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A Comparison of MOBILE1 vs. MOBILE2

By
Phil Lorang
Tom Cackette
Jay Wallace

U.S. Environmental Protection Agency
Office of Air, Noise, and Radiation
Office of Mobile Source Air Pollution Control
Emission Control Technology Division
Ann Arbor, Michigan 48105

A COMPARISON OF MOBILE1 VS. MOBLILE2

I. Pre-1981 models - without I/M

II. 1981 and later models - without I/M

III. Pre-1981 models - with I/M

IV. 1981 and later models - with I/M

I. Major differences in the emission factors which are included in MOBILE2.

A. Light-duty diesel powered vehicles and trucks

B. Current and future model year emission rates

1. Light-duty gasoline powered vehicles (current only)

a. Additional in-use vehicle data
b. Wider mileage range
c. Adjustments for misfueling

2. Light-duty gasoline powered trucks

a. Additional in-use vehicle data
b. Adjustments for misfueling (1975+)
c. New standards
d. Parameter adjustment (1981 choke, idle mixture)
e. Redefinition of useful life (1984)
f. 10% AQL SEA (1984)
g. Allowable maintenance (1984)
h. 100% idle test (1984)

3. Heavy-duty vehicles (both gasoline & diesel powered)

a. Data based on transient test procedure
b. New standards
c. I.B.2.e-h

4. Motorcycles

a. Standards
b. Additional data

5. New non-methane HC fractions by catalyst system

II. How MOBILE2 differs from MOBILE1

MOBILE2 operates in a manner similar to MOBILE1. MOBILE2 was designed to maintain input/output sequences that as much as possible are like the previous model. MOBILE2 has several new options, thus most of the differences between MOBILE2 and MOBILE1 are the result of inclusion of additional options.

A. Diagnostic Messages - all input data are checked against allowable limits

1. Errors which terminate the program

a. Under all situations where the program terminates, MOBILE2 will write out an appropriate message

b. Examples

1) "Value of flag" out of bounds for flag "name of flag"

2) "Region code" out of bounds for region

2. Warnings indicate, MOBILE2 has automatically changed an input parameter to avoid inaccurate output results

a. They do not terminate the program

b. Examples

1) "Value of Speed" Speed reduced to 55 mph, Maximum

2) Equation "equation number" zeroes all idle coefficient (and total) for region="region #", vehicle type="vehicle type #", and pollutant="pollutant #".

2. Options that are obsolete

   a. Use of heavy-duty power/cid correction factor. (However, the MOBILE1 information data requirements are retained to maintain input compatibility with MOBILE1. If the flag for this option is set, MOBILE2 will ignore all associated information).

   b. Input of three average speeds. (MOBILE1 required under one option the input of an average speed for the three different sequences in the FTP. MOBILE2 no longer analyzes bag information for the speed correction factor).

3. Options that are unavailable but could easily be reinstated.

   a. Free format (list-directed) reads

   b. Unformatted output

C. Internally MOBILE2 has the following diffeneces from MOBILE1

1. Maximum number of equations is 15 instead of 10

2. Maximum calendar year for calculated emission factors is 2020 instead of 1995

3. More relevant documentation in the program

4. Modular design - more subprograms and block data

5. Size of MOBILE2 about the same as MOBILE1

III. MOBILE1 versus MOBILE2 emission factors (graphics)

A. LDGV's (Non-methane HC, CO and NOx plots)

1. FTP conditions (calendar years 1975 thru 2000)

2. Speed affects (5 to 55 mph calendar year 1987)

3. Temperature affects (0° to 100°F calendar year 1987)

B. All vehicles combined (Non-methane HC, CO and NOx plots)

1. FTP conditions (calendar years 1975 thru 2000)

2. Speed affects (5 to 55 mph calendar year 1987)

3. Temperature affects (0° to 100°F calendar year 1987)

2) MOBILE2 basic temperature correction factor equations

3) MOBILE2 basic speed correction factor equations

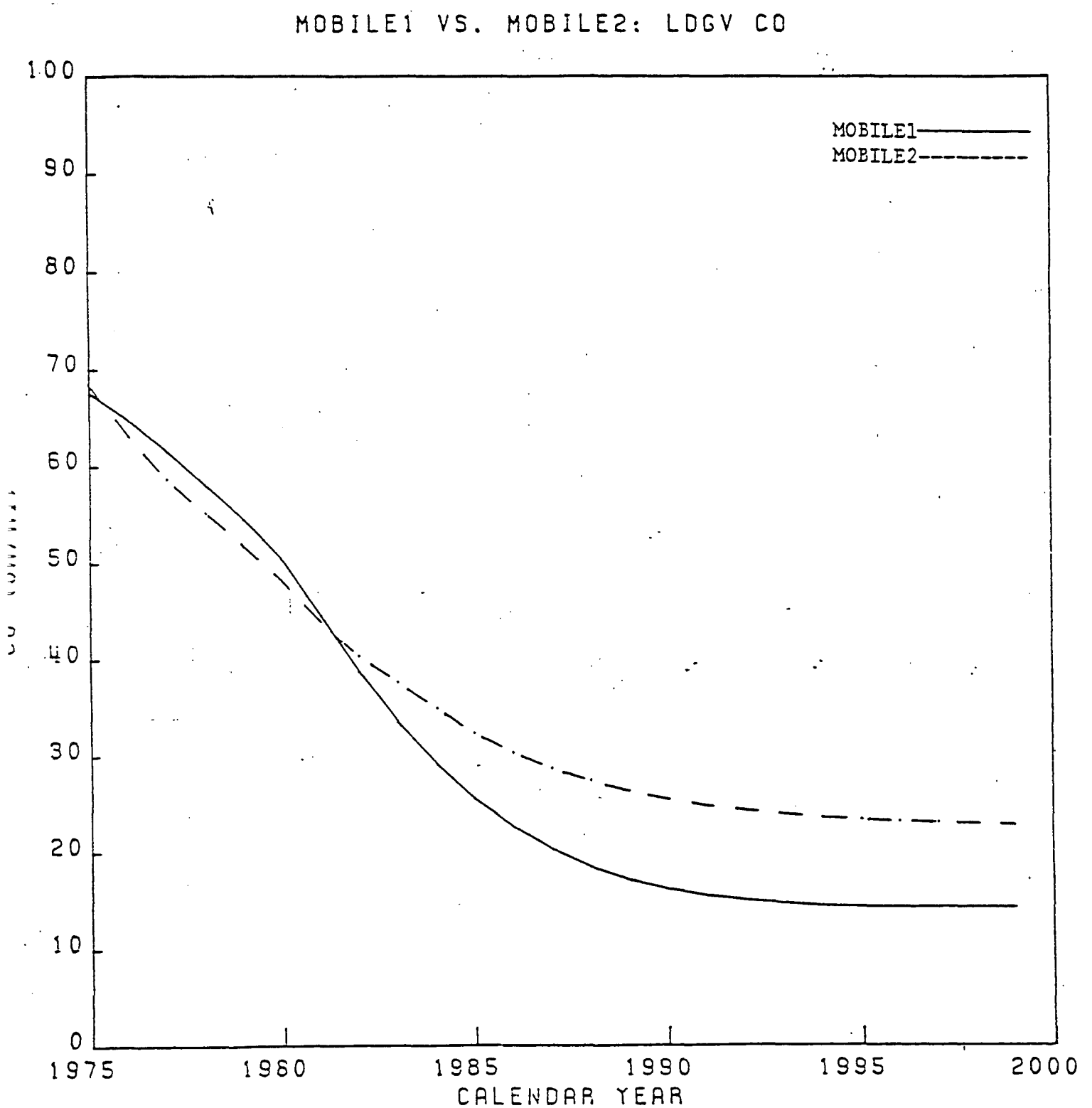
4) A set of composite emission results for calendar years 1982 and 1987 (individual vehicle types and all vehicles combined) versus speed.

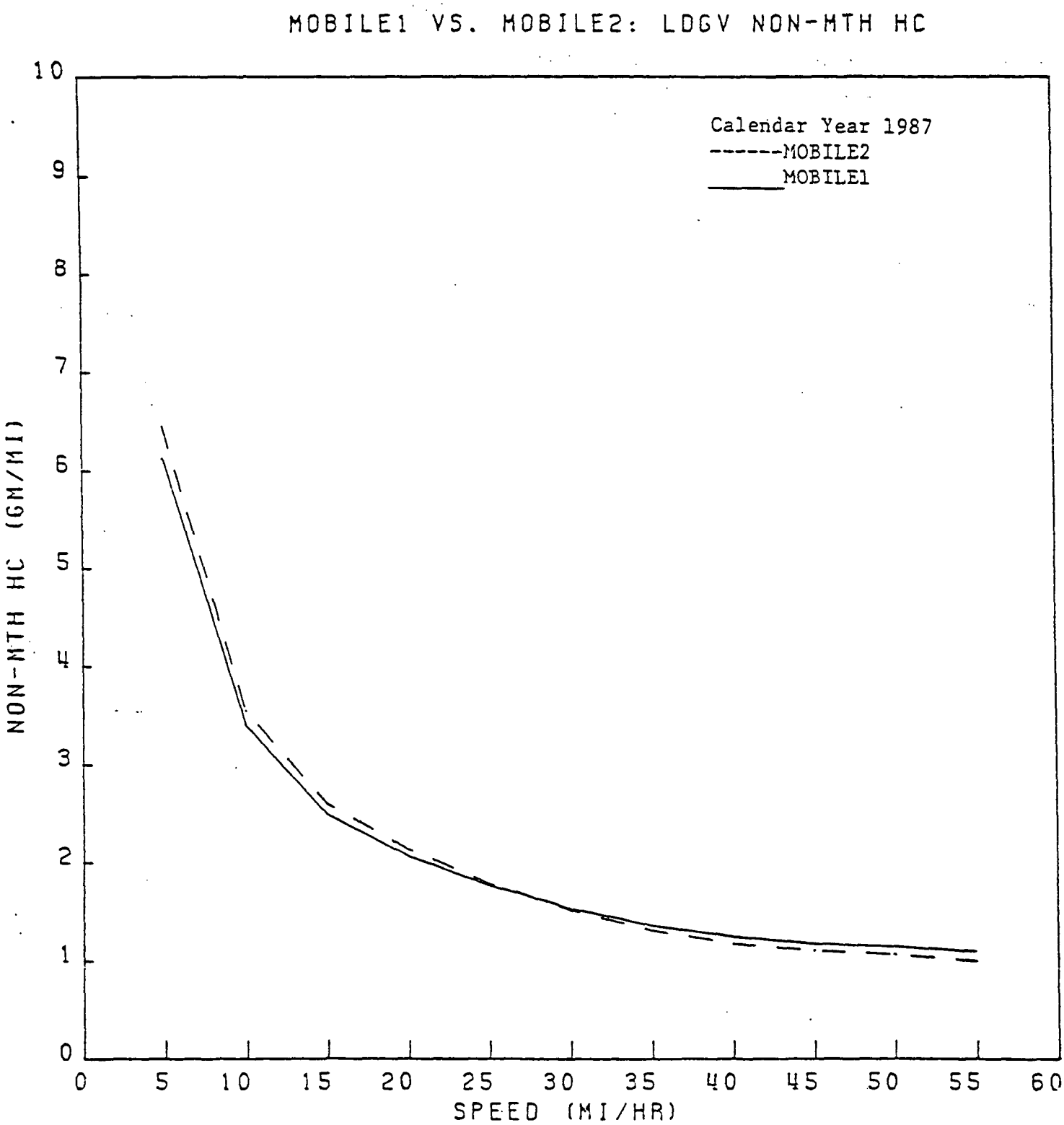
5) Another set of composite emission results versus temperature.

