

SECTION 8.6

OFF-ROAD RECREATIONAL VEHICLES OFF-ROAD USE OF MOTORCYCLES & ALL TERRAIN VEHICLES (ATVs) (Updated - April 1994)

SOURCE CATEGORY CODES AND DESCRIPTION

47464 Recreational . Off-Road Motor Vehicles . Gasoline Combustion .
Trail Bikes . Motorcycles

83477 Recreational . Off-Road Motor Vehicles . Gasoline Combustion .
All-Terrain Vehicles (ATVs)

EMISSION INVENTORY CODES AND DESCRIPTION

850-872-1100-0000 Off-Road Use Of Motorcycles

850-874-1100-0000 All-Terrain Vehicles (ATVs)

METHOD DESCRIPTION

These categories are used to inventory the combustion emissions from the recreational, off-road use of motorcycles and all-terrain vehicles (ATVs), including the emissions of on-road motorcycles used off-road. The baseline information for these categories including emission factors are presented in Table I. The results of this inventory are presented in Table II (CES 47464) and Table III (CES 83477).

Four types of motorcycles are considered in this method: on-highway, dual purpose, off-highway and competition motorcycles. ATVs are estimated to be 30 percent 2-stroke and 70 percent 4-stroke engines. The motorcycle/ATV population, annual off-road mileage, and number of hours used per operating day are required to determine the emissions.

On-highway motorcycles (street bikes) meet the highest standards among the four types. They are allowed to be ridden off-road without an off-highway license, although they are not suitable for rough-terrain riding. Off-highway motorcycles (trail bikes) are designed for rough terrain, but are not allowed on the highway. The dual purpose bike is designed for rough terrain, but is allowed on the highway. The dual purpose bike is designed to meet both the street bike standards and the needs of the trail bike rider. A competition motorcycle may be one designed for competition only or any of the other three types, and may not meet street bike or trail bike standards.

The total population of off-road motorcycles (OFRMs) and ATVs together is 324,200 based on values presented by the Motorcycle Industry Council (MIC) in 1990.¹ The ATV fraction of this total is 50.6% based on statewide data collected by the Department of Motor Vehicles (DMV).² The total population of dual purpose motorcycles is 107,000 based on values presented by MIC in 1990.¹ The off-road fraction of dual purpose motorcycles is 74% (MIC).¹

TEMPORAL ACTIVITY

Most of the annual activity occurs during the spring, summer, and fall seasons. The weekly activity is uniform on weekdays, but about twice as high on weekends. Daily activity occurs during the daylight hours. (These temporal activities are standard for recreational type activities).

ASSUMPTIONS

1. The total population of OFRMs and ATVs can be represented by MIC's estimates for California.¹
2. The split between OFRMs and ATVs for California can be based on the percent of registration of each vehicle from DMV.²

3. The 2-stroke and 4-stroke population split for motorcycles can be represented by 30% and 70% respectively based on MIC.¹
4. The 4-stroke population for dual purpose motorcycles used off-road is 74% based on MIC values.¹
5. The average speed is estimated at 20 MPH by Booz-Allen and Hamilton (BAH) and ARB staff.³
6. The hours of use per day is estimated at 3 hrs/day by BAH and ARB staff.³
7. Usage is estimated at 40 times/year based on MIC estimates.¹
8. The 2-stroke emission factors are estimated for HC, CO, and NOx by ARB staff. The 2-stroke emission factors are estimated for SOx and PM by ARB staff and BAH.³
9. The 4-stroke emission factors are estimated for HC, CO, and NOx by ARB staff. The 4-stroke emission factors are estimated for SOx and PM by ARB staff and BAH.³
10. The distribution of emissions and activity are based upon the 1987 area source methodology.⁴

CHANGES IN METHODOLOGY

The ATV inventory is a new category. The OFRM category has subdivisions of 2-stroke and 4-stroke engine types. The emission factors of each engine type are assumed to be the same for competition and trail OFRMs. The emission factors for dual motorcycles are the same as on-road motorcycle emission factors.

DIFFERENCES BETWEEN 1987 AND 1990 EMISSION ESTIMATES

The ATV inventory is a new category in 1990. The TOG, CO, NOx, and SOx emissions are much higher in 1990 due to an increase in OFRM population.

