Report of . . .

TCE Emission Testing

performed for . . .

General Motors Corporation
CPC Group

Grand Rapids, Michigan

on the . . .

Soil Vapor Extraction System Exhaust

September 21, 1989
21099

EDI Engineering & Science
Environmental Engineering, Geology, Biology and Chemistry
a subsidiary of WW Engineering & Science

Grand Rapids, Michigan (616) 942-9600 Livonia, Michigan (313) 591-0520

PC989.SS

SOURCE EMISSION TESTING
at
GENERAL MOTORS - CPC
GRAND RAPIDS, MICHIGAN
SOIL VAPOR EXTRACTION SYSTEM EXHAUST
DATE: 9/21/89

EDI Engineering & Science

5555 Glenwood Hills Pkwy, S.E.; GRAND RAPIDS, MI 49508; (616) 942-9600

INTRODUCTION

EDI Engineering & Science was retained by the General Motors Corporation to conduct trichloroethylene (TCE) emission testing on the soil vapor vacuum extraction system located at their CPC facility in Grand Rapids, Michigan. The purpose of the testing was to determine compliance with the special conditions of the MDNR permit to install No. 92-88.

The testing was performed by R. Scott Cargill and Dan J. Madden of EDI on September 21, 1989. Assisting in the test was Mr. Don Veltman of CPC.

TABLE 1

TCE EMISSION RESULTS
SOIL VAPOR EXTRACTION SYSTEM EXHAUST
GENERAL MOTORS - CPC
GRAND RAPIDS, MI
SEPTEMBER 21, 1989

Sample	Time	Air Flow Rate(1) DSCFM	Temp. °F	% Moisture	TCE Concentrations Mg/M^3
1	14:40- 15:40	109	91	2.92	N.D.(2)
2	15:44- 16:44				N.D.
3	16:45- 17:45				N.D.

(1) Standard temperature and pressure = 70°F and 29.92 in. Hg.

(2) Non detected at a detection limit of 0.0017 mg/m^3.

EDI Engineering & Science

SUMMARY OF EXHAUST GAS PARAMETERS

COMPANY NAME: GENERAL MOTORS - CPC TEST DATE: 9/21/89
COMPANY LOCATION: GRAND RAPIDS, MICHIGAN
SOURCE NAME: SOIL VAPOR EXTRACTION SYSTEM EXHAUST
SAMPLING STAFF: CARGILL / MADDEN

	SAMPLE NUMBER	1
G1.	STACK RADIUS, inches	2.0
G2.	AREA OF STACK, sq. ft.	0.09
G3.	BAROMETRIC PRESSURE, in. HG.	29.34
G4.	STATIC PRESSURE IN STACK, in. H2O	0.04
G5.	STACK GAS TEMPERATURE, deg. F	91
G6.	AVG. SQRT VELOCITY PRESSURE OF POINTS SAMPLED	0.387
G7.	PERCENT MOISTURE AT TEST LOCATION	2.92
G8.	PERCENT MOISTURE BEFORE COLLECTOR	2.92
G9.	DRY GAS COMPOSITION: % OXYGEN	20.90
	% CARBON DIOXIDE	0.00
	% CARBON MONOXIDE	0.00
	% NITROGEN	79.10
G10.	PERCENT EXCESS AIR AT TEST LOCATION	
	DENSITY AND MOLECULAR WEIGHT OF STACK GAS:	
G11.	DRY, @ STP, lbs./cu.ft.	0.0746
G12.	WET, @ STP, lbs./cu.ft.	0.0737
G13.	WET, @ STACK CONDITIONS, lbs./cu.ft.	0.0696
G14.	MOLECULAR WEIGHT, DRY, @ STP, lbs./mole	28.84
G15.	AVERAGE GAS VELOCITY, feet/min.	1368
	STACK GAS FLOW RATE:	
G16.	STACK CONDITIONS, ACFM	119
G17.	STANDARD CONDITIONS, SCFM	113
G18.	STANDARD CONDITIONS, DRY SCFM	109

STANDARD TEMPERATURE AND PRESSURE (STP) = 29.92 inches HG, 70 deg. F

DISCUSSION OF RESULTS

The results for the TCE emission sampling are found in Table 1. TCE was non detected at a detection limit of 0.0017 mg/m^3 for all three samples. The detection limit is well below the established emission limit of 16.0 mg/m^3.

SOURCE DESCRIPTION

The source tested was the exhaust of the soil vapor vacuum extraction system. Soil vapor is taken from a 20 foot deep well and passed through a knock out drum then a carbon absorption unit before being emitted to the atmosphere through a four inch I.D. exhaust duct.

SAMPLING PROTOCOL

Sampling was conducted on the four inch I.D. exhaust duct at a distance well beyond the optimum location of eight stack diameters downstream and two stack diameters upstream as stated in U.S. EPA Method 1. The sampling and analysis were performed in accordance with U.S. EPA Reference Method 18. Three one hour samples were collected on the exhaust using carbo-trap sorbent tubes. The TCE was recovered in the laboratory by thermal desorption and analyzed using gas chromatography. Exhaust gas parameters were determined by U.S. EPA Reference Methods 1-4. All quality control and quality assurance requirements prescribed in the methods were incorporated in the sampling and analysis.