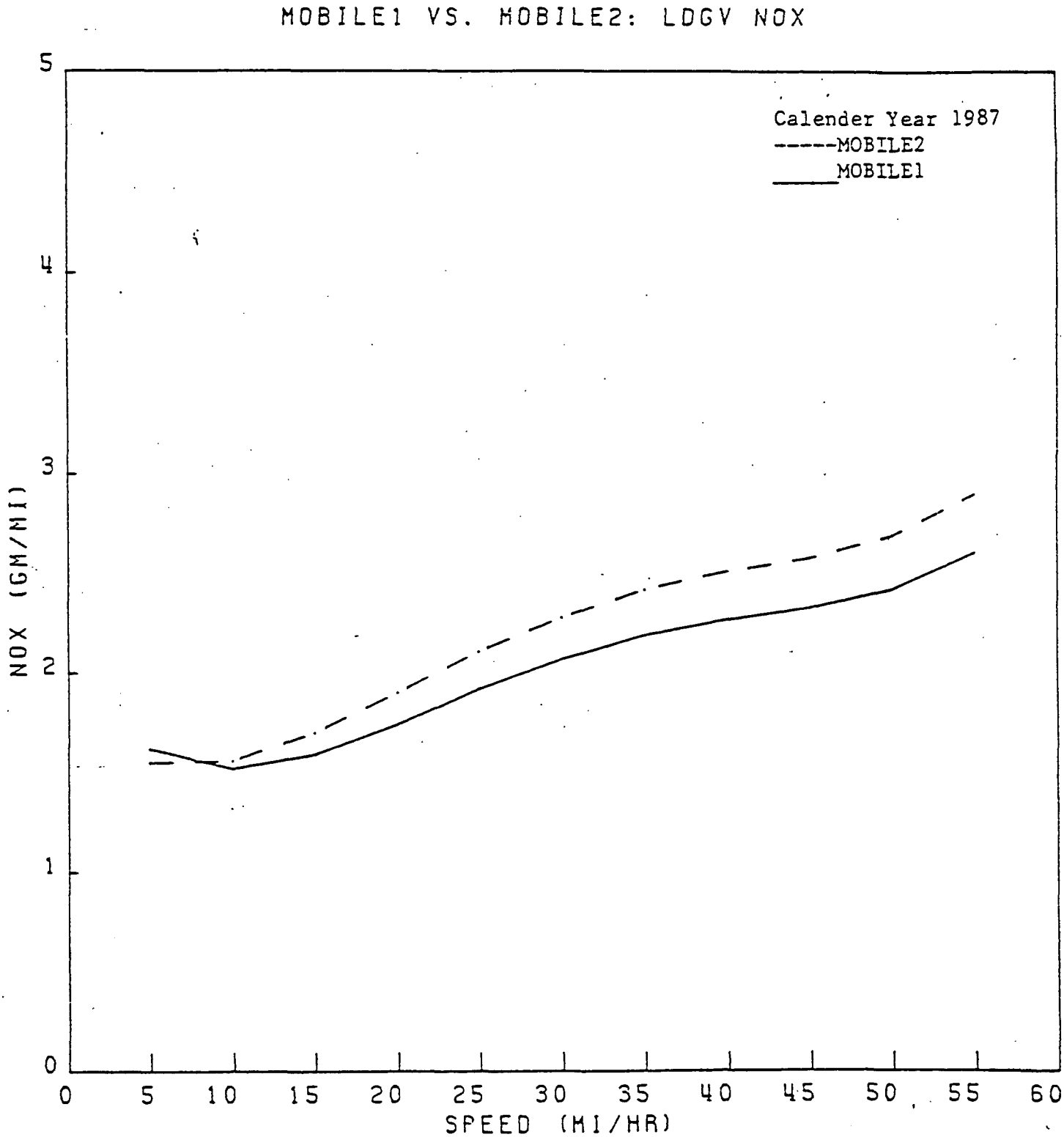
b. Tables

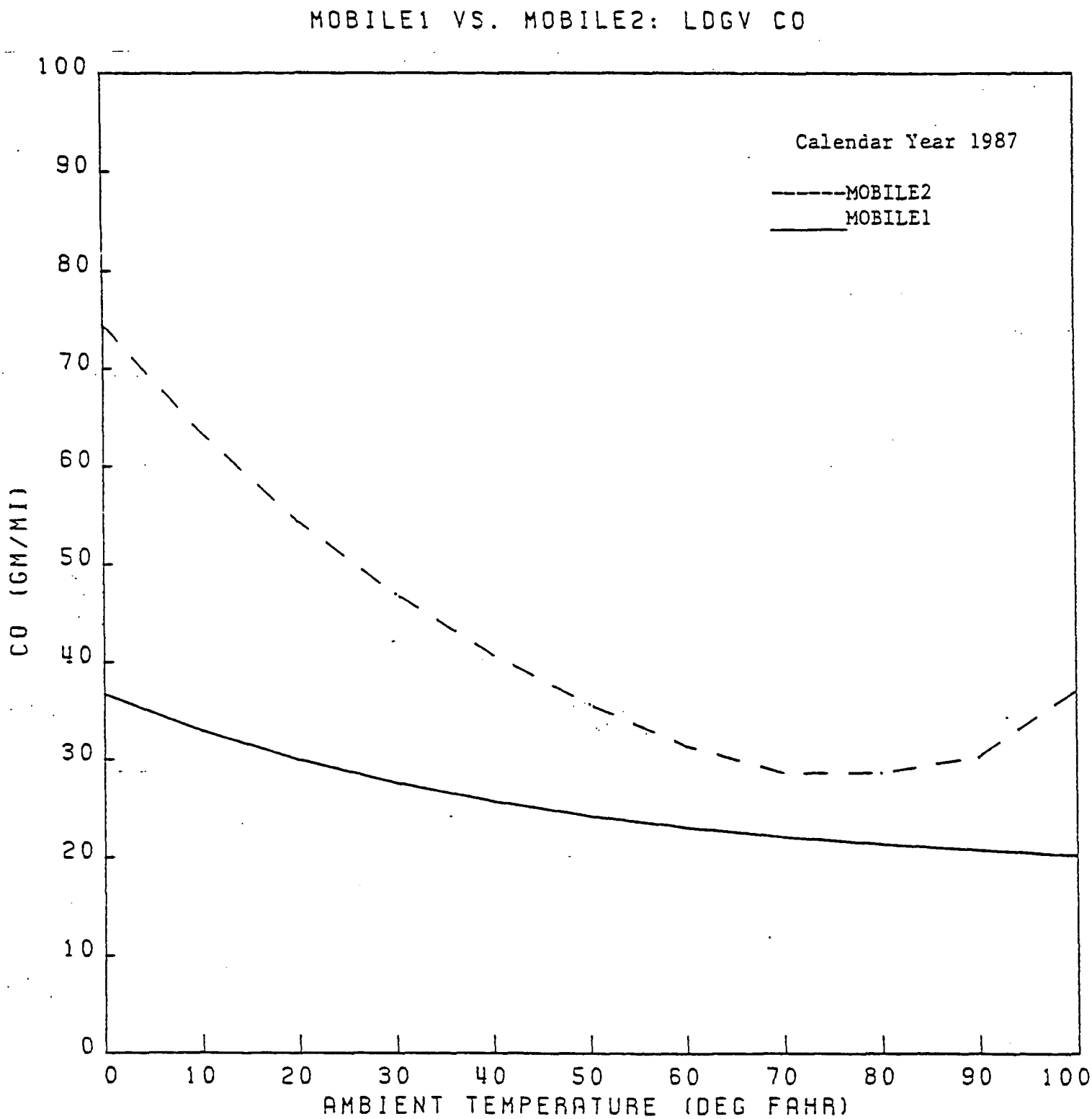
1) Emission results by vehicle type for several calendar years by various combinations of temperature, speed and percent of VMT in cold/hot starts.

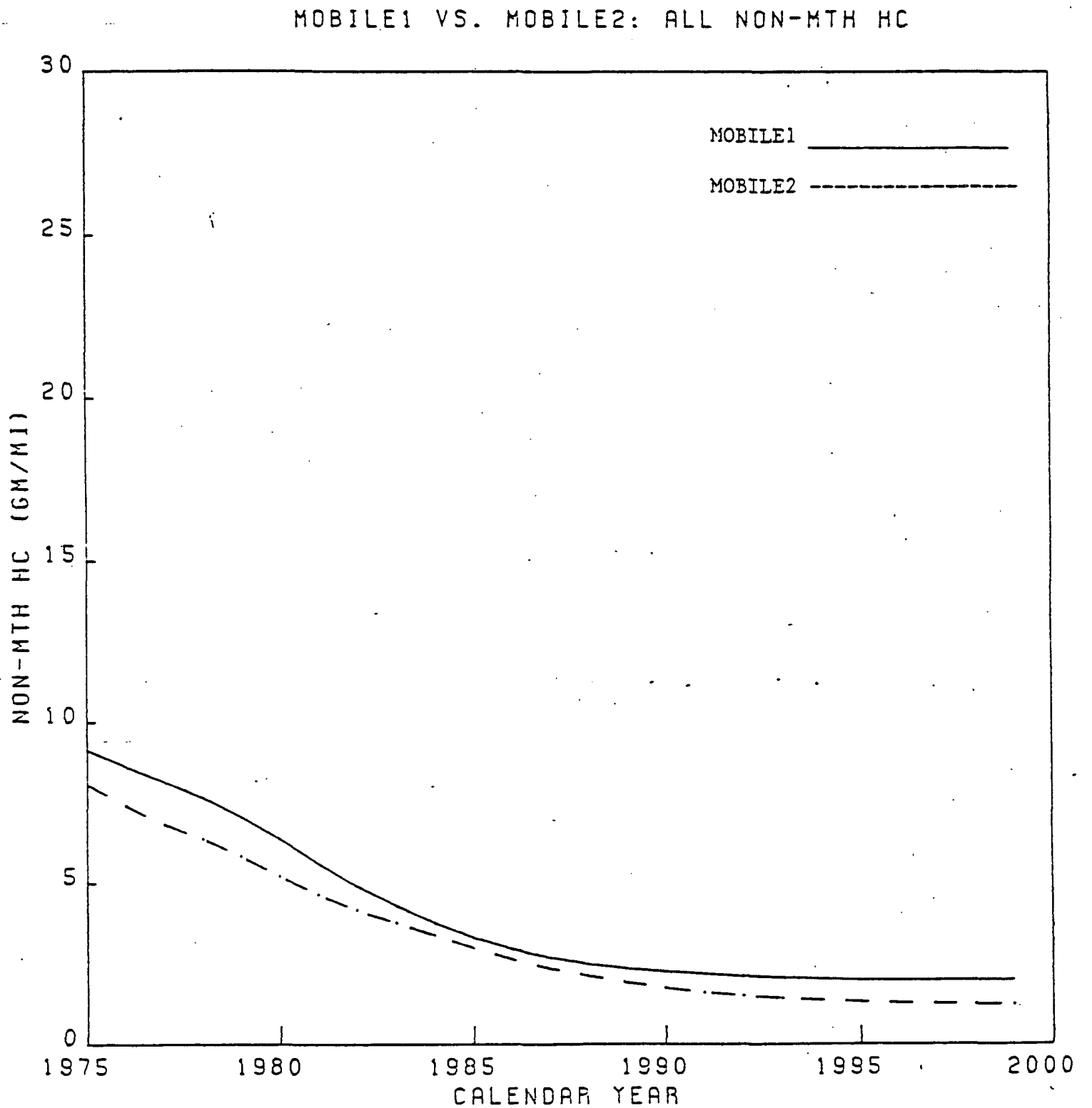
2) Emission results by different vehicle types for several calendar years by various combinations of air conditioning, extra load and trailer towing usage patterns.


MOBILE1 VS. MOBILE2: LDGV CO
MOBILE1
MOBILE2
100
90
80
70
60
50
40
30
20
10
0
1975
1980
1985
1990
1995
2000
CALENDAR YEAR


MOBILE1 VS. MOBILE2: LDGV NON-MTH HC
Calendar Year 1987
------MOBILE2
_____MOBILE1
NON-MTH HC (GM/MI)
SPEED (MI/HR)
0
1
2
3
4
5
6
7
8
9
10
0
5
10
15
20
25
30
35
40
45
50
55
60


MOBILE1 VS. MOBILE2: LDGV NOX
Calender Year 1987
-----MOBILE2
_____MOBILE1
NOX (GM/MI)
SPEED (MI/HR)
0
1
2
3
4
5
0
5
10
15
20
25
30
35
40
45
50
55
60


MOBILE1 VS. MOBILE2: LDGV CO
Calendar Year 1987
MOBILE2
MOBILE1
CO (GM/MI)
AMBIENT TEMPERATURE (DEG FAHR)
0
10
20
30
40
50
60
70
80
90
100


MOBILE1 VS. MOBILE2: ALL NON-MTH HC
MOBILE1
MOBILE2
NON-MTH HC (GM/MI)
30
25
20
15
10
5
0
1975
1980
1985
1990
1995
2000
CALENDAR YEAR

Comparison of MOBILE1 and MOBILE2 (Fleetwide)
(Start I/M 1/1/83, Evaluate 1/1/88)

	Stringency (%)	Base Credit (%)		With Training (%)	
		M1	*M2	M1	*M2
HC	10	21	31	37	32
	20	24	35	44	35
	30	28	37	48	38
	40	30	39	51	40
	50	31	39	55	40
CO	10	18	28	41	30
	20	25	33	49	36
	30	29	36	54	40
	40	33	38	57	42
	50	36	40	58	42

* Uses simple idle test/50% identification rate for 1981+ vehicles.

MOBILE2
No Mechanic Training
Start I/M 1/1/83
Evaluate 1/1/88

1987 I/M Benefits (Fleetwide)

1981 Identification Rate

Pre-1981 Stringency	0 (no test)		50% (simple idle)		70% (2 speed idle) (2 mode loaded)		90% (3 stage idle)	
	HC	CO	HC	CO	HC	CO	HC	CO
0	0	0	12	14	15	19	17	25
10	18	14	31	28	33	34	36	40
20	22	20	35	33	37	39	40	45
30	25	23	37	36	40	42	42	48
40	27	25	39	38	41	44	44	50
50	27	26	39	40	41	46	44	52

1987 I/M Benefits (Sub-Fleet Basis)

	Pre-1981			1981+	
Stringency	HC	CO	Identification Rate	HC	CO
10	32	27	50%	29	29
20	39	37	70%	35	41
30	43	43	90%	41	53
40	46	47			
50	46	50			

Contribution to Non-I/M Inventory

	HC	CO
Pre-1981	58%	53%
1981+	42%	47%

MOBILE2
Incremental Benefits Due to MT
Start I/M 1/1/83
Evaluate 1/1/88

1987 I/M Benefits (Fleetwide)

1981+ Identification Rate

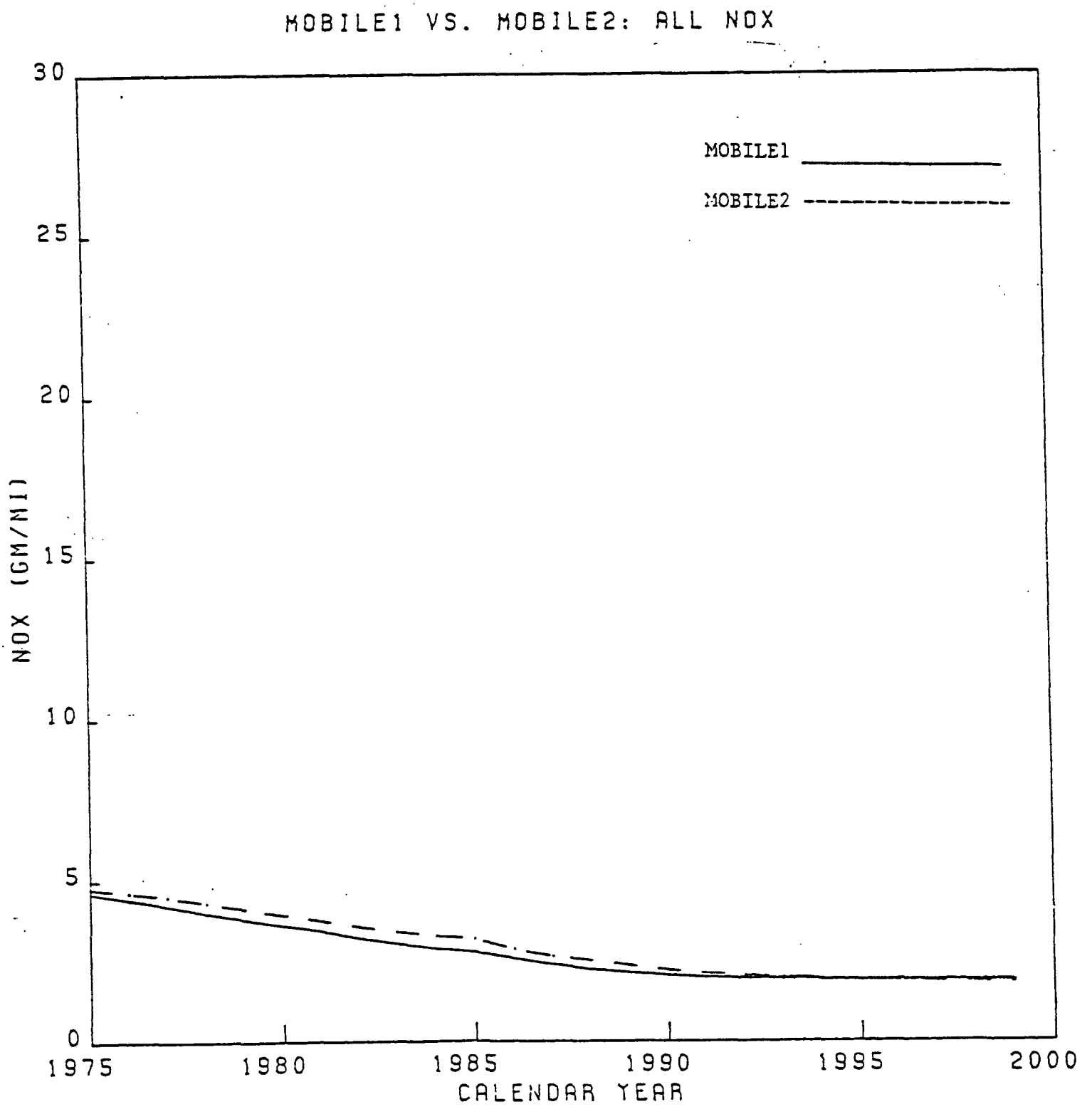
Pre-1981 Stringency	0 (no test)		50% (simple idle)		70% (2 speed idle) (2 mode loaded)		90% (3 stage idle)	
	HC	CO	HC	CO	HC	CO	HC	CO
10	1	3	1	2	1	2	0	2
20	1	2	0	3	1	3	0	2
30	1	3	1	4	1	4	1	3
40	1	3	1	4	2	41	1	3
50	1	2	1	2	2	2	1	2

