Cal/EPA

California
Environmental
Protection
Agency

Air Resources Board

P.O. Box 2815
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Pete Wilson
Governor

James M. Strock
Secretary for Environmental Protection

June 10, 1996

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Dear Kirk and David:

RE: ARCO ET AL. V UNOCAL-DECLASSIFICATION OF TOYOTA SUBMISSION

Enclosed is a copy of information submitted to the Air Resources Board on or about April 17, 1991 which has been declassified by Toyota.

Sincerely,

James R. Ryden
Staff Counsel

Enclosure

In the Matter of Union Oil Company of California
Docket No. 9305

RX 19

DEPOSITION EXHIBIT
U.S. District Court (C.D. Ca.)
C.A. No. CV-95-2379 RG (JRx)
DX Exhibit 567
Date 6-17-96 Stirewalt & Associates

DEFENDANTS' TRIAL EXHIBIT
U.S. District Court (C.D. Ca.)
C.A. No. 95-2379 KMW (JRx)
DTX 567

TOYOTA

9/17/91

Note Confidentiality of data!

X.C. Dean
Susan
Bob F.

R.O.

NOTE: CONFIDENTIAL

1. LEV

STATUS OF TOYOTA'S CLEAN VEHICLE DEVELOPMENT PROGRAMS

1. HC 0.25 Std.

* Achieved by '92 MY Camry and Celica with 2.2L L-4 Engine. (Certification Test, 1 Year in Advance of CARB Requirement)
* Added Technologies: More Precise A/F Control
  2 Group Fuel Injection System
  Reducing Engine-out HC

2. TLEV Std.

* Test Cars: Camry and Celica with 2.2L L-4 Engine. These Are Toyota's Lowest Emission Vehicles
* Added Technologies: Quick A/F Feed-back Control
  Earlier Warm-up Catalyst Control
  Electrically-Heated O_2 Sensor
  Larger Under Body CAtalyst
* Concerns: Very Hard to Reduce NMHC Emissions at 50°F (10°C)

3. LEV Std.

* Test Cars: Camry and Celica with 2.2L L-4 Engine
* Added Technologies: Electrically-Heated Catalyst
  (Working with 4 EHC Makers)

* Concerns:

1. EHC Related Problems
   - Unacceptable Durability (Telescoping)
   - High Electric Power Consumption
   - Increased Vehicle Weight/Fuel Consumption
   - Unknown

2. Other Problems
   - NOx 0.2

[illegible] power consumption [illegible]

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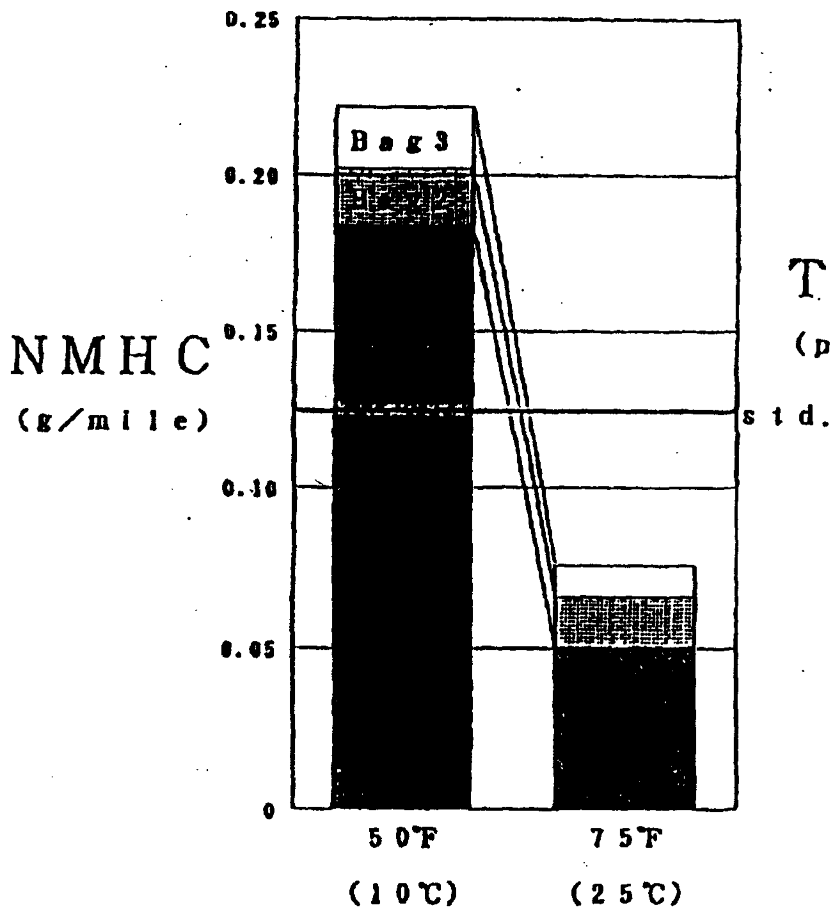
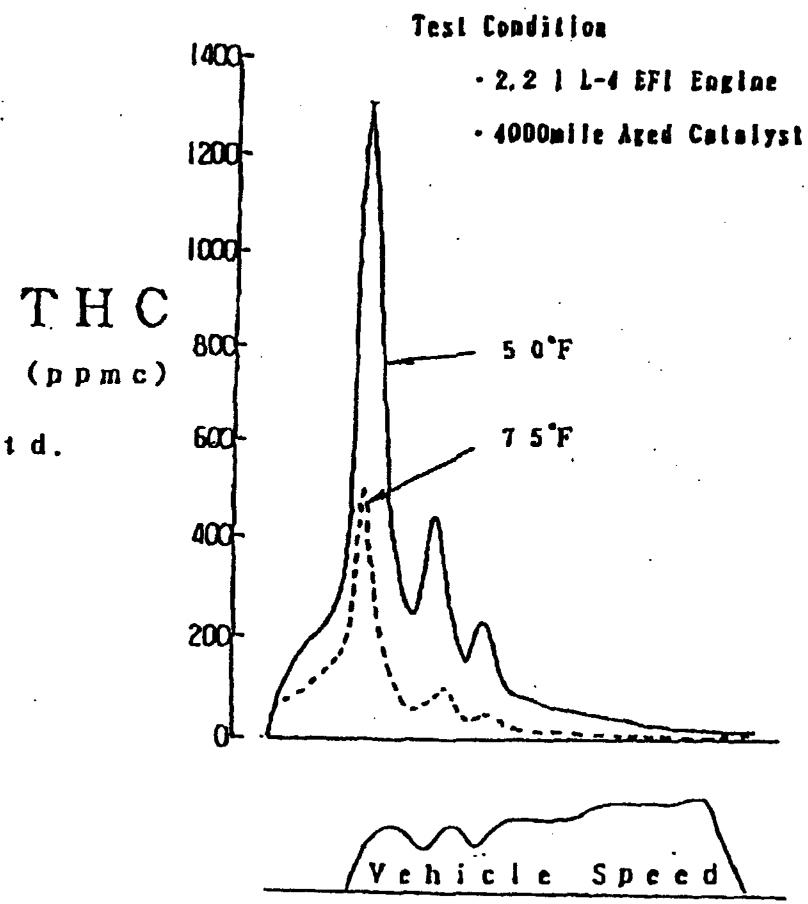
Cold 50°F Test





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EHC SYSTEM - UNDERBODY LOCATION

