Monitoring Emissions Testing

#1 - The NMHC were determined by direct injection to a FID. During the first 20 minutes of each run, sample was injected directly into the FID. The second 20 minutes of each run a charcoal scrubber was placed in line before the FID. The charcoal scrubbed all hydrocarbons except methane. The NMHC were determined from the difference between the total hydrocarbons and methane.

#2 - During the first sampling run on Boiler #2 a power failure occured. The power was off for approximately 2 minutes. The data for this run did not include the time during the power failure or the time (2 minutes) after the power failure.

SUMMARY OF RESULTS

GASEOUS EMISSIONS COMPLIANCE TESTING

CLIENT: R.F. MACDONALD

SITE: TOMATEK, INC.

UNIT: BOILER #1

TEST DATE: OCTOBER 19, 1989

RUN:	1	2	3
TIME:	1724-1804	1824-1904	1920-2000
PROCESS CONDITIONS			
Fuel Flow Rate, SCFH :	80,690	80,690	80,690
Fuel GCV, Btu/SCF :	1,044	1,044	1,044
Heat Input, MMBtu/Hr :	84.24	84.24	84.24
GASEOUS EMISSIONS			
Concentration			
CO_2, % v\v dry :	7.6	7.5	7.6
O_2, % v\v dry :	7.1	7.2	7.3
NO_x, ppm v\v dry :	23.2	23.3	23.1
NO_x, ppm @ 3% O_2 :	30.1	30.4	30.4
CO, ppm v\v dry :	138.3	136.7	135.0
CO, ppm @ 3% O_2 :	179.4	178.6	177.7
NMHC, ppm v\v dry :	3.3	3.9	5.1
NMHC, ppm @ 3% O_2 :	4.3	5.1	6.7
Emission Rate			
NO_x as NO_2, lb/MMBtu :	0.037	0.037	0.037
NO_x as NO_2, lb/Hr :	3.12	3.12	3.12
NO_x as NO_2, lb/Day :	74.9	74.9	74.9
CO, lb/MMBtu :	0.133	0.132	0.132
CO, lb/Hr :	11.2	11.1	11.1
CO, lb/Day :	268.8	266.4	266.4
NMHC as CH_4, lb/MMBtu:	0.002	0.002	0.003
NMHC as CH_4, lb/Hr :	0.17	0.17	0.25
NMHC as CH_4, lb/Day :	4.08	4.08	6.00

SUMMARY OF RESULTS

GASEOUS EMISSIONS COMPLIANCE TESTING

CLIENT: R.F. MACDONALD

SITE: TOMATEK, INC.

UNIT: BOILER #2

TEST DATE: OCTOBER 19, 1989

RUN:	1	2	3
TIME:	1254-1338	1408-1448	1508-1548
PROCESS CONDITIONS			
Fuel Flow Rate, SCFH :	81,536	81,536	81,536
Fuel GCV, Btu/SCF :	1,044	1,044	1,044
Heat Input, MMBtu/Hr :	85.12	85.12	85.12
GASEOUS EMISSIONS			
Concentration			
CO_2, % v\v dry :	7.7	7.6	7.8
O_2, % v\v dry :	6.5	6.5	6.4
NO_x, ppm v\v dry :	25.2	26.1	25.7
NO_x, ppm @ 3% O_2 :	31.3	32.4	31.7
CO, ppm v\v dry :	134.5	118.6	138.0
CO, ppm @ 3% O_2 :	167.2	147.4	170.4
NMHC, ppm v\v dry :	7.8	3.9	5.4
NMHC, ppm @ 3% O_2 :	9.7	4.8	6.7
Emission Rate			
NO_x as NO_2, lb/MMBtu :	0.038	0.039	0.039
NO_x as NO_2, lb/Hr :	3.23	3.32	3.32
NO_x as NO_2, lb/Day :	77.5	79.7	79.7
CO, lb/MMBtu :	0.124	0.109	0.126
CO, lb/Hr :	10.6	9.28	10.7
CO, lb/Day :	254.4	222.7	256.8
NMHC as CH_4, lb/MMBtu:	0.004	0.002	0.003
NMHC as CH_4, lb/Hr :	0.34	0.17	0.26
NMHC as CH_4, lb/Day :	8.16	4.08	6.24

CONSTANT MONITORING

REF: Bay Area AQMD, Manual of Procedures, San Francisco, CA, Methods ST-5, ST-6, ST-13A, ST-14, ST-19A, January, 1982
: State of California, Air Resources Board, Draft Stationary Source Test Methods, Method 1-100, June, 1979

METHOD SUMMARY:

A representative sample of duct gas was extracted through a probe, filter, condenser and sample line by a pump. The sample was then pumped into a sampling manifold for distribution to one or more sample analyzers. The analyzers output a continuous analog recording of the concentrations of the analyzed gases in the sample. All analyzers were calibrated with EPA Protocol gases (traceable to National Bureau of Standards SRMs) or with recently analyzed gases (analysis by EPA Reference Methods).

SAMPLING SYSTEM:

A Pyrex glass or stainless steel probe with a Pyrex wool or glass fiber mat filter was positioned in the duct. The end of the probe was located at a point of average duct flow and average pollutant concentrations. The probe was connected with a short (about 2 feet) Teflon line to a sample conditioning train. The conditioning train included three glass knockout traps connected in series with glass unions and immersed in an ice bath. The train was connected with a Teflon line (1/4 inch o.d.) to the pneumatic delivery system which was housed in the monitoring van.

PNEUMATIC DELIVERY SYSTEM:

The Teflon sample line delivered sample gas through an in-line Balston filter to the Teflon-lined diaphragm sample pump. The flow rate of the sample gas was regulated with main and bypass-flow needle valves and was read on the main flow meter (typical setting 10 SCFH). A 10 PSI pressure-relief valve kept the entire system pressure at a safe level. The manifold pressure was regulated with an exhaust needle valve and was read on the pressure gauge (typical setting 1 PSI). The sample in the manifold was delivered through needle valves and flow meters to the various analyzers.

LEAK CHECK PROCEDURE:

The sampling system was checked for leaks by plugging the end of the probe. The exhaust needle valve was closed and the entire sample flow was directed through one analyzer flow meter (range 0-1.0 SCFH). The bypass valve was closed until the vacuum gauge showed at least 15 inches Hg. vacuum. The leak rate was observed at the analyzer flow meter (maximum allowable 2% of total sample flow). The system was checked for leaks before and after sampling.

CALIBRATION PROCEDURE:

Each analyzer was calibrated before and after each sample run. Either a Hoke four-way selector valve or a series of 3-way solenoid valves were used to direct the flow of the various calibration gases into the sample manifold. Each analyzer was calibrated with a zero gas (typically, ambient air or zero grade Nitrogen) and with a span gas (typical span gas concentration 60 to 90 percent of analyzer full scale and/or similar to expected sample concentration). All zero and span checks were recorded and noted on the recorder strip charts.

STRIP CHART DATA REDUCTION:

The analog recordings were averaged over time periods as shown on the data pages (typically 5 minutes, 15 minutes or 30 minutes). The data for each averaging period was digitized and recorded as average percent of full scale. These sample readings were then compared with the zero and span gas readings for calculations of the average concentration for each averaging period.

Any drift of the zero and span readings from the beginning to the end of a sampling period was corrected by calculating apparent zero and span readings for the midpoint of each averaging period. The sample average concentrations were then calculated from the sample readings and the apparent zero and span readings.

CONSTANT MONITORING (cont)

CALCULATIONS (Strip Chart Analysis):

Calculations were performed based on the following equations:

Symbol Identification

Subscripts i and f indicate initial and final respectively (beginning and end of sampling period)

z = zero reading, % full scale
s = span reading, % full scale
t = averaging time period numbered 1 to n
n = number of t's in the sampling period
Delta z = rate of change of zero reading, % full scale/time interval
Delta s = rate of change of span reading, % full scale/time interval
Rt = average sample reading over time t, % full scale
zt = corrected (apparent) zero reading for midpoint of t, % full scale
st = corrected (apparent) span reading for midpoint of t, % full data
Cs = span gas concentration, ppm or % vol. (as shown on data sheet)
Ct = average sample concentration for time t, ppm or % vol. (as indicated)

Equations:

Apparent Zero:

Delta z = (zf-zi) / n

For each t from 1 to n,

zt = Delta z/2 + Delta z * (t-1) + zi

Apparent Span:

Delta s = (sf-si) / n

For each t from 1 to n,

st = Delta s/2 + Delta s * (t-1) + si

Average Sample Concentrations:

Ct = (Rt - Zt / st - zt) * Cs

CONSTANT MONITORING

ANALYZERS:

Thermo Electron Model 10 Nitrogen Oxides Analyzer

The Thermo Electron chemiluminescent analyzer is used to measure parts per million of Nitrogen Oxides in the dry sample gas. The analyzer measures the concentration of NOx by converting NOx to NO and then measuring the light emitted by the reaction of NO with ozone.

The sample gas is drawn into the analyzer by a vacuum pump which partially evacuates the reaction chamber. The sample flows through a NO2 to NO converter for NOx analysis or may pass through the converter for NO analysis. The sample then flows through a temperature controlled critical orifice into the partially evacuated reaction chamber.

Ambient air is also drawn into the analyzer as a source for the generation of ozone. The air flows through a desiccant cartridge for drying, then through an ozone generator which converts some of the oxygen in the air to ozone. The ozonated air then flows through a temperature controlled critical orifice into the reaction chamber.

The sample gas and the ozonated air are mixed in the reaction chamber, where the following reaction takes place:

$$NO + O3 \rightarrow NO2 + O2 + hv$$

The intensity of the chemiluminescence is proportional to the concentration of NO in the reaction chamber. The light emitted by this chemiluminescent reaction shines through a window in the chamber onto a photomultiplier tube (PMT). A spinning chopper wheel between the reaction chamber and the PMT allows the dark PMT output to be compared electronically with the PMT output with light generated by the above reaction. The signal is processed electronically and output for recording of the concentration of NO (or NOx if the converter is used).

CONSTANT MONITORING

ANALYZERS:

Infrared Industries IR-702 Carbon Dioxide

The Infrared Industries non-dispersive infrared analyzer is used to measure the percent dry volume of Carbon Dioxide in the dry sample gas. The analyzer determines CO2 concentrations by measuring the absorption of specific wavelengths of infrared radiation.

The sample gas flows through a cylindrical cell. An infrared source located at the focal point of a concave mirror shines a beam through the sample cell and through a parallel reference cell which contains ambient air. A coaxial chopper disc rotates to send the infrared beams alternately through the sample and reference cells. The radiant beams, after passing through the two cells, are reflected by a second mirror onto two photon detectors with spectral filters. The detectors convert the optical energy from the radiant beams into electrical signals. The signals from the beams passing through the reference cell are compared to the signals from the sample cell beams. Any absorption of the infrared beam in the sample cell by CO2 in the sample gas will cause a proportional difference in the signals from the sample cell and the reference cell beams. This signal difference is converted electronically to an output signal that is linearly proportional to the concentration of CO2 in the sample gas.

CONSTANT MONITORING

ANALYZERS:

Infrared Industries IR-702 Carbon Monoxide

The Infrared Industries non-dispersive infrared analyzer is used to measure the parts per million dry volume of Carbon Monoxide in the dry sample gas. The analyzer determines CO concentrations by measuring the absorption of specific wavelengths of infrared radiation.

The sample gas flows through a cylindrical cell. An infrared source located at the focal point of a concave mirror shines a beam through the sample cell and through a parallel reference cell which contains ambient air. A coaxial chopper disc rotates to send the infrared beams alternately through the sample and reference cells. The radiant beams, after passing through the two cells, are reflected by a second mirror onto two photon detectors with spectral filters. The detectors convert the optical energy from the radiant beams into electrical signals. The signals from the beams passing through the reference cell are compared to the signals from the sample cell beams. Any absorption of the infrared beam in the sample cell by CO in the sample gas will cause a proportional difference in the signals from the sample cell and the reference cell beams. This signal difference is converted electronically to an output signal that is linearly proportional to the concentration of CO in the sample gas.

CONSTANT MONITORING

Analyzers:

Teledyne Analytical Instruments Series 320 Oxygen Analyzer

The Teledyne Analytical Instruments fuel cell oxygen detector continuously measures the percentage of oxygen in a gas atmosphere. The analyzer utilizes a micro-fuel cell which consumes oxygen from the atmosphere around the cell and generates a proportional electric current.

Sample gas is passed over a gas permeable membrane in the fuel-cell chamber. Oxygen diffuses through the membrane and oxidizes lead on the anode. The electron current resulting from this reaction is amplified and output to a built-in meter and a recorder port. A selective range attenuation circuit and a temperature compensation circuit generate temperature compensated outputs for all ranges.

CONSTANT MONITORING

ANALYZERS:

J.U.M. Engineering Model 3-100 Total Hydrocarbon Analyzer:

The J.U.M. 3-100 continuously measures the concentration of hydrocarbons in a gas atmosphere. The analyzer utilizes a flame ionization detector, into which flows a continuous stream of sample gas for measurement.

Sample gas is pulled into the analyzer by an internal diaphragm pump, which then passes the sample into a flame ionization detector (FID). The analyzer uses a cylinder of compressed Hydrogen and filtered ambient air from the internal pump to operate a small flame into which sample gas is introduced. The FID measures the specific ionization produced by the breaking of any Carbon-Hydrogen bonds in the sample compounds as they are oxidized to CO2 and H2O in the flame. The electron current from the detector is amplified and output to a built-in meter and a recorder port. A selective range attenuation circuit generates outputs for ranges of 0 to 10 through 0 to 10,000 ppm Carbon.

