CALIFORNIA ENERGY COMMISSION
TRANSPORTATION POLICY COMMITTEE
Workshop on the Fuel Efficient Tire Program (Assembly Bill 844)
December 7, 2007
10 am – 5 pm
1516 NINTH STREET, HEARING ROOM A
SACRAMENTO, CA

AGENDA

Opening Remarks
Jim Boyd, Vice Chair and Presiding Member, Transportation Committee
Jeff Byron, Commissioner and Associate Member, Transportation Committee

Background and Overview

Introduction - Ray Tuvell, CEC Staff

Synopsis of the Report of the Committee for the National Tire Efficiency Study – Dr. Marion Pottinger, M'gineering

Summary of the International Energy Agency Energy Efficient Tyres Workshop – Dr. Alan Meier, Lawrence Berkeley Lab

SAE Rolling Resistance Task Group Overview – Dr. Jim Popio, Smither's Scientific

Energy Commission Tire Testing Results – Bruce Lambilotte, Smither's Scientific

Michelin Corporation "Green Meters" - Michael Wischhusen, Michelin

US Tire Industry Perspective on AB844 Implementation – Tracey Norberg, Rubber Manufacturers Association

Moving Forward with California's Tire Efficiency Program – Luke Tonachel, National Resources Defense Counsel

General Public and Interested Parties Presentations, Questions, and Comments

Implementation of AB 844

CEC Process Description - Ray Tuvell, CEC Staff
Caryn Holmes, CEC Staff Counsel

Topics of Discussion:
Tire Rolling Resistance Test Protocol
Tire Manufacturer Reporting Requirements
Fuel Efficient Tire Rating System
Verification and Compliance