Vehicle: '90MY Celica
2.2L L-4 Engine
4A/T

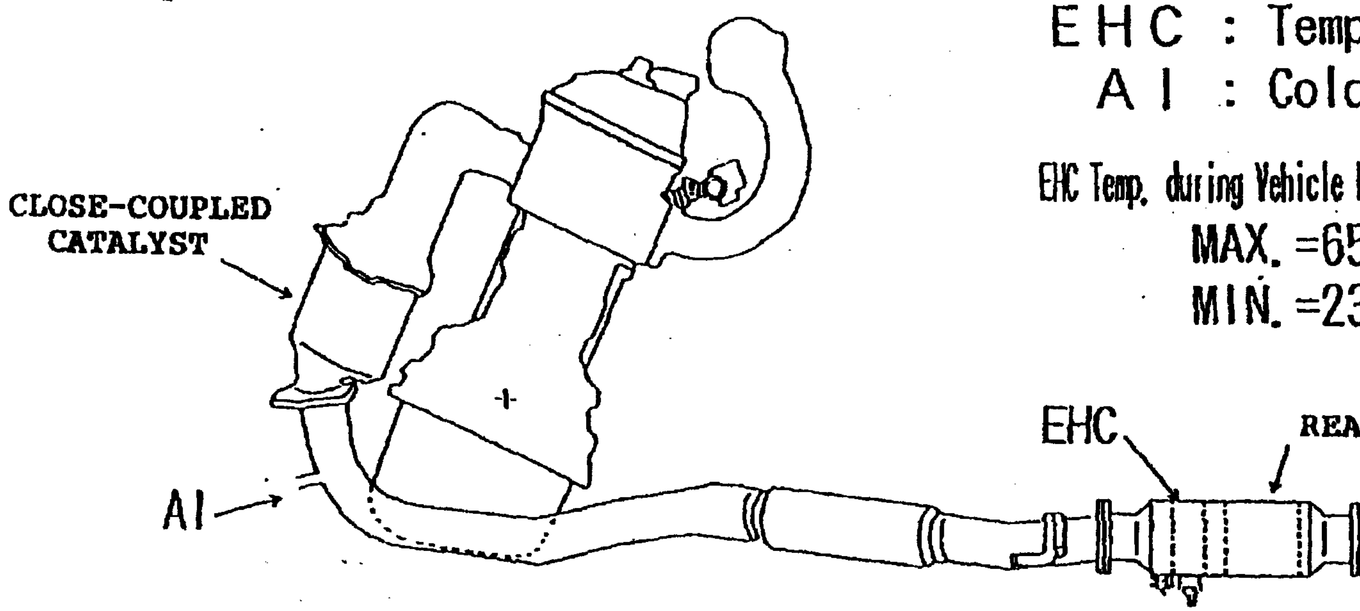
EHC : Temp. Set=350°C

AI : Cold 1min.

EHC Temp. during Vehicle Durability Test

MAX. =650 °C

MIN. =230 °C



*EHC samples provided by GRACE to TOYOTA in December of 1989.

EHC SYSTEM - CLOSE-COUPLED MANIFOLD LOCATION

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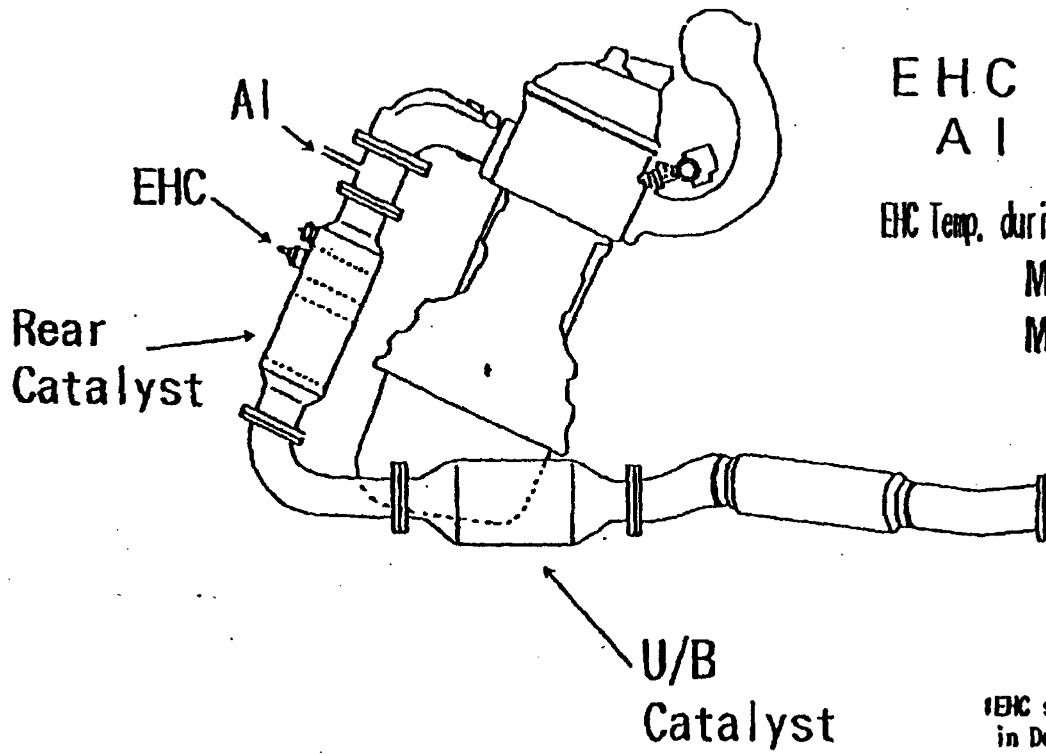
Vehicle: '90MY Celica
2.2L L-4 Engine
4A/T
EHC : Temp. Set=350℃
A I : Cold 1min.

EHC Temp. during Vehicle Durability Test
MAX. =800 ℃
MIN. =400 ℃



*EHC samples provided by GRACE to TOYOTA in December of 1989.

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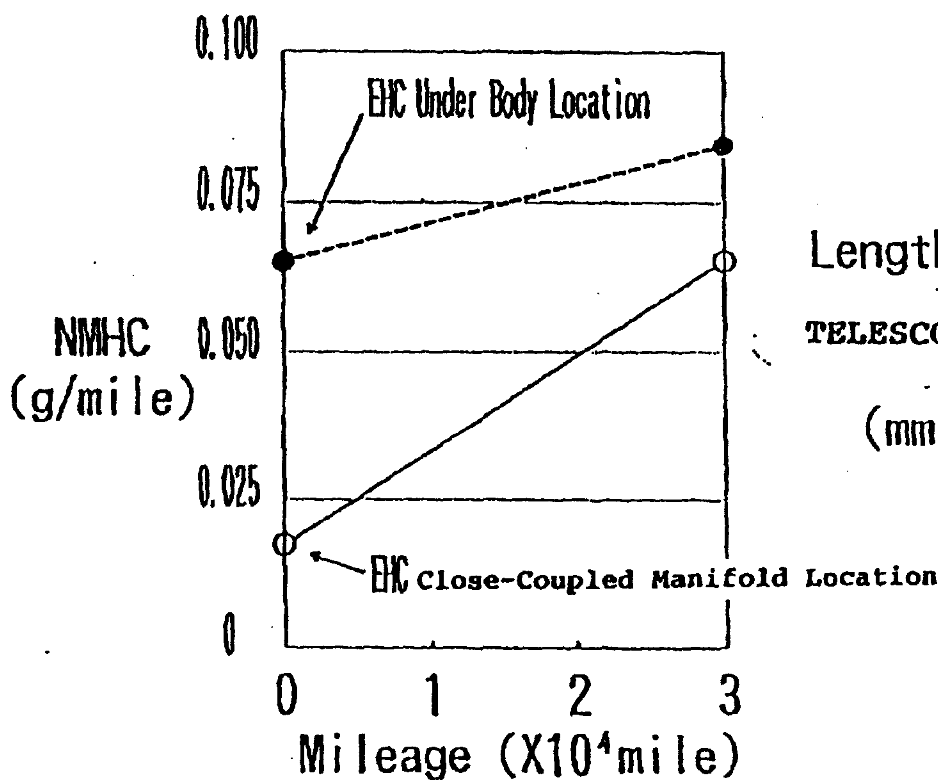
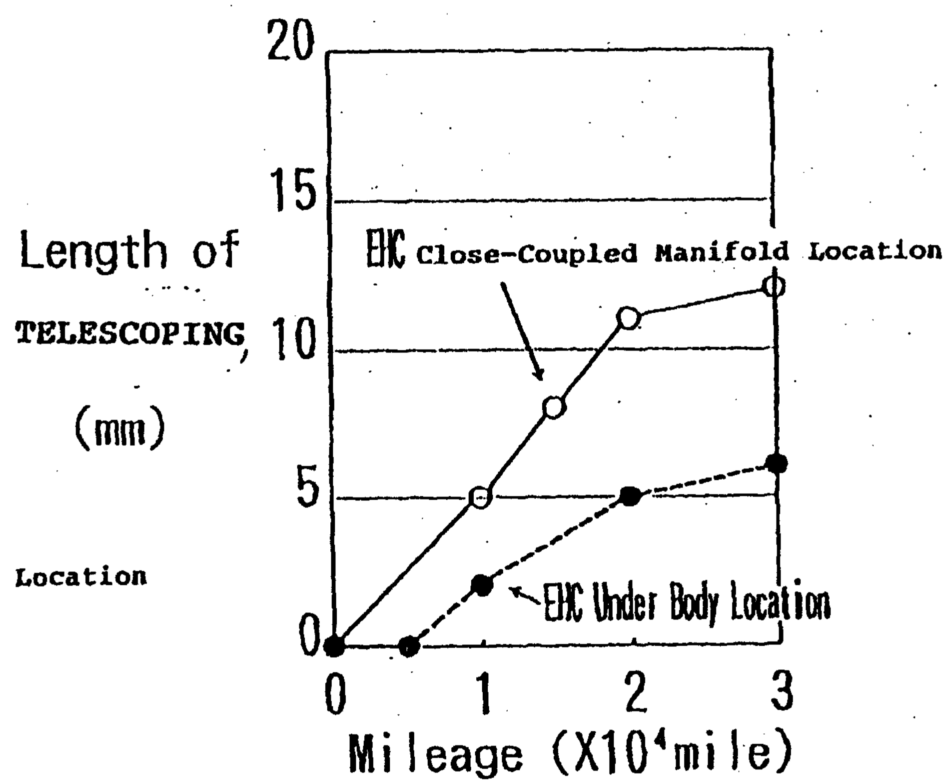
NMHC and TELESCOPING of EHC FOILS DURING VEHICLE DURABILITY TEST