RECOMMENDATIONS

The activity data needs improvement (e.g. miles/yr) and the emission factors need to be revised. There are great uncertainties in the emission factors, emission factors based on a breakdown of vehicle population by engine type and size would give better results.

SAMPLE CALCULATIONS

EMISSIONS ESTIMATE

Calculation of number of miles/year off-road motorcycles used:

$$20 \text{ mph} \times 3 \text{ hrs/day} \times 40 \text{ days/yr} = 2400 \text{ miles/year}$$

The OFRM and ATV population and emission factors are found in Table I. The emission estimates for California are shown below.

4-stroke (off-road) motorcycle population = 112108

TOG	(112108)(2400 mi/yr)(2.43 g/mi)/(454 g/lb)(2000 lb/T)	=	720.1 T/yr
CO	(112108)(2400 mi/yr)(51.63 g/mi)/(454 g/lb)(2000 lb/T)	=	15299.0 T/yr
NOx	(112108)(2400 mi/yr)(0.36 g/mi)/(454 g/lb)(2000 lb/T)	=	106.7 T/yr
SOx	(112108)(2400 mi/yr)(0.02 g/mi)/(454 g/lb)(2000 lb/T)	=	5.9 T/yr
PM	(112108)(2400 mi/yr)(0.012 g/mi)/(454 g/lb)(2000 lb/T)	=	3.6 T/yr

4-stroke (dual purpose) motorcycle population = 79180

TOG	(79180)(2400 mi/yr)(3.23 g/mi)/(454 g/lb)(2000 lb/T)	=	676.0 T/yr
CO	(79180)(2400 mi/yr)(15.15 g/mi)/(454 g/lb)(2000 lb/T)	=	3170.7 T/yr
NOx	(79180)(2400 mi/yr)(0.69 g/mi)/(454 g/lb)(2000 lb/T)	=	144.4 T/yr
SOx	(79180)(2400 mi/yr)(0.02 g/mi)/(454 g/lb)(2000 lb/T)	=	4.2 T/yr
PM	(79180)(2400 mi/yr)(0.01 g/mi)/(454 g/lb)(2000 lb/T)	=	2.1 T/yr

4-stroke (on-road) motorcycle population = 41968

TOG	(41968)(2400 mi/yr)(3.23 g/mi)/(454 g/lb)(2000 lb/T)	=	358.3 T/yr
CO	(41968)(2400 mi/yr)(15.15 g/mi)/(454 g/lb)(2000 lb/T)	=	1680.6 T/yr
NOx	(41968)(2400 mi/yr)(0.69 g/mi)/(454 g/lb)(2000 lb/T)	=	76.5 T/yr
SOx	(41968)(2400 mi/yr)(0.02 g/mi)/(454 g/lb)(2000 lb/T)	=	2.2 T/yr
PM	(41968)(2400 mi/yr)(0.01 g/mi)/(454 g/lb)(2000 lb/T)	=	1.1 T/yr

2-stroke (off-road) motorcycle population = 48046

TOG	(48046)(2400 mi/yr)(24.0 g/mi)/(454 g/lb)(2000 lb/T)	=	3047.9 T/yr
CO	(48046)(2400 mi/yr)(32.0 g/mi)/(454 g/lb)(2000 lb/T)	=	4063.8 T/yr
NOx	(48046)(2400 mi/yr)(0.06 g/mi)/(454 g/lb)(2000 lb/T)	=	7.6 T/yr
SOx	(48046)(2400 mi/yr)(0.02 g/mi)/(454 g/lb)(2000 lb/T)	=	2.5 T/yr
PM	(48046)(2400 mi/yr)(0.014 g/mi)/(454 g/lb)(2000 lb/T)	=	1.8 T/yr

Total emissions from all OFRMs are shown below:

TOG	720.1 + 676.0 + 358.3 + 3047.9	=	4802.3 T/yr
CO	15299.0 + 3170.7 + 1680.6 + 4063.8	=	24214.1 T/yr
NOx	106.7 + 144.4 + 76.5 + 7.6	=	335.2 T/yr
SOx	5.9 + 4.2 + 2.2 + 2.5	=	14.8 T/yr
PM	3.6 + 2.1 + 1.1 + 1.8	=	8.6 T/yr

Total number of 1000 gallons burned (process rate) for OFRMs:

Street/Dual:

(Population of M/C)(2400 miles/yr)/(90 miles/gallon)(1000 gallons/1000 gallons) = 1000 gallons burned