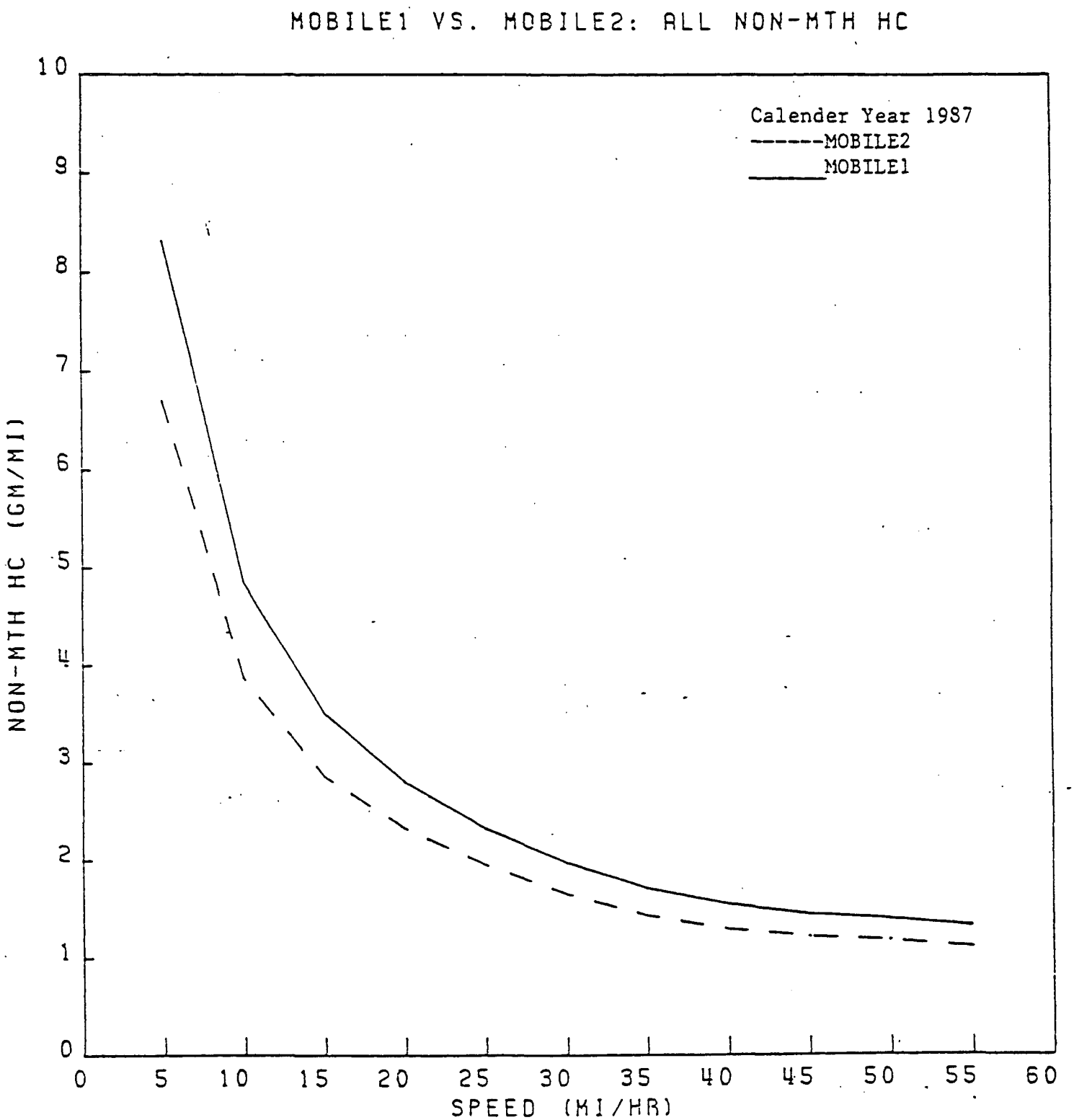
1987 I/M Benefits (Sub-Fleet Basis)

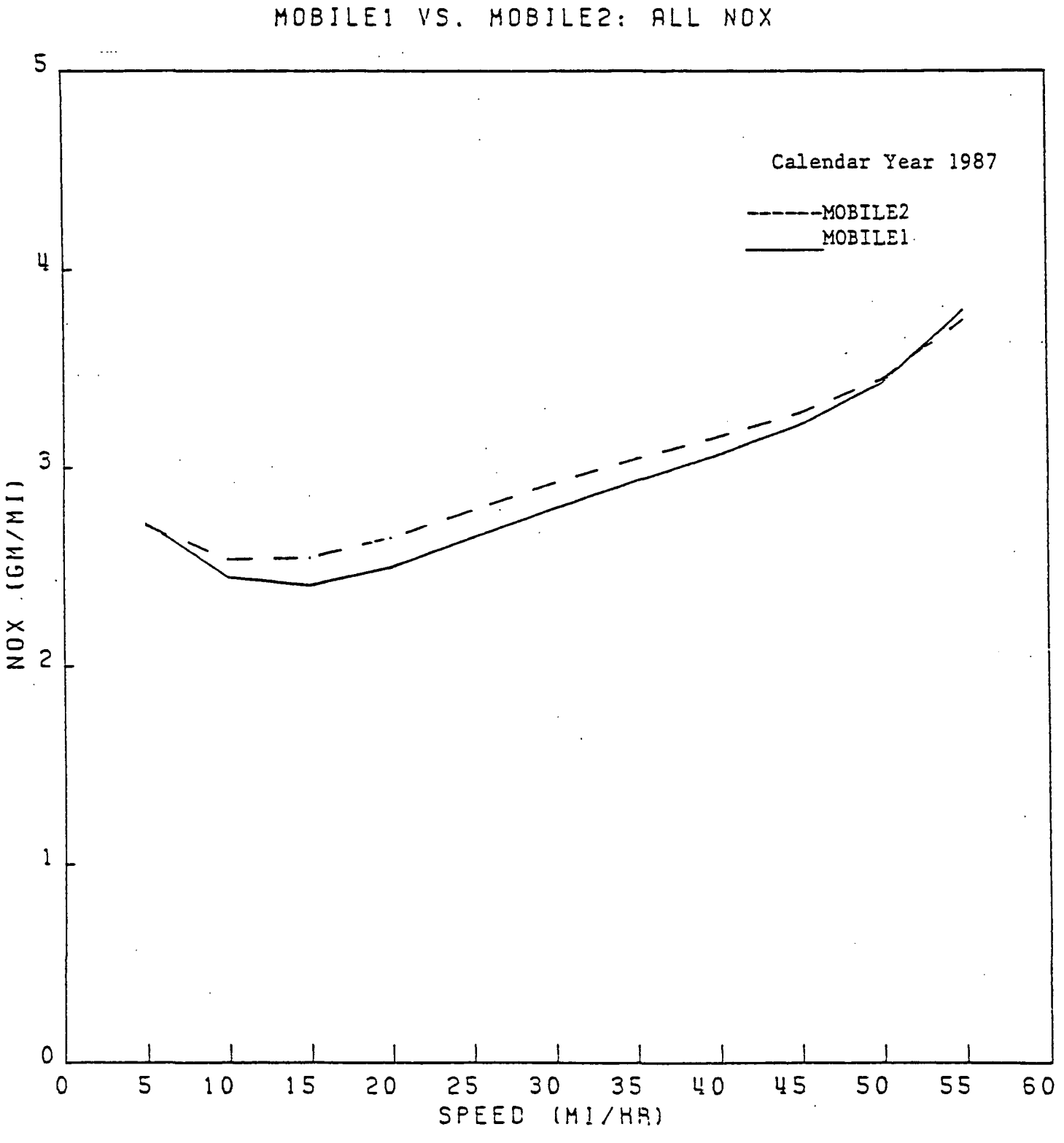
	Pre-1981			1981+	
Stringency	HC	CO	Identification Rate	HC	CO
10	0	4	50%	0	0
20	0	5	70%	0	0
30	2	6	90%		
40	2	6			
50	2	4			