Comment: ‡Did not accept TOYOTA's Durability Standard





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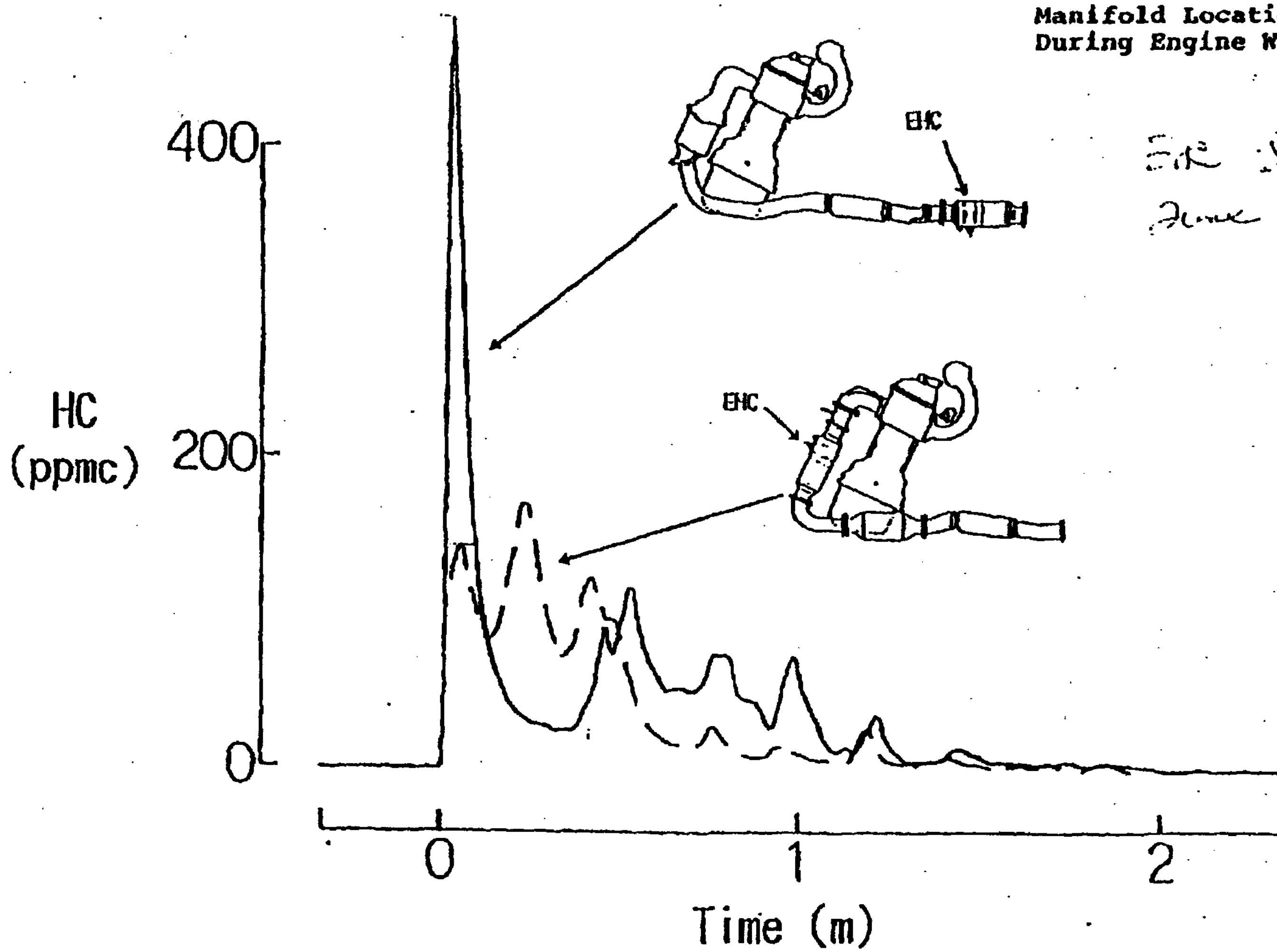
TAILPIPE EMISSIONS AT COLD START DURING FTP TEST

COMMENT: HC Emission of EHC Close-Coupled Manifold Location is Lower During Engine Warm-up.



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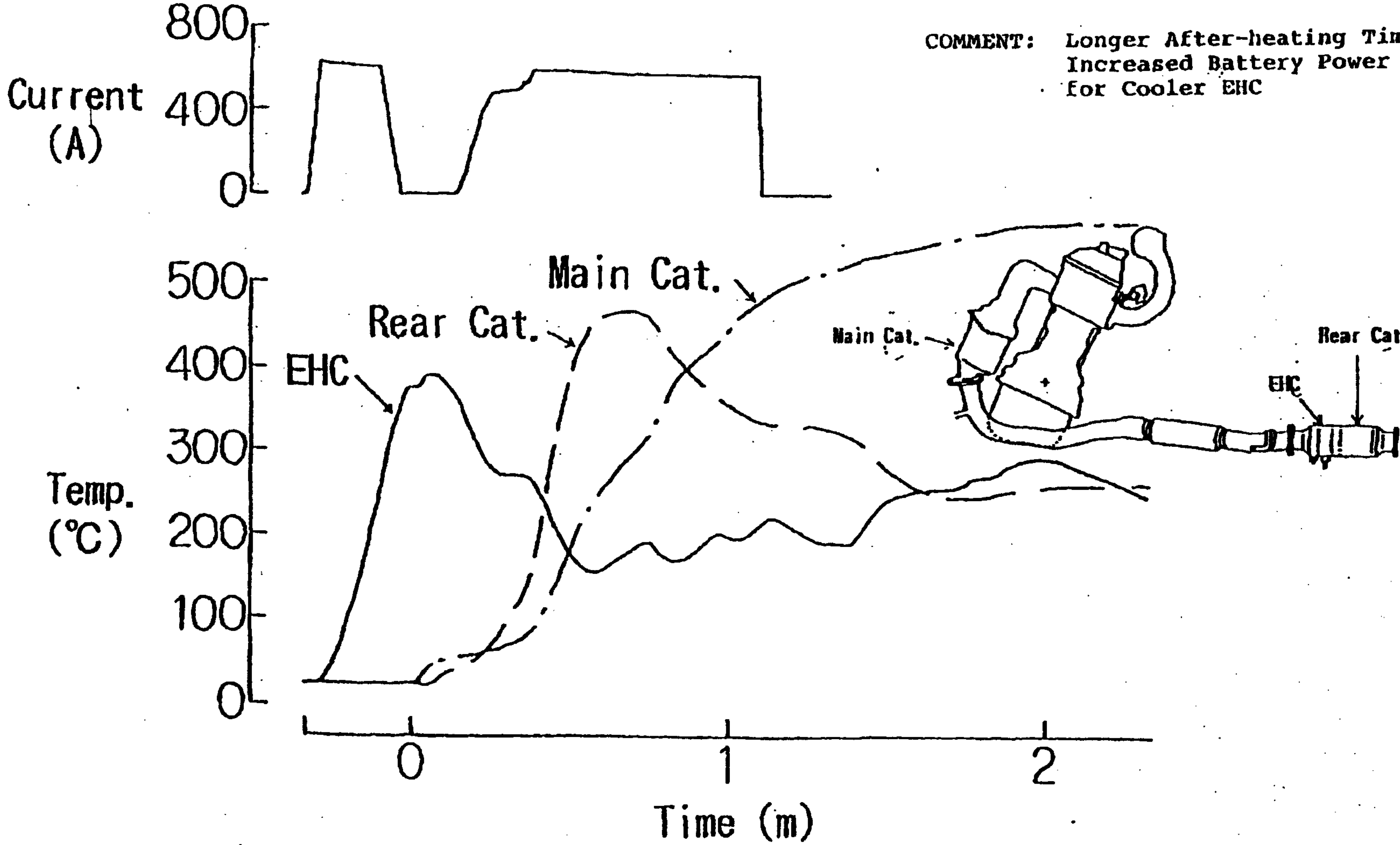
Catalyst Temp. and EHC Current of EHC Under Body Location

COMMENT: Longer After-heating Time and Increased Battery Power Draw for Cooler EHC