(79180 + 41968)(26.7 gallons/year)/1000 (gallons/1000 gallons) = 3231 (1000 gallons) process rate

Trail/Competition:

(Population of M/C)(2400 miles/yr)/(33 miles/gallon)(1000 gallons/1000 gallons) = 1000 gallons burned

(112108 + 48046)(72.7 gallons/year)/1000 (gallons/1000 gallons) = 11643 (1000 gallons) process rate

Total OFRM process rate:

3231 + 11643 = 14874 (1000 gallons) total process rate

ATV emission calculation:

2-stroke ATV population = 49214

TOG	(49214)(2400 mi/yr)(24.0 g/mi)/(454 g/lb)(2000 lb/T)	=	3121.9 T/yr
CO	(49214)(2400 mi/yr)(32.0 g/mi)/(454 g/lb)(2000 lb/T)	=	4162.6 T/yr
NOx	(49214)(2400 mi/yr)(0.06 g/mi)/(454 g/lb)(2000 lb/T)	=	7.8 T/yr
SOx	(49214)(2400 mi/yr)(0.02 g/mi)/(454 g/lb)(2000 lb/T)	=	2.6 T/yr
PM	(49214)(2400 mi/yr)(0.014 g/mi)/(454 g/lb)(2000 lb/T)	=	1.8 T/yr

4-stroke ATV population = 114831

TOG (114831)(2400 mi/yr)(2.43 g/mi)/(454 g/lb)(2000 lb/T) = 737.5 T/yr
CO (114831)(2400 mi/yr)(51.63 g/mi)/(454 g/lb)(2000 lb/T) = 15670.6 T/yr
NOx (114831)(2400 mi/yr)(0.36 g/mi)/(454 g/lb)(2000 lb/T) = 109.3 T/yr
SOx (114831)(2400 mi/yr)(0.02 g/mi)/(454 g/lb)(2000 lb/T) = 6.1 T/yr
PM (114831)(2400 mi/yr)(0.012 g/mi)/(454 g/lb)(2000 lb/T) = 3.6 T/yr

Total ATV emission estimates:

TOG 737.5 + 3121.9 = 3859.4 T/y
CO 15670.6 + 4162.6 = 19833.2 T/y
NOx 109.3 + 7.8 = 117.1 T/y
SOx 6.1 + 2.6 = 8.7 T/y
PM 3.6 + 1.8 = 5.4 T/y

Total number of 1000 gallons burned (process rate) for ATVs:

(Population of ATVs)(2400 miles/yr)/(33 miles/gallon)(1000 gallons/1000 gallons) = 1000 gallons burned
(114831 + 49214)(72.7 gallons/year)/1000 (gallons/1000 gallons) = 11926 (1000 gallons) total ATV process rate

DEFINITION OF TERMS

MIC MOTORCYCLE INDUSTRY COUNCIL, INC.
DMV DEPARTMENT OF MOTOR VEHICLES
BAH BOOZ-ALLEN & HAMILTON INC.
ARB AIR RESOURCES BOARD
M/C MOTORCYCLE
ATV ALL-TERRAIN VEHICLE
OFRM OFF-ROAD MOTORCYCLE

REFERENCES

1. Motorcycle Industry Council, 1991 Motorcycle Statistical Annual, 1991.
2. Department of Motor Vehicles, State of California, "Off Highway Currently Registered", Feb. 28, 1991.
3. Booz-Allen & Hamilton Inc., Off-Road Mobile Equipment Emission Inventory Estimate, Draft January 1992.
4. Air Resources Board, Methods for Assessing Area Source Emissions in California, September 1991.

