

# Effects of Ethanol on Emissions of Gasoline LDVs

**TOYOTA Motor Corporation**

Brent Crary  
Toyota Technical Center  
Ann Arbor, MI

May 4, 2000

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# Objective

Present Toyota's concern about the effects of ethanol containing gasoline on vehicle emissions.

# ***General Results***

**When there is about 10% ethanol in gasoline instead of MTBE:**

**Evaporative Emissions:** ↑

**Tailpipe NOx Emissions:** ↑

**Tailpipe CO ↓**  
**Tailpipe HC (=?)**

# Test Fuels

		"MTBE"	E10-A	E10-B
		Phase II (w/MTBE)	E10 (lower RVP)	E10 (higher RVP)
RVP	kPa	47	48.5	52.2
RON		96.3	101.3	97.2
FIA	vol. %			
	Aroma.	24.0	23.0	24.1
	Olefin	5.0	5.0	3.4
	T10	60.0	57.2	57.5
	T50	96.0	97.6	100.0
	T90	143.5	145.6	147.0
Oxy.	vol. %			
	MTBE	11.1	0.0	0.0
	Ethanol	0.0	11.2	8.9
S	ppmw	30	29	30

E10-C: Indolene Cert. Fuel + 10% Ethanol; (higher RVP)

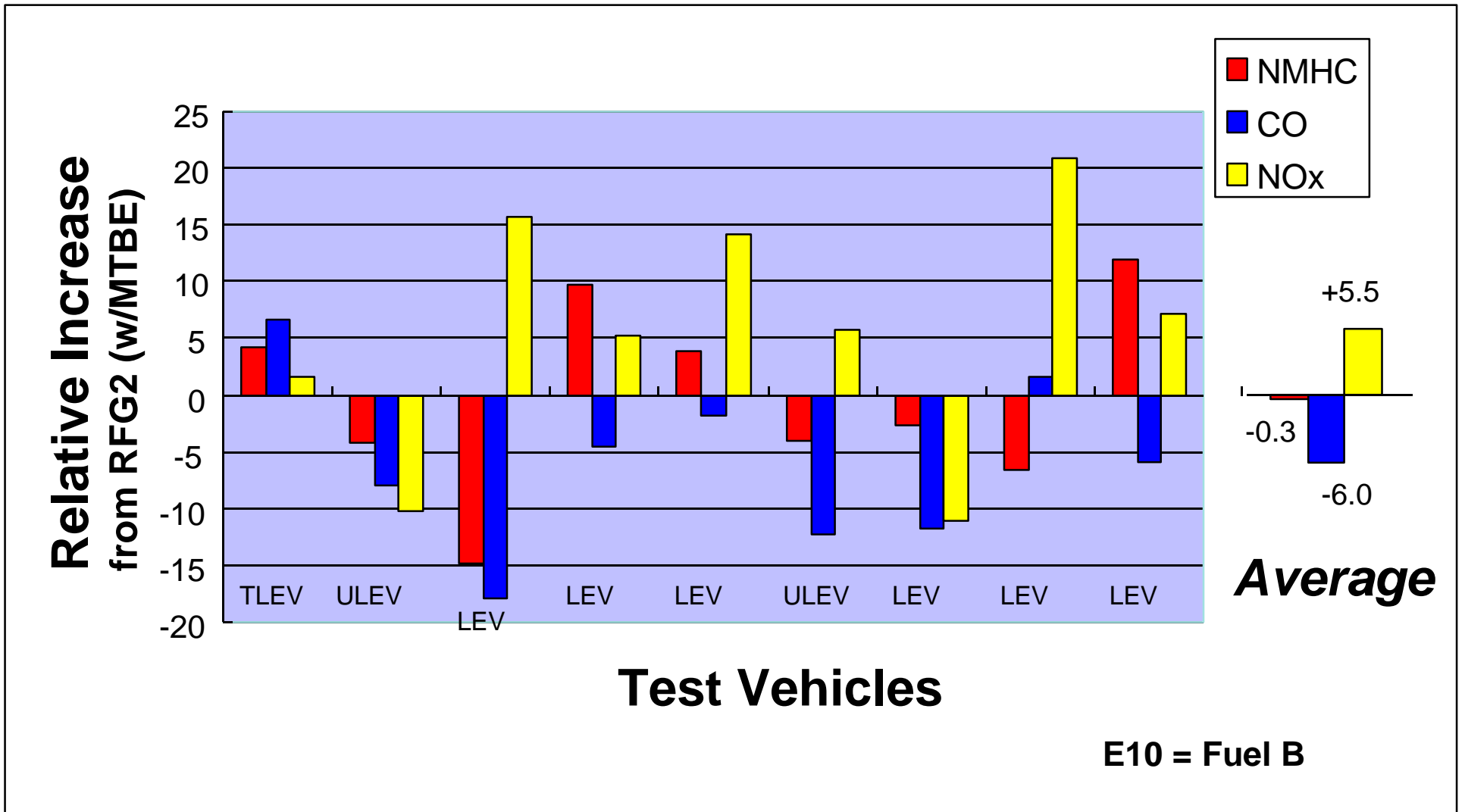
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# **I. Tailpipe Emissions**