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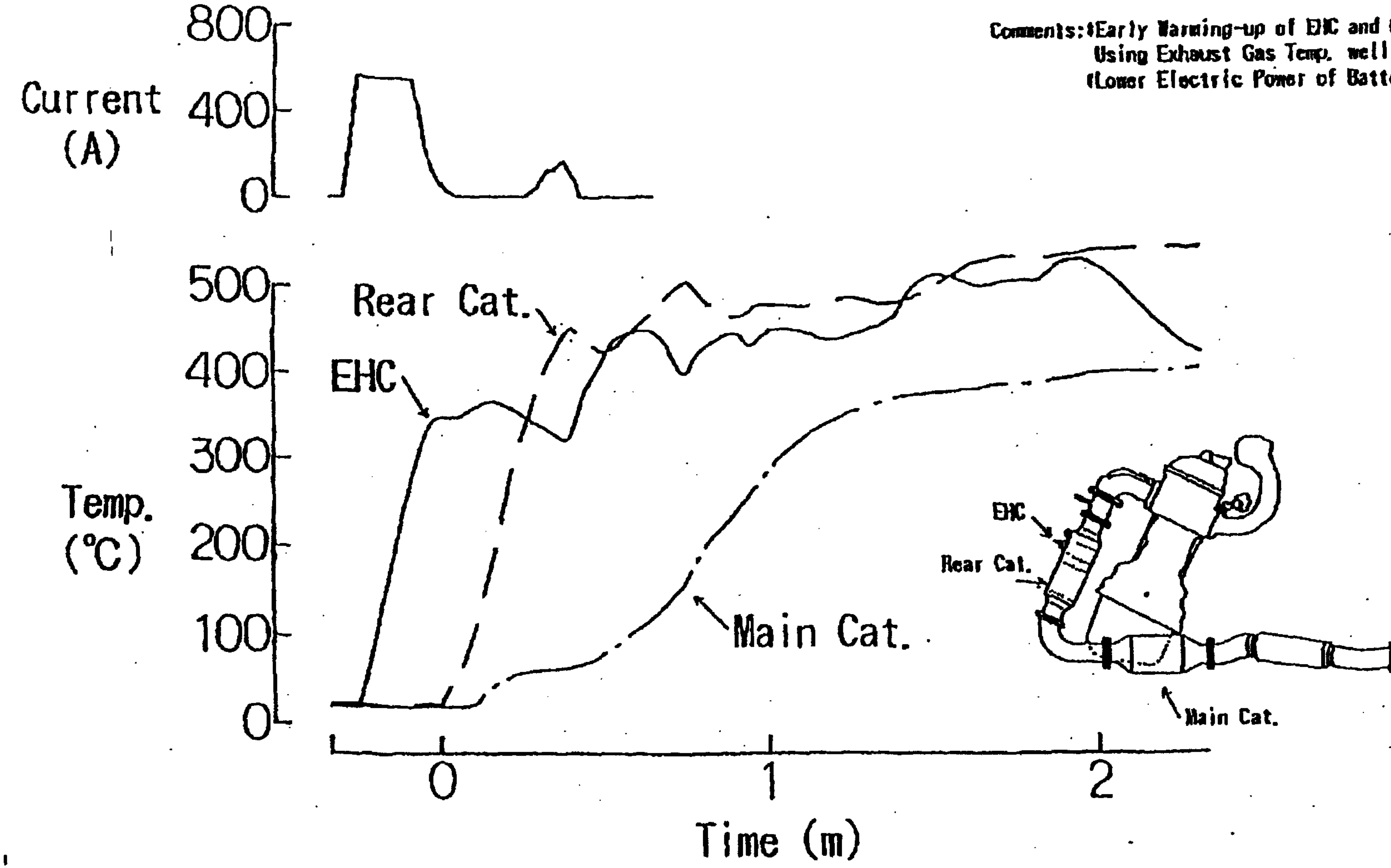
CATALYST TEMPERATURE and EHC CURRENT OF EHC - CLOSE-COUPLED LOCATION

Comments: •Early Warming-up of EHC and Catalysts by Using Exhaust Gas Temp. well
•Lower Electric Power of Battery



SUMMARY OF TOYOTA'S CLEAN VEHICLE DEVELOPMENT

1. TOYOTA will Market '92 MY Camry and Celica with 2.2L L-4 Engine to meet 0.25 HC Std. 1 Year in Advance of CARB Requirement.

2. Prototype Car with 2.2L L-4 Engine is Reaching the TLEV Std., but Larger Cars With Larger Displacement Engines will be Difficult.

3. Every Effort is Being Made to Develop an EHC Equipped Vehicle That Meets LEV Standards.

4. First Priority of EHC Development is Structural Durability at the Close-Coupled Manifold Location.

5. We have been Developing EHC with CAMET and Three EHC Makers, but Telescoping Appeared in Each EHC Tested.

6. It is Very Hard to Reduce NMHC Emissions at 50°F (10°C) Test Condition. Therefore, TOYOTA Requires a Feasible Emission Standard at 50°F (10°C) Test Conditions.

7. Please Sufficiently Consider the Fact That Automobile Manufacturers Must Achieve Stringent LEV, CAFE, OBD II, And Safety Standards Concurrently. The Avalanche of These Standards Will Severely Stress the Limited Personnel, and Financial Resources of all Manufacturers.

2. Fuel

1. TOYOTA Reported at the Last Meeting That the 50% Distillation Temperature of Gasoline Affects HC Emissions.

   A 10 Degree Celcius Decrease of 50% Distillation Temperature Reduces Tailpipe HC Emissions by about 15%. (See Fig. 1)

2. TOYOTA has Recently Conducted 3 Additional Tests in Order to Confirm the Effect of Distillation Characteristics of Gasoline. Three Models of TOYOTA Passenger Cars Which Have Different Emission and Fuel Control Systems Have Been Tested. The Test Result Shows Again That a Decrease of T_{50} (50% Distillation Temperature) Conclusively Reduces HC Emissions. (See Fig. 2)

3. The Mechanism of the Change of Vehicle Driveability and HC/CO Emissions by T_{50} were Studied Using an Engine on the Dynamometer.

The Result Indicates:

(1) Engine Torque Responds More Smoothly and Quickly to Throttle Opening When Using Lower T_{50} Gasoline. (See Fig. 3a)

An MTBE Blended Gasoline Shows Poorer Engine Response Than Non-MTBE Blended Gasoline Having the Same T_{50}. (See Fig. 3b)

Similar Results Obtained in a Different Test Are Attached. (See Fig. 4)

(2) More HC is Emitted by Using a Higher T_{50} Gasoline Under Engine Deceleration Conditions. This is Caused by More Liquid Gasoline Flowing Through the Engine Intake System When a Higher T_{50} Gasoline is Used. (See Fig. 5)

MTBE-blending Does Not Affect the HC Emission if the Same T_{50} Fuels Are Used.