Note that the analyzer will respond differently to each of the various possible hydrocarbon compounds which might be present in a sample. The analyzer is usually calibrated with a known concentration of Propane, and the response factor of the sample with respect to Propane can only be known accurately if the constituents of the sample are known accurately. There is, therefore, some compromise between accuracy and practicality when the output of a direct FID instrument is used to determine total hydrocarbon emissions.

EMISSION RATE CALCULATIONS

PROCEDURE:

Emission rates were calculated one of two ways:
- Either pollutant concentrations and duct gas volume flow rates were used to calculate the emission rates, or
- Emission rates were calculated from the measured pollutant concentrations and the measured fuel flows. The calculations were based on the EPA "F" factor for stoichiometric combustion.

The calculations were performed using the equation shown below.

CALCULATIONS:

Symbol Identification:

C = average concentration, ppm volume dry
E = emission rate, lb/MMBTU
ER1 = emission rate, lb/hr based on volume flow rates
ER2 = emission rate, lb/hr based on EPA "f" factor
F = emission rate factor, SDCF/MMBTU
I = unit heat input, MMBTU/hr
K1 = conversion constant
K2 = conversion constant
MW = molecular weight, gm/mole, NO_2= 46.01, SO_2=64.06, CO=28, etc.
%O2 = oxygen concentration of sample, % vol. dry
Qstd(dry) = volume flow rate of duct gas at standard conditions, dry basis

EQUATIONS:

$ER1 = C * MW * Qstd(dry) * K1$

where K1 = $1.581 * 10^{-7}$ for 60°F standard conditions
$1.557 * 10^{-7}$ for 68°F standard conditions
$1.552 * 10^{-7}$ for 70°F standard conditions

$ER2 = E * I$

where:

$E = C * F * 20.9 / (20.9 - \%O2)$
$C = PPM * MW * K2$
$K2 = 2.59 * 10E-09$

NOTE: Results are shown on the Results Summary pages.

DATA SHEETS
BOILER #1

CONSTANT MONITORING

DATA AND RESULTS:

Client: RF MACDONALD
Date: 09/19/89

Unit: BOILER #1
Point:

Analyzer: TECO 10
Serial Number:
Analyzer Range: 100
Recorder Range: 1V
Last Linearity:

Zero Gas: Nitrogen
Span Gas: NOX
Cyl #: SCOTT AAL-6503
Concentration: 81.54
Units: ppm (vol. dry)
Interval(min): 4

RUN 1

Analysis Interval		Time Hour	Minute	Analyzer response % Full Scale		[Conc.]
Initial Zero		17	8	2.7	-	0.0
Initial Span		17	10	84.2	-	81.5
Interval	1	17	24	25.8	-	23.1
Interval	2	17	28	25.8	-	23.1
Interval	3	17	32	25.9	-	23.2
Interval	4	17	36	25.8	-	23.1
Interval	5	17	40	25.9	-	23.2
Interval	6	17	44	25.9	-	23.2
Interval	7	17	48	26.0	-	23.3
Interval	8	17	52	25.8	-	23.1
Interval	9	17	56	26.0	-	23.3
Interval	10	18	0	26.0	-	23.3
Final Zero		18	4	2.8	-	0.0
Final Span		18	8	84.9	-	81.5

Zero Drift %FS = 0.1
Span Drift %FS = 0.6

Run Average 23.2

CONSTANT MONITORING

DATA AND RESULTS:

Client: RF MACDONALD
Date: 09/19/89

Unit: BOILER #1
Point:

Analyzer: TECO 10
Serial Number:
Analyzer Range: 100
Recorder Range: 1V
Last Linearity:

Zero Gas: Nitrogen
Span Gas: NOX
Cyl #: SCOTT AAL-6503
Concentration: 81.54
Units: ppm (vol. dry)
Interval(min): 4

RUN 2

Analysis Interval		Time Hour	Minute	Analyzer response % Full Scale		[Conc.]
Initial Zero		18	4	2.8	-	0.0
Initial Span		18	8	84.9	-	81.5
Interval	1	18	24	26.3	-	23.3
Interval	2	18	28	26.3	-	23.3
Interval	3	18	32	26.3	-	23.3
Interval	4	18	36	26.3	-	23.3
Interval	5	18	40	26.2	-	23.2
Interval	6	18	44	26.2	-	23.2
Interval	7	18	48	26.3	-	23.3
Interval	8	18	52	26.3	-	23.3
Interval	9	18	56	26.3	-	23.3
Interval	10	19	0	26.0	-	23.0
Final Zero		19	4	3.0	-	0.0
Final Span		19	8	84.5	-	81.5

Zero Drift %FS = 0.2
Span Drift %FS = -0.6

Run Average 23.3

CONSTANT MONITORING

DATA AND RESULTS:

Client: RF MACDONALD
Date: 09/19/89

Unit: BOILER #1
Point:

Analyzer: TECO 10
Serial Number:
Analyzer Range: 100
Recorder Range: 1V
Last Linearity:

Zero Gas: Nitrogen
Span Gas: NOX
Cyl #: SCOTT AAL-6503
Concentration: 81.54
Units: ppm (vol. dry)
Interval(min): 4

RUN 3

Analysis Interval		Time Hour	Minute	Analyzer response % Full Scale		[Conc.]
Initial Zero		19	4	3.0	-	0.0
Initial Span		19	8	84.5	-	81.5
Interval	1	19	20	26.2	-	23.2
Interval	2	19	24	26.2	-	23.2
Interval	3	19	28	26.2	-	23.2
Interval	4	19	32	26.1	-	23.1
Interval	5	19	36	26.1	-	23.1
Interval	6	19	40	26.1	-	23.1
Interval	7	19	44	26.0	-	23.0
Interval	8	19	48	26.1	-	23.1
Interval	9	19	52	26.2	-	23.2
Interval	10	19	56	26.1	-	23.1
Final Zero		20	0	2.9	-	0.0
Final Span		20	4	84.8	-	81.5

Zero Drift %FS = -0.1
Span Drift %FS = 0.4

Run Average 23.1

CONSTANT MONITORING

DATA AND RESULTS:

Client: RF MACDONALD
Date: 09/19/89
Unit: BOILER #1
Point:

Analyzer: INFRARED
Serial Number:
Analyzer Range: 1000
Recorder Range: .1V
Last Linearity:

Zero Gas: Nitrogen
Span Gas: CO
Cyl #: SCOTT AAL-6503
Concentration: 838.3
Units: ppm (vol. dry)
Interval(min): 4

RUN 1

Analysis Interval		Time Hour	Minute	Analyzer response % Full Scale		[Conc.]
Initial Zero		17	8	4.0	-	0.0
Initial Span		17	10	87.2	-	838.3
Interval	1	17	24	17.2	-	133.0
Interval	2	17	28	17.2	-	133.0
Interval	3	17	32	16.8	-	129.0
Interval	4	17	36	17.1	-	132.0
Interval	5	17	40	17.3	-	134.0
Interval	6	17	44	18.2	-	143.1
Interval	7	17	48	19.8	-	159.2
Interval	8	17	52	18.4	-	145.1
Interval	9	17	56	17.8	-	139.0
Interval	10	18	0	17.5	-	136.0
Final Zero		18	4	5.1	-	0.0
Final Span		18	8	87.6	-	838.3

Zero Drift %FS = 1.1
Span Drift %FS = -0.7

Run Average 138.3

CONSTANT MONITORING

DATA AND RESULTS:

Client: RF MACDONALD
Date: 09/19/89
Unit: BOILER #1
Point:

Analyzer: INFRARED
Serial Number:
Analyzer Range: 1000
Recorder Range: 1V
Last Linearity:

Zero Gas: Nitrogen
Span Gas: CO
Cyl #: SCOTT AAL-6503
Concentration: 838.3
Units: ppm (vol. dry)
Interval(min): 4

RUN 2

Analysis Interval		Time Hour	Minute	Analyzer response % Full Scale		[Conc.]
Initial Zero		18	4	5.1	-	0.0
Initial Span		18	8	87.6	-	838.3
Interval	1	18	24	17.7	-	128.0
Interval	2	18	28	18.5	-	136.2
Interval	3	18	32	18.9	-	140.2
Interval	4	18	36	18.8	-	139.2
Interval	5	18	40	18.5	-	136.2
Interval	6	18	44	18.3	-	134.1
Interval	7	18	48	18.2	-	133.1
Interval	8	18	52	19.0	-	141.2
Interval	9	18	56	19.1	-	142.3
Interval	10	19	0	18.5	-	136.2
Final Zero		19	4	4.2	-	0.0
Final Span		19	8	86.8	-	838.3

Zero Drift %FS = -0.9
Span Drift %FS = 0.1

Run Average 136.7

CONSTANT MONITORING

DATA AND RESULTS:

Client: RF MACDONALD
Date: 09/19/89

Unit: BOILER #1
Point:

Analyzer: INFRARED
Serial Number:
Analyzer Range: 1000
Recorder Range: .1V
Last Linearity:

Zero Gas: Nitrogen
Span Gas: CO
Cyl #: SCOTT AAL-6503
Concentration: 838.3
Units: ppm (vol. dry)
Interval(min): 4

RUN 3

Analysis Interval		Time Hour	Minute	Analyzer response % Full Scale		[Conc.]
Initial Zero		19	4	4.2	-	0.0
Initial Span		19	8	86.8	-	838.3
Interval	1	19	20	17.5	-	135.0
Interval	2	19	24	17.1	-	130.9
Interval	3	19	28	17.5	-	135.0
Interval	4	19	32	18.5	-	145.1
Interval	5	19	36	18.2	-	142.1
Interval	6	19	40	18.0	-	140.1
Interval	7	19	44	17.3	-	133.0
Interval	8	19	48	17.0	-	129.9
Interval	9	19	52	17.0	-	129.9
Interval	10	19	56	16.9	-	128.9
Final Zero		20	0	4.0	-	0.0
Final Span		20	4	86.2	-	838.3

Zero Drift %FS = -0.2
Span Drift %FS = -0.4

Run Average 135.0

CONSTANT MONITORING

DATA AND RESULTS:

Client: RF MACDONALD
Date: 09/19/89

Unit: BOILER #1
Point:

Analyzer: JUM
Serial Number:
Analyzer Range: 100
Recorder Range: 10V
Last Linearity:

Zero Gas: Nitrogen
Span Gas: PROPANE
Cyl #: SCOTT B-112
Concentration: 100.2
Units: ppm (vol. dry)
Interval(min): 4

RUN 1

Analysis Interval		Time Hour	Minute	Analyzer response % Full Scale		[Conc.]
Initial Zero		17	18	4.3	-	0.0
Initial Span		17	22	96.8	-	100.2
Interval	1	17	24	11.3	-	7.6
Interval	2	17	28	11.7	-	8.0
Interval	3	17	32	11.6	-	7.9
Interval	4	17	36	11.8	-	8.1
Interval	5	17	40	12.1	-	8.4
Interval	6[1]	17	44	10.0	-	6.2
Interval	7[1]	17	48	12.0	-	8.3
Interval	8[1]	17	52	10.7	-	6.9
Interval	9[1]	17	56	10.5	-	6.7
Interval	10[1]	18	0	10.3	-	6.5
Final Zero		18	17	4.2	-	0.0
Final Span		18	20	96.5	-	100.2

Zero Drift %FS = -0.1
Span Drift %FS = -0.2

Run Average 7.5

1. Charcoal in-line

CONSTANT MONITORING

DATA AND RESULTS:

Client: RF MACDONALD
Date: 09/19/89

Unit: BOILER #1
Point:

Analyzer: JUM
Serial Number:
Analyzer Range: 100
Recorder Range: 10V
Last Linearity:

Zero Gas: Nitrogen
Span Gas: PROPANE
Cyl #: SCOTT B-112
Concentration: 100.2
Units: ppm (vol. dry)
Interval(min): 4

RUN 2

Analysis Interval		Time Hour	Minute	Analyzer response % Full Scale		[Conc.]
Initial Zero		18	17	4.2	-	0.0
Initial Span		18	20	96.5	-	100.2
Interval	1	18	24	11.5	-	7.9
Interval	2	18	28	11.8	-	8.3
Interval	3	18	32	11.7	-	8.1
Interval	4	18	36	11.8	-	8.3
Interval	5	18	40	11.7	-	8.1
Interval	6[1]	18	44	10.5	-	6.8
Interval	7[1]	18	48	10.5	-	6.8
Interval	8[1]	18	52	10.3	-	6.6
Interval	9[1]	18	56	10.6	-	6.9
Interval	10[1]	19	0	10.7	-	7.1
Final Zero		19	14	4.3	-	0.0
Final Span		19	18	96.5	-	100.2

Zero Drift %FS = 0.1
Span Drift %FS = -0.1

Run Average 7.5

1. Charcoal in-line

CONSTANT MONITORING

DATA AND RESULTS:

Client: RF MACDONALD
Date: 09/19/89

Unit: BOILER #1
Point:

Analyzer: JUM
Serial Number:
Analyzer Range: 100
Recorder Range: 10V
Last Linearity:

Zero Gas: Nitrogen
Span Gas: PROPANE
Cyl #: SCOTT B-112
Concentration: 100.2
Units: ppm (vol. dry)
Interval(min): 4

RUN 3

Analysis Interval		Time Hour	Minute	Analyzer response % Full Scale		[Conc.]
Initial Zero		19	14	4.3	-	0.0
Initial Span		19	18	96.5	-	100.2
Interval	1	19	20	11.4	-	7.7
Interval	2	19	24	11.5	-	7.8
Interval	3	19	28	11.7	-	8.0
Interval	4	19	32	11.8	-	8.2
Interval	5	19	36	11.6	-	7.9
Interval	6[1]	19	40	10.0	-	6.2
Interval	7[1]	19	44	10.2	-	6.4
Interval	8[1]	19	48	10.3	-	6.5
Interval	9[1]	19	52	9.9	-	6.1
Interval	10[1]	19	56	9.9	-	6.1
Final Zero		20	2	4.2	-	0.0
Final Span		20	4	97.0	-	100.2