## **II. Causes of Evaporative Emissions Increase**

1. Volatility
2. Permeation

# E10 Gasoline Effect on Tail-Pipe Emissions



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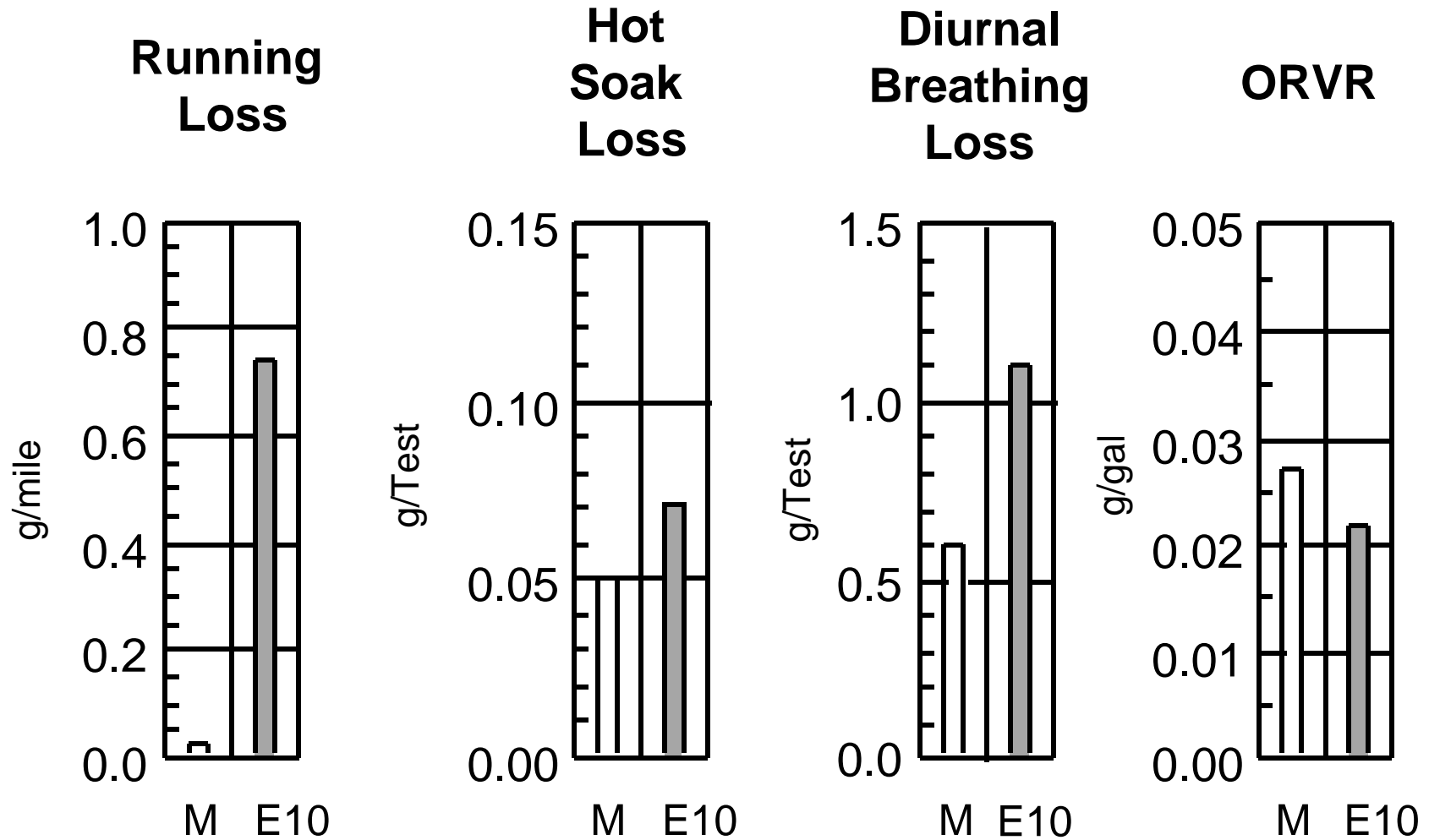
# **I. Tailpipe Emissions**