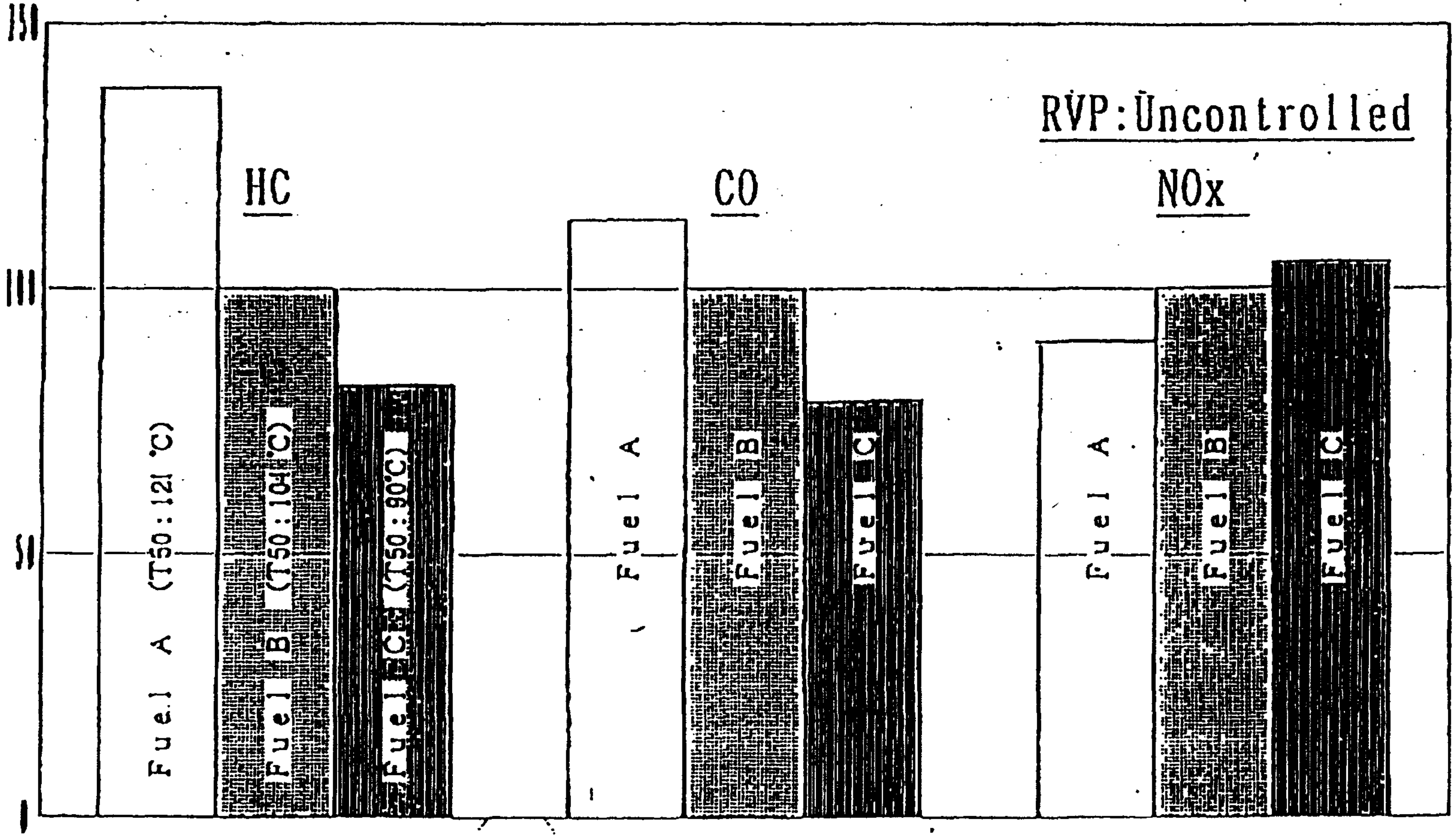


Fig. 1 Effect of T_{50} on Exhaust Emissions(Fuel B=100)