General Public and Interested Parties Presentations, Questions, and Comments

Adjourn
Vice Chair Jim Boyd

Synopsis of the National Tire Efficiency Study

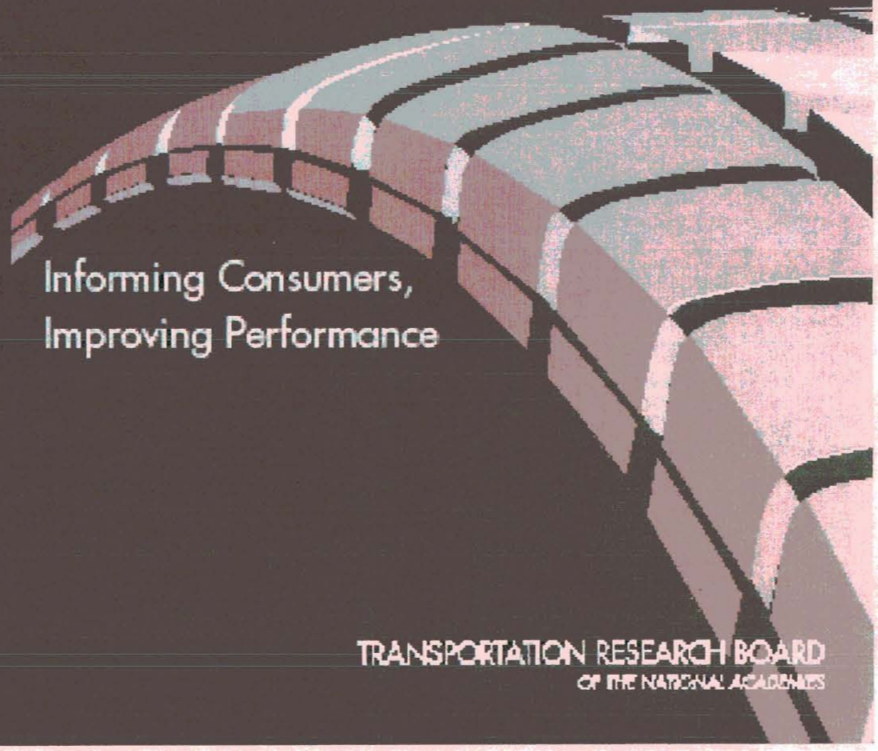
by

M. G. Pottinger
J. D. Walter
J. D. Eagleburger

TRB Special Report 286 TIRES AND PASSENGER VEHICLE FUEL ECONOMY

SPECIAL REPORT 286

TIRES AND PASSENGER VEHICLE FUEL ECONOMY



Informing Consumers, Improving Performance

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

CHARGE

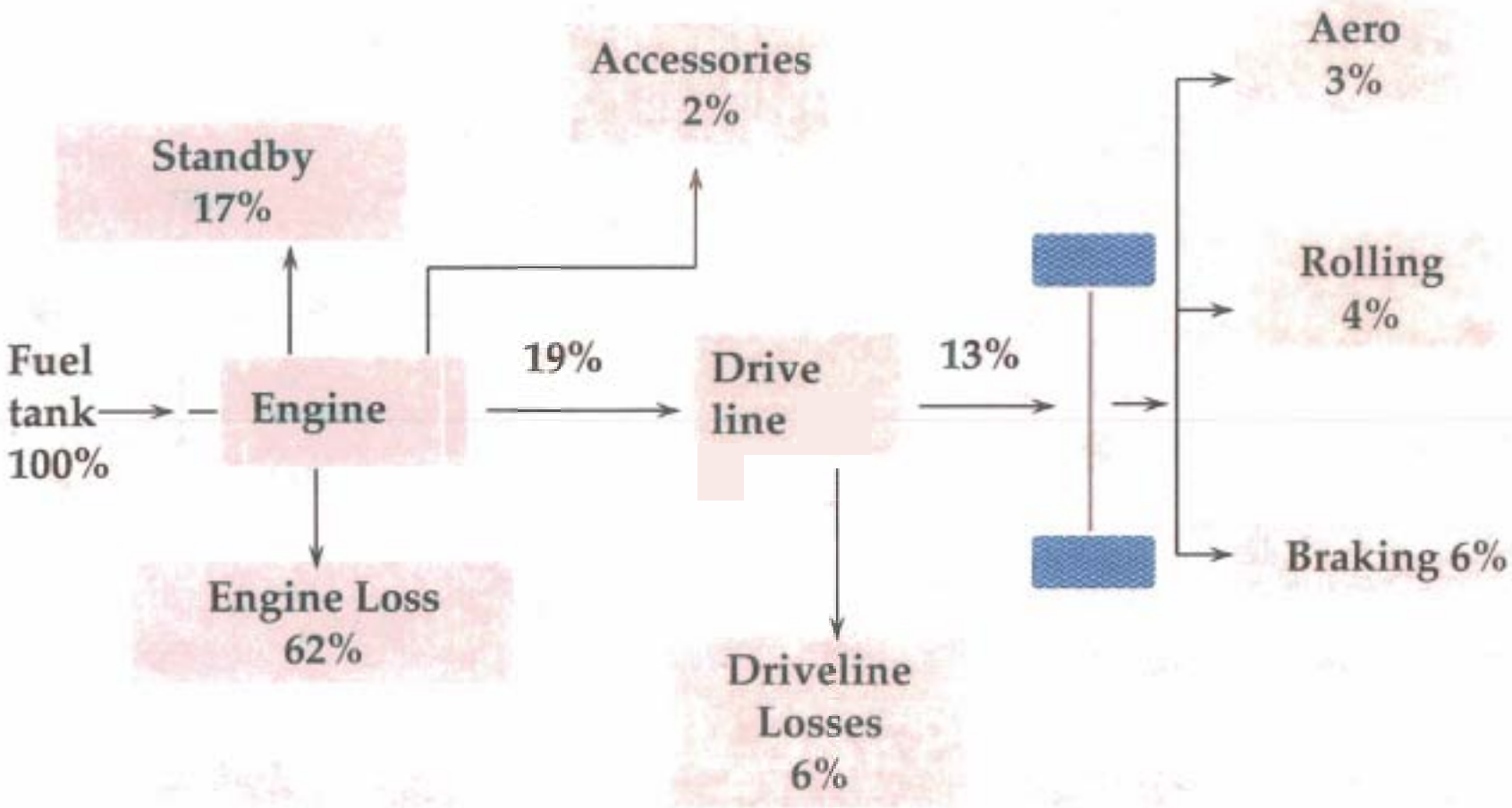
- Evaluate effects of lowering rolling resistance of replacement passenger tires on:
  - –Vehicle fuel consumption
  - –Tire wear and scrap tire generation
  - –Tire performance characteristics and highway safety
  - –Consumer spending on tires and fuel

OUTLINE OF PRESENTATION

- Fuel energy utilization in driving.
- Tire energy usage.
- Committee conclusions.
- Committee recommendation.