## **II. Causes of Evaporative Emissions Increase**

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# Results of Evap / ORVR Tests

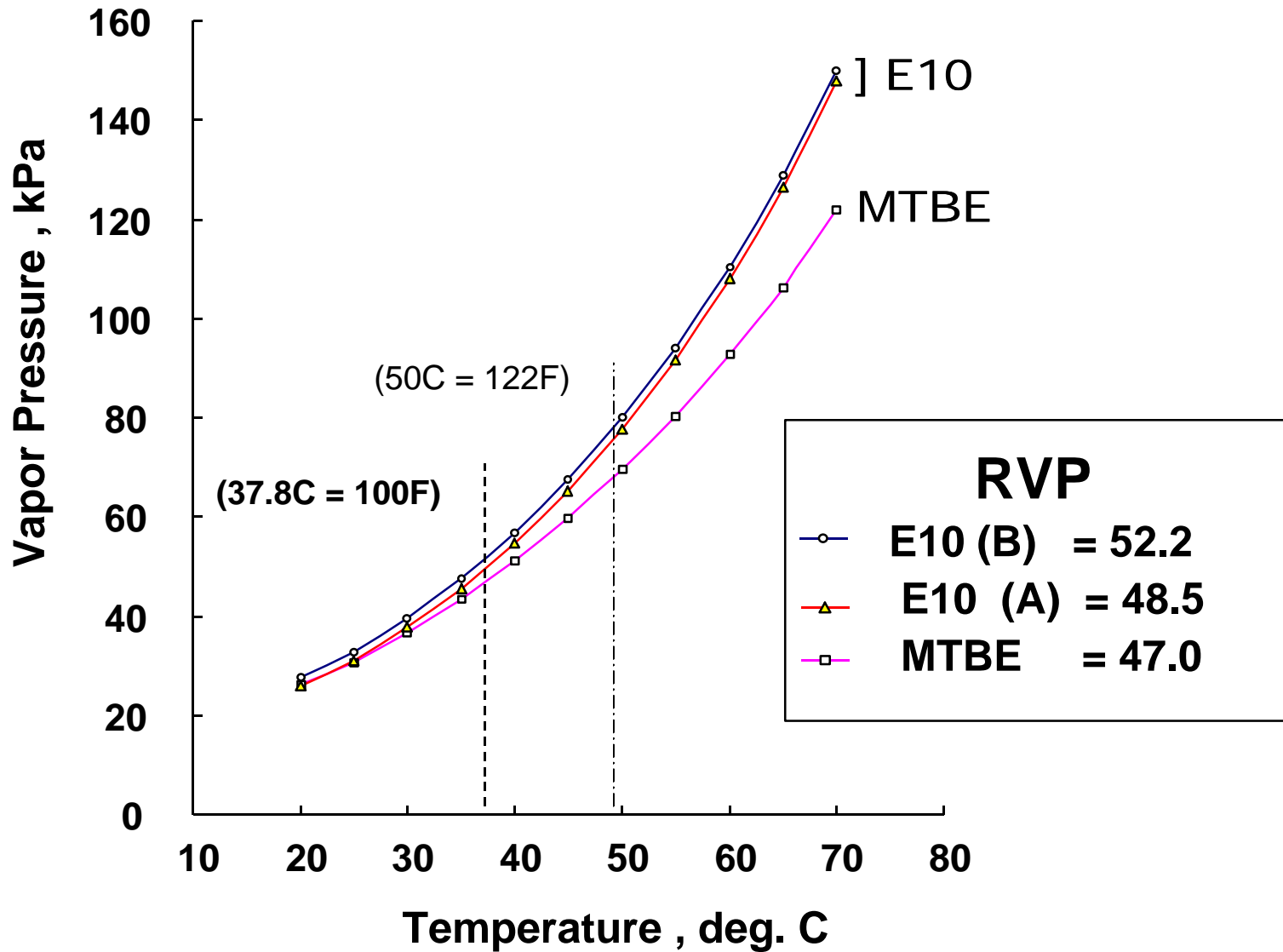


Key: M = MTBE  
E10 = Fuel B (high RVP)