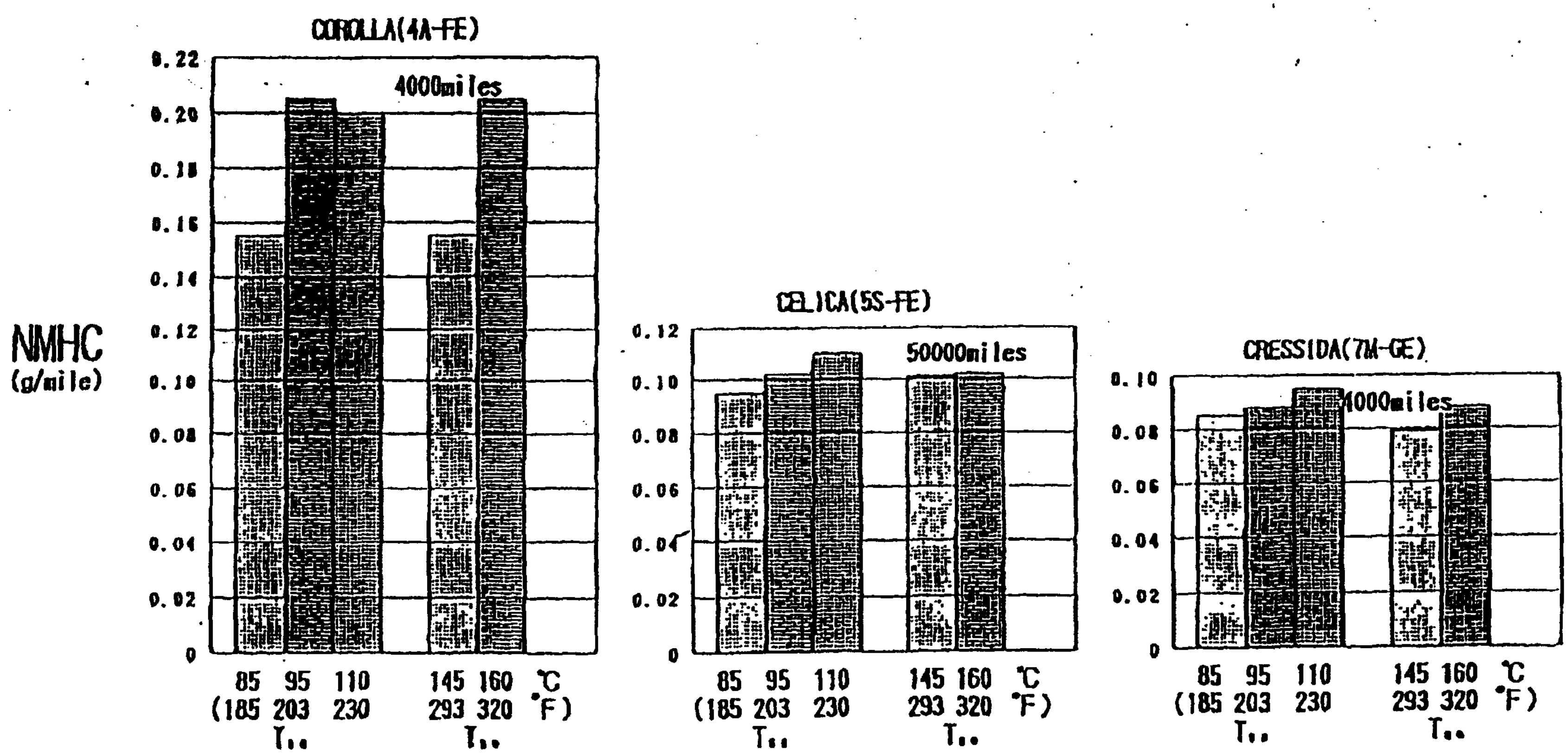


Fig. 2 Effect of T_{50} and T_{90} on Exhaust Emissions

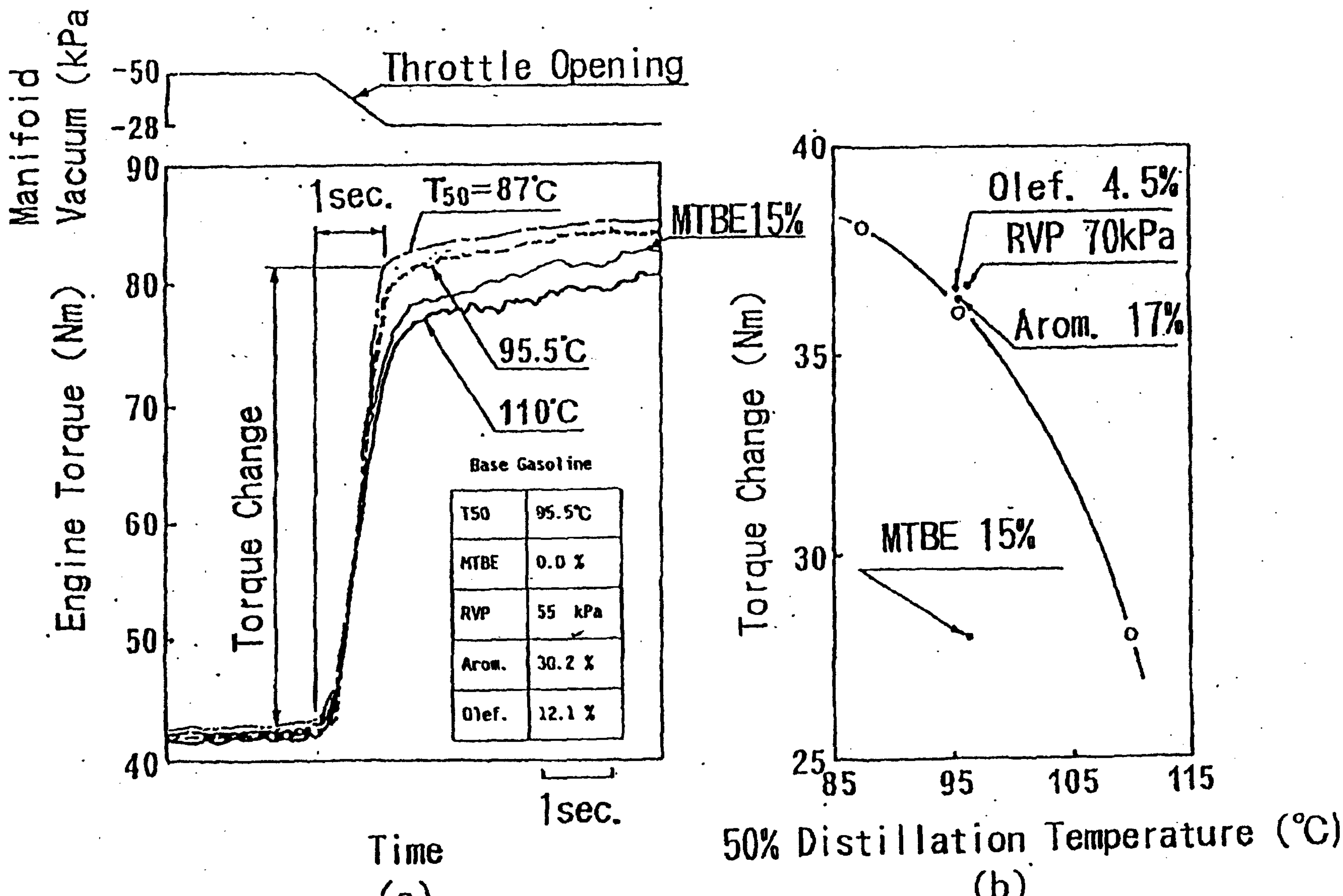


Fig. 3 Effect of Gasoline Characteristics on Engine Response

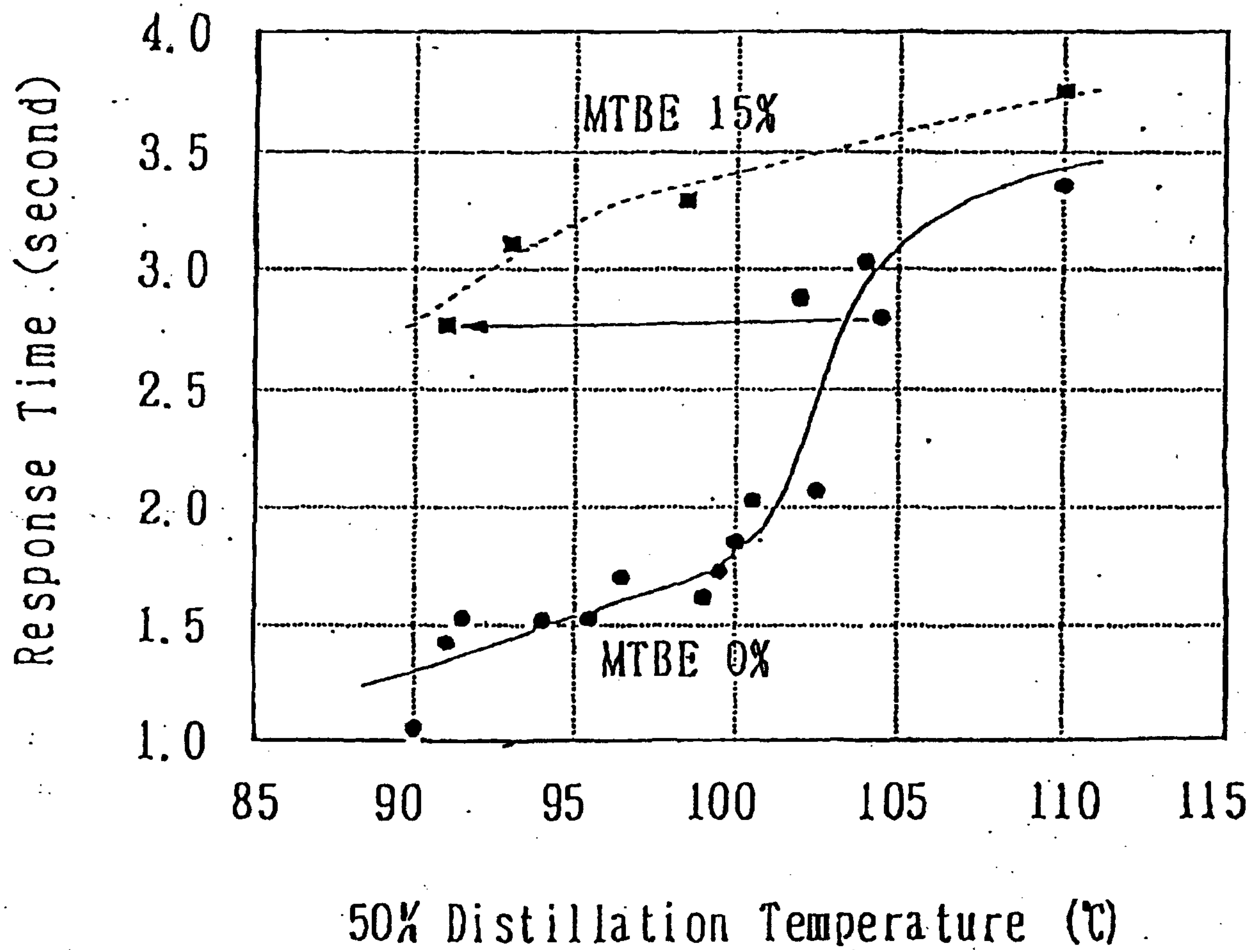


Fig. 4 Effect of MTBE Blends on Driveability(SAE 902094)

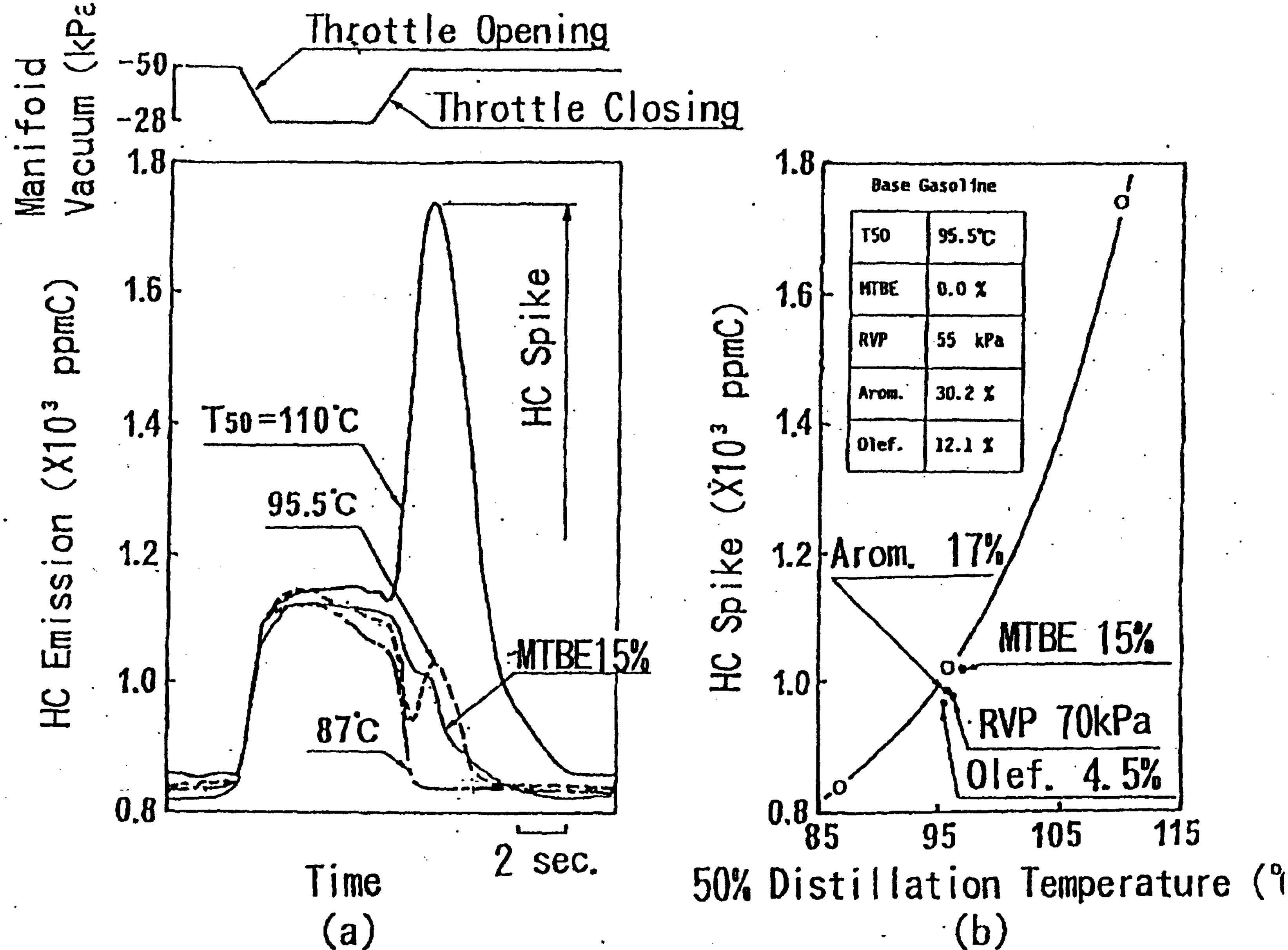


Fig. 5 Effect of Gasoline Characteristics on HC Emission

3. Reactivity

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Fuel Specification

Hydrocarbon Type, Vol.%	Type I (Base Fuel)	Type II (Low Aromatic Fuel)
Aromatics	29.0	21.2
Olefins	5.0	3.8
Satulates	66.0	75.0
Distillation, ℃		
IBP	34	32
10%	55	52
50%	105	92
90%	153	138