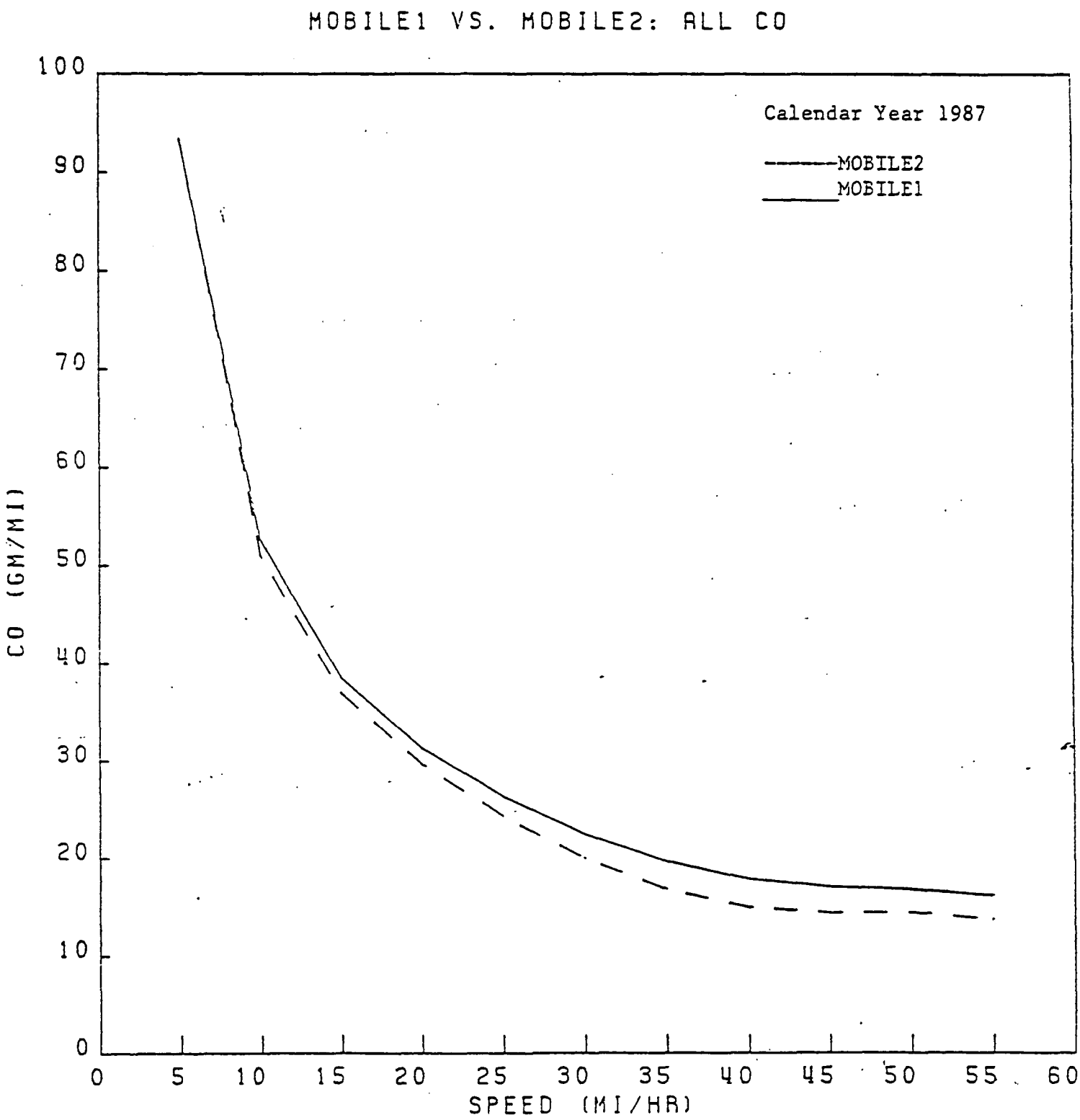
Contribution to Non-I/M Inventory

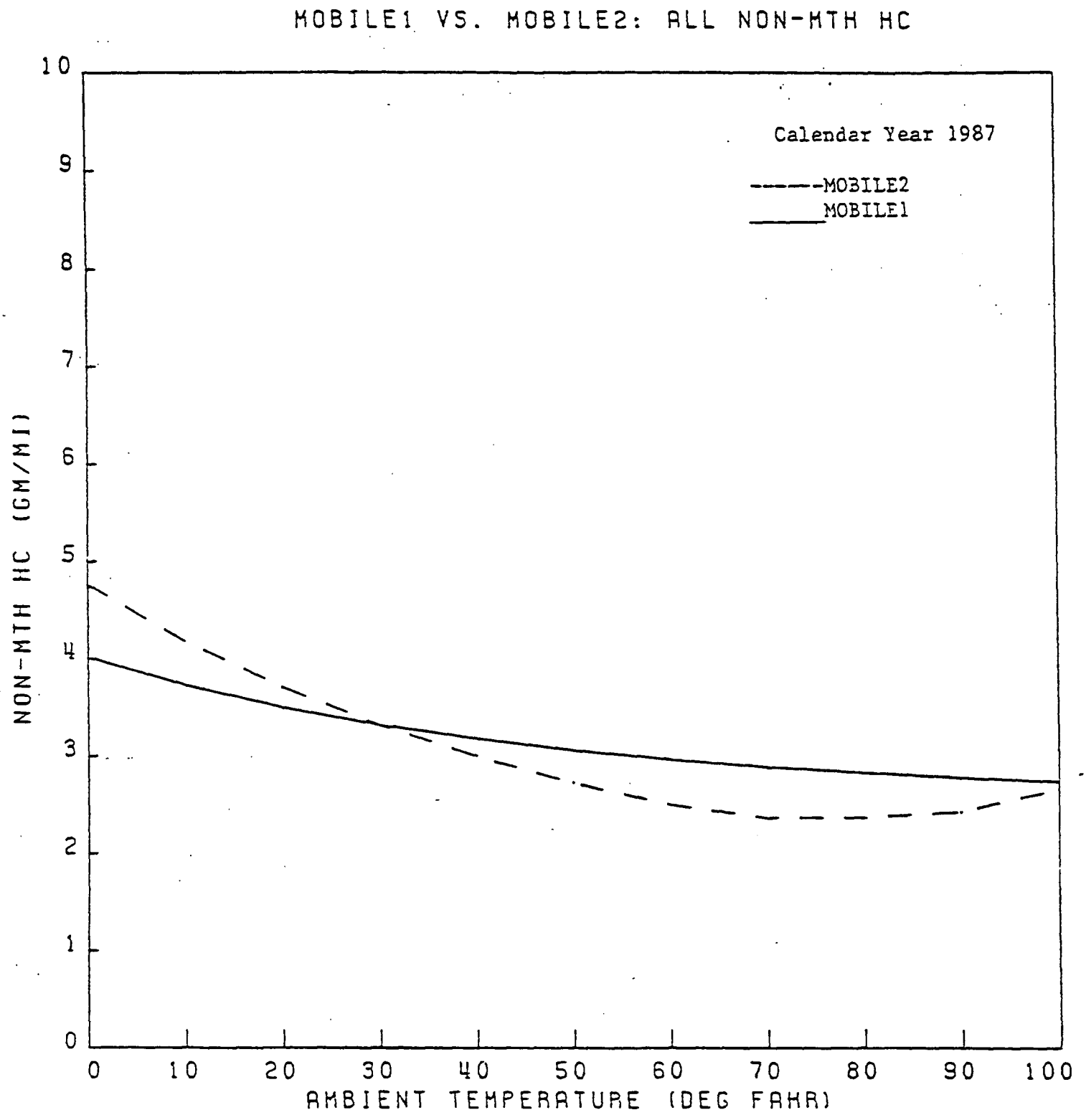
	HC	CO
Pre-1981	58%	53%
1981+	42%	47%

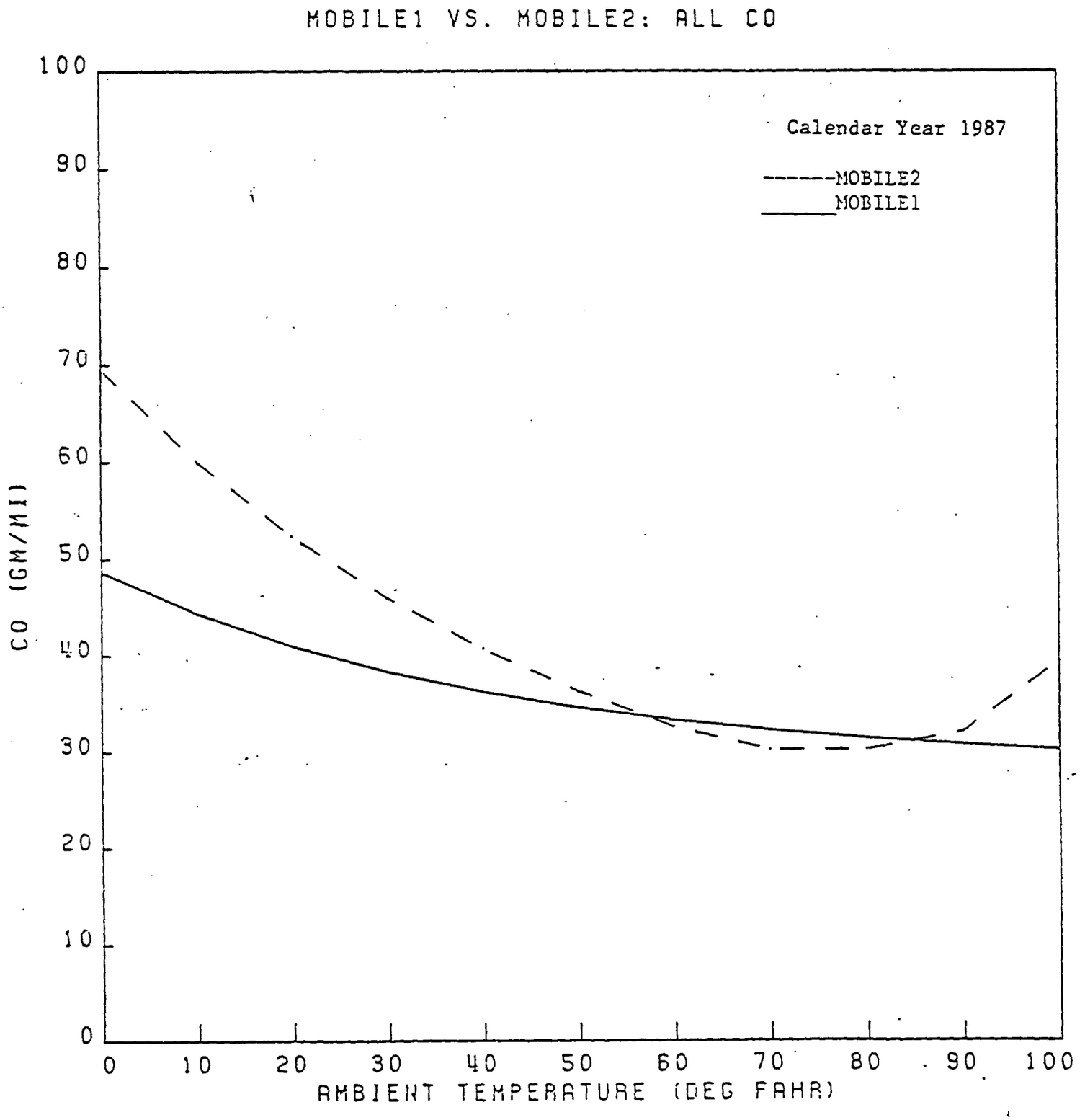

MOBILE1 VS. MOBILE2: ALL NOX
MOBILE1
MOBILE2
NOX (GM/MI)
30
25
20
15
10
5
0
1975
1980
1985
1990
1995
2000
CALENDAR YEAR

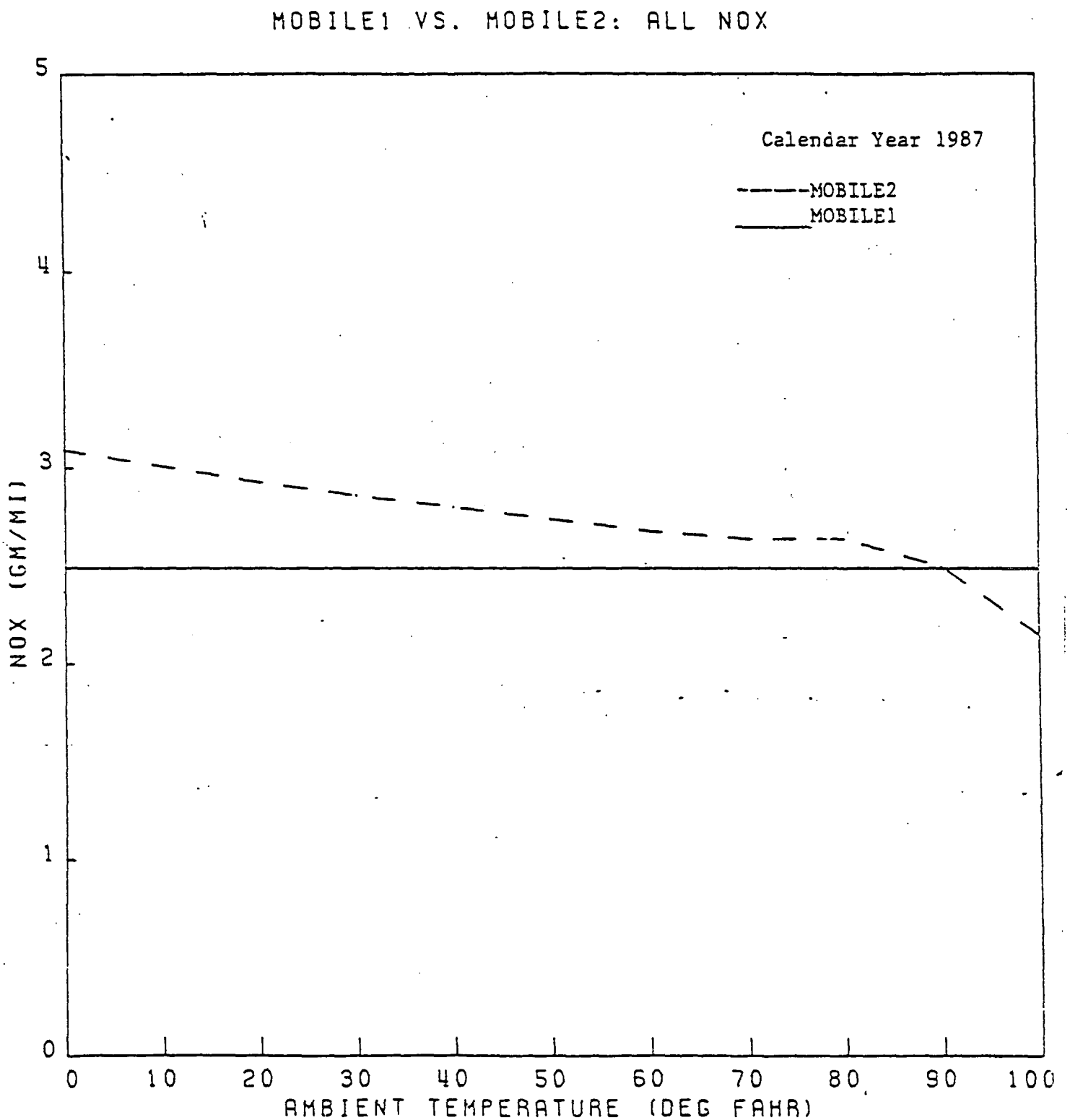

MOBILE1 VS. MOBILE2: ALL NON-MTH HC
Calender Year 1987
------MOBILE2
_____MOBILE1
NON-MTH HC (GM/MI)
SPEED (MI/HR)
0
1
2
3
4
5
6
7
8
9
10
0
5
10
15
20
25
30
35
40
45
50
55
60

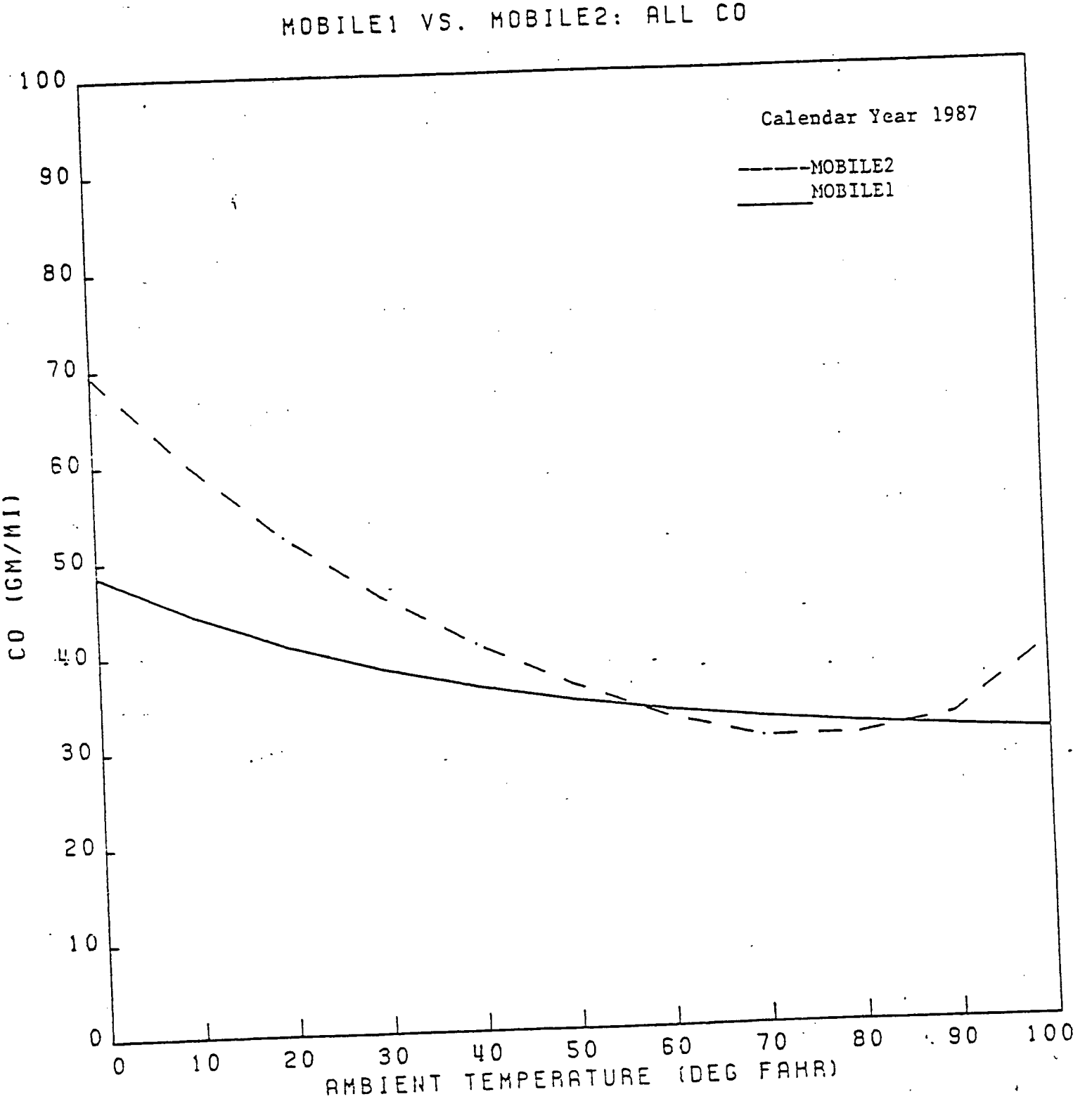

MOBILE1 VS. MOBILE2: ALL NOX
Calendar Year 1987
------MOBILE2
_____MOBILE1
NOX (GM/MI)
SPEED (MI/HR)
0
1
2
3
4
5
0
5
10
15
20
25
30
35
40
45
50
55
60


MOBILE1 VS. MOBILE2: ALL CO
Calendar Year 1987
MOBILE2
MOBILE1
CO (GM/MI)
SPEED (MI/HR)
0
10
20
30
40
50
60
70
80
90
100
0
5
10
15
20
25
30
35
40
45
50
55
60


MOBILE1 VS. MOBILE2: ALL NON-MTH HC
Calendar Year 1987
-----MOBILE2
_____MOBILE1
NON-MTH HC (GM/MI)
0
1
2
3
4
5
6
7
8
9
10
0
10
20
30
40
50
60
70
80
90
100
AMBIENT TEMPERATURE (DEG FAHR)


MOBILE1 VS. MOBILE2: ALL CO
Calendar Year 1987
------MOBILE2
_____MOBILE1
CO (GM/MI)
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
AMBIENT TEMPERATURE (DEG FAHR)


MOBILE1 VS. MOBILE2: ALL NOX
Calendar Year 1987
MOBILE2
MOBILE1
NOX (GM/MI)
5
4
3
2
1
0
0
10
20
30
40
50
60
70
80
90
100
AMBIENT TEMPERATURE (DEG FAHR)


MOBILE1 VS. MOBILE2: ALL CO
Calendar Year 1987
MOBILE2
MOBILE1
CO (GM/MI)
AMBIENT TEMPERATURE (DEG FAHR)
0
10
20
30
40
50
60
70
80
90
100