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APRIL 1994

D20146

Table I

Baseline Information for OFRMs and ATVs

Assumptions	Data	Source
Total Population Off-Rd	324200	MIC
ATV fraction of Off-Rd	50.6% 164045	MIC
2-st. pop. ATV (off-road)	30% 49214	MIC
4-st. pop. ATV (off-road)	70% 114831	MIC
M/C fraction of Off-Rd	49.4% 160155	MIC
2-stroke pop. M/C (off-road)	30% 48046	MIC
4-stroke pop. M/C (off-road)	70% 112108	MIC
Total DMV registration Off-Rd	307985	DMV
Total Population On-Rd	524600	MIC
4-stroke pop. M/C (on-road)	8% 41968	MIC
Total Population Dual Purpose	107000	MIC
4-stroke pop. (Dual purpose)	74% 79180	MIC
Competition vehicle (off-road)	41% of population	MIC+STAFF
Real Competition veh. pop.	8-10% of population	STAFF
Average Speed	20 MPH	BAH+STAFF
Hours used	3 hrs/day	BAH+STAFF
Usage	40 times/year	MIC
Annual miles traveled	2400 mi/year	calculation
2-stroke emission factors for off-road M/C and ATV	24 g/mi TOG	STAFF
	32 g/mi CO	STAFF
	.06 g/mi NOx	STAFF
	.02 g/mi SOx	BAH + STAFF
	.014 g/mi PM	BAH + STAFF
4-stroke emission factors for off-road M/C and ATV	2.43 g/mi TOG	MIC
	51.63 g/mi CO	MIC
	.36 g/mi NOx	STAFF
	.02 g/mi SOx	BAH + STAFF
	.012 g/mi PM	BAH + STAFF
4-stroke emission factors for dual motorcycles and on-road M/C	3.23 g/mi TOG	STAFF
	15.15 g/mi CO	STAFF
	.69 g/mi NOx	STAFF
	.02 g/mi SOx	STAFF
	.01 g/mi PM	STAFF
Off-Road M/C:		
Current competition pop.	65663 (160155 * 41%)	
2-stroke competition pop.	48046	
4-stroke competition pop.	17617	
non-comp. pop. 4-st (off-road)	94491	
non-comp. pop. 4-st (dual-purpose)	79180	

** A study done by the California Department of Transportation in November, 1990, indicates that five out of every six off-road motorcycles and three out of every five all-terrain vehicles used are currently not registered. Staff is looking into this information for possible emission impacts.

15/02/94

TABLE -II
 1990 AREA SOURCE EMISSIONS
 ACTIVITY: RECREATIONAL
 PROCESS: OFF-ROAD MOTOR VEHICLES
 ENTRAPMENT: GASOLINE ENGINES
 DUMP: TRAIL BIKES, MOTORCYCLES