	Type I (Base Fuel)	Type II (Low Aromatic Fuel)
Specific Gravity	0.7426	0.7243
Sulfur, %	0.018	0.003
Oxygenated HC, %	0	< 0.1
Reid Vapor Pres.	8.7	9.0
Research Octane Number	96.8	90.6
Motor Octane Number	87.2	84.0

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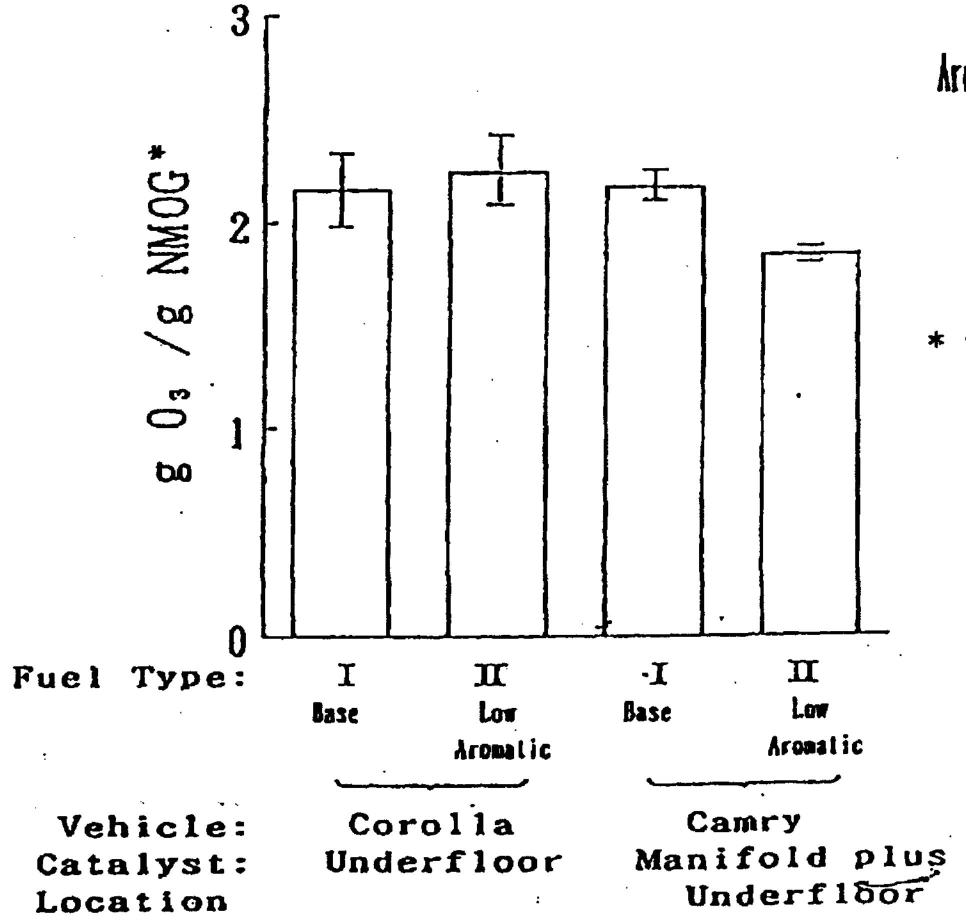
Effect of Fuel Type on g O_3/g NMOG



Mode: FTP (2 Tests)

Aromatics of Fuel: Type I ··· 29.0%

Type II ··· 21.2%

* {[(g/mile of Exhaust NMOG No. 1) × (Incremental Reactivity Factor for Exhaust NMOG No. 1)] + [(g/mile of Exhaust NMOG No. 2) × (Incremental Reactivity Factor for Exhaust NMOG No. 2)] + · · · } /(Total g/mile of NMOG Emissions)

Low aromatic fuel is effective when used in conjunction with a close-coupled catalyst.

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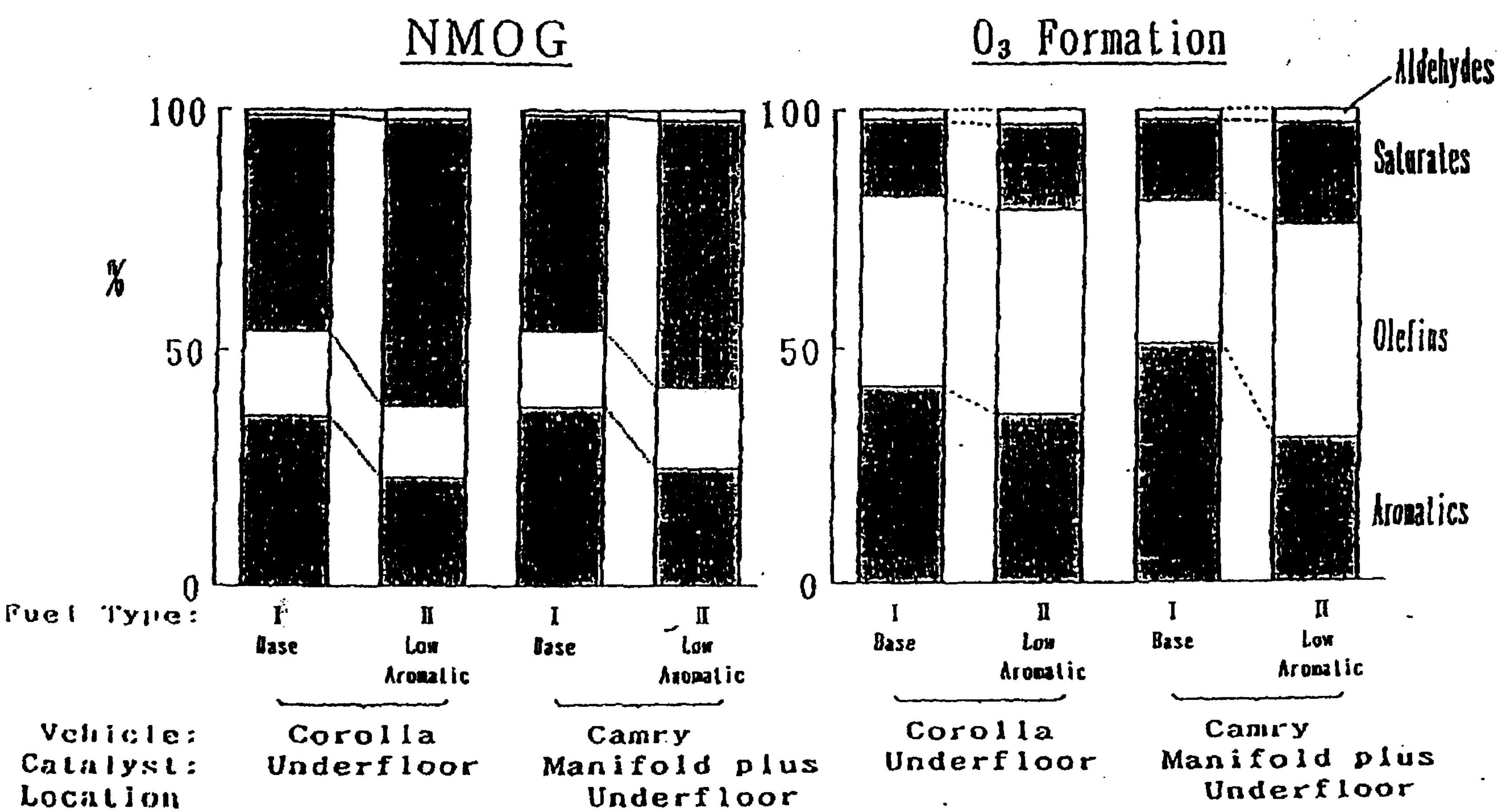
Contribution of Hydrocarbon Components



With low aromatic fuel, aromatic compounds are reduced but olefin compounds are increased, thereby, O_3 formation is increased.