MOBILE1 VS. MOBILE2: ALL NOX

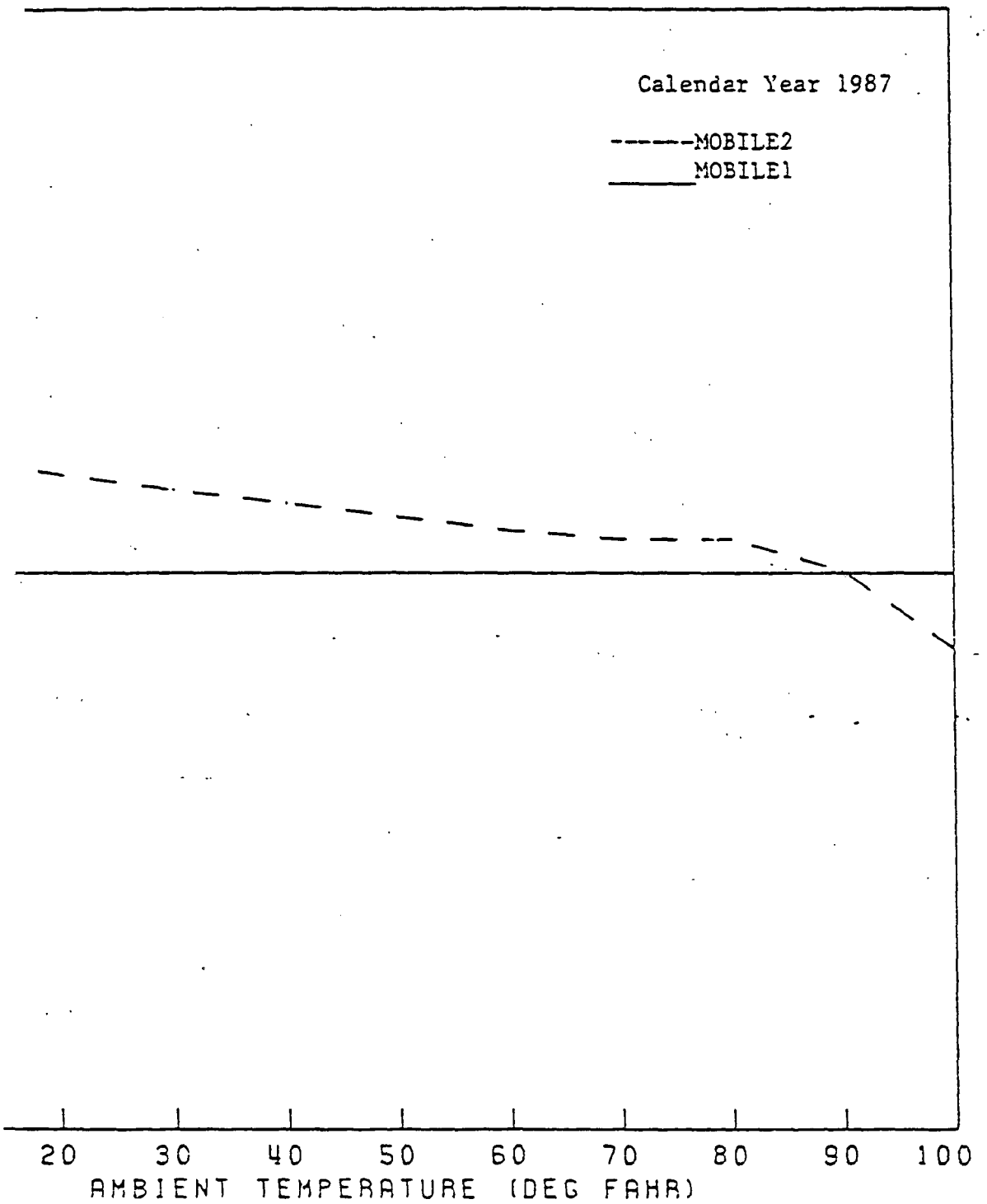


TABLE 1.1.1

REGISTRATION MIX AND ANNUAL
MILEAGE ACCUMULATION FOR
LOW ALTITUDE 49-STATE
GHT DUTY GASOLINE-POWERED VEHICLES

MODEL YEAR INDEX**	REGISTRATION MIX*	ANNUAL MILES TRAVELED*
1	0.072	14400.
2	0.101	13900.
3	0.092	13400.
4	0.071	12800.
5	0.092	12300.
6	0.103	11800.
7	0.089	11200.
8	0.071	10700.
9	0.066	10200.
10	0.059	9600.
11	0.048	9100.
12	0.035	8600.
13	0.030	8000.
14	0.023	7500.
15	0.015	7000.
16	0.010	6400.
17	0.005	5900.
18	0.003	5400.
19	0.002	4900.
20+	0.015	4300.

*DEFAULT INFORMATION THAT MAY BE ALTERED BY THE MOBILE2
USER WITH INFORMATION ABOUT THE LOCAL AREA.

**THE INDICES REFER TO THE MOST RECENT MODEL YEAR
VEHICLES IN ANY GIVEN CALENDAR YEAR. INDEX 1 REFERENCES
THE NEWEST MODEL YEAR VEHICLES AND INDEX 20+ REFERENCES
THE OLDEST MODEL YEAR VEHICLES.

DATE: NOVEMBER 26, 1980

DATE: NOVEMBER 26, 1980
TABLE 1.1.8

FLEET SALES FRACTION* FOR
LOW ALTITUDE 49-STATE
LIGHT DUTY GASOLINE-POWERED VEHICLES

MODEL YEARS	FRACTION
PRE-1975	1.000
1975	0.998
1976	0.997
1977	0.995
1978	0.991
1979	0.972
1980	0.966
1981	0.953
1982	0.925
1983	0.911
1984	0.905
1985	0.886
1986	0.862
1987	0.835
1988	0.824
1989	0.813
1990	0.803
1991+	0.800

* THE ESTIMATED FRACTION OF THE LIGHT-DUTY VEHICLE FLEET WHICH IS GASOLINE-POWERED.

DATE: NOVEMBER 26, 1980

TABLE 1.1.9

CUMULATIVE MILEAGE FOR
LOW ALTITUDE 49-STATE
LIGHT DUTY GASOLINE-POWERED VEHICLES

MODEL YEAR INDEX*	JANUARY 1 FLEET CUMULATIVE MILEAGE
1	1800.
2	10784.
3	24809.
4	38331.
5	51284.
6	63709.
7	75631.
8	86984.
9	97809.
10	108131.
11	117884.
12	127109.
13	135831.
14	143984.
15	151609.
16	158731.
17	165284.
18	171309.
19	176833.
20+	181855.

*THE INDICES REFER TO THE MOST RECENT MODEL YEAR VEHICLES IN ANY GIVEN CALENDAR YEAR. INDEX 1 REFERENCES THE NEWEST MODEL YEAR VEHICLES AND INDEX 20+ REFERENCES THE OLDEST MODEL YEAR VEHICLES.

DATE: NOVEMBER 26, 1980

TABLE 1.1.10

EXAMPLE TRAVEL WEIGHTING FACTOR CALCULATION FOR
LOW ALTITUDE 49-STATE
LIGHT DUTY GASOLINE-POWERED VEHICLES
JANUARY 1, 1985

MODEL YEAR INDEX*	(A) FLEET REGISTRATION	(B) SALES FRACTION	(A*B)	(C=A*B/SUM1) VEHICLE TYPE REGISTRATION	(D) ANNUAL MILEAGE ACCUMULATION	(C*D)	(C*D/SUM2) TRAVEL FRACTIONS
1	0.024	0.886	0.021	0.023	14400.	335.3	0.029
2	0.101	0.905	0.091	0.100	14275.	1425.3	0.124
3	0.092	0.911	0.084	0.092	13775.	1263.7	0.110
4	0.071	0.925	0.065	0.072	13250.	948.8	0.082
5	0.092	0.953	0.087	0.095	12675.	1209.8	0.105
6	0.103	0.966	0.099	0.108	12175.	1319.4	0.115
7	0.089	0.972	0.086	0.094	11650.	1099.5	0.096
8	0.071	0.991	0.071	0.077	11075.	854.4	0.074
9	0.066	0.995	0.066	0.072	10575.	758.2	0.066
10	0.059	0.997	0.059	0.064	10050.	647.5	0.056
11	0.048	0.998	0.048	0.052	9475.	494.2	0.043
12	0.035	1.000	0.035	0.038	8975.	342.5	0.030
13	0.030	1.000	0.030	0.033	8450.	277.2	0.024
14	0.023	1.000	0.023	0.025	7875.	198.0	0.017
15	0.015	1.000	0.015	0.016	7375.	121.0	0.011
16	0.010	1.000	0.010	0.011	6850.	74.1	0.006
17	0.005	1.000	0.005	0.006	6275.	37.7	0.003
18	0.003	1.000	0.003	0.003	5775.	15.8	0.001
19	0.002	1.000	0.002	0.002	5275.	9.8	0.001
20+	0.015	1.000	0.015	0.016	4750.	75.8	0.007
		SUM1:	0.915		SUM2:	11507.9	

*THE INDICES REFER TO THE MOST RECENT MODEL YEAR VEHICLES IN ANY GIVEN CALENDAR YEAR. INDEX 1 REFERENCES THE NEWEST MODEL YEAR VEHICLES AND INDEX 20+ REFERENCES THE OLDEST MODEL YEAR VEHICLES.

WHERE:

A = REGISTRATION MIX FROM TABLE 1.1.7, NEWEST MODEL YEAR ADJUSTED TO JAN 1.

B = FLEET SALES FRACTION FROM TABLE 1.1.8

D = SALES WEIGHTED ANNUAL MILEAGE ACCUMULATION RATE FROM TABLE 1.1.7, ADJUSTED TO JANUARY 1.

$D(1)$ = ANNUAL MILES(1)

$D(MY1) = .25*(\text{ANNUAL MILES}(MY1)) + .75*(\text{ANNUAL MILES}(MY1-1))$, $MY1=2,\ldots,20+$

DATE: NOVEMBER 26, 1980

A COMPARISON OF MOBILE1 to MOBILE2

II 1981 and Later Models - Without I/M

° Both analyses used a similar methodology in that they divided the fleet into different categories of vehicles. The categories are delineated on the basis of vehicle operating condition. The emissions performance of each category of vehicles is described by an equation which describes the emissions produced by the vehicles in a category over time. The categories are then weighted together to give fleet emission factors.

° The analyses differ significantly, however, in that they delinate very different categories of vehicles.

° MOBILE1, although a good estimate at the time it was produced (1978), was based on some assumptions that have since proven wrong. It was also based on very limited data (9 Volvos).

° MOBILE2 incorporates new assumptions, based on the best information currently on hand, and is based on a sizeable data base obtained from representative "New Technology" vehicles actually on the road.

- (92) 1980 California X-Body's
- (97) 1979 Ford 351 CID engine family
- (29) Miscellaneous Foreign and Domestic Fuel-Injected vehicles (1979)

° The major phenomenon observed in the data, and subsequently modeled in MOBILE2, was the presence of a small group of vehicles which had suffered a loss of computer control of the engine and were thereafter producing average emissions 1200% of the CO standard and over 900% of the HC standard. These vehicles were low mileage vehicles, and even though they made up only 5% of the fleet's population, they contributed 50% of the fleet's overall CO emissions and over 35% of the fleet's HC emissions.

° MOBILE2 delineated a category made up of these kinds of vehicles and named it the "Primary" category. The size of the Primary category, (i.e. the incidence of vehicles with a loss of computer control) is expected to increase as the fleet ages. This assumption of an increasing incidence is based partly on limited data of higher mileage New Technology vehicles (the Volvos) as well as on the engineering argument that the system will continue to fail and not be repaired as components age and as vehicle owners have less desire to correctly maintain their vehicle. Tampering and improper maintenance will also contribute to the incidence of this phenomenon.

° Graph's 1-3 illustrate the concepts discussed above. Note that the misfueling phenomenon is also modeled by delineating a Misfueling category (a static 8% of the fleet). The remainder of the vehicles in the fleet are represented by the Secondary category: generally well-maintained vehicles and vehicles with a problem which does not lead to the Primary category (i.e., does not lead to a full loss of computer control).

° A similar approach was used for NOx. The significant phenomena accounted for were EGR failure, misfueling, and the NOx effects of what happens when a vehicle enters the HC/CO Primary category.

III Pre 1981 Models With I/M

° A simulation program was used at EPA to develop I/M benefits in MOBILE2 as was done for MOBILE1.

° The simulation tracks a fleet of cars by model year through 19 years of experience with specified I/M programs. Percent benefits to be applied to emissions factors are produced in a form usable by MOBILE2.

° MOBILE2 contains the fixed benefits which are indexed by stringency, age of vehicles, age at first inspection, pollutant, technology, and presence or absence of mechanic training.

° Both simulations started with samples of cars from Emission Factors.

° More cars were available for MOBILE2 simulation

	MOBILE1	MOBILE2
Tech I	180 model years 1973-74	2678 model years 1968-74
Tech II	587 model year 1975	2456 model years 1975-79

° MOBILE1 assumed all cars entered I/M program at one year of age. MOBILE2 considers age of vehicle when I/M starts.

° MOBILE1 and MOBILE2 both determine cutpoints at initial inspection to obtain desired failure rate and keep same cutpoints year to year allowing failure rate to vary.

° MOBILE1 treats HC and CO completely independently. In MOBILE2, both FTP HC and CO are affected by any repair and relationships between FTP and idle include both HC and CO for predictive purposes.

° MOBILE1 (without MT) assumes after maintenance idle score is equal to cutpoint if specific pollutant was failed. MOBILE2 predicts after maintenance mean idle score from mean mileage and both HC and CO cutpoints. Prediction is based on analysis of data from Portland and New Jersey I/M programs.

° MOBILE1 predicts after maintenance FTP from cutpoint by specific pollutant. Prediction based on data from cars which were not actually in I/M program. MOBILE2 predicts after maintenance mean FTP from mean mileage, mean idle scores (both HC and CO) and idle test failure mode. Prediction based on analysis of Portland Study data from cars after actual I/M field repairs.

° MOBILE1 fleet FTP deterioration following maintenance is parallel to nonI/M case. In MOBILE2, fleet FTP deteriorates so as to reach non-I/M case at fixed mileage increment. The mileage increment was determined through analysis of Portland Study data from cars after actual I/M repairs. In general, MOBILE2 reflects a greater rate of deterioration following maintenance.

Mileage Increment to Reach Non-I/M Case
(MOBILE2)

	HC	CO
Tech I (pre 1975)	7,400	40,000
Tech II (1975-79)	27,000	57,200

° MOBILE1 assumes idle HC deteriorates as an exact function of FTP HC. Idle CO function of FTP CO. Relationships based on data from non-I/M cars. In MOBILE2, each idle emission is a function of FTP HC, FTP CO, mileage and CID plus random variation. These relationships based on analysis of Portland Study data.

° In MOBILE1, mechanic training yields after maintenance FTP levels equal to new car standards (unless already below standards). In MOBILE2, these FTP levels are a function of mileage based on Portland Mechanic Training Study. Levels are equal to or slightly below levels already being achieved in Portland without training (due to Portland's tight idle cutpoints) and generally above new car standards. Difference between trained and untrained levels after repairs will be larger in programs with looser cutpoints.