CES: 47464

PROCESS RATE UNIT: 1000 GALLONS BURNED

AB COUNTY	PROCESS RATE	TOG EMISSIONS (TONS/YEAR)	CO EMISSIONS (TONS/YEAR)	NOX EMISSIONS (TONS/YEAR)	SO ₂ EMISSIONS (TONS/YEAR)	PM EMISSIONS (TONS/YEAR)
GBV ALPINE	1	.30	1.30	.00	.00	.00
INYO	24	7.60	38.30	.50	.00	.00
MONO	12	3.90	19.70	.30	.00	.00
LC LAKE	44	14.40	72.40	1.00	.00	.00
LT EL DORADO	33	10.60	53.30	.70	.00	.00
PLACER	9	3.10	15.20	.20	.00	.00
MC AMADOR	24	7.90	39.60	.50	.00	.00
CALAVERAS	10	4.80	24.40	.30	.00	.00
EL DORADO	31	10.10	50.70	.70	.00	.00
HARTIPOSA	11	3.70	18.60	.20	.00	.00
NEVADA	19	9.00	45.00	.60	.00	.00
PLACER	12	7.80	39.00	.50	.00	.00
SUTTER	17	5.50	27.50	.40	.00	.00
TEHAMA	2	.60	3.00	.00	.00	.00
TUOLUMNE	38	12.30	62.20	.80	.00	.00
NC DEL NORTE	9	2.80	14.20	.20	.00	.00
BLANDFORD	76	24.00	120.80	1.70	.00	.00
HERNDON	24	8.00	40.00	.50	.00	.00
TRINITY	10	3.40	17.00	.20	.00	.00
NCC MONTEREY	150	48.50	244.40	3.40	.10	.10
SAN BENITO	4	14.50	72.20	.90	.00	.00
SANTA CRUZ	150	50.50	254.00	3.50	.10	.10
NEP LASSEN	21	6.80	34.10	.50	.00	.00
YUBA	1	.30	1.50	.00	.00	.00
SISKIYOU	12	3.90	19.50	.30	.00	.00
SC LOS ANGELES	1515	1,134.80	5,721.20	77.20	1.50	2.00
ORANGE	1024	528.10	2,640.50	34.90	.70	.90
RIVERSIDE	874	187.80	939.00	12.70	.20	.30
SAN BERNARDINO	842	271.90	1,370.00	19.00	.40	.50
SCC SAN LUIS OBISPO	160	51.60	260.20	3.60	.00	.10
SANTA BARBARA	180	57.60	288.00	4.20	.00	.10
VENTURA	509	124.30	620.00	11.50	.00	.10
SD SAN DIEGO	1096	353.90	1,784.60	24.70	1.10	.60
SED IMPERIAL	45	14.60	73.10	1.00	.00	.00
KERN	48	15.20	76.10	1.10	.00	.00
LOS ANGELES	78	24.60	123.00	1.70	.00	.00
RIVERSIDE	214	67.20	336.00	4.90	.00	.10
SAN BERNARDINO	199	62.70	313.50	4.50	.00	.10
SF ALAMEDA	504	162.80	814.00	11.70	.00	.10
CONTRA COSTA	219	69.60	348.00	5.10	.00	.00
MARIN	111	35.10	175.50	2.60	.00	.00
NAPA	60	18.00	90.00	1.30	.00	.00
SAN FRANCISCO	49	15.00	75.00	1.00	.00	.00
SAN MATEO	257	79.80	399.00	5.90	.00	.00
SANTA CLARA	1233	246.60	1,233.00	18.90	.00	.00
SOLANO	123	36.90	184.50	2.70	.00	.00
SONOMA	204	61.20	306.00	4.70	.00	.00
SJV FRESNO	213	63.90	319.50	4.70	.00	.00
KERN	96	28.80	144.00	2.10	.00	.00
KINGS	4	1.20	6.00	.00	.00	.00
MARIANA	4	1.20	6.00	.00	.00	.00
MERCED	6	1.80	9.00	.00	.00	.00
SAN JOAQUIN	136	40.80	204.00	3.00	.00	.00
STANISLAUS	126	37.80	189.00	2.70	.00	.00
TULARE	134	40.20	201.00	2.90	.00	.00
SV BUTTE	106	31.80	159.00	2.40	.00	.00
COLUSA	13	3.90	19.50	.30	.00	.00
GLENN	27	8.10	40.50	.60	.00	.00
PLACER	10	3.00	15.00	.20	.00	.00
SACRAMENTO	439	131.70	658.50	9.90	.00	.00
SHASTA	120	36.00	180.00	2.40	.00	.00
SOLANO	44	13.20	66.00	.90	.00	.00
SUTTER	17	5.10	25.50	.30	.00	.00
TEHAMA	7	2.10	10.50	.10	.00	.00
YOLO	17	5.10	25.50	.30	.00	.00
YUBA	30	9.00	45.00	.60	.00	.00
TOTAL* FOR 47464	14529	4,702.50	23,478.00	328.20	13.80	7.90

FRACTION OF REACTIVE ORGANIC GASES (FROG): .9676
 (REACTIVE ORGANIC GASES (ROG) EMISSIONS = TOG X FROG)
 FRACTION OF PM10 (FRPM10): .9940
 (PM10 EMISSIONS = PM X FRPM10)

05/02/94

TABLE -III
1990 AREA SOURCE EMISSIONS
ACTIVITY: RECREATIONAL
PROCESS: OFF-ROAD MOTOR VEHICLES
ENTRAINMENT: GASOLINE - CBSTN
DIMN: MOTORCYCLES ATV