Zero Drift %FS = -0.1
Span Drift %FS = 0.6

Run Average 7.1

1. Charcoal in-line

CONSTANT MONITORING

DATA AND RESULTS:

Client: RF MACDONALD
Date: 09/19/89

Unit: BOILER #1
Point:

Analyzer: TELEDYNE
Serial Number:
Analyzer Range: 25
Recorder Range: 1V
Last Linearity:

Zero Gas: Nitrogen
Span Gas: O2
Cyl #: AMBIENT
Concentration: 20.9
Units: % (vol. dry)
Interval(min): 4

RUN 1

Analysis Interval		Time Hour	Minute	Analyzer response % Full Scale		[Conc.]
Initial Zero		17	8	10.0	-	0.0
Initial Span		17	10	94.3	-	20.9
Interval	1	17	24	38.7	-	7.1
Interval	2	17	28	38.7	-	7.1
Interval	3	17	32	38.7	-	7.1
Interval	4	17	36	38.7	-	7.1
Interval	5	17	40	38.7	-	7.1
Interval	6	17	44	38.0	-	6.9
Interval	7	17	48	38.7	-	7.1
Interval	8	17	52	38.8	-	7.1
Interval	9	17	56	38.9	-	7.2
Interval	10	18	0	38.9	-	7.2
Final Zero		18	4	10.0	-	0.0
Final Span		18	8	94.3	-	20.9

Zero Drift %FS = 0.0
Span Drift %FS = 0.0

Run Average 7.1

CONSTANT MONITORING

DATA AND RESULTS:

Client: RF MACDONALD
Date: 09/19/89

Unit: BOILER #1
Point:

Analyzer: TELEDYNE
Serial Number:
Analyzer Range: 25
Recorder Range: 1V
Last Linearity:

Zero Gas: Nitrogen
Span Gas: O2
Cyl #: AMBIENT
Concentration: 20.9
Units: % (vol. dry)
Interval(min): 4

RUN 2

Analysis Interval		Time Hour	Minute	Analyzer response % Full Scale		[Conc.]
Initial Zero		18	4	10.0	-	0.0
Initial Span		18	8	94.3	-	20.9
Interval	1	18	24	39.0	-	7.2
Interval	2	18	28	39.0	-	7.2
Interval	3	18	32	39.0	-	7.2
Interval	4	18	36	39.0	-	7.2
Interval	5	18	40	39.0	-	7.2
Interval	6	18	44	39.0	-	7.2
Interval	7	18	48	38.9	-	7.2
Interval	8	18	52	38.9	-	7.2
Interval	9	18	56	38.9	-	7.2
Interval	10	19	0	38.9	-	7.2
Final Zero		19	4	10.0	-	0.0
Final Span		19	8	94.0	-	20.9

Zero Drift %FS = 0.0
Span Drift %FS = -0.3

Run Average 7.2

CONSTANT MONITORING

DATA AND RESULTS:

Client: RF MACDONALD
Date: 09/19/89

Unit: BOILER #1
Point:

Analyzer: TELEDYNE
Serial Number:
Analyzer Range: 25
Recorder Range: 1V
Last Linearity:

Zero Gas: Nitrogen
Span Gas: O2
Cyl #: AMBIENT
Concentration: 20.9
Units: % (vol. dry)
Interval(min): 4

RUN 3

Analysis Interval		Time Hour	Minute	Analyzer response % Full Scale		[Conc.]
Initial Zero		19	4	10.0	-	0.0
Initial Span		19	8	94.0	-	20.9
Interval	1	19	20	39.0	-	7.2
Interval	2	19	24	39.0	-	7.2
Interval	3	19	28	39.0	-	7.2
Interval	4	19	32	39.0	-	7.2
Interval	5	19	36	39.1	-	7.2
Interval	6	19	40	39.2	-	7.3
Interval	7	19	44	39.3	-	7.3
Interval	8	19	48	39.6	-	7.4
Interval	9	19	52	39.7	-	7.4
Interval	10	19	56	39.5	-	7.3
Final Zero		20	0	10.0	-	0.0
Final Span		20	4	95.0	-	20.9

Zero Drift %FS = 0.0
Span Drift %FS = 1.0

Run Average 7.3

CONSTANT MONITORING

DATA AND RESULTS:

Client: RF MACDONALD
Date: 09/19/89

Unit: BOILER #1
Point:

Analyzer: INFRARED
Serial Number:
Analyzer Range: 20
Recorder Range: .1V
Last Linearity:

Zero Gas: Nitrogen
Span Gas: CO2
Cyl #: LINDE K94324
Concentration: 15
Units: % (vol. dry)
Interval(min): 4

RUN 1

Analysis Interval		Time Hour	Minute	Analyzer response % Full Scale		[Conc.]
Initial Zero		17	12	20.1	-	0.0
Initial Span		17	16	91.2	-	15.0
Interval	1	17	24	55.5	-	7.5
Interval	2	17	28	55.3	-	7.4
Interval	3	17	32	55.4	-	7.4
Interval	4	17	36	55.7	-	7.5
Interval	5	17	40	55.8	-	7.5
Interval	6	17	44	56.3	-	7.6
Interval	7	17	48	57.0	-	7.8
Interval	8	17	52	57.2	-	7.8
Interval	9	17	56	57.4	-	7.9
Interval	10	18	0	57.0	-	7.8
Final Zero		18	10	20.1	-	0.0
Final Span		18	14	90.8	-	15.0

Zero Drift %FS = 0.0
Span Drift %FS = -0.4

Run Average 7.6

CONSTANT MONITORING

DATA AND RESULTS:

Client: RF MACDONALD
Date: 09/19/89

Unit: BOILER #1
Point:

Analyzer: INFRARED
Serial Number:
Analyzer Range: 20
Recorder Range: .1V
Last Linearity:

Zero Gas: Nitrogen
Span Gas: CO2
Cyl #: LINDE K94324
Concentration: 15
Units: % (vol. dry)
Interval(min): 4

RUN 2

Analysis Interval		Time Hour	Minute	Analyzer response % Full Scale		[Conc.]
Initial Zero		18	10	20.1	-	0.0
Initial Span		18	14	90.8	-	15.0
Interval	1	18	24	54.8	-	7.4
Interval	2	18	28	55.1	-	7.4
Interval	3	18	32	55.2	-	7.4
Interval	4	18	36	55.3	-	7.5
Interval	5	18	40	55.5	-	7.5
Interval	6	18	44	56.0	-	7.6
Interval	7	18	48	56.3	-	7.7
Interval	8	18	52	56.3	-	7.7
Interval	9	18	56	56.2	-	7.7
Interval	10	19	0	56.0	-	7.6
Final Zero		19	10	20.1	-	0.0
Final Span		19	12	90.8	-	15.0

Zero Drift %FS = 0.0
Span Drift %FS = 0.0

Run Average 7.5

CONSTANT MONITORING

DATA AND RESULTS:

Client: RF MACDONALD
Date: 09/19/89
Unit: BOILER #1
Point:

Analyzer: INFRARED
Serial Number:
Analyzer Range: 20
Recorder Range: .1V
Last Linearity:

Zero Gas: Nitrogen
Span Gas: CO2
Cyl #: LINDE K94324
Concentration: 15
Units: % (vol. dry)
Interval(min): 4

RUN 3

Analysis Interval		Time Hour	Minute	Analyzer response % Full Scale		[Conc.]
Initial Zero		19	10	20.1	-	0.0
Initial Span		19	12	90.8	-	15.0
Interval	1	19	20	54.7	-	7.3
Interval	2	19	24	55.2	-	7.4
Interval	3	19	28	55.5	-	7.5
Interval	4	19	32	55.7	-	7.6
Interval	5	19	36	55.7	-	7.6
Interval	6	19	40	56.0	-	7.6
Interval	7	19	44	56.3	-	7.7
Interval	8	19	48	56.5	-	7.7
Interval	9	19	52	56.2	-	7.7
Interval	10	19	56	55.8	-	7.6
Final Zero		20	5	20.0	-	0.0
Final Span		20	10	93.2	-	15.0

Zero Drift %FS = -0.1
Span Drift %FS = 2.5

Run Average 7.6

DATA SHEETS
BOILER #2

CONSTANT MONITORING

DATA AND RESULTS:

Client: RF MACDONALD
Date: 09/19/89
Unit: BOILER #2
Point:

Analyzer: TECO 10
Serial Number:
Analyzer Range: 100
Recorder Range: 1V
Last Linearity:

Zero Gas: Nitrogen
Span Gas: NOX
Cyl #: SCOTT AAL-6503
Concentration: 81.54
Units: ppm (vol. dry)
Interval(min): 4

RUN 1

Analysis Interval		Time Hour	Minute	Analyzer response % Full Scale		[Conc.]
Initial Zero		12	37	2.2	-	0.0
Initial Span		12	40	83.5	-	81.4
Interval	1	12	54	26.0	-	23.8
Interval	2	12	58	26.0	-	23.8
Interval	3	13	2	26.8	-	24.6
Interval	4	13	6	27.3	-	25.1
Interval	5	13	10	27.1	-	24.9
Interval	6	13	14	27.5	-	25.3
Interval	7	13	18	27.0	-	24.8
Interval	8	13	26	28.7	-	26.5
Interval	9	13	30	28.7	-	26.5
Interval	10	13	34	28.2	-	26.0
Final Zero		13	36	2.5	-	0.0
Final Span		13	41	86.3	-	81.4

Zero Drift %FS = 0.3
Span Drift %FS = 2.5
Run Average 25.2

CONSTANT MONITORING

DATA AND RESULTS:

Client: RF MACDONALD
Date: 09/19/89

Unit: BOILER #2
Point:

Analyzer: TECO 10
Serial Number:
Analyzer Range: 100
Recorder Range: 1V
Last Linearity:

Zero Gas: Nitrogen
Span Gas: NOX
Cyl #: SCOTT AAL-6503
Concentration: 81.54
Units: ppm (vol. dry)
Interval(min): 4

RUN 2

Analysis Interval		Time Hour	Minute	Analyzer response % Full Scale		[Conc.]
Initial Zero		13	36	2.5	-	0.0
Initial Span		13	41	86.3	-	81.4
Interval	1	14	4	29.5	-	26.2
Interval	2	14	8	29.4	-	26.1
Interval	3	14	12	29.0	-	25.7
Interval	4	14	16	29.3	-	26.0
Interval	5	14	20	29.1	-	25.8
Interval	6	14	24	29.5	-	26.2
Interval	7	14	28	29.5	-	26.2
Interval	8	14	32	29.5	-	26.2
Interval	9	14	36	29.5	-	26.2
Interval	10	14	40	29.4	-	26.1
Final Zero		14	45	2.8	-	0.0
Final Span		14	49	86.0	-	81.4

Zero Drift %FS = 0.3
Span Drift %FS = -0.6

Run Average 26.1

CONSTANT MONITORING

DATA AND RESULTS:

Client: RF MACDONALD
Date: 09/19/89

Unit: BOILER #2
Point:

Analyzer: TECO 10
Serial Number:
Analyzer Range: 100
Recorder Range: 1V
Last Linearity:

Zero Gas: Nitrogen
Span Gas: NOX
Cyl #: SCOTT AAL-6503
Concentration: 81.54
Units: ppm (vol. dry)
Interval(min): 4

RUN 3

Analysis Interval		Time Hour	Minute	Analyzer response % Full Scale		[Conc.]
Initial Zero		14	45	2.8	-	0.0
Initial Span		14	49	86.0	-	81.5
Interval	1	15	8	28.8	-	25.5
Interval	2	15	12	29.0	-	25.7
Interval	3	15	16	29.0	-	25.7
Interval	4	15	20	29.3	-	26.0
Interval	5	15	24	28.9	-	25.6
Interval	6	15	28	29.1	-	25.8
Interval	7	15	32	29.1	-	25.8
Interval	8	15	36	29.2	-	25.9
Interval	9	15	40	29.0	-	25.7
Interval	10	15	44	28.9	-	25.6
Final Zero		15	48	2.8	-	0.0
Final Span		15	55	86.2	-	81.5

Zero Drift %FS = 0.0
Span Drift %FS = 0.2

Run Average 25.7

CONSTANT MONITORING

DATA AND RESULTS:

Client: RF MACDONALD
Date: 09/19/89
Unit: BOILER #2
Point:

Analyzer: INFRARED
Serial Number:
Analyzer Range: 1000
Recorder Range: .1V
Last Linearity:

Zero Gas: Nitrogen
Span Gas: CO
Cyl #: SCOTT AAL-6503
Concentration: 838.3
Units: ppm (vol. dry)
Interval(min): 4

RUN 1

Analysis Interval		Time Hour	Minute	Analyzer response % Full Scale		[Conc.]
Initial Zero		12	37	5.5	-	0.0
Initial Span		12	40	88.3	-	838.3
Interval	1	12	54	19.0	-	136.7
Interval	2	12	58	19.3	-	139.7
Interval	3	13	2	18.8	-	134.7
Interval	4	13	6	17.8	-	124.5
Interval	5	13	10	18.4	-	130.6
Interval	6	13	14	17.2	-	118.5
Interval	7	13	18	18.5	-	131.6
Interval	8	13	26	19.9	-	145.8
Interval	9	13	30	19.0	-	136.7
Interval	10	13	34	19.9	-	145.8
Final Zero		13	36	9.0	-	0.0
Final Span		13	41	92.0	-	838.3