Hence, low aromatic fuel offers further potential for reducing O_3 formation if olefin compounds can

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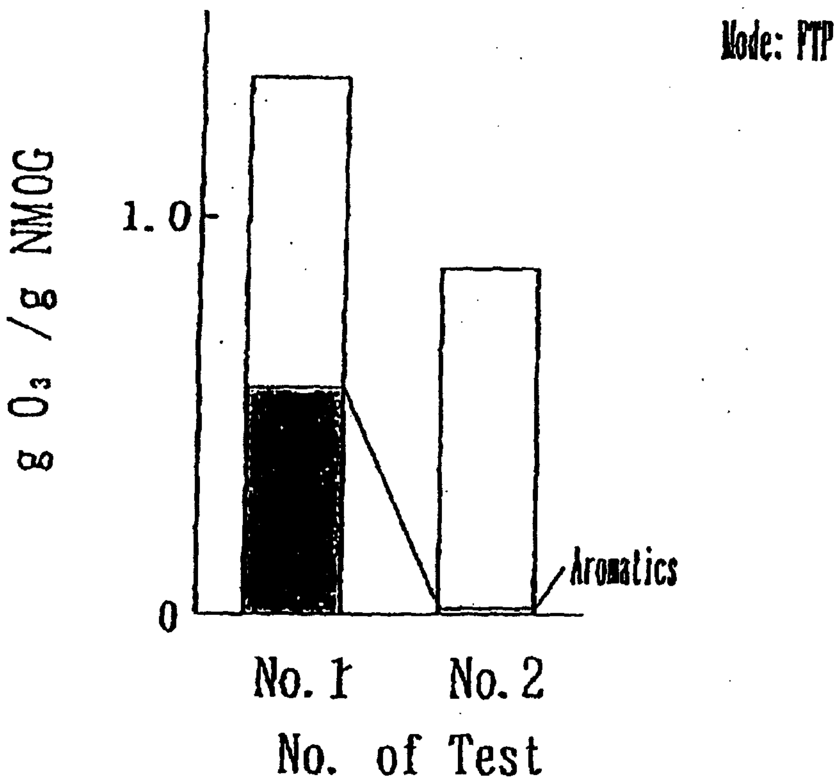
Repeatability of g O_3 /g NMOG in LPG Fueled Vehicle



- Aromatic compounds are greatly reduced when LPG is used. (No. 2)
- The data of No. 1 test include errroneous results ascribable to the after-effects of preceding test. (No. 1)
- It is presumed that the reason of the error is caused by desorption of HC which is adsorbed in gas sampling line and bag under preceeding test of high level HC emission vehicle.

SUMMARY

- Fuel composition is an important factor of exhaust gas reactivity.

- Exhaust gas reactivity is also affected by engine type and exhaust system, especially catalyst location.

  Efforts must be made to produce fuels with low propensity for O_3 formation.

- It was observed that a test result could be affected by the preceding test.

  Test procedures for HC emissions must be established to avoid erroneous results.

4. EV

HISTORY OF TOYOTA EV DEVELOPMENT

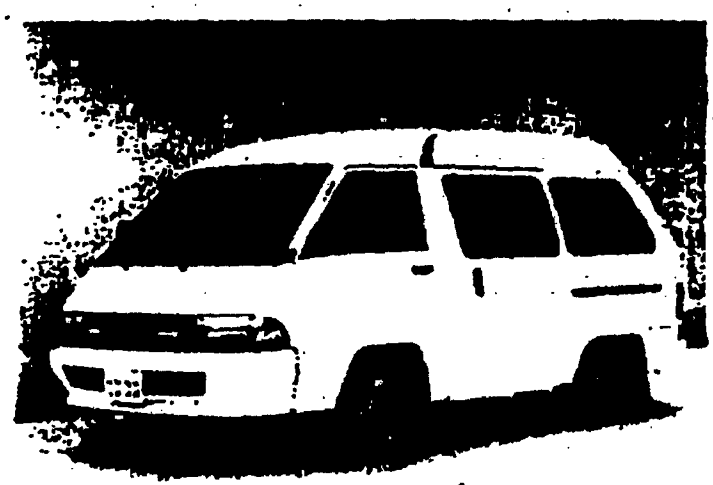
Item \ Vehicle	EV-10	EV-20	EV-30	EV-40	EV VAN
Vehicle	Corolla II EV	Corolla II EV	commuter car	guide car	Town ACE Electric Van
Battery	Lead-Acid	⇦	Zn-Br or Lead-Acid	⇦	Ni-Cd or Lead-Acid
Motor	DC shunt	AC induction	⇦	⇦	⇦
Max speed	105	100	43	20	85
Range (km) (at const. speed) (km/h)	120 (40)	120 (40)	165 (30)	90 (15)	160 (40)
Publication	1983	1985	1987	1989	1990

TOWN ACE ELECTRIC VAN
SPECIFICATIONS

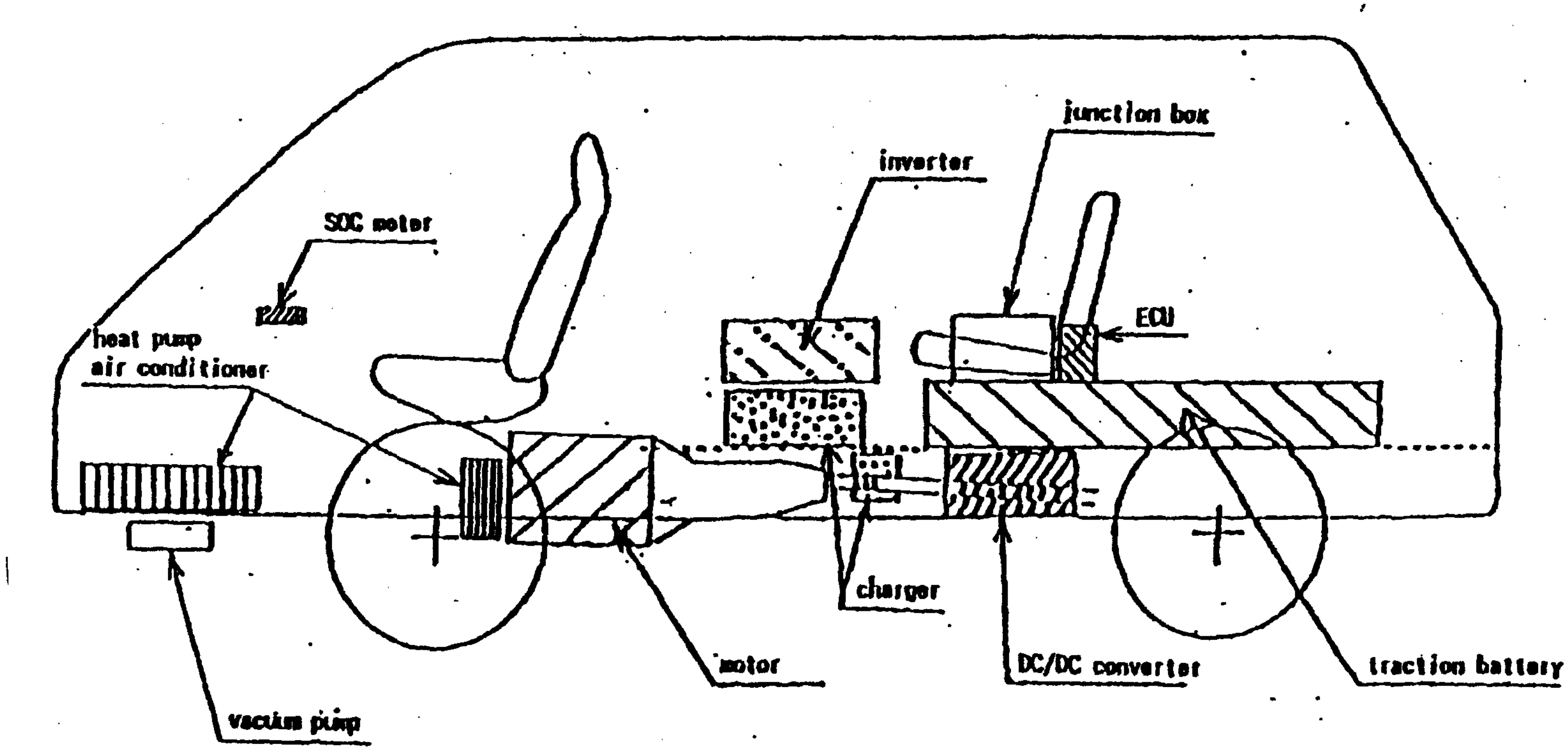
Length	(mm)	4360
Width	(mm)	1685
Hight	(mm)	1905
Passengers		4
GVW	(kg)	2240
Motor (Rated Output)	(kW)	20
Maximum Speed	(Km/h)	85
Range (at 40Km/h const. speed)	(Km)	160
Acceleration (0 →40Km/h)	(sec)	7.5

Accessories

- Heat Pump Air Conditioner
  (Heating/Cooling Capacity 3720kcal/h / 2900kcal/h)
- On Board Charger
  (Charge hour 8 ~ 10 Hr)
- State of Charge Meter



ELECTRIC VAN COMPONENT LAYOUT



EV Problems

①Technological Problems

- Limited Driving Range
- Limited Passenger and Pay Load Capacity
- High Costs (Initial and Maintenance)

②Market Problems

- Potential EV users
- Existence of Supporting Infrastructure
  (Quick Charge Station etc.)
- Incentives
  (Preferential Use of Parking Areas
  Reduction of taxes etc.)