Where the energy goes

Urban Driving



Characterizing Tire Energy Usage

F_{RR} = POWER / VELOCITY
= N-m/sec • sec/m = N

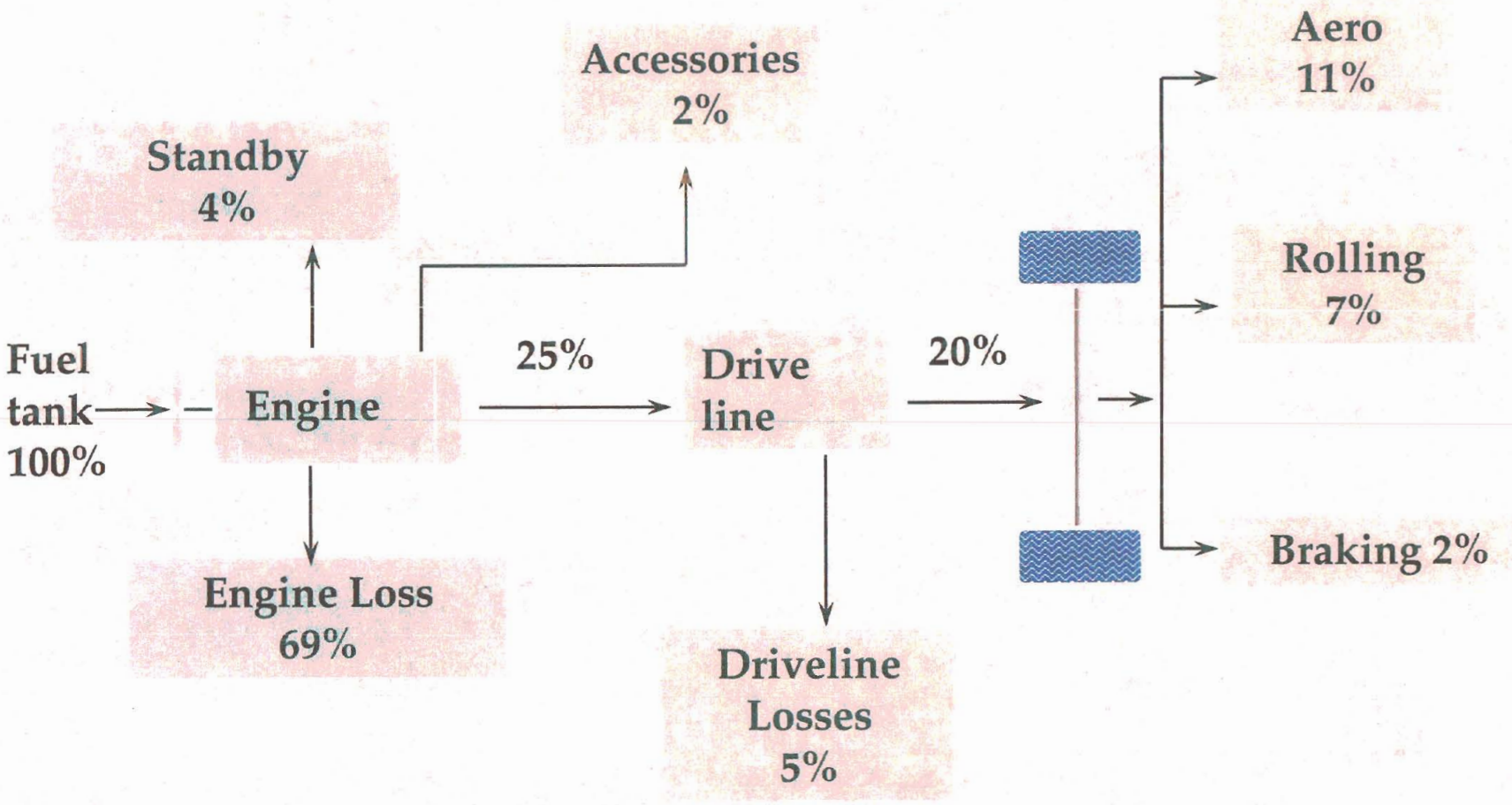
RRC = F_{RR} / LOAD = N/N

RRC = f (P, LOAD)

Velocity matters at speeds above the legal speeds in the USA.