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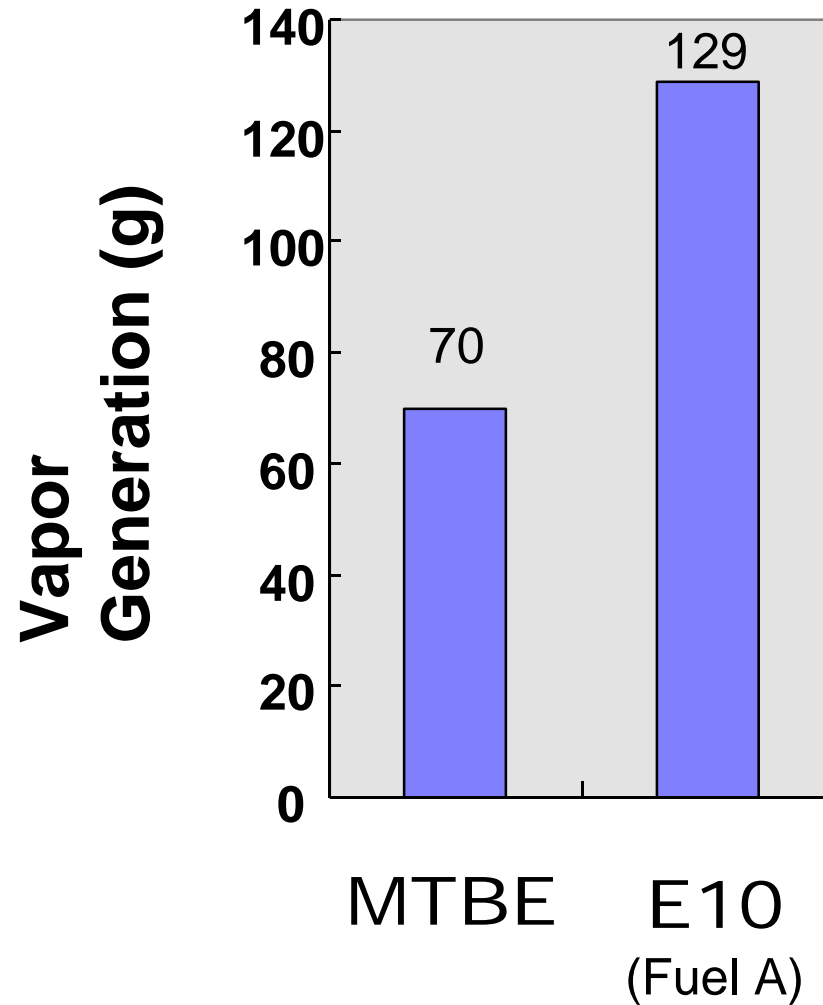


# Fuel Volatility Characteristics



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# Vapor Generation during Running Loss Tests