Zero Drift %FS = 3.5
Span Drift %FS = 0.2
Run Average 134.5

CONSTANT MONITORING

DATA AND RESULTS:

Client: RF MACDONALD
Date: 09/19/89
Unit: BOILER #2
Point:

Analyzer: INFRARED
Serial Number:
Analyzer Range: 1000
Recorder Range: .1V
Last Linearity:

Zero Gas: Nitrogen
Span Gas: CO
Cyl #: SCOTT AAL-6503
Concentration: 838.3
Units: ppm (vol. dry)
Interval(min): 4

RUN 2

Analysis Interval		Time Hour	Minute	Analyzer response % Full Scale		[Conc.]
Initial Zero		13	36	4.5	-	0.0
Initial Span		13	41	86.5	-	838.3
Interval	1	14	4	16.0	-	117.6
Interval	2	14	8	15.8	-	115.5
Interval	3	14	12	16.5	-	122.7
Interval	4	14	16	16.3	-	120.6
Interval	5	14	20	16.1	-	118.6
Interval	6	14	24	16.4	-	121.7
Interval	7	14	28	16.0	-	117.6
Interval	8	14	32	16.0	-	117.6
Interval	9	14	36	16.0	-	117.6
Interval	10	14	40	15.9	-	116.5
Final Zero		14	45	5.0	-	0.0
Final Span		14	49	87.5	-	838.3

Zero Drift %FS = 0.5
Span Drift %FS = 0.5
Run Average 118.6

CONSTANT MONITORING

DATA AND RESULTS:

Client: RF MACDONALD
Date: 09/19/89

Unit: BOILER #2
Point:

Analyzer: INFRARED
Serial Number:
Analyzer Range: 1000
Recorder Range: .1V
Last Linearity:

Zero Gas: Nitrogen
Span Gas: CO
Cyl #: SCOTT AAL-6503
Concentration: 838.3
Units: ppm (vol. dry)
Interval(min): 4

RUN 3

Analysis Interval		Time Hour	Minute	Analyzer response % Full Scale		[Conc.]
Initial Zero		14	45	5.0	-	0.0
Initial Span		14	49	87.5	-	838.3
Interval	1	15	8	19.2	-	144.3
Interval	2	15	12	18.6	-	138.2
Interval	3	15	16	19.5	-	147.3
Interval	4	15	20	17.4	-	126.0
Interval	5	15	24	18.4	-	136.2
Interval	6	15	28	19.0	-	142.3
Interval	7	15	32	18.3	-	135.1
Interval	8	15	36	18.4	-	136.2
Interval	9	15	40	18.5	-	137.2
Interval	10	15	44	18.5	-	137.2
Final Zero		15	48	5.0	-	0.0
Final Span		15	55	86.8	-	838.3

Zero Drift %FS = 0.0
Span Drift %FS = -0.7

Run Average 138.0

ECOSERVE, Inc.

ENVIRONMENTAL SERVICES

CONSTANT MONITORING

DATA AND RESULTS:

Client: RF MACDONALD

Unit: BOILER #2

Date: 09/19/89

Point:

Analyzer: JUM

Serial Number:

Zero Gas: Nitrogen

Span Gas: PROPANE

CONSTANT MONITORING

DATA AND RESULTS:

Client: RF MACDONALD
Date: 09/19/89

Unit: BOILER #2
Point:

Analyzer: JUM
Serial Number:
Analyzer Range: 100
Recorder Range: 10V
Last Linearity:

Zero Gas: Nitrogen
Span Gas: PROPANE
Cyl #: SCOTT B112
Concentration: 100.2
Units: ppm (vol. dry)
Interval(min): 4

RUN 1

Analysis Interval		Time Hour	Minute	Analyzer response % Full Scale		[Conc.]
Initial Zero		12	47	4.5	-	0.0
Initial Span		12	50	97.0	-	100.2
Interval	1	12	54	7.9	-	3.7
Interval	2	12	58	7.8	-	3.6
Interval	3	13	2	7.5	-	3.2
Interval	4	13	6	7.0	-	2.7
Interval	5	13	10	7.4	-	3.1
Interval	6[1]	13	14	5.5	-	1.1
Interval	7[1]	13	18	6.5	-	2.2
Interval	8[1]	13	26	4.5	-	0.0
Interval	9[1]	13	30	4.4	-	-0.1
Interval	10[1]	13	34	4.8	-	0.3
Final Zero		13	54	2.0	-	0.0
Final Span		13	56	90.7	-	100.2

Zero Drift %FS = -2.5
Span Drift %FS = -3.8

Run Average 2.0

1. Charcoal in-line

CONSTANT MONITORING

DATA AND RESULTS:

Client: RF MACDONALD
Date: 09/19/89

Unit: BOILER #2
Point:

Analyzer: JUM
Serial Number:
Analyzer Range: 100
Recorder Range: 10V
Last Linearity:

Zero Gas: Nitrogen
Span Gas: PROPANE
Cyl #: SCOTT B112
Concentration: 100.2
Units: ppm (vol. dry)
Interval(min): 4

RUN 2

Analysis Interval		Time Hour	Minute	Analyzer response % Full Scale		[Conc.]
Initial Zero		14	0	4.2	-	0.0
Initial Span		14	2	97.0	-	100.2
Interval	1	14	4	7.5	-	3.6
Interval	2	14	8	7.7	-	3.8
Interval	3	14	12	8.0	-	4.1
Interval	4	14	16	7.7	-	3.8
Interval	5	14	20	8.0	-	4.1
Interval	6[1]	14	24	6.5	-	2.5
Interval	7[1]	14	28	6.7	-	2.7
Interval	8[1]	14	32	6.5	-	2.5
Interval	9[1]	14	36	6.7	-	2.7
Interval	10[1]	14	40	6.5	-	2.5
Final Zero		15	00	4.1	-	0.0
Final Span		15	04	96.4	-	100.2

Zero Drift %FS = -0.1
Span Drift %FS = -0.5

Run Average 3.2

1. Charcoal in-line

CONSTANT MONITORING

DATA AND RESULTS:

Client: RF MACDONALD
Date: 09/19/89

Unit: BOILER #2
Point:

Analyzer: JUM
Serial Number:
Analyzer Range: 100
Recorder Range: 10V
Last Linearity:

Zero Gas: Nitrogen
Span Gas: PROPANE
Cyl #: SCOTT B-112
Concentration: 100.2
Units: ppm (vol. dry)
Interval(min): 4

RUN 3

Analysis Interval		Time Hour	Minute	Analyzer response % Full Scale		[Conc.]
Initial Zero		15	0	4.1	-	0.0
Initial Span		15	4	96.4	-	100.2
Interval	1	15	8	8.7	-	5.0
Interval	2	15	12	8.6	-	4.9
Interval	3	15	16	9.0	-	5.3
Interval	4	15	20	8.5	-	4.8
Interval	5	15	24	8.5	-	4.8
Interval	6[1]	15	28	7.0	-	3.1
Interval	7[1]	15	32	7.0	-	3.1
Interval	8[1]	15	36	6.9	-	3.0
Interval	9[1]	15	40	6.8	-	2.9
Interval	10[1]	15	44	7.4	-	3.6
Final Zero		16	12	6.3	-	0.0
Final Span		16	15	98.8	-	100.2

Zero Drift %FS = 2.2
Span Drift %FS = 0.2

Run Average 4.1

1. Charcoal in-line

CONSTANT MONITORING

DATA AND RESULTS:

Client: RF MACDONALD
Date: 09/19/89

Unit: BOILER #2
Point:

Analyzer: TELEDYNE
Serial Number:
Analyzer Range: 25
Recorder Range: 1V
Last Linearity:

Zero Gas: Nitrogen
Span Gas: O2
Cyl #: AMBIENT
Concentration: 20.9
Units: % (vol. dry)
Interval(min): 4

RUN 1

Analysis Interval		Time Hour	Minute	Analyzer response % Full Scale		[Conc.]
Initial Zero		12	37	10.0	-	0.0
Initial Span		12	40	93.8	-	20.9
Interval	1	12	54	35.7	-	6.4
Interval	2	12	58	35.7	-	6.4
Interval	3	13	2	36.8	-	6.7
Interval	4	13	6	36.5	-	6.6
Interval	5	13	10	36.3	-	6.6
Interval	6	13	14	36.5	-	6.6
Interval	7	13	18	36.0	-	6.5
Interval	8	13	26	36.2	-	6.5
Interval	9	13	30	36.0	-	6.5
Interval	10	13	34	35.8	-	6.4
Final Zero		13	36	10.0	-	0.0
Final Span		13	41	93.5	-	20.9

Zero Drift %FS = 0.0
Span Drift %FS = -0.3

Run Average 6.5

CONSTANT MONITORING

DATA AND RESULTS:

Client: RF MACDONALD
Date: 09/19/89
Unit: BOILER #2
Point:

Analyzer: TELEDYNE
Serial Number:
Analyzer Range: 25
Recorder Range: 1V
Last Linearity:

Zero Gas: Nitrogen
Span Gas: O2
Cyl #: AMBIENT
Concentration: 20.9
Units: % (vol. dry)
Interval(min): 4

RUN 2

Analysis Interval		Time Hour	Minute	Analyzer response % Full Scale		[Conc.]
Initial Zero		13	36	10.0	-	0.0
Initial Span		13	41	93.5	-	20.9
Interval	1	14	4	36.4	-	6.6
Interval	2	14	8	36.2	-	6.6
Interval	3	14	12	35.7	-	6.4
Interval	4	14	16	36.3	-	6.6
Interval	5	14	20	35.8	-	6.5
Interval	6	14	24	36.3	-	6.6
Interval	7	14	28	36.0	-	6.5
Interval	8	14	32	36.3	-	6.6
Interval	9	14	36	36.3	-	6.6
Interval	10	14	40	36.0	-	6.5
Final Zero		14	45	10.0	-	0.0
Final Span		14	49	93.5	-	20.9

Zero Drift %FS = 0.0
Span Drift %FS = 0.0
Run Average 6.5

CONSTANT MONITORING

DATA AND RESULTS:

Client: RF MACDONALD
Date: 09/19/89

Unit: BOILER #2
Point:

Analyzer: TELEDYNE
Serial Number:
Analyzer Range: 25
Recorder Range: 1V
Last Linearity:

Zero Gas: Nitrogen
Span Gas: O2
Cyl #: AMBIENT
Concentration: 20.9
Units: % (vol. dry)
Interval(min): 4

RUN 3

Analysis Interval		Time Hour	Minute	Analyzer response % Full Scale		[Conc.]
Initial Zero		14	45	10.0	-	0.0
Initial Span		14	49	93.5	-	20.9
Interval	1	15	8	35.2	-	6.3
Interval	2	15	12	35.1	-	6.3
Interval	3	15	16	35.3	-	6.3
Interval	4	15	20	35.8	-	6.5
Interval	5	15	24	35.2	-	6.3
Interval	6	15	28	35.5	-	6.4
Interval	7	15	32	35.5	-	6.4
Interval	8	15	36	35.7	-	6.4
Interval	9	15	40	35.5	-	6.4
Interval	10	15	44	35.3	-	6.3
Final Zero		15	48	9.9	-	0.0
Final Span		15	55	93.8	-	20.9

Zero Drift %FS = -0.1
Span Drift %FS = 0.4

Run Average 6.4

CONSTANT MONITORING

DATA AND RESULTS:

Client: RF MACDONALD
Date: 09/19/89
Unit: BOILER #2
Point:

Analyzer: INFRARED
Serial Number:
Analyzer Range: 20
Recorder Range: .1V
Last Linearity:

Zero Gas: Nitrogen
Span Gas: CO2
Cyl #: LINDE K94324
Concentration: 15
Units: % (vol. dry)
Interval(min): 4

RUN 1

Analysis Interval		Time Hour	Minute	Analyzer response % Full Scale		[Conc.]
Initial Zero		12	42	20.0	-	0.0
Initial Span		12	44	95.5	-	15.0
Interval	1	12	54	59.3	-	7.8
Interval	2	12	58	59.8	-	7.9
Interval	3	13	2	58.5	-	7.6
Interval	4	13	6	58.3	-	7.6
Interval	5	13	10	58.6	-	7.7
Interval	6	13	14	58.7	-	7.7
Interval	7	13	18	59.1	-	7.8
Interval	8	13	26	59.0	-	7.7
Interval	9	13	30	59.0	-	7.7
Interval	10	13	34	59.4	-	7.8
Final Zero		13	46	20.0	-	0.0
Final Span		13	48	98.0	-	15.0

Zero Drift %FS = 0.0
Span Drift %FS = 2.5
Run Average 7.7

CONSTANT MONITORING

DATA AND RESULTS:

Client: RF MACDONALD
Date: 09/19/89
Unit: BOILER #2
Point:

Analyzer: INFRARED
Serial Number:
Analyzer Range: 20
Recorder Range: .1V
Last Linearity:

Zero Gas: Nitrogen
Span Gas: CO2
Cyl #: LINDE K94324
Concentration: 15
Units: % (vol. dry)
Interval(min): 4

RUN 2

Analysis Interval		Time Hour	Minute	Analyzer response % Full Scale		[Conc.]
Initial Zero		13	48	20.0	-	0.0
Initial Span		13	50	95.0	-	15.0
Interval	1	14	4	57.2	-	7.4
Interval	2	14	8	57.7	-	7.5
Interval	3	14	12	58.3	-	7.7
Interval	4	14	16	58.2	-	7.6
Interval	5	14	20	58.4	-	7.7
Interval	6	14	24	58.4	-	7.7
Interval	7	14	28	58.7	-	7.7
Interval	8	14	32	58.1	-	7.6
Interval	9	14	36	58.0	-	7.6
Interval	10	14	40	58.2	-	7.6
Final Zero		14	50	20.0	-	0.0
Final Span		14	54	93.9	-	15.0