Where the energy goes

Highway Driving



Conclusions

1. REDUCING ROLLING RESISTANCE OF REPLACEMENT TIRES IN FLEET BY 10% IS FEASIBLE

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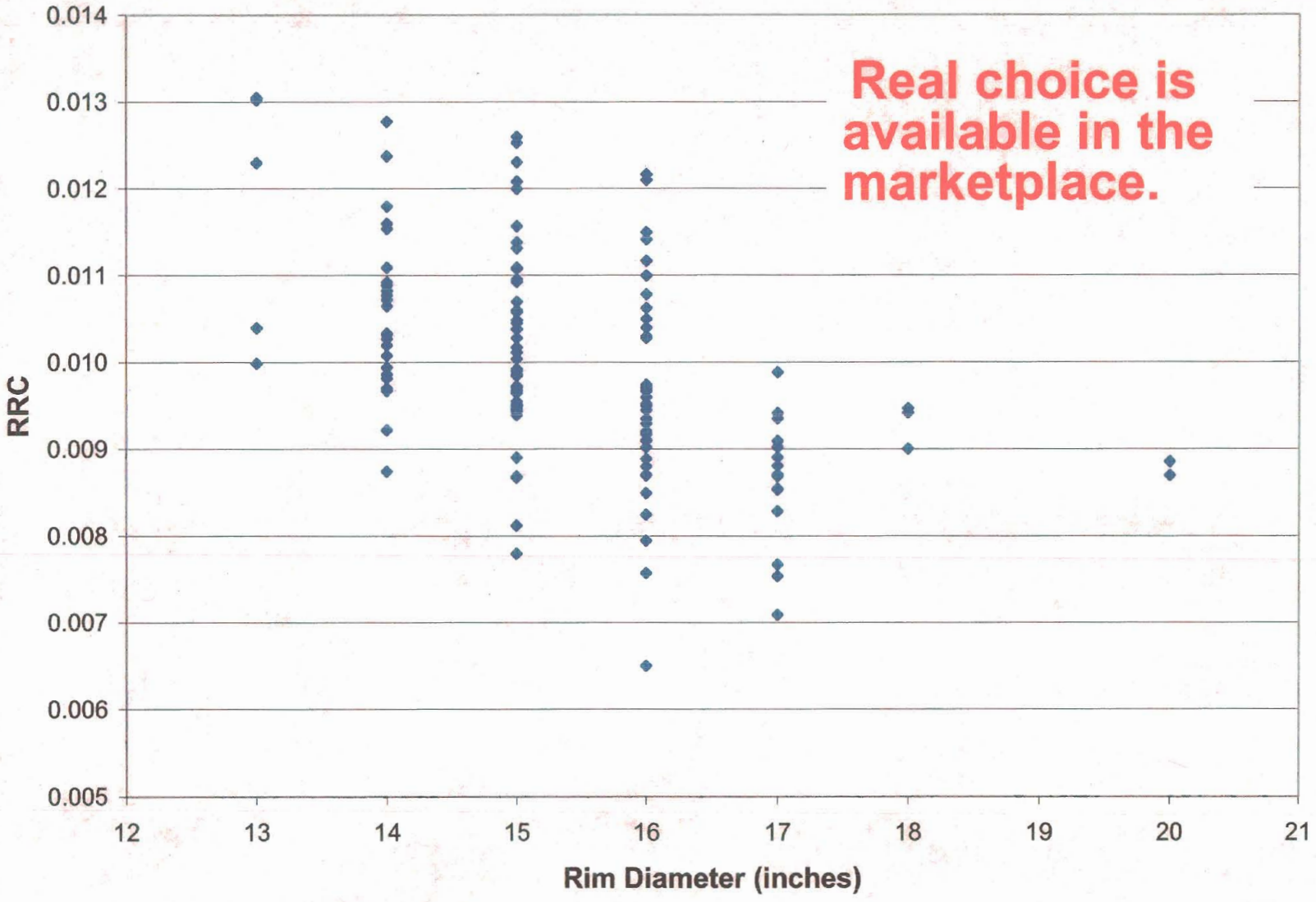
   - **Can change the mix of existing tires purchased.**