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# **I. Tailpipe Emissions**

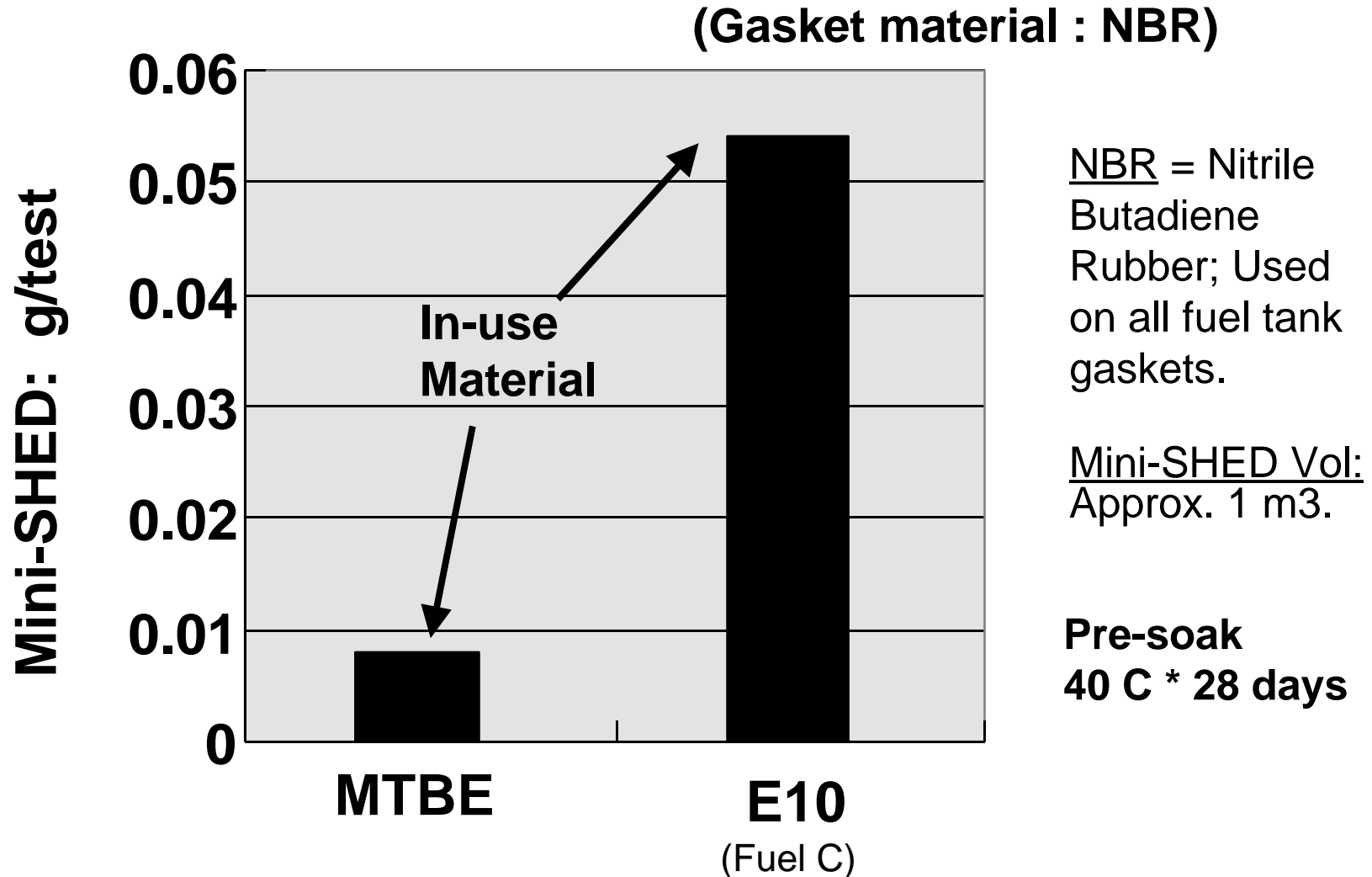
## **II. Causes of Evaporative Emissions Increase**