Zero Drift %FS = 0.0
Span Drift %FS = -1.1

Run Average 7.6

CONSTANT MONITORING

DATA AND RESULTS:

Client: RF MACDONALD
Date: 09/19/89

Unit: BOILER #2
Point:

Analyzer: INFRARED
Serial Number:
Analyzer Range: 20
Recorder Range: .1V
Last Linearity:

Zero Gas: Nitrogen
Span Gas: CO2
Cyl #: LINDE K94324
Concentration: 15
Units: % (vol. dry)
Interval(min): 4

RUN 3

Analysis Interval		Time Hour	Minute	Analyzer response % Full Scale		[Conc.]
Initial Zero		14	50	20.0	-	0.0
Initial Span		14	54	93.9	-	15.0
Interval	1	15	8	58.7	-	7.9
Interval	2	15	12	59.0	-	7.9
Interval	3	15	16	59.0	-	7.9
Interval	4	15	20	58.3	-	7.8
Interval	5	15	24	58.5	-	7.8
Interval	6	15	28	58.2	-	7.8
Interval	7	15	32	58.0	-	7.7
Interval	8	15	36	58.1	-	7.7
Interval	9	15	40	58.2	-	7.8
Interval	10	15	44	58.2	-	7.8
Final Zero		16	04	20.1	-	0.0
Final Span		16	10	94.0	-	15.0

Zero Drift %FS = 0.1
Span Drift %FS = 0.0

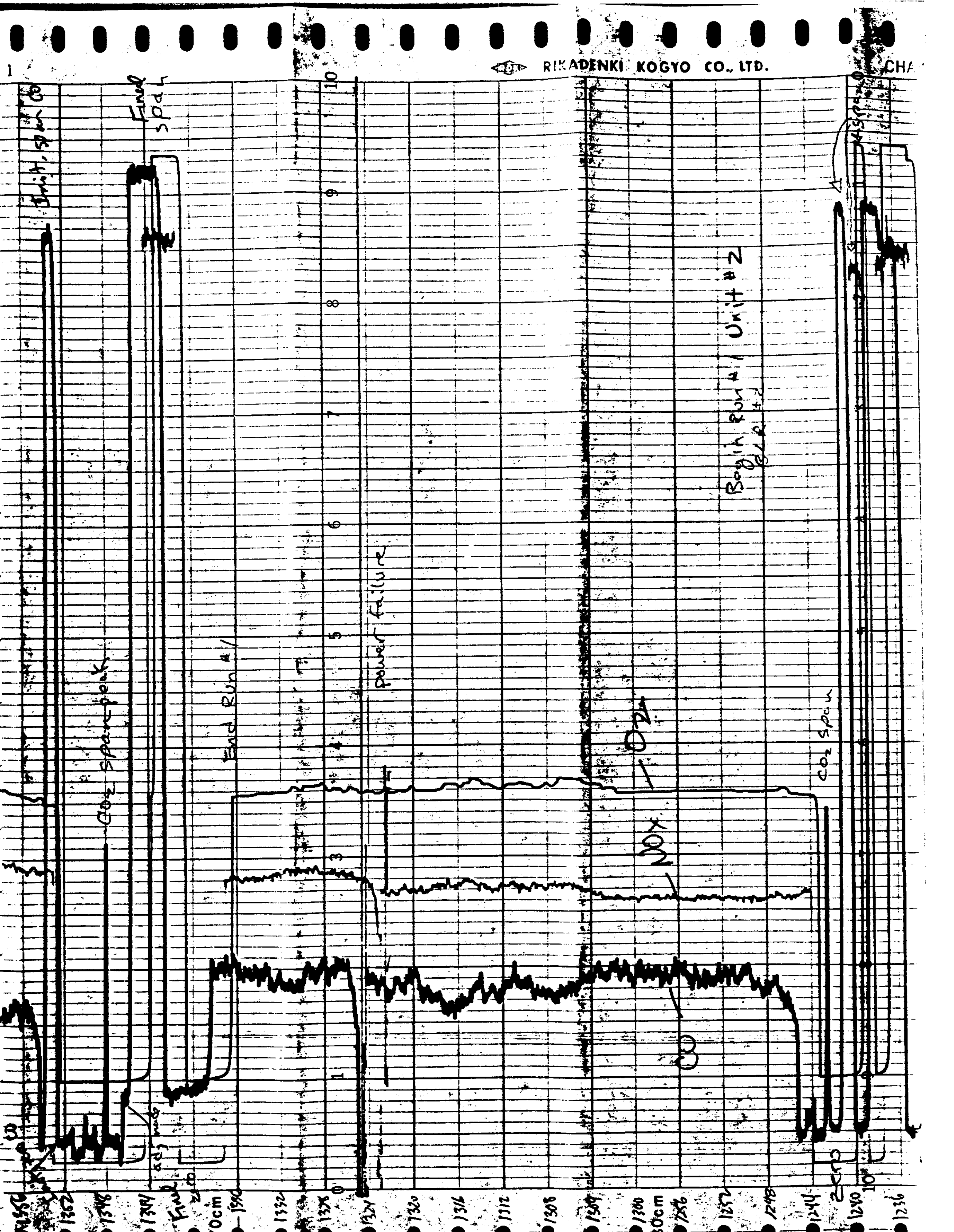
Run Average 7.8

APPENDIX

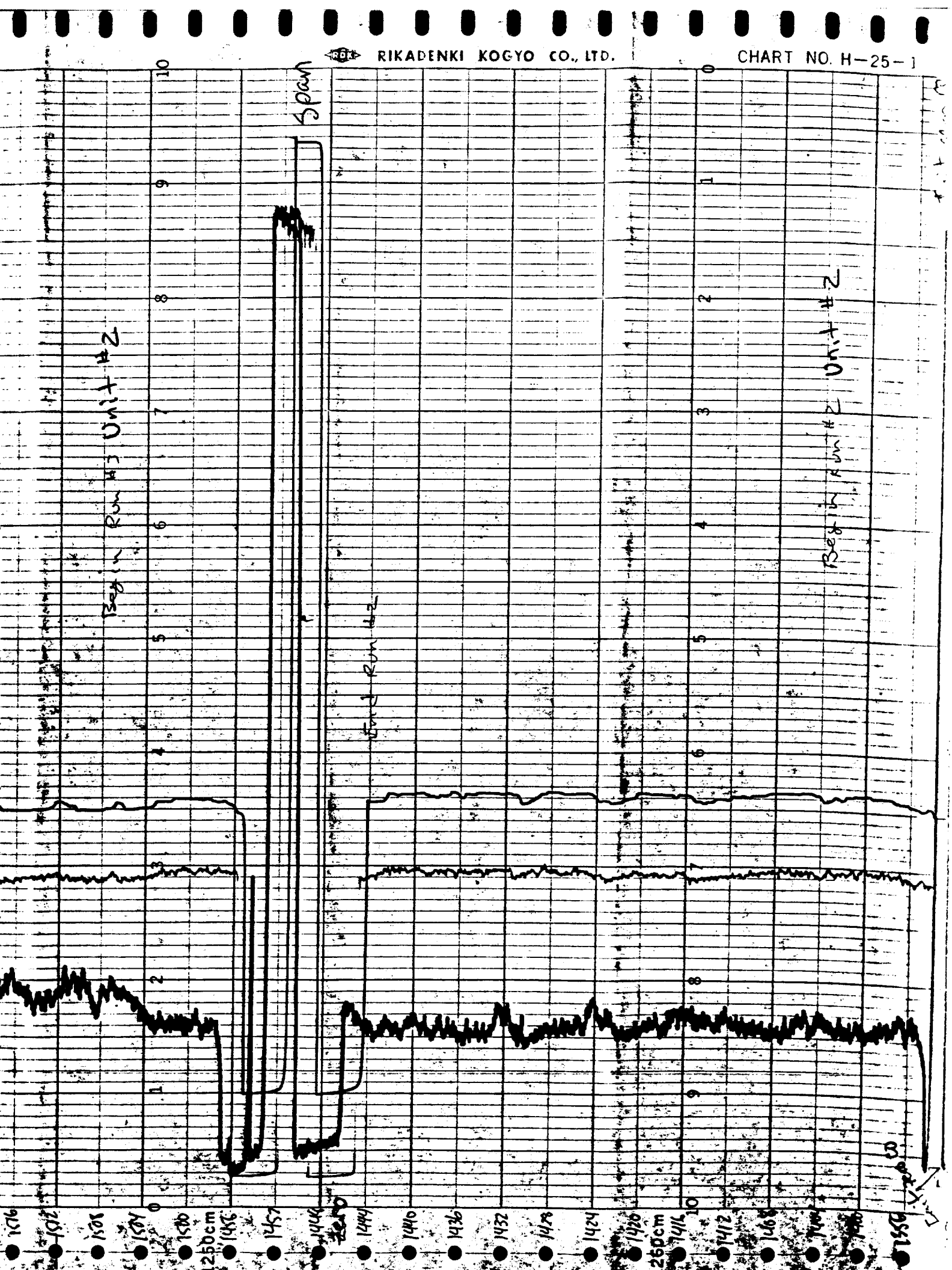
RF MacDonald - TomateK 19 Oct. 89

Pen #/color	Parameter	Range	Span	Zero	Chart
1 Red	CO	0-1000ppm	838.3ppm (1)	N_2	15cm/hr
2 Black	NOx	0-100 ppm	81.41ppm (1)	N_2	"
3 Blue	O_2	0-25%	20.9% (2)	N_2	"
1 Red	NMHC	0-100ppm	100.2ppm (3)	N_2	"
2 Black	CO_2	0-20%	15.0% (4)	N_2	"

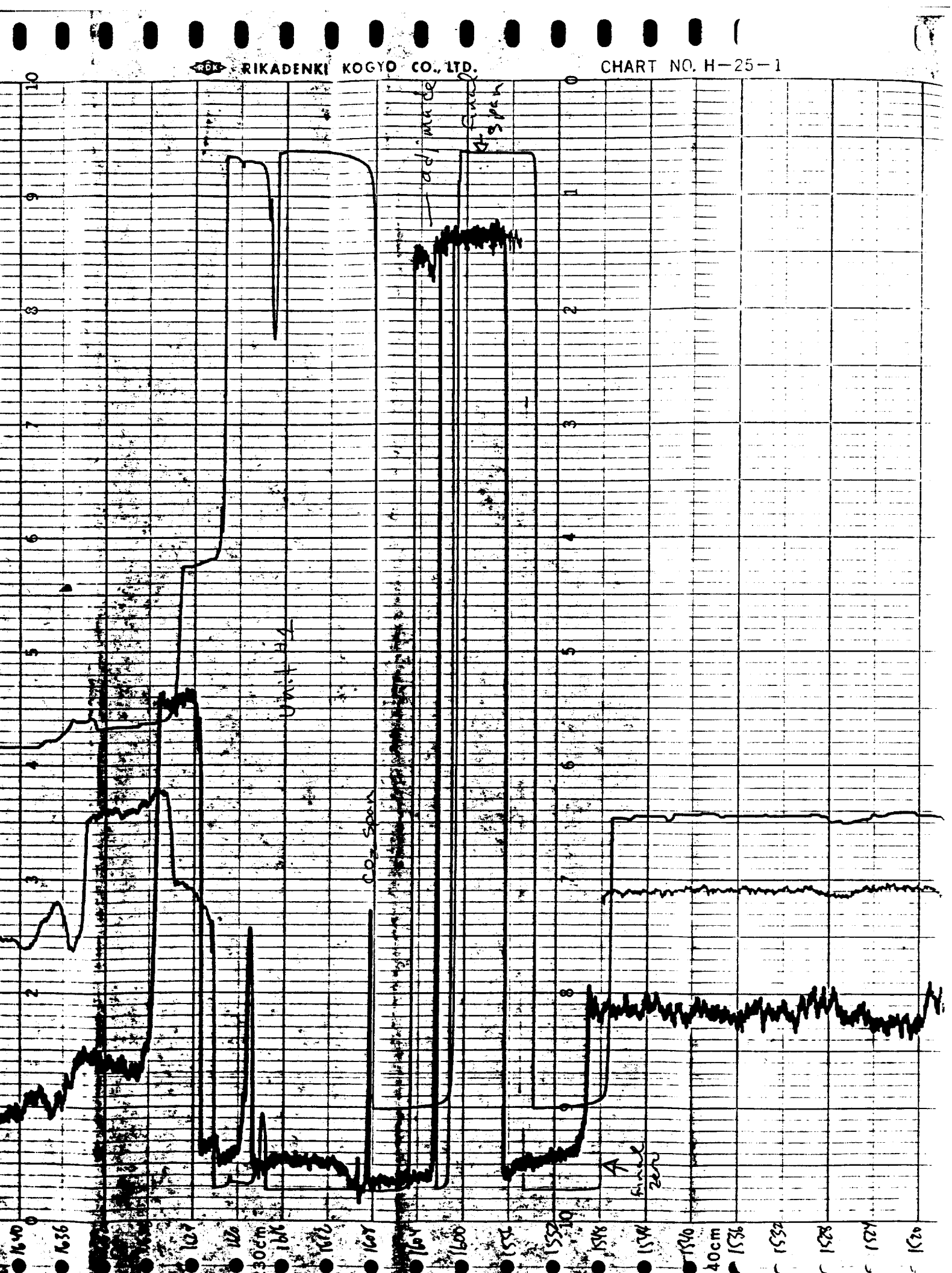
(1) Scott Cylinder # AAL-6503
(2) Ambient Air 20.9%
(3) Scott Cylinder # B-112
(4) Linde Cylinder # K94324