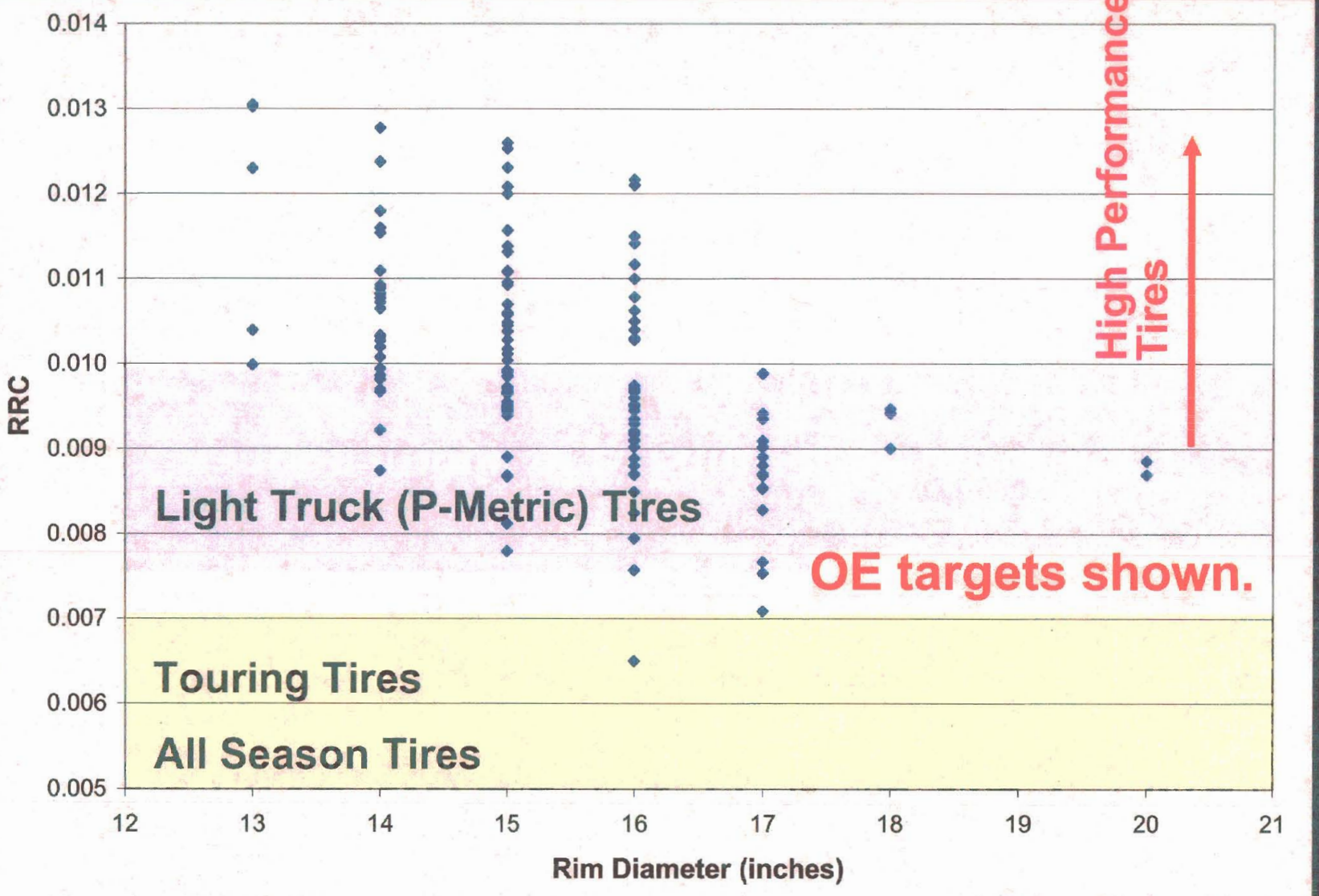
–RRCs for "A" Traction Rated Tires



Conclusions

1. REDUCING ROLLING RESISTANCE OF REPLACEMENT TIRES IN FLEET BY 10% IS FEASIBLE
   - **Changes in mix of existing tires purchased**
   - **Migration of OE tire technologies**

–RRCs for "A" Traction Rated Tires



Conclusions

1. REDUCING ROLLING RESISTANCE OF REPLACEMENT TIRES IN FLEET BY 10% IS FEASIBLE
   - **Changes in mix of existing tires purchased**
   - **Migration of OE tire technologies**
   - **If we all watched our inflation pressure, we could reduce operating rolling resistance by an average of about 5% right now.**

2. ROLLING RESISTANCE HAS A MEANINGFUL EFFECT ON FUEL ECONOMY

- 10% reduction in rolling resistance will improve fuel economy by 1 to 2 %

Models of Effect on MPG from 10% Change in RRC (base = 0.008)

	RRC down 10%		RRC up 10%	
	City Mpg	Hwy Mpg	City Mpg	Hwy Mpg
GM	+1.1	+1.6	-1.4	-1.9
NETL	+0.7	+2.0	-0.7	-1.7
Ross	+1.0	+1.9	-1.0	-1.9
EEA	+1.3	+2.0	-1.3	-1.9

1 to 2% change in mpg is reasonable rule of thumb.

2. ROLLING RESISTANCE HAS A MEANINGFUL EFFECT ON FUEL ECONOMY

- 10% reduction in rolling resistance will increase fuel economy by 1 to 2 %
- 80 percent of passenger vehicles have replacement tires.
- Each 1% improvement in fuel economy of these vehicles will save ~1 billion gallons (23.8 million barrels) of fuel annually.
- The 10% reduction in replacement tire rolling resistance would have an effect like reducing the number of cars and light trucks on the road by about 2 to 4 million vehicles.