This report was prepared by:

David D. Engelhardt

David D. Engelhardt
Senior Specialist
Air Quality Services

APPENDIX A

FIELD DATA

EDI Engineering & Science

PITOT TRAVERSE DATA

COMPANY NAME: GENERAL MOTORS - CPC TEST DATE: 9/21/89

COMPANY LOCATION: GRAND RAPIDS, MICHIGAN

SOURCE NAME: SOIL VAPOR EXTRACTION SYSTEM EXHAUST

SAMPLING STAFF: CARGILL / MADDEN

RUN NUMBER:	1	% CARBON DIOXIDE:	0
STACK RADIUS, in.:	2	% OXYGEN:	20.9
GAS TEMPERATURE, Deg F:	91	% CARBON MONOXIDE:	0
STATIC PRESSURE, in. H2O:	.04	PITOT FACTOR:	.85
BAROMETRIC PRESSURE:	29.34		

PT. #	POINT LOCATION, INCHES	VELOCITY PRESSURE, INCHES OF WATER ______ PORT ______ 1
1	1.00	0.15
2	3.00	0.15

EDI Engineering & Science
Environmental Engineering, Geology, Biology and Chemistry
611 Cascade W Pkwy, SE, Grand Rapids, MI 49506-2179 (616) 942-9600
a subsidiary of WW Engineering & Science

Field Data Sheet

Date: 9/21/89

Client: CPC Grand Rapids

Project #:

Barometric Pressure: 29.34

Ambient Temperature: 87°F
91°F Stack
79°F WB

Sample Number	Location	Pump Number	Start Time	Elapse Time	Pump Flow Rate
#1	TCE Exhaust	SKC#4	2:40pm	60min	≅100cc/min
#2	"	"	3:44pm	"	"
#3	"	"	4:45pm	"	"
OVA	Begin 0 ppm				
	End 0ppm				

EDI Engineering & Science
Environmental Engineering
Geology, Biology and Chemistry

Date: 9/21/89
Client: CPC Grand Rapids
Project No: ____________

Programable Pump Calibration Record

Barometric Pressure 2934 Temperature °F 76. Desired Flow Rate cc/min 100/50

Pump Number	Flow Rate cc/min	Average Flow Rate cc/min
SKC #1	1. 110.32	
	2. 103.45	
	3. 98.68	
	4. 99.50	
	5. 101.2	
* SKC #4	1. 108.2	103.51 Actual 100.37 STP
	2. 105.34	
	3. 102.61	
	4. 99.28	
	5. 102.1	
SKC #3	1. 60.3	
	2. 52.25	
	3. 48.61	
	4. 52.68	
	5. 51.72	
SKC #_	1. 45.94	
	2. 50.50	
	3. 45.35	
	4. 49.86	
	5. 50.21	
	1.	
	2.	
	3.	
	4.	
	5.	

6.02l

APPENDIX B

CALCULATIONS

TCE CALCULATION

$ug/l = mg/m^3$

Detection Limit: .01 ug/6.02 l = 0.0017 mg/m^3

CALCULATION FORMULAS

MOISTURE TRAIN CALCULATIONS:

M1. BAROMETRIC PRESSURE, inches of Mercury

M2. DURATION OF SAMPLE, minutes

M3. METER CALIBRATION FACTOR

M4. AVERAGE METER TEMPERATURE, degrees F

M5. AVERAGE METER PRESSURE, inches of water

M6. METER VOLUME, ACTUAL, cubic feet

M7. METER VOLUME, STP, cubic feet

$$M7 = M3 * M6 * \frac{530}{M4 + 460} * \frac{M1 + .07355 * M5}{29.92}$$

M8. LIQUID VOLUME OF WATER CONDENSED, milliliters

M9. VAPOR VOLUME OF WATER CONDENSED, @ STP, cubic feet

$$M9 = M8 * 0.0474$$

M10. TOTAL GAS SAMPLED, @ STP, cubic feet

$$M10 = M7 + M9$$

M11. PERCENT MOISTURE

$$M11 = \frac{M9}{M10} * 100$$

EXHAUST GAS CALCULATIONS:

G1. STACK DIMENSIONS, inches

G2. AREA OF STACK, square feet

$$G2\ (ROUND) = \frac{3.14159 * (DIA/2)\hat{}2}{144}$$

$$G2\ (RECT.) = \frac{WIDTH * LENGTH}{144}$$

G3. BAROMETRIC PRESSURE, inches of Mercury

G4. STATIC PRESSURE IN STACK, inches of water

G5. STACK GAS TEMPERATURE, degrees F

G6. AVG. SQRT VELOCITY PRESSURE OF POINTS SAMPLED

G7. PERCENT MOISTURE AT TEST LOCATION

$$G7 = \frac{P13}{P14} * 100$$

CALCULATION FORMULAS CONTINUED

G8. PERCENT MOISTURE BEFORE COLLECTOR

G9. DRY GAS COMPOSITION, %O2, %CO2, %CO, %N2

G10. PERCENT EXCESS AIR AT TEST LOCATION

$$G10 = 100 * \frac{\%O2 - 0.5 * \%CO}{.264 * \%N2 - \%O2 + .5 * \%CO}$$

G11. DENSITY, DRY, @STP, lbs./cu. ft.