RIKADENKI KOGYO CO., LTD.
CO2 span peak
Final span
End Run #1
Power failure
Begin Run #1 / Unit #2
O2
NOx
CO
CO2 span
zero

RIKADENKI KOGYO CO., LTD. CHART NO. H-25-1

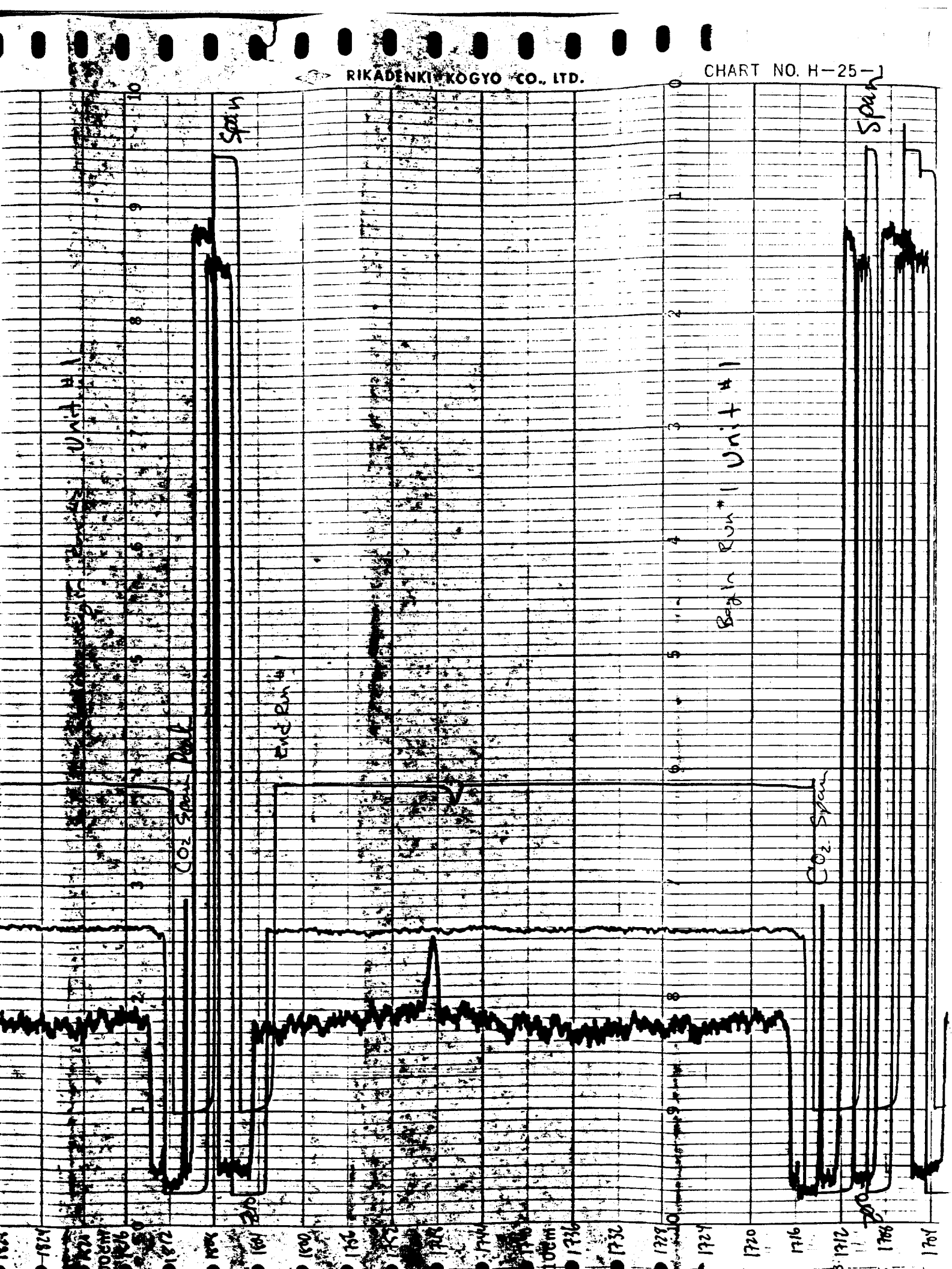


RIKADENKI KOGYO CO., LTD. CHART NO. H-25-1

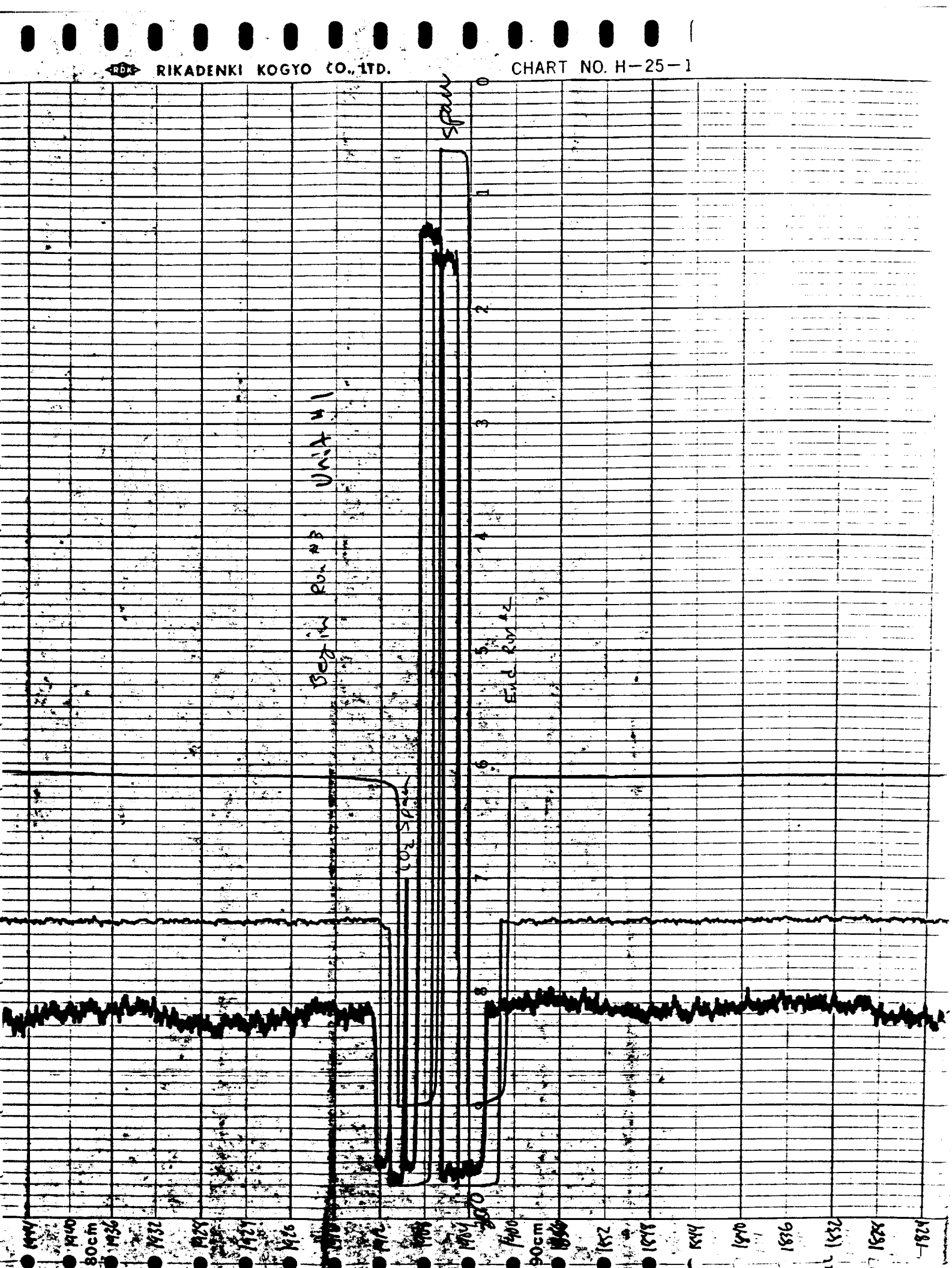


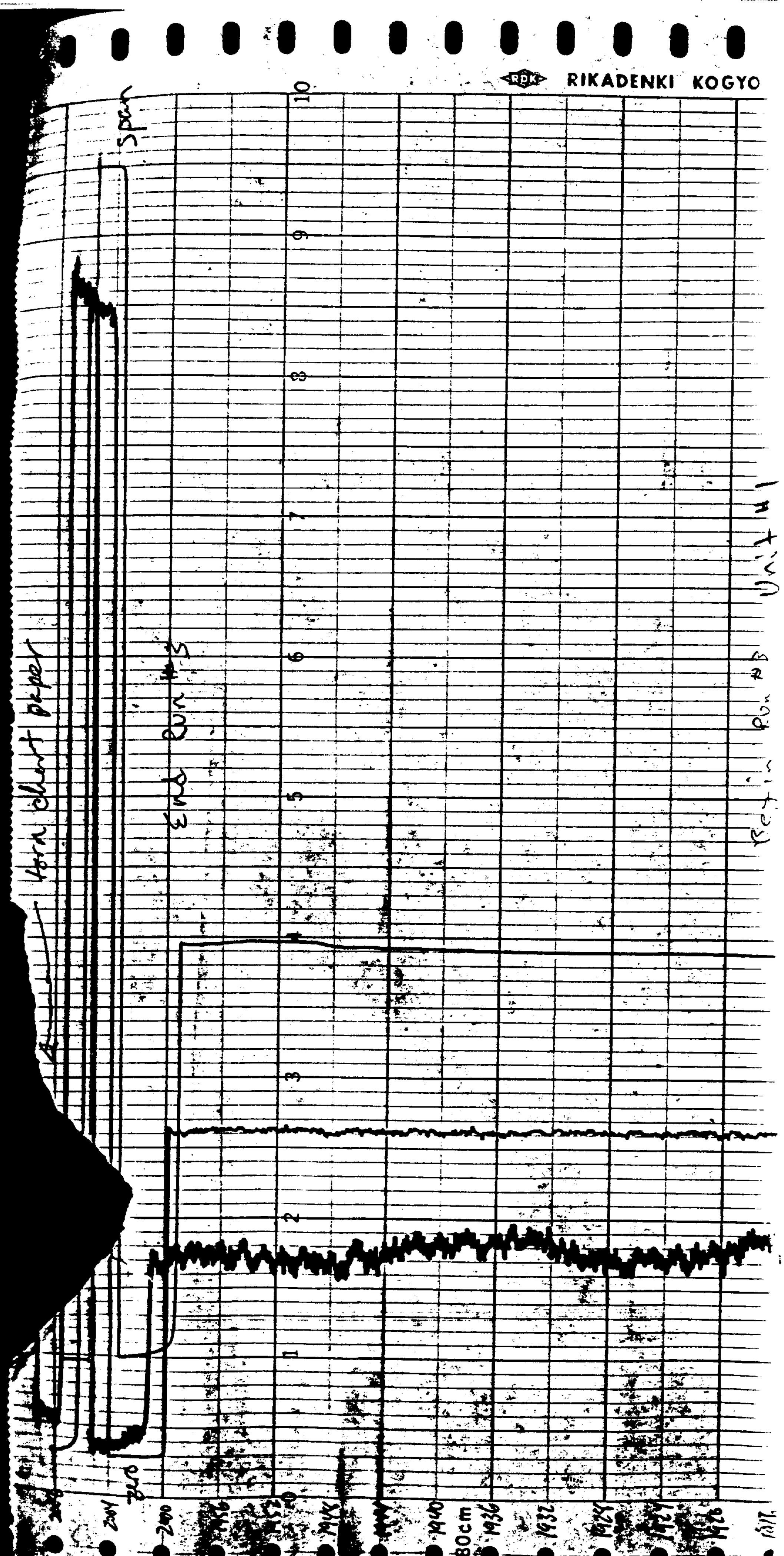
RIKADENKI KOGYO CO., LTD.