1. Volatility

2. Permeation

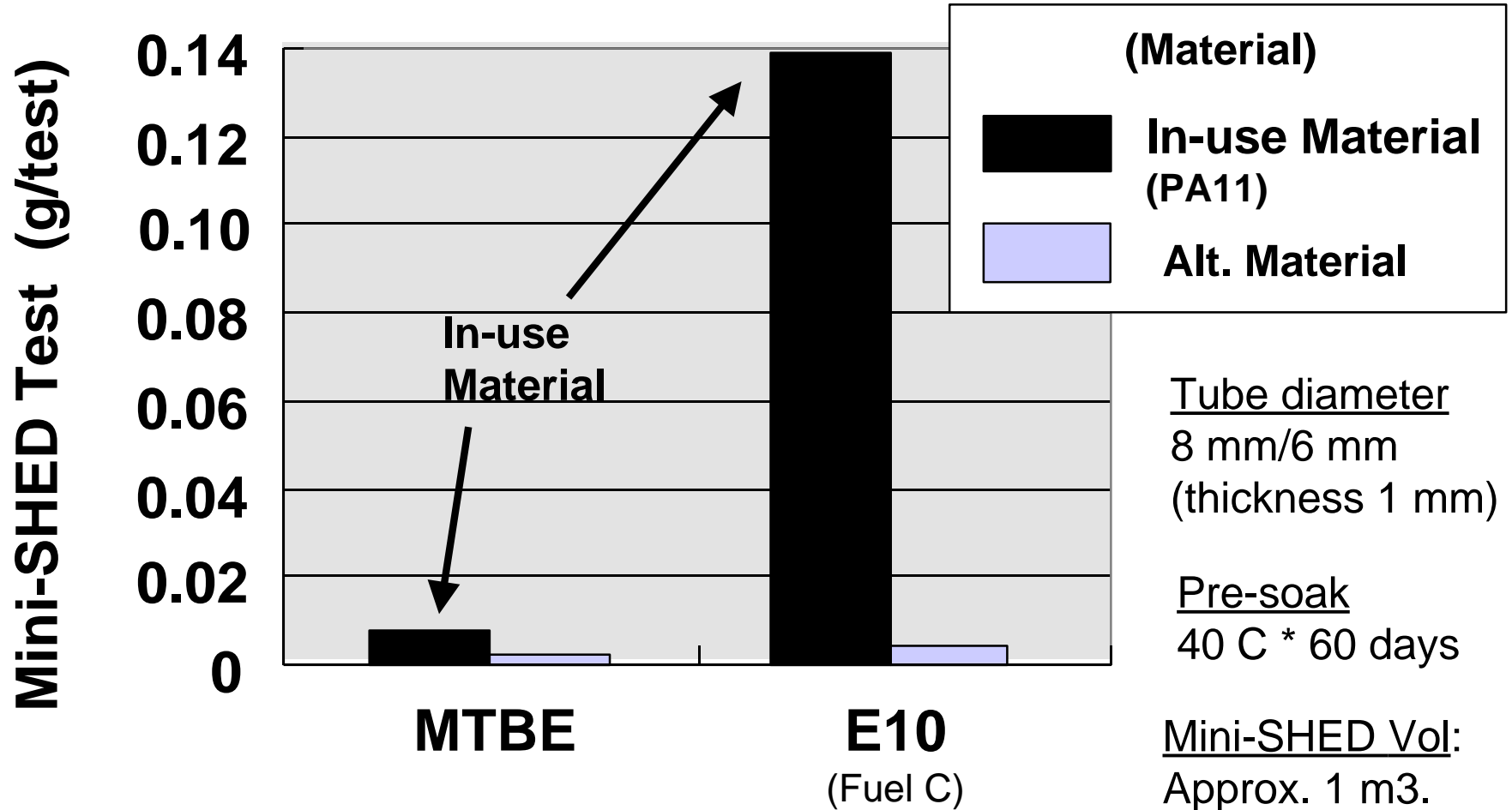
# Component Testing

## Permeation of Pump Sender Gaskets



# Component Testing

## Permeation of Plastic Fuel Tubes

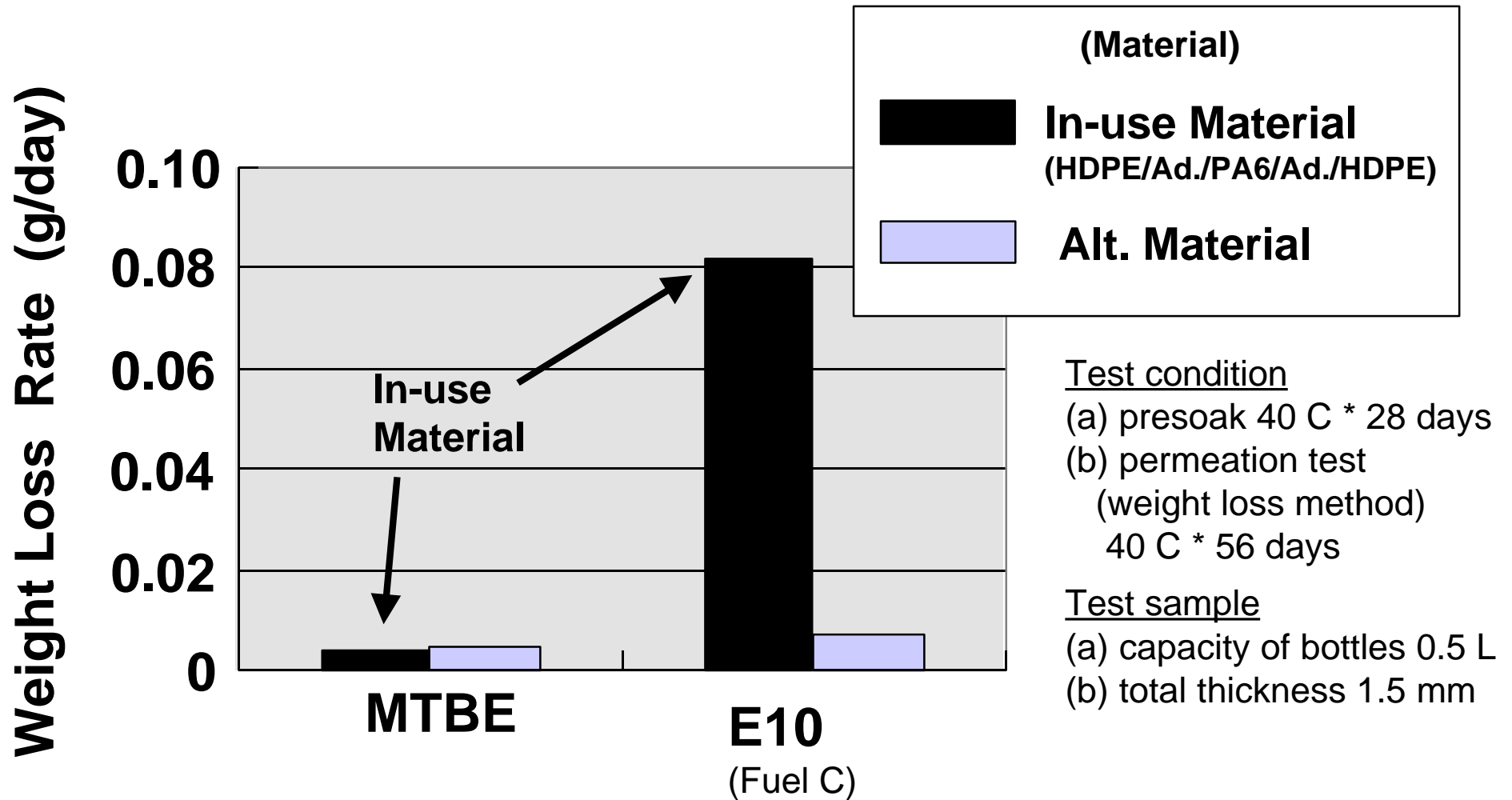


Alt. Material: ETFE/Ad./PA12 (Ad. = adhesive)

(PA = Poly Amid; ETFE = Ethylene Tetra Fluoro-Ethylene Copolymer)

# Component Testing

## Permeation of Plastic Bottles



Alt Material: HDPE/Ad./EVOH/Ad./HDPE (Ad. = adhesive)  
(HDPE = High Density Poly Ethylene; EV-OH = Ethylene Venyl Alcohol Copolymer)

# Summary of Ethanol Effects

	In-use Vehicles	Future Models
<b>Evaporative Emissions</b>	RL      ↑ HSL     ↑ DBL     ↑	Near-zero Emissions: <i>“Challenging”</i>  Zero Emissions: <i>“Very Difficult”</i>
<b>Permeation Effects</b>	Rubber            ↑ Plastic Tanks    ↑ Plastic Hoses    ↑	
<b>Tailpipe Emissions (Ave.)</b>	HC      -0.3% CO      -6.0% NOx     +5.5%	Requires re-calibration of engine controls

# Conclusions

**The use of ethanol will cause:**

- **Evaporative emissions to increase in comparison to MTBE.**
- **Significant increases of *in-use vehicle* evaporative emissions.**
- **Tailpipe emissions of NO<sub>x</sub> to increase.**

**More study is needed to determine the emissions effects of RFG3 with ethanol.**