$$G11 = \frac{.0827 * \%O2 + .1137 * \%CO2 + (\%CO + \%N2) * .0724}{100}$$

G12. DENSITY, WET, @STP, lbs./cu. ft.

$$G12 = G11 * \frac{100 - G7}{100} + .0465 * \frac{G7}{100}$$

G13. DENSITY, WET, @ STACK CONDITIONS, lbs./cu. ft.

$$G13 = G12 * \frac{530}{G5 + 460} * \frac{G3 + .07355 * G4}{29.92}$$

G14. MOLECULAR WEIGHT, DRY, lbs./mole

$$G14 = G11 * 386.9$$

G15. AVERAGE GAS VELOCITY, feet/minute

$$G15 = P5 * G6 * \frac{1096}{SQRT(G13)}$$

G16. STACK GAS FLOW RATE, ACFM

$$G16 = G2 * G15$$

G17. STACK GAS FLOW RATE, SCFM

$$G17 = G16 * \frac{530}{G5 + 460} * \frac{G3 + .07355 * G4}{29.92}$$

G18. STACK GAS FLOW RATE, DRY, DSCFM

$$G18 = G17 * \frac{100 - G7}{100}$$

CALCULATION FORMULAS CONTINUED

PARTICULATE TRAIN CALCULATIONS:

P1. NUMBER OF POINTS SAMPLED

P2. DURATION OF SAMPLE, minutes

P3. NOZZLE DIAMETER, inches

P4. NOZZLE AREA, square feet

$$P4 = \frac{3.14159 * (P3/2)^2}{144}$$

P5. PITOT CALIBRATION FACTOR

P6. METER CALIBRATION FACTOR

P7. AVERAGE FILTER TEMPERATURE, degrees F

P8. AVERAGE METER TEMPERATURE, degrees F

P9. AVERAGE METER PRESSURE, inches of water

P10. METER VOLUME, ACTUAL, cubic feet

P11. METER VOLUME, @ STP, cubic feet

$$P11 = P10 * P6 * \frac{530}{P8 + 460} * \frac{G3 + .07355 * P9}{29.92}$$

P12. LIQUID VOLUME OF WATER CONDENSED, milliliters

P13. VAPOR VOLUME OF WATER CONDENSED, @ STP, cubic feet

$$P13 = P12 * 0.0474$$

P14. TOTAL GAS SAMPLED, @ STP, cubic feet

$$P14 = P11 + P13$$

P15. WEIGHT OF GAS SAMPLED, DRY, pounds

$$P15 = P11 * G11$$

P16. WEIGHT OF GAS SAMPLED, WET, pounds

$$P16 = P14 * G12$$

P17. PERCENT ISOKINETICS

$$P17 = \frac{100 * 29.92 * (G5 + 460) * P14}{530 * (G3 + .07355 * G4) * P2 * P4 * G15}$$

CALCULATION FORMULAS CONTINUED

CONCENTRATION CONVERSION FACTORS:

P18. 50 % EXCESS AIR, AFER COLLECTOR

$$P18 = \frac{G14 + 18 * G7/(100 - G7)}{.1826 * \%N2 - 2.0592 * \%O2 + G14 + 18 * G7/(100 - G7)}$$

P19. 50 % EXCESS AIR, BEFORE COLLECTOR

$$P19 = \frac{G14 + 18 * G7/(100 - G7)}{.1826 * \%N2 - 2.0592 * \%O2 + G14 + 18 * G8/(100 - G8)}$$

P20. MOISTURE BEFORE COLLECTOR

$$P20 = \frac{G14 + 18 * G7/(100 - G7)}{G14 + 18 * G8/(100 - G8)}$$

PARTICULATE EMISSION CALCULATIONS:

E1. TOTAL WEIGHT PARTICULATE COLLECTED, grams

E2. LBS. PARTICULATE/1000 LBS. GAS, ACTUAL

$$E2 = E1 * \frac{1000}{454 * P16}$$

E3. LBS. PARTICULATE/1000 LBS. GAS, DRY

$$E3 = E2 * P20$$

E4. LBS. PARTICULATE/1000 LBS. GAS, WET, 50% EA

$$E4 = E2 * P18$$

E5. LBS. PARTICULATE/1000 LBS. GAS, DRY, 50% EA

$$E5 = E2 * P19$$

E6. GRAINS/DRY STANDARD CUBIC FOOT

$$E6 = \frac{E1 * 7000 * 100}{454 * P14 * (100 - G7)}$$

E7. POUNDS/HOUR

$$E7 = \frac{G17 * G12 * 1000 * E1 * .06}{454 * P16}$$

E8. POUNDS/MILLION BTU

$$E8 = \frac{E7}{\text{CAPACITY, MM BTU/HR}}$$