IV 1981 and Later Models - With I/M

° MOBILE1's I/M benefits for the 1981-and-later fleet were based on data from a group of 1975-76 California vehicles. These vehicles represented the most advanced technology vehicles for which data were available at the time MOBILE1 was developed. They were not, however, Three-Way catalyst vehicles (i.e. they were not really representative).

° MOBILE2's I/M benefits for CO are based on the ability of the various I/M short tests to identify Primary category vehicles. HC benefits are based on the identification of Primary category vehicles and the identification of vehicles with severe ignition and misfire problems.

° These benefits are calculated using the same model used to determine emission factors without I/M. That is, a percentage of the vehicles in the Primary category are assumed to be identified in an I/M program, repaired, and thereafter to adopt the emissions performance of either the Secondary or Misfueling categories.

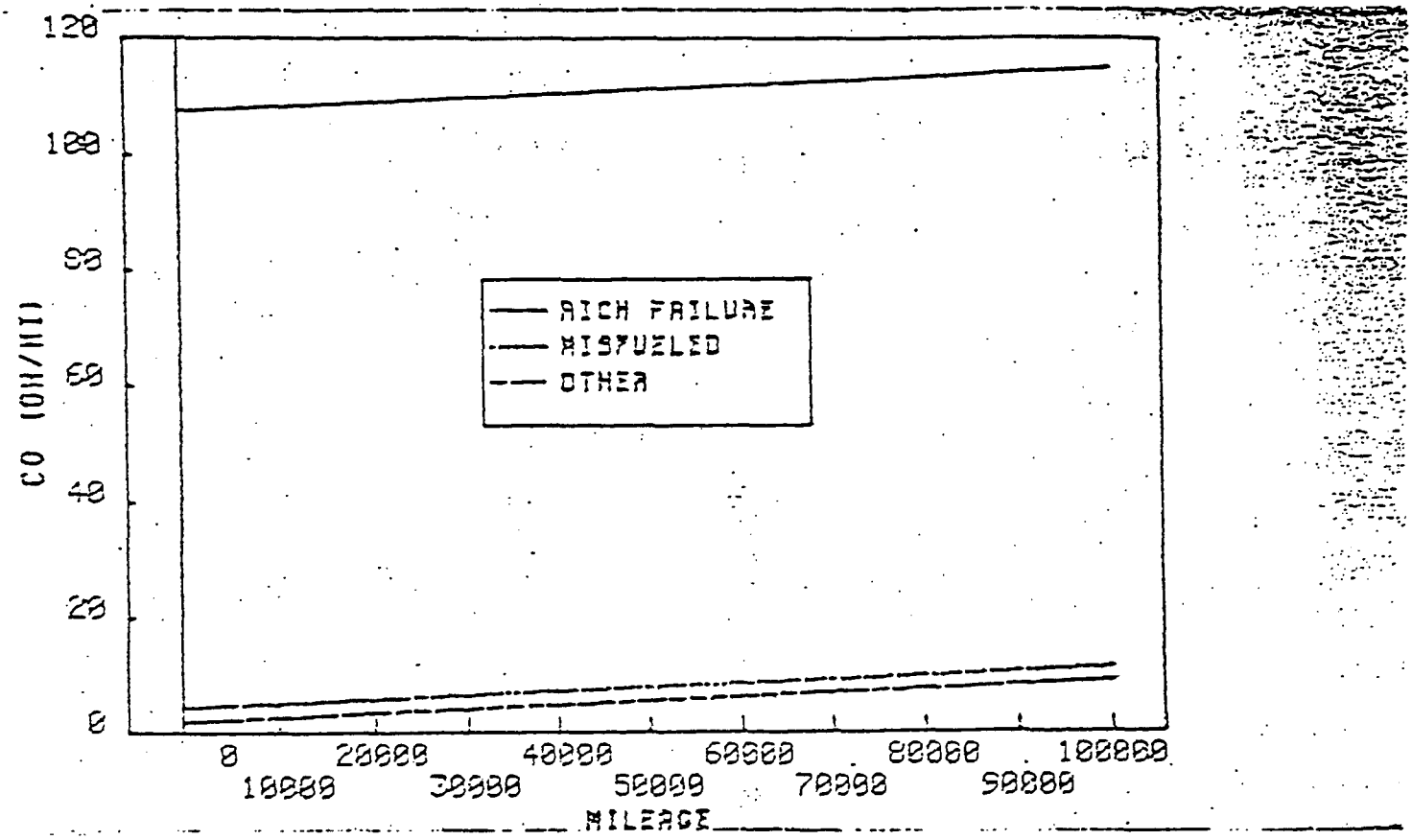
- The benefits associated with the identification of vehicles with ignition/misfire problems are modeled by lowering the slope of the emission factor equations which describe the HC emissions performance of the various categories of the fleet.

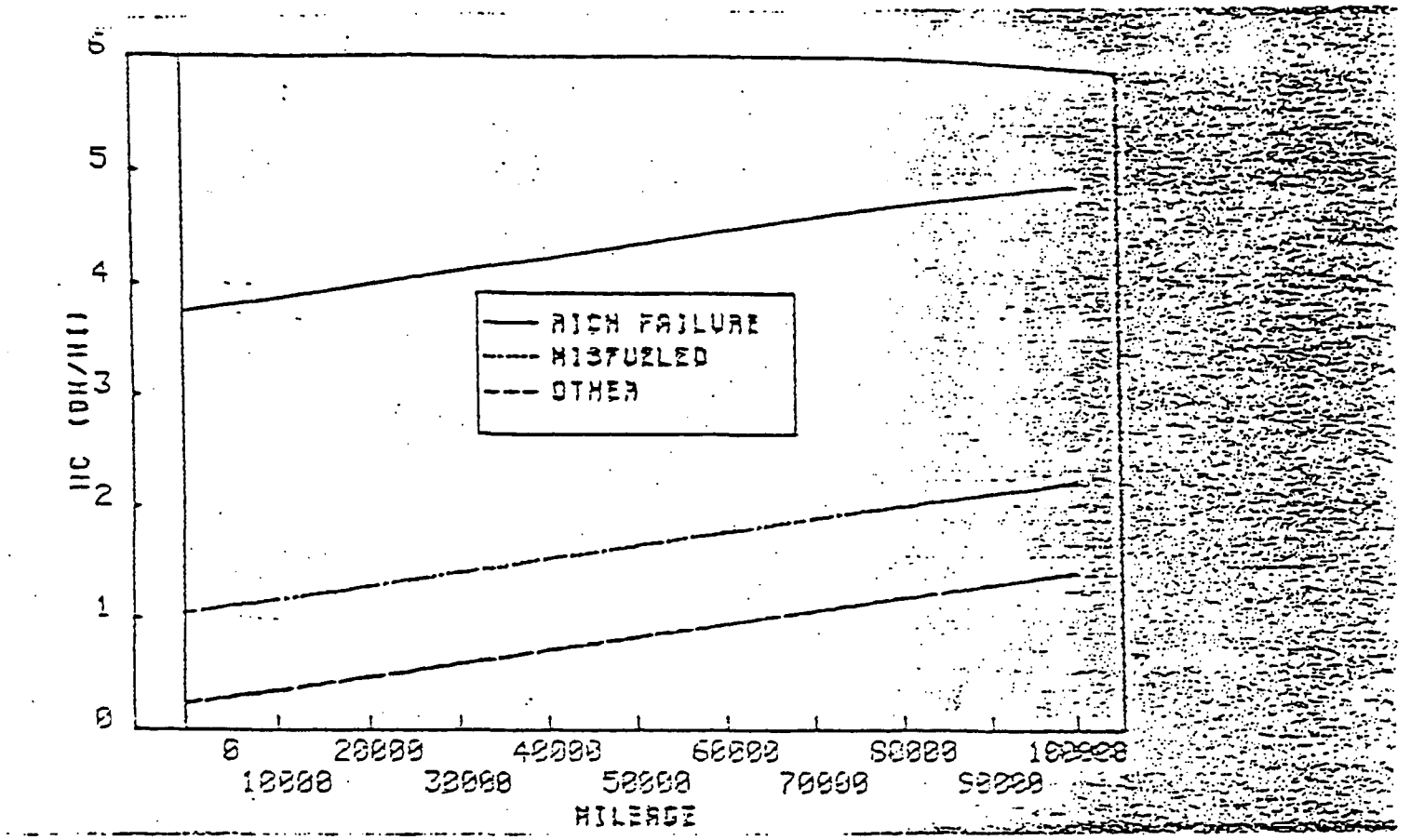
- The percentage of Primary category vehicles identified by an I/M program is mainly a function of which I/M test is used and secondarily a function of what cutpoint is used. That is, some tests are assumed to be more capable of identifying Primary category vehicles and are therefore assigned more benefit if they are used (e.g. 2500 rpm/Idle vs. Idle).

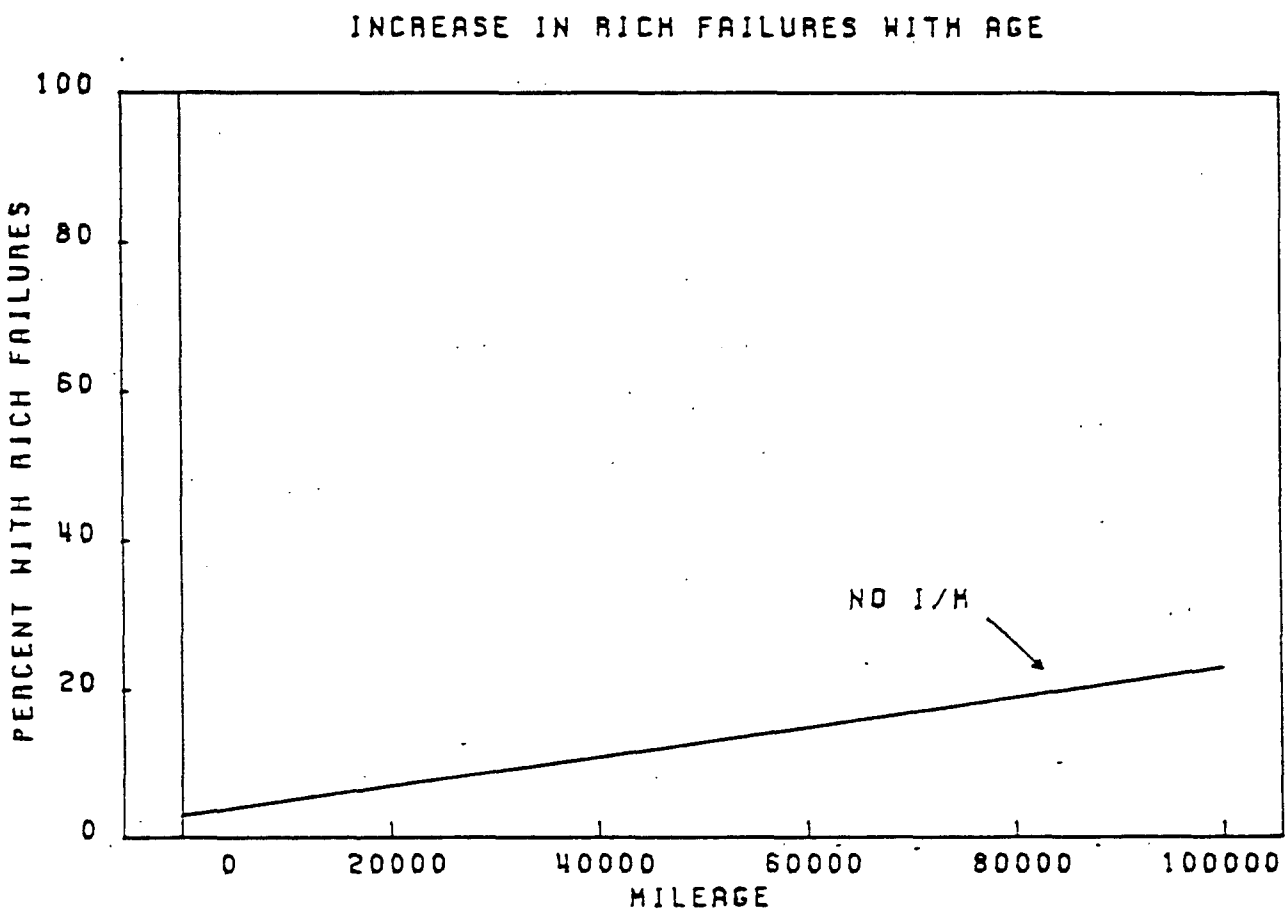
- The percentage of Primary category vehicles identified by a given I/M short test is known as the Identification Rate. The Identification Rates developed for the various short tests are based on data from the Primary category vehicles found among the representative in-use fleet described earlier.

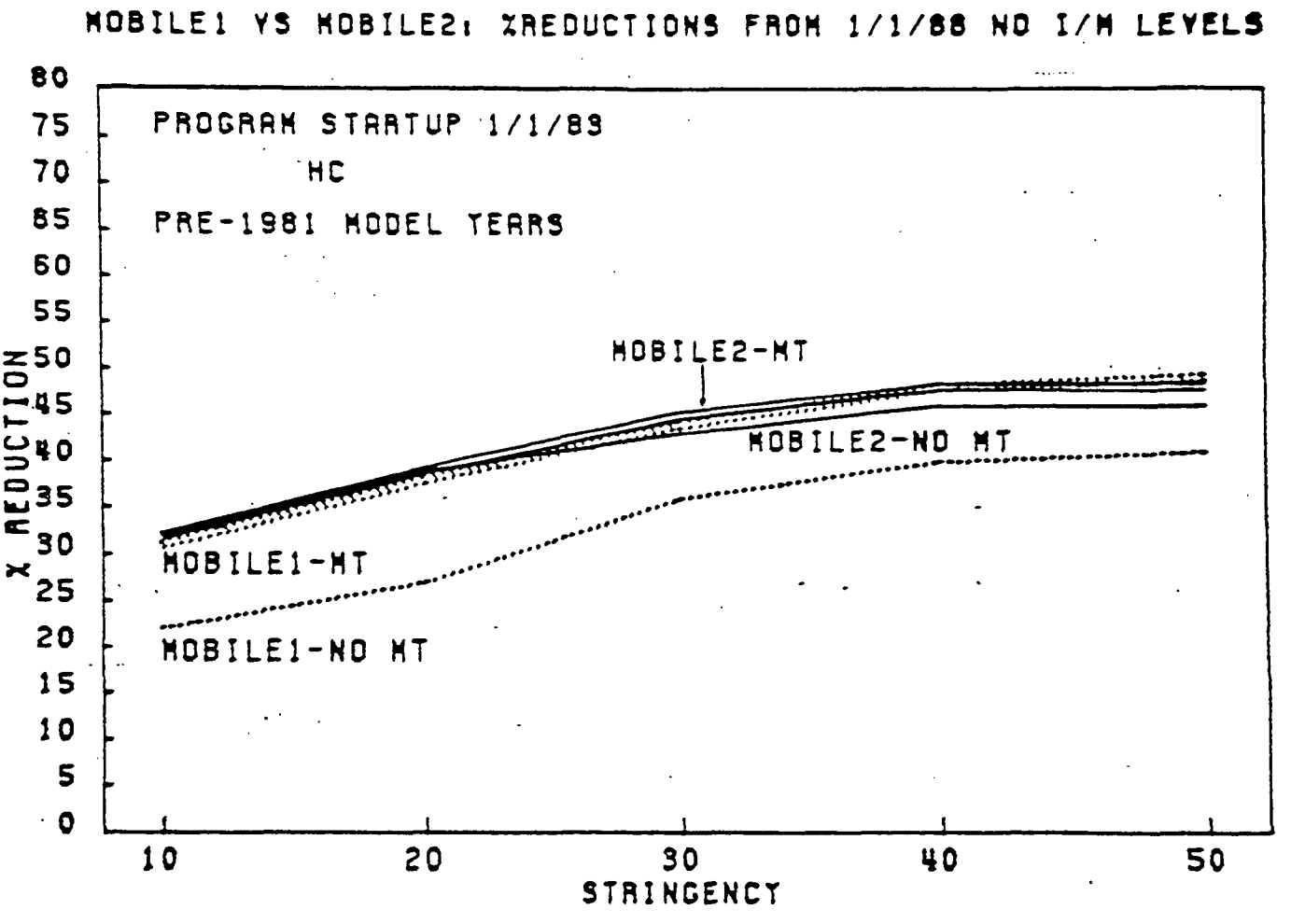
- The Identification Rate therefore replaces Stringency Factor as the key variable for 1981-and-later vehicles.