CES: 83477

PROCESS RATE UNIT: 1000 GALLONS BURNED

AB COUNTY	PROCESS RATE	TOG EMISSIONS (TONS/YEAR)	CO EMISSIONS (TONS/YEAR)	NOX EMISSIONS (TONS/YEAR)	SOX EMISSIONS (TONS/YEAR)	PM EMISSIONS (TONS/YEAR)
GBV ALPINE	1	4.20	1.30	.00	.00	.00
INYO	19	4.80	24.80	.10	.00	.00
MONO	6	2.00	10.10	.10	.00	.00
LC LAKE	23	7.50	38.30	.20	.00	.00
LT EL DORADO	17	5.40	27.60	.20	.00	.00
PLACER	5	1.70	8.90	.10	.00	.00
MC AMADOR	15	5.00	25.70	.20	.00	.00
CALAVERAS	15	5.00	25.70	.20	.00	.00
EL DORADO	4	1.50	7.50	.00	.00	.00
MERCED	5	1.70	8.90	.10	.00	.00
DE YUBA	5	1.70	8.90	.10	.00	.00
DIABLO	5	1.70	8.90	.10	.00	.00
STEVENS	2	1.00	5.00	.00	.00	.00
TUOLUMNE	19	6.10	31.30	.20	.00	.00
NC DEL NORTE	7	2.30	11.80	.10	.00	.00
EL DORADO	10	4.80	24.80	.10	.00	.00
EL DORADO	10	4.80	24.80	.10	.00	.00
SHASTA	11	3.30	17.10	.10	.00	.00
TRINITY	11	3.30	17.10	.10	.00	.00
NCC MONTEREY	72	23.20	119.10	.70	.10	.00
SAN BENITO	20	50.00	250.00	.40	.00	.00
SANTA CRUZ	40	50.00	250.00	.40	.00	.00
NEP LASSEN	22	7.00	35.00	.20	.00	.00
SIERRA	12	4.00	20.00	.10	.00	.00
SISKIYOU	12	4.00	20.00	.10	.00	.00
SC LOS ANGELES	2453	792.80	4,072.30	24.10	1.10	1.10
ORANGE	1702	523.80	2,619.40	16.10	.80	.80
RIVERSIDE	2709	842.00	4,210.00	25.00	1.10	1.10
SAN BERNARDINO	981	317.60	1,632.00	9.00	.70	.70
SCC SAN LUIS OBISPO	86	27.90	143.60	.80	.10	.00
SANTA BARBARA	82	26.70	133.40	.80	.10	.00
VENTURA	269	87.40	447.30	2.60	.20	.00
SD SAN DIEGO	1868	604.60	3,106.90	18.30	1.40	.80
SEB IMPERIAL	117	37.90	194.60	1.10	.10	.10
KERN	117	37.90	194.60	1.10	.10	.10
LOS ANGELES	23	7.00	35.00	.20	.00	.00
RIVERSIDE	222	70.00	350.00	2.20	.20	.20
SAN BERNARDINO	232	73.00	365.00	2.30	.20	.20
SF ALAMEDA	171	55.40	284.60	1.70	.10	.10
CONTRA COSTA	151	47.90	243.60	1.50	.10	.10
MARIN	24	7.50	38.30	.20	.00	.00
MABA	11	3.50	17.50	.10	.00	.00
SAN FRANCISCO	14	4.40	22.20	.10	.00	.00
SAN MATEO	11	3.50	17.50	.10	.00	.00
SANTA CLARA	234	73.00	365.00	2.30	.20	.20
SOLANO	102	31.80	169.90	1.00	.00	.00
SONOMA	102	31.80	169.90	1.00	.00	.00
SJV FRESNO	318	102.90	528.60	3.10	.20	.10
KERN	241	75.30	381.60	2.40	.20	.10
KINGS	70	22.00	110.00	.70	.00	.00
MARIANA	10	3.00	15.00	.10	.00	.00
MERCED	183	57.90	294.60	1.80	.10	.10
SAN JOAQUIN	220	68.00	340.00	2.20	.10	.10
STANISLAUS	202	63.50	322.50	2.00	.10	.10
TULARE	202	63.50	322.50	2.00	.10	.10
SV BUTTE	115	37.30	191.60	1.10	.10	.10
COLUSA	19	5.90	29.50	.20	.00	.00
GLENN	22	6.80	34.00	.20	.00	.00
PLACER	74	22.70	113.50	.70	.00	.00
SACRAMENTO	246	75.90	389.50	2.50	.20	.20
SHASTA	152	46.60	233.00	1.50	.10	.10
SOLANO	102	31.80	169.90	1.00	.00	.00
SUTTER	49	14.70	73.50	.50	.00	.00
TEHAMA	44	13.20	67.00	.40	.00	.00
YOLO	40	12.00	60.00	.40	.00	.00
YUBA	37	11.20	56.00	.40	.00	.00
TOTAL* FOR 83477	11925	3,847.20	19,580.10	115.60	8.30	4.50

FRACTION OF REACTIVE ORGANIC GASES (FROG): .9676

(REACTIVE ORGANIC GASES (ROG) EMISSIONS = TOG X FROG)

FRACTION OF PM10 (FRPM10): .9940

(PM10 EMISSIONS = PM X FRPM10)