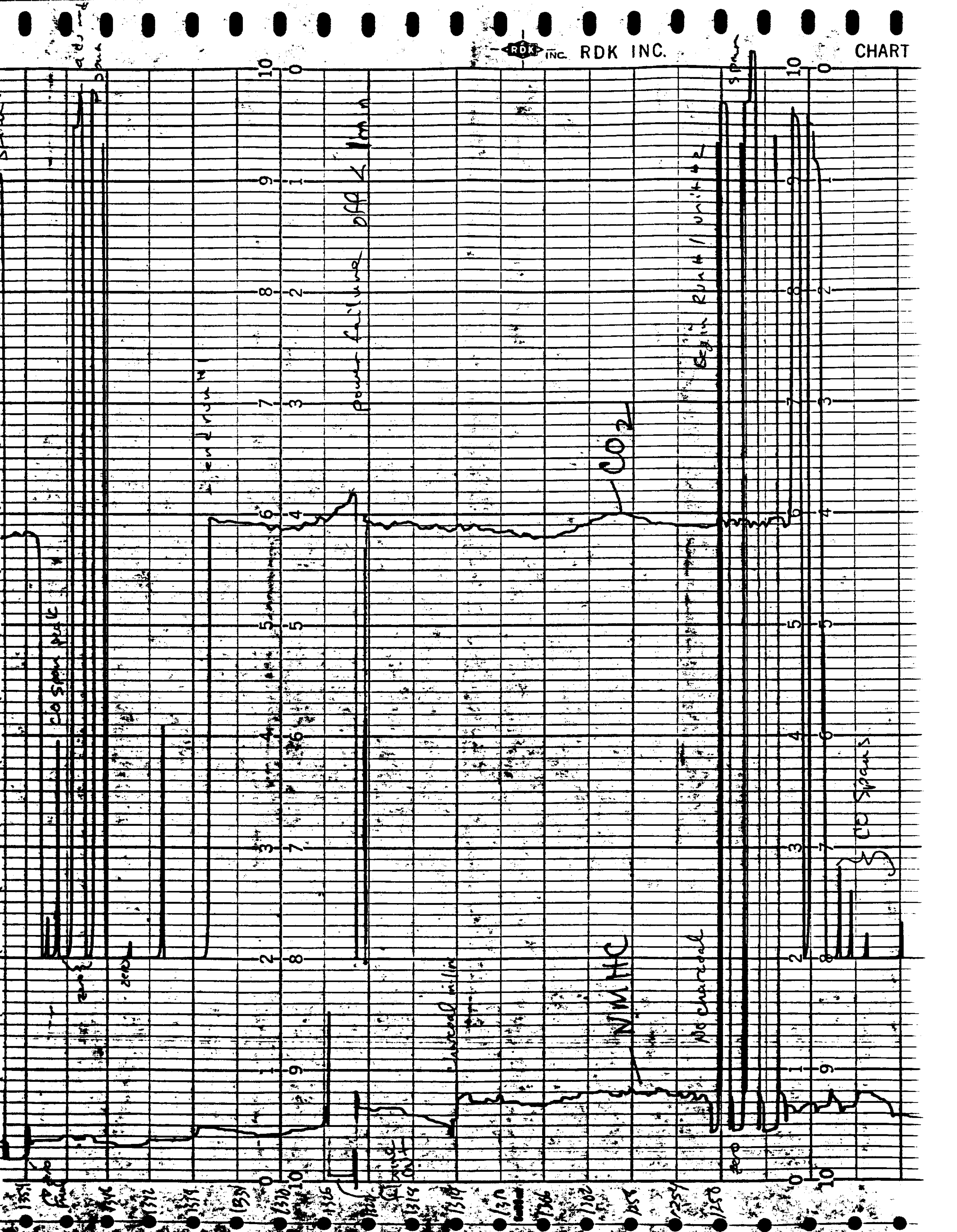
CHART NO. H-25-1

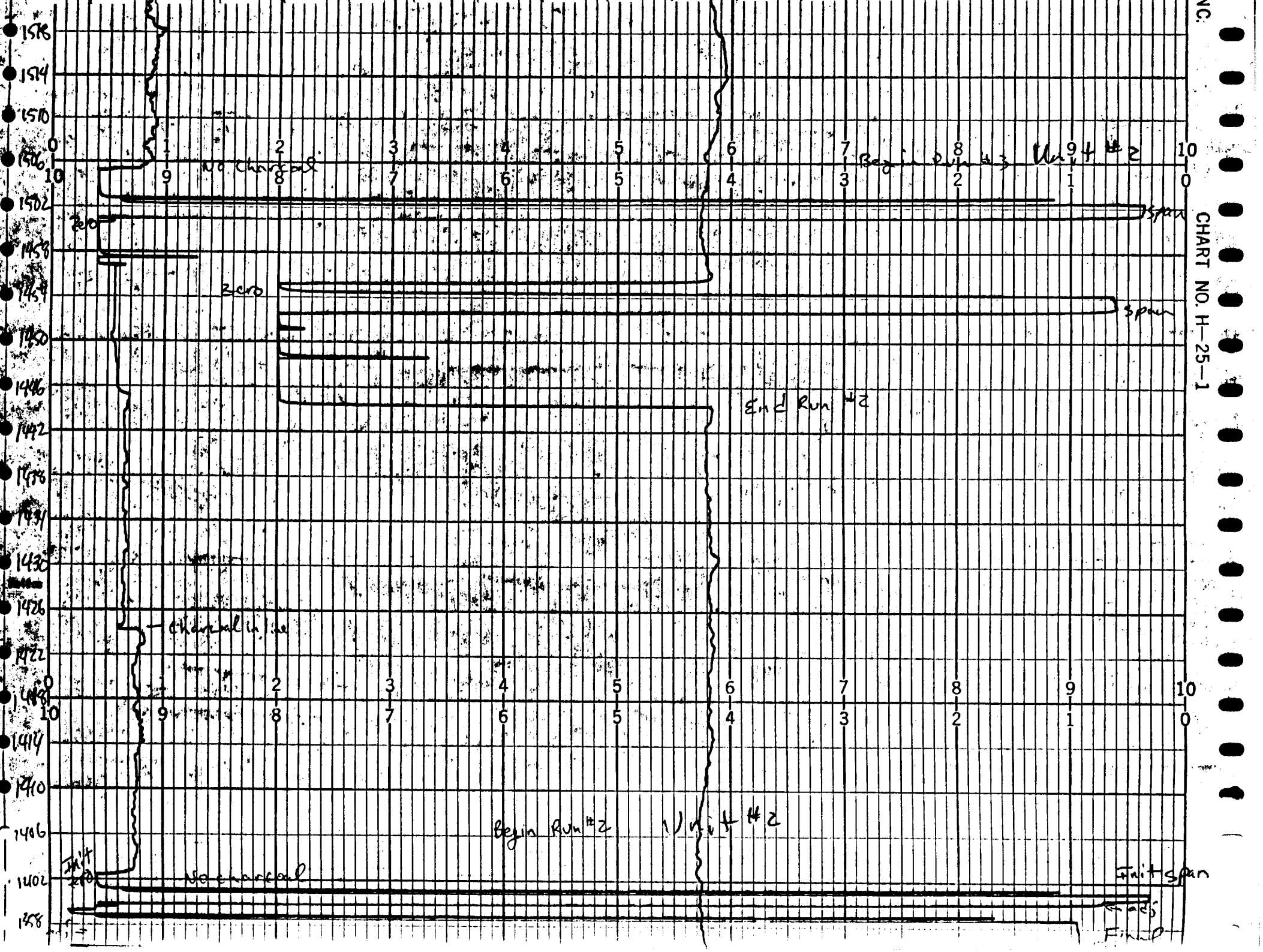


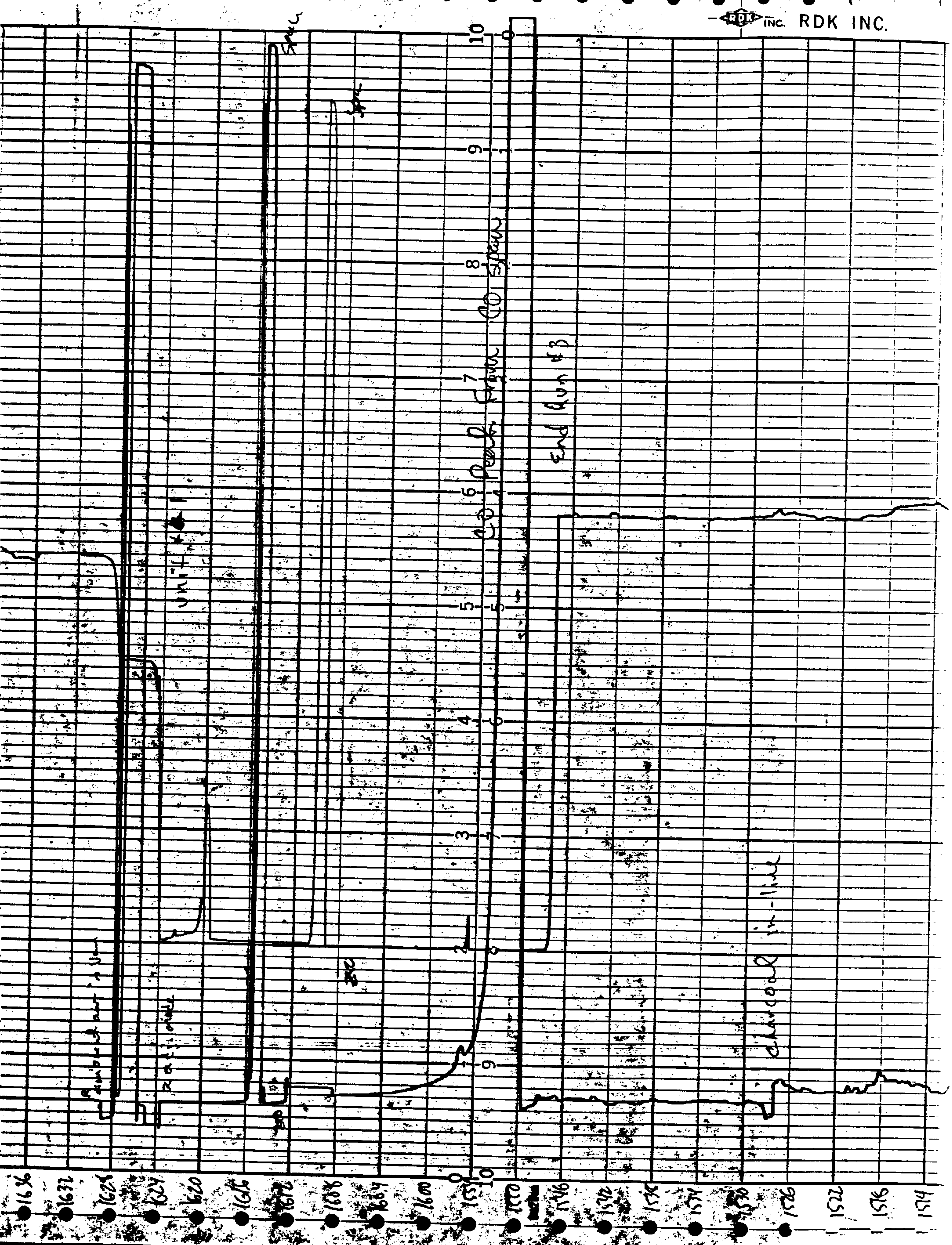
RIKADENKI KOGYO CO., LTD. CHART NO. H-25-1