- Actual I/M failure rates of 1981-and-later vehicles are expected to be no higher than 10 percent in the first year of an I/M program started on January 1, 1983. The failure rate should be lower in all subsequent years.

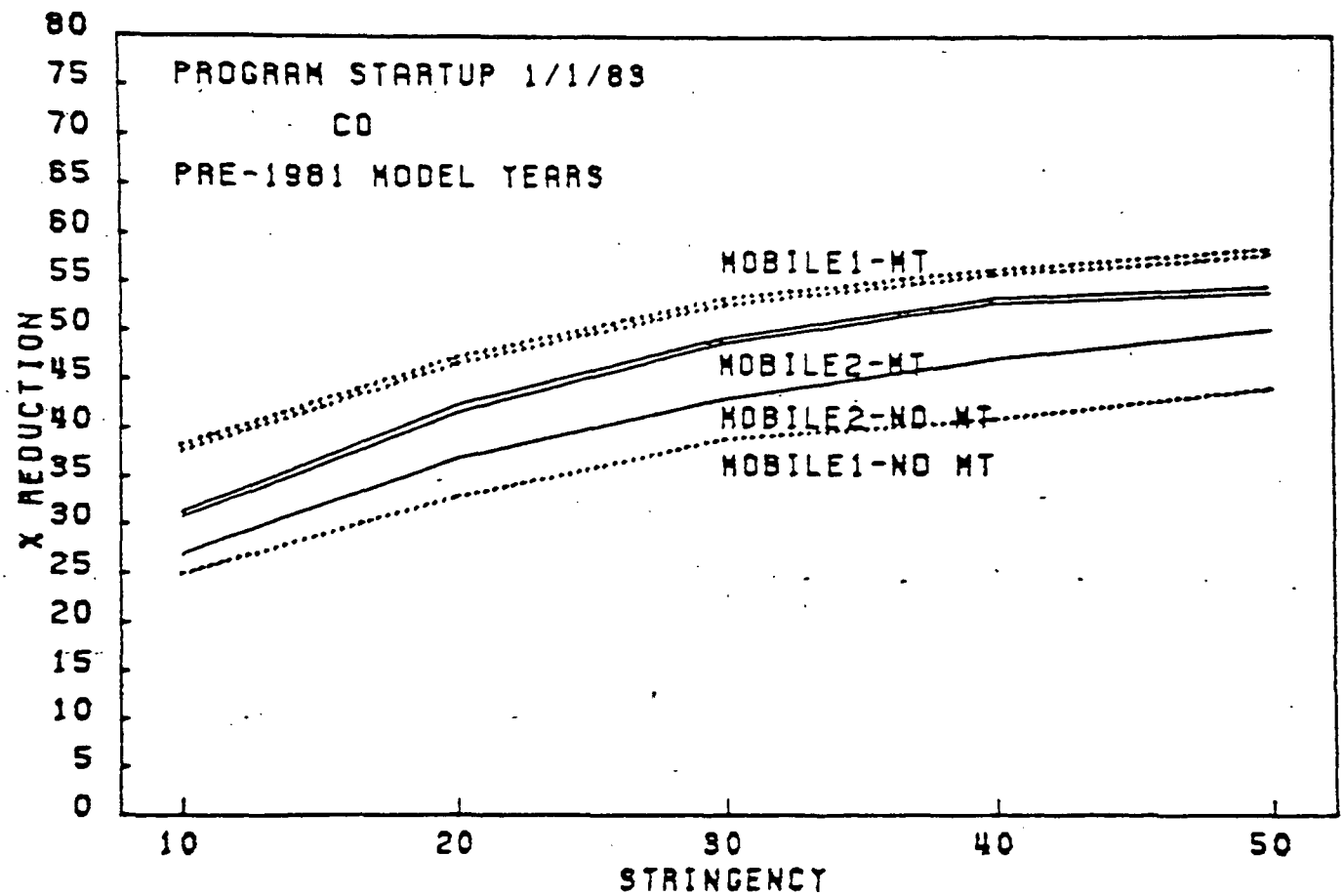

120
100
80
60
40
20
0
CO (GM/MI)
RICH FAILURE
MISFUELED
OTHER
0
20000
40000
60000
80000
100000
10000
30000
50000
70000
90000
MILEAGE


6
5
4
3
2
1
0
HC (DH/HI)
RICH FAILURE
MISFUELED
OTHER
0
10000
20000
30000
40000
50000
60000
70000
80000
MILEAGE

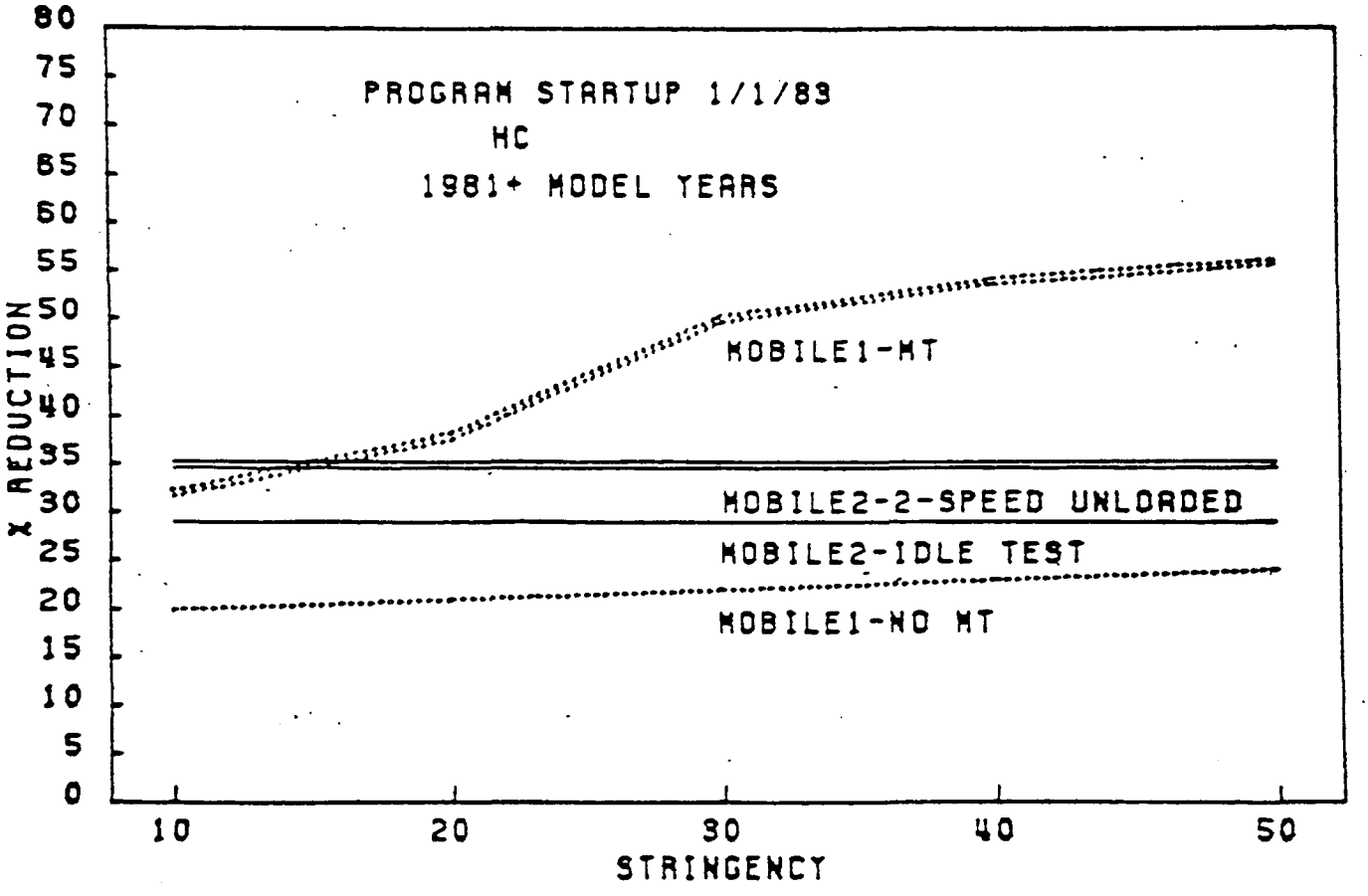

INCREASE IN RICH FAILURES WITH AGE
PERCENT WITH RICH FAILURES
100
80
60
40
20
0
NO I/M
0
20000
40000
60000
80000
100000
MILEAGE


MOBILE1 VS MOBILE2: %REDUCTIONS FROM 1/1/88 NO I/M LEVELS
PROGRAM STARTUP 1/1/83
HC
PRE-1981 MODEL YEARS
MOBILE2-MT
MOBILE2-NO MT
MOBILE1-MT
MOBILE1-NO MT
% REDUCTION
STRINGENCY
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
10
20
30
40
50

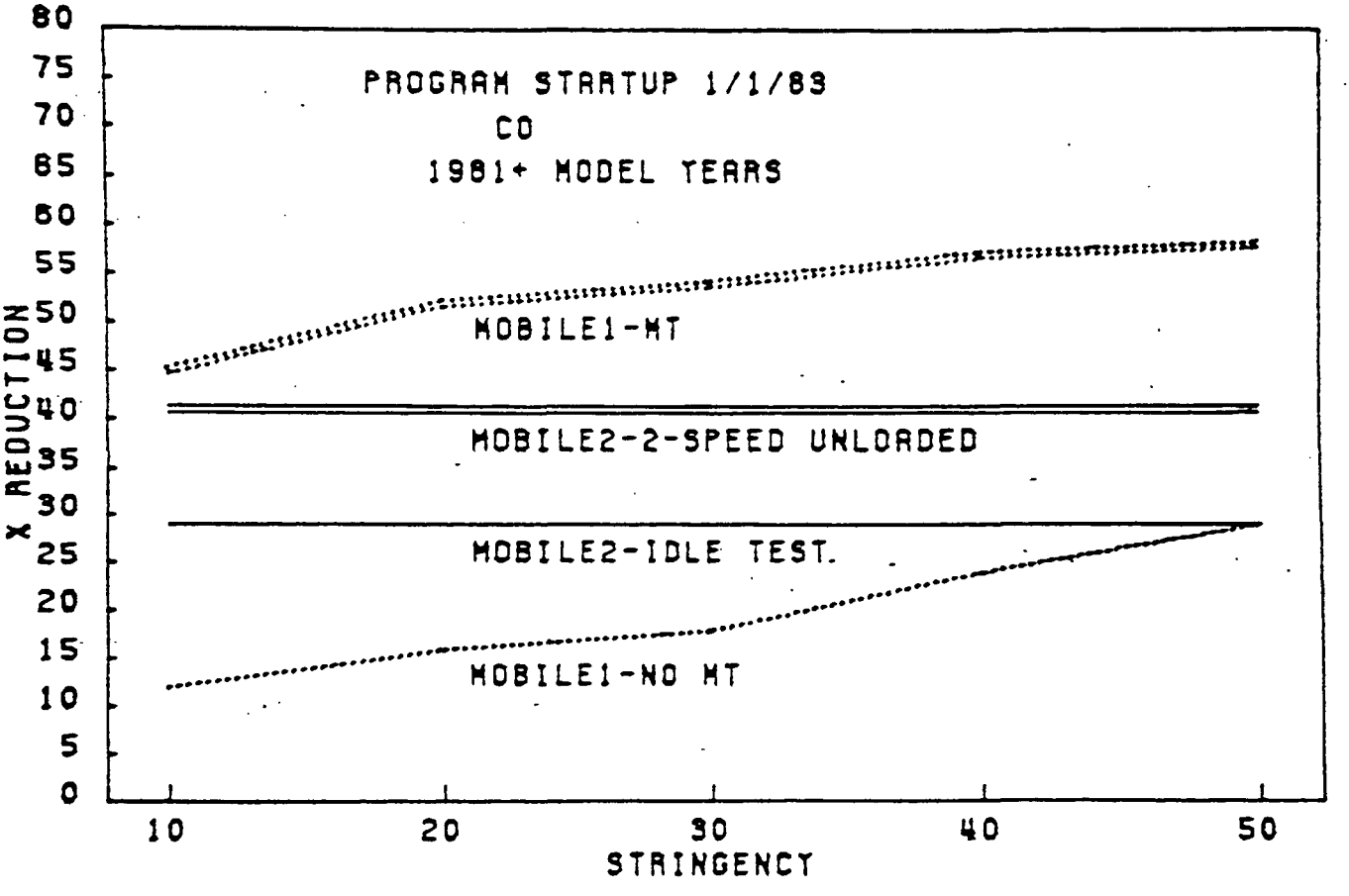
MOBILE1 VS MOBILE2: %REDUCTIONS FROM 1/1/88 NO I/M LEVELS