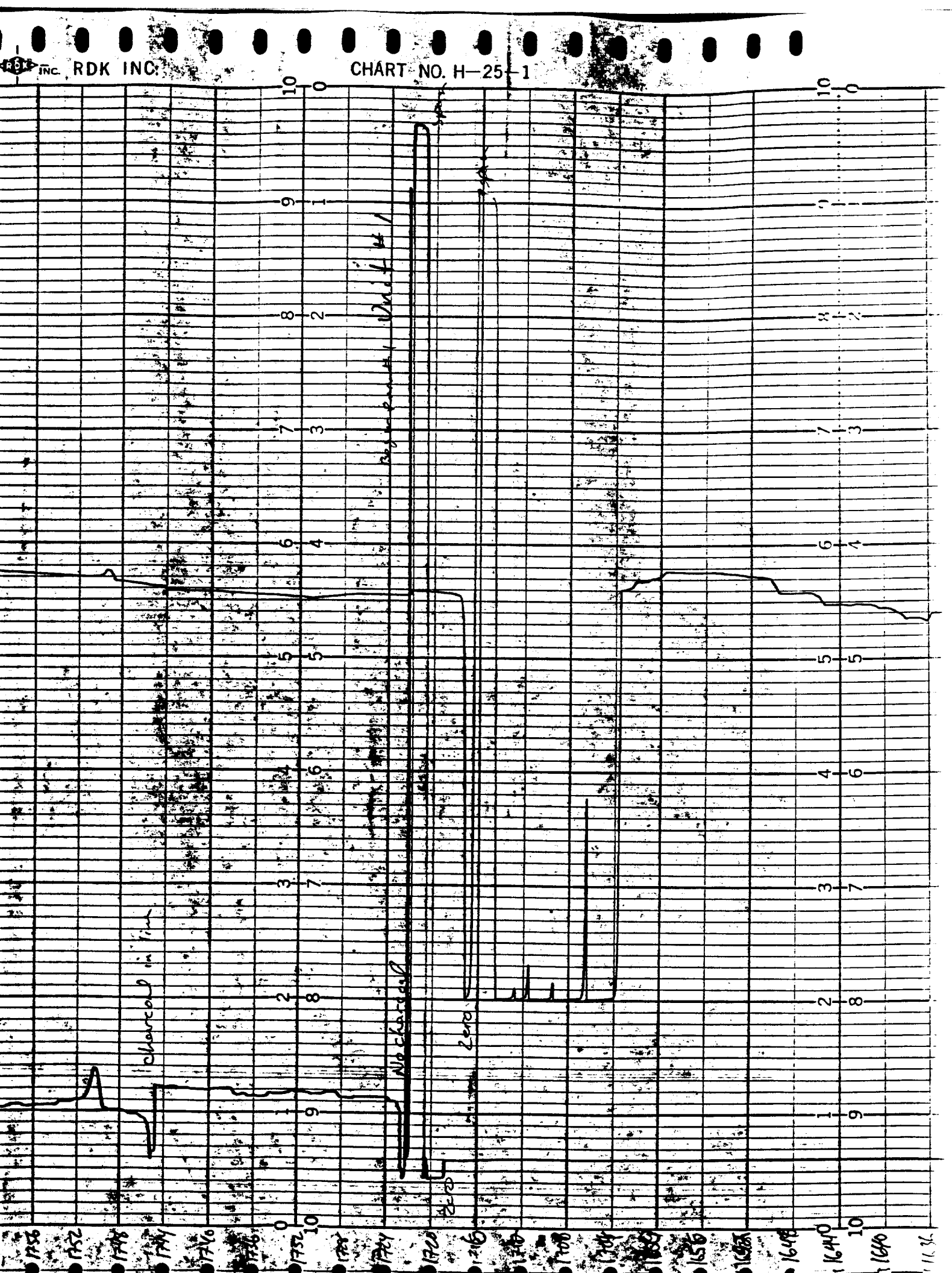


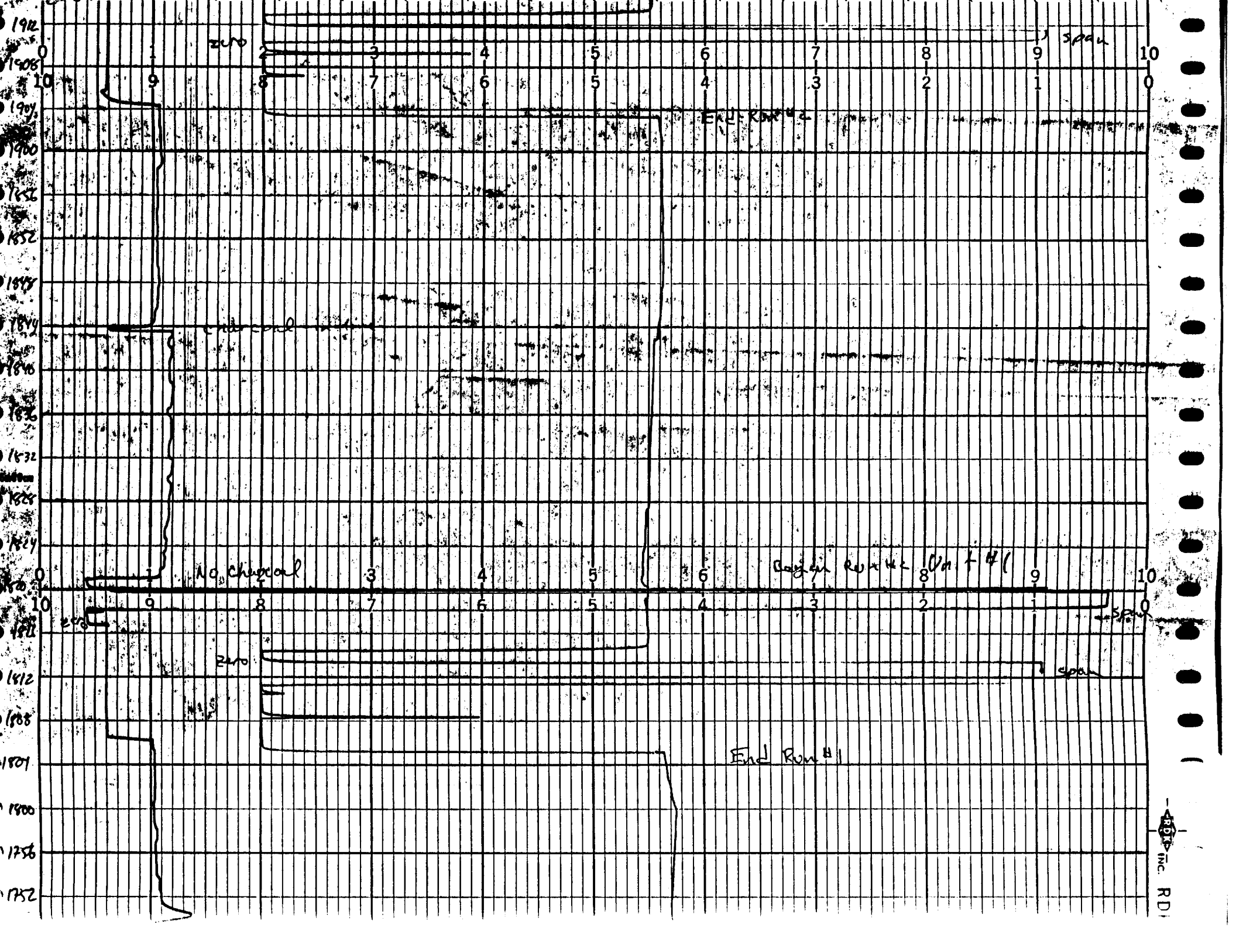

RIKADENKI KOGYO
torn chart paper
End Run #3
Span
Zero
Unit 1
80cm


RDK INC.
CHART
CO2
NMHC
Power failure off 4 min
End run #1
Begin Run #1 unit #2
No charcoal
CO span peak
CO spans


1518
1514
1510
1506
1502
1498
1494
1490
1486
1482
1478
1474
1470
1466
1462
1458
1454
1450
1446
1442
1438
1434
1430
1426
1422
1418
1414
1410
1406
1402
1398
No change
Zero
Span
Zero
Span
End Run #2
Channel line
Begin Run #2 Unit #2
Unit Zero
No change
Unit Span
Unit #2
Begin Run #3 Unit #2
CHART NO. H-25-1
NC.


RDK INC.
CO Peak from CO Span
End Run #3
charcoal in-line
1636
1632
1628
1620
1600
1546
1542
1522


INC. RDK INC.
CHART NO. H—25—1
Recharged Unit #1
Recharged in line
No charge
Zero


zero
span
End Run #1
Charcoal Run #1
No Charcoal
Begin Run #2 Unit #1
zero
span
zero
End Run #1
RDI INC. RDI

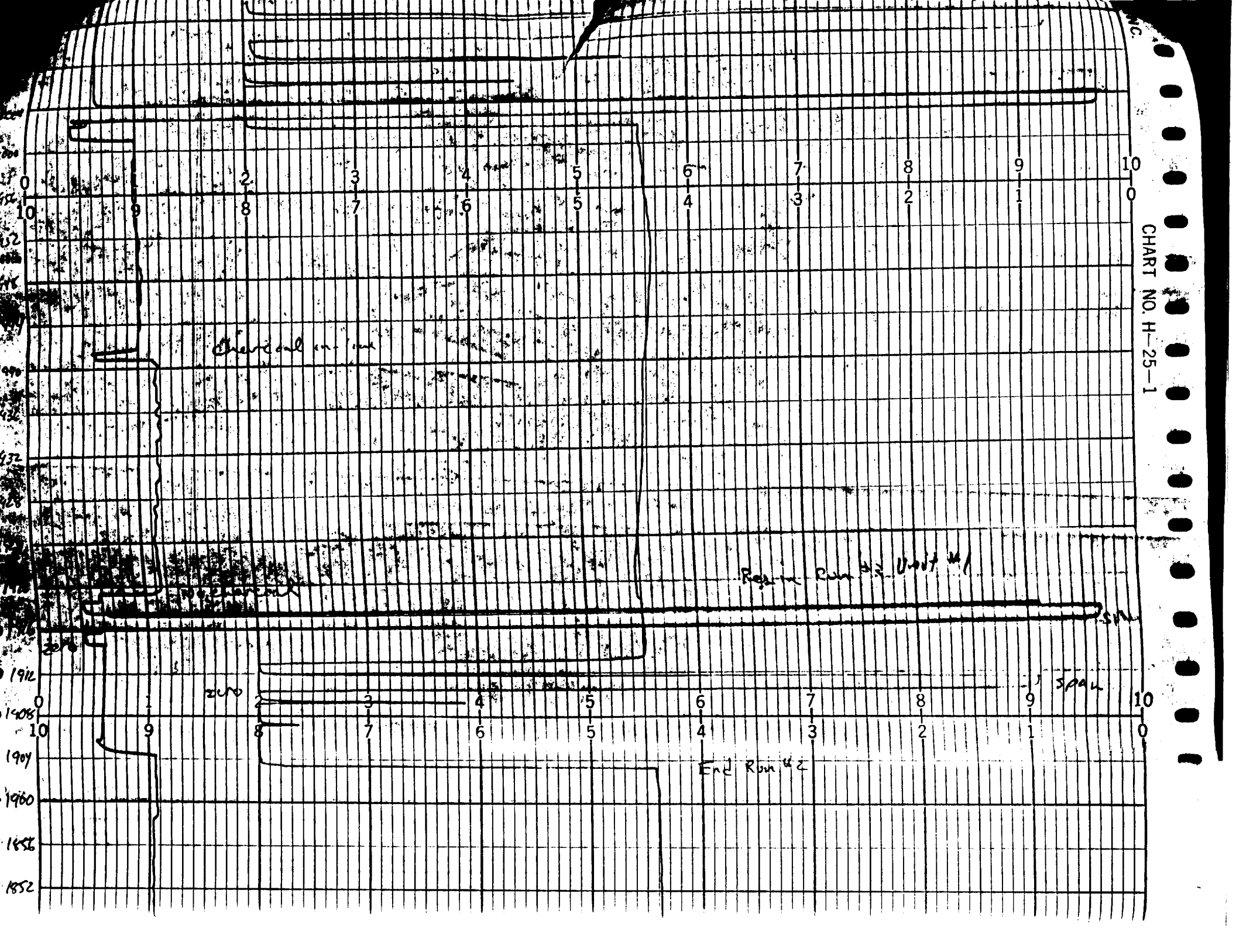


CHART NO. H-25-1
Run #1 Unit #1
End Run #2

Scott Specialty Gases

2600 CAJON BLVD. SAN BERNARDINO, CA 92411 (714) 887-2571

Date: 3-3-87

Our Project No.: 405771

Your P.O. No.: 2534

ECOSERVE, INC.
690 B Garcia
Pittsburg, CA 94565
Attn: Joanie O;Keefe

Gentlemen:

Thank you for choosing Scott for your Specialty Gas needs. The analyses for the gases ordered, as reported by our laboratory, are listed below. Results are in volume percent, unless otherwise indicated.

ANALYTICAL REPORT

Cyl. No. B-2168 Analytical Accuracy ±1%

Component	Concentration
Propane	999.8 PPM
Nitrogen	Balance

Cyl. No. B-112 Analytical Accuracy ±1%

Component	Concentration
Propane	100.2 PPM
Nitrogen	Balance

Cyl. No. B-940 Analytical Accuracy ±1%

Component	Concentration
Carbon Dioxide	1.001%
Nitrogen	Balance

Cyl. No. _____ Analytical Accuracy _____

Component	Concentration

Analyst _____

Approved By _____

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.

RECEIVED AUG 4 1989

Scott Specialty Gases

a division of

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

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

ECOSERVE
ATTN: ERIC DUELTGE

Shipped From: Scott SAN BERNARDINO
Date Shipped 8-2-89
Our Project No: 1658
Your P.O. No: 4988
Page 1 of 1
Expiration Date: 2-2-90

CERTIFICATE OF ANALYSIS – EPA PROTOCOL GASES*

Certified Per Traceability Protocol No. 1 Procedure No. G1 Cylinder No. AAL-6503 Cylinder Pressure 1900 psig Certified Accuracy +1 % NBS Traceable

COMPONENTS	CERTIFIED CONC	REFERENCE STD SRM/CRM NO.	REFERENCE STD CYL. NO.	REFERENCE STD CONC.
Nitric Oxide	81.44 PPM	SRM 1684 B	CAL-12787	94.80 PPM
NOX	81.54 PPM			
Sulfur Dioxide	80.33 PPM	CRM 1694	AAL-6025	95.1 PPM
Carbon Monoxide	838.3 PPM	CRM 2637	AAL-10133	2412 PPM

GAS ANALYZER MAKE/MODEL/SERIAL NO.	LAST CAL. DATE	ANALYTICAL PRINCIPLE
Thermo-Electron 10 AR S/N 14853-150	5-2-89	Chemi-Luminenscen
Horiba AIA 23 S/N 56174104	4-20-89	Infra-red
Horiba AIA 24 S/N 4564403	6-23-89	Infra-red

BALANCE GAS Nitrogen

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

Component Nitric Oxide

First Analysis Date 7-19-89 Units PPM

Z 0.00	R 94.60	T 80.88
R 94.58	Z 0.01	T 80.85
Z 0.01	T 80.85	R 94.58

Mean Test Assay 81.04 PPM

Second Analysis Date 7-26-89 Units PPM

Z 0.00	R 94.88	T 81.48
R 94.75	Z 0.06	T 81.40
Z 0.06	T 81.30	R 94.58

Mean Test Assay 81.44 PPM

Component Sulfur Dioxide

Date 7-20-89 Units PPM

Z 00.0	R 95.0	T 80.7
R 95.0	Z 00.1	T 80.7
Z 00.1	T 80.7	R 95.0

Mean Test Assay 80.53 PPM

Date 7-31-89 Units PPM

Z 00.0	R 95.0	T 80.5
R 95.0	Z 00.0	T 80.5
Z 00.0	T 80.5	R 95.0

Mean Test Assay 80.33 PPM

Component Carbon Monoxide

Date 7-20-89 Units PPM

Z 00.0	R 93.6	T 52.0
R 93.6	Z 00.0	T 51.9
Z 00.0	T 51.9	R 93.6

Mean Test Assay 838.3 PPM

Date 7-31-89 Units PPM

Z 00.0	R 93.6	T 52.0
R 93.6	Z 00.0	T 51.9
Z 00.0	T 51.9	R 93.6

Mean Test Assay 838.3 PPM

Chronology: Date

Assay

Analyst Doug Hagberg/Maynard Johnson Approved By:

LINDE GASES OF THE WEST

Linde Gases & West
7 South Linden Avenue
South San Francisco, CA 94080
(415) 873-2055

LINDE GASES OF THE WEST
1900 Loveridge Road
Pittsburg, Ca. 94565

Date: 6-26-89
Linde Order No.: 60158
Customer P.O No.: 06269

Dear Sir:

This is your Certificate of Analysis for :

Cylinder Number	Mixture Components	Requested Composition	Certified Composition
K-853973	OXYGEN	8%	8.0%
	CARBON DIOXIDE	15%	15.0%
	NITROGEN	77%	77.0%

Sincerely,

J. A. Taranta
OPERATIONS SUPERVISOR

COA-6MC

19 Oct. 89 Process Data RF MacDonald - Tomatek

Boiler #2

Time	SCF (SCF x 1000)
12:41	147,799
12:54	147,816
13:11	147,840
13:41	147,879
14:54	147,978
15:30	148,029

Boiler #1

Time	SCF (SCF x 1000)
17:08	148,115
18:08	148,196
19:08	148,274
20:02	148,349