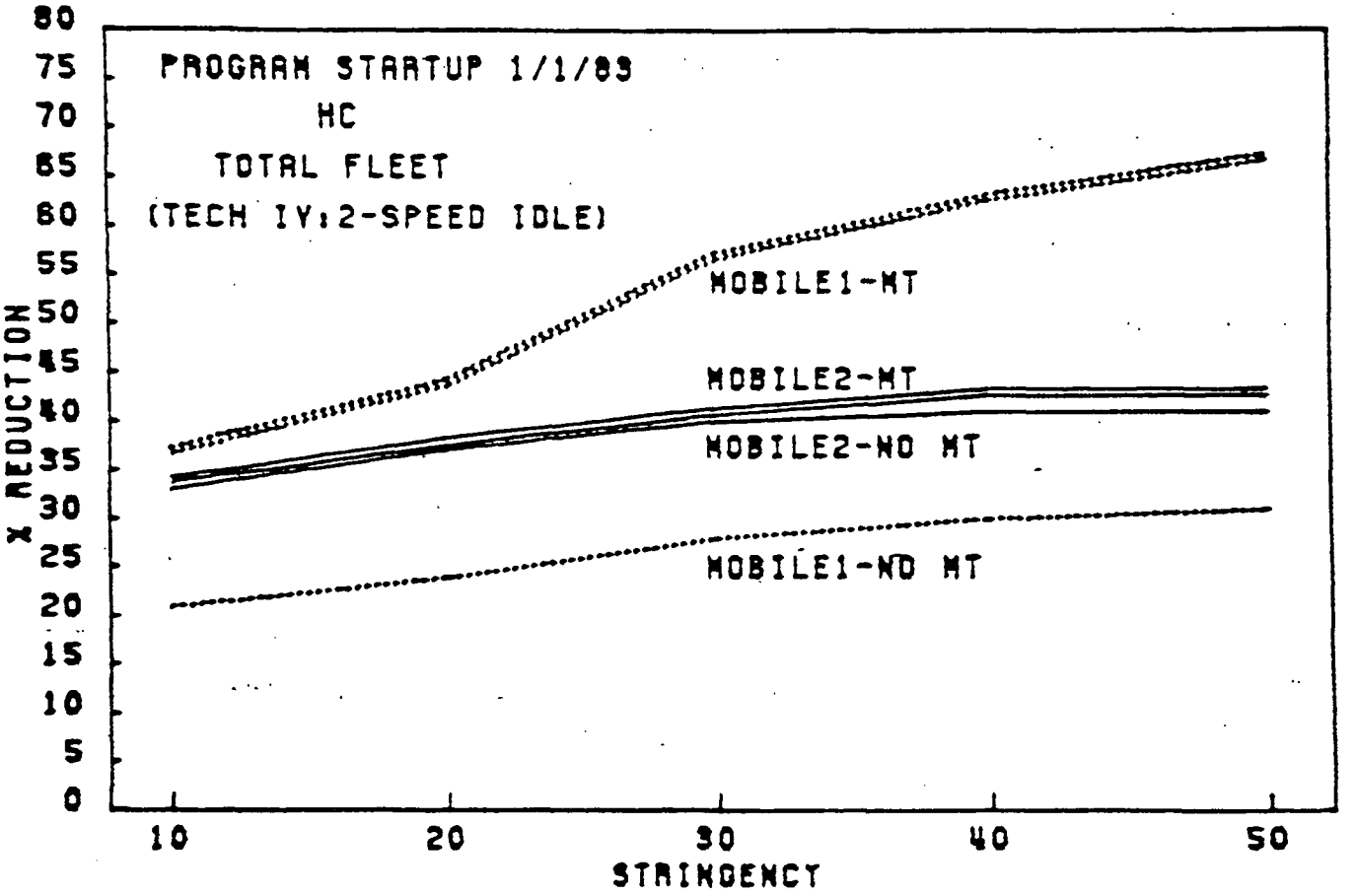
MOBILE1 VS MOBILE2: %REDUCTIONS FROM 1/1/88 NO I/M LEVELS



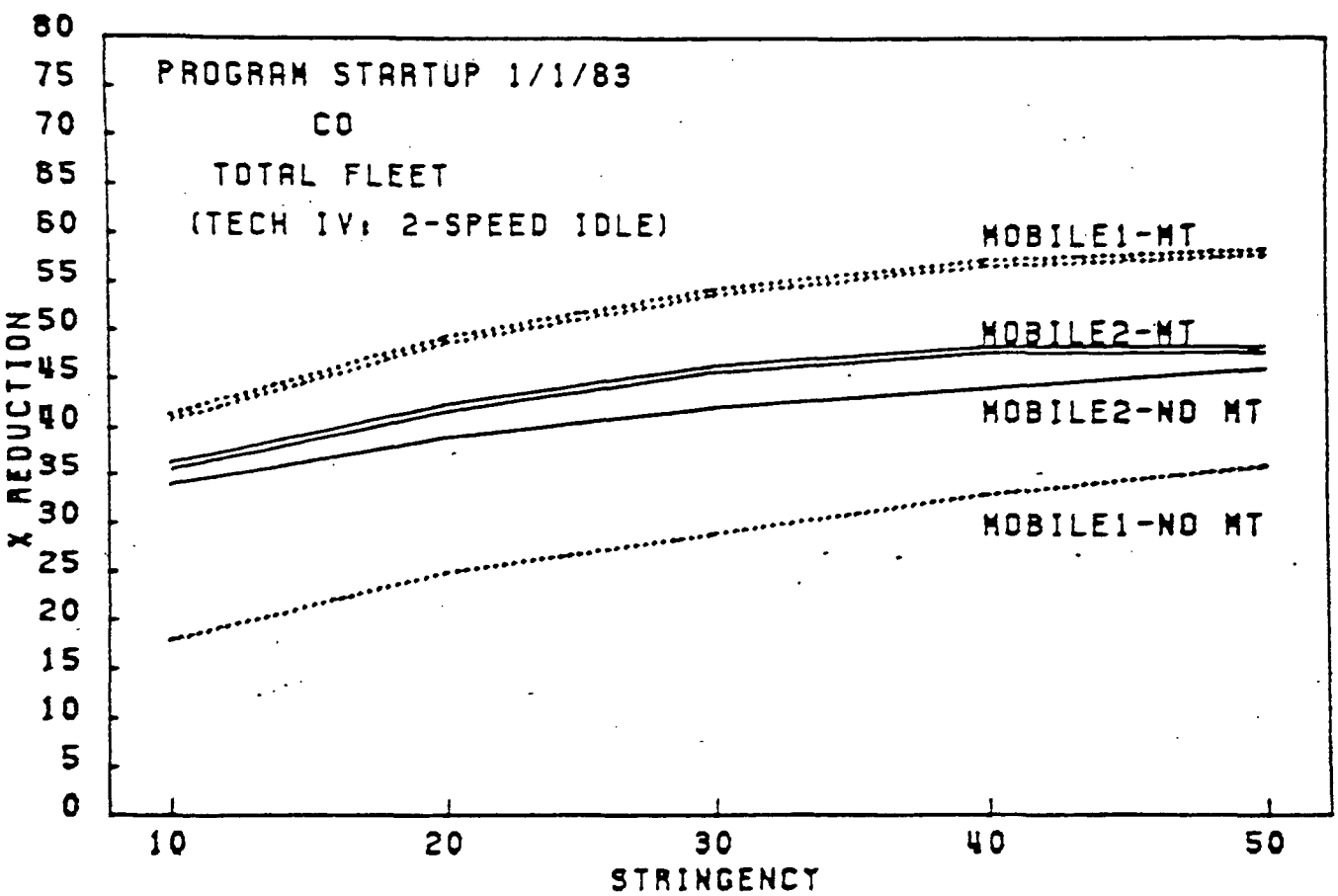
MOBILE1 VS MOBILE2: %REDUCTIONS FROM 1/1/88 NO I/M LEVELS



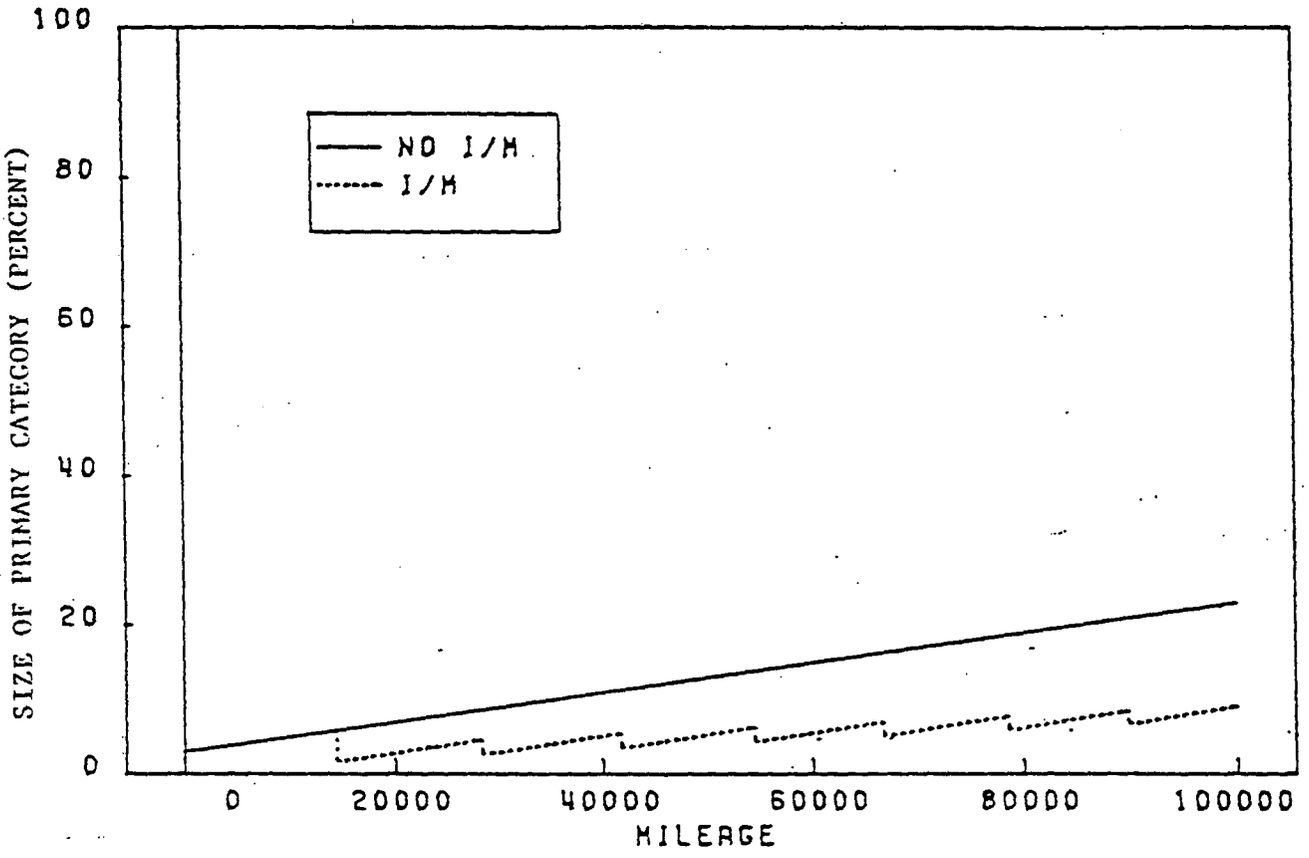
MOBILE1 VS MOBILE2: %REDUCTIONS FROM 1/1/88 NO I/M LEVELS

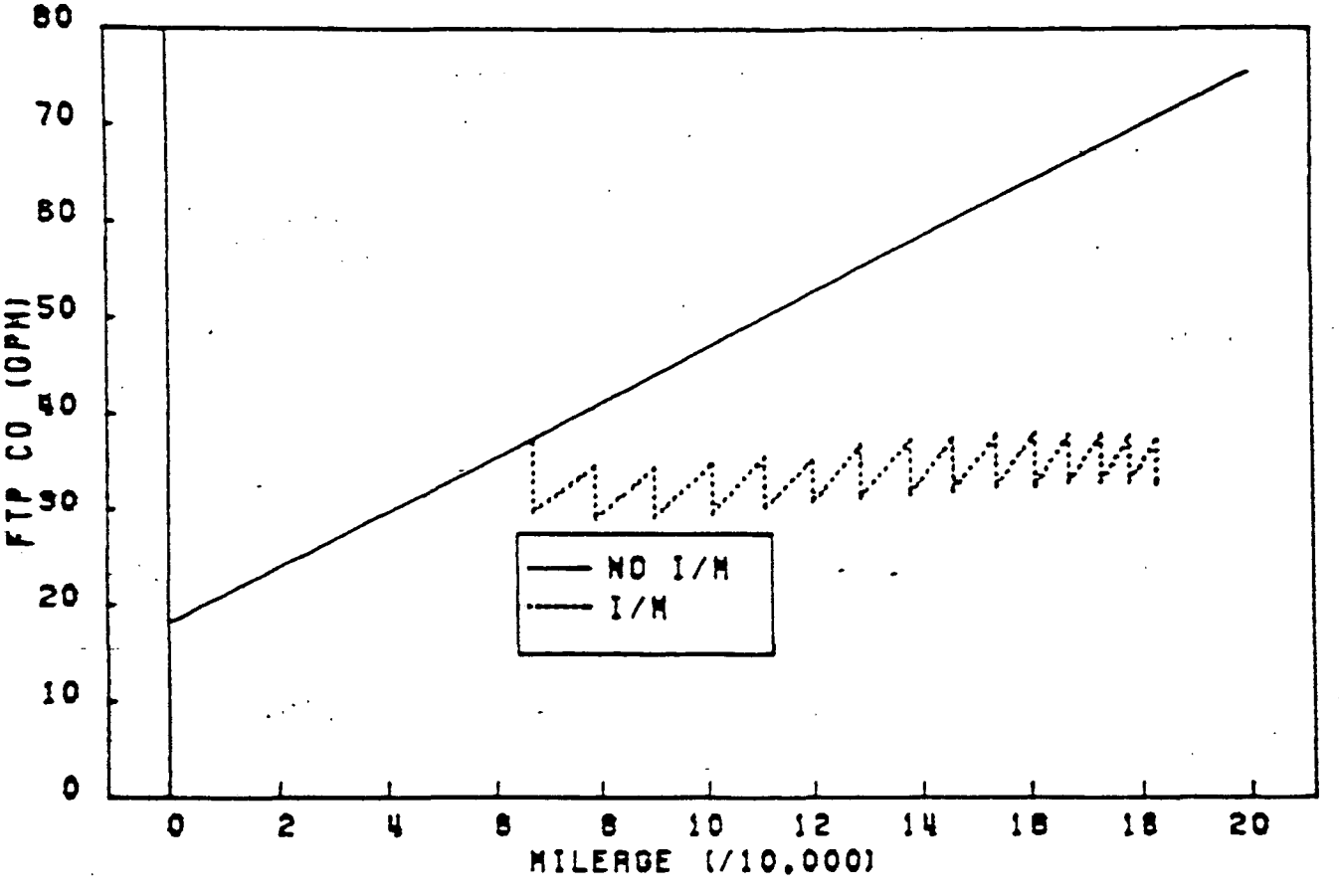


MOBILE1 VS MOBILE2: %REDUCTIONS FROM 1/1/88 NO I/M LEVELS



I/M REDUCES THE NUMBER OF PRIMARY CATEGORY VEHICLES




80
70
60
50
40
30
20
10
0
FTP CO (GPM)
0
2
4
6
8
10
12
14
16
18
20
MILEAGE (/10,000)
NO I/M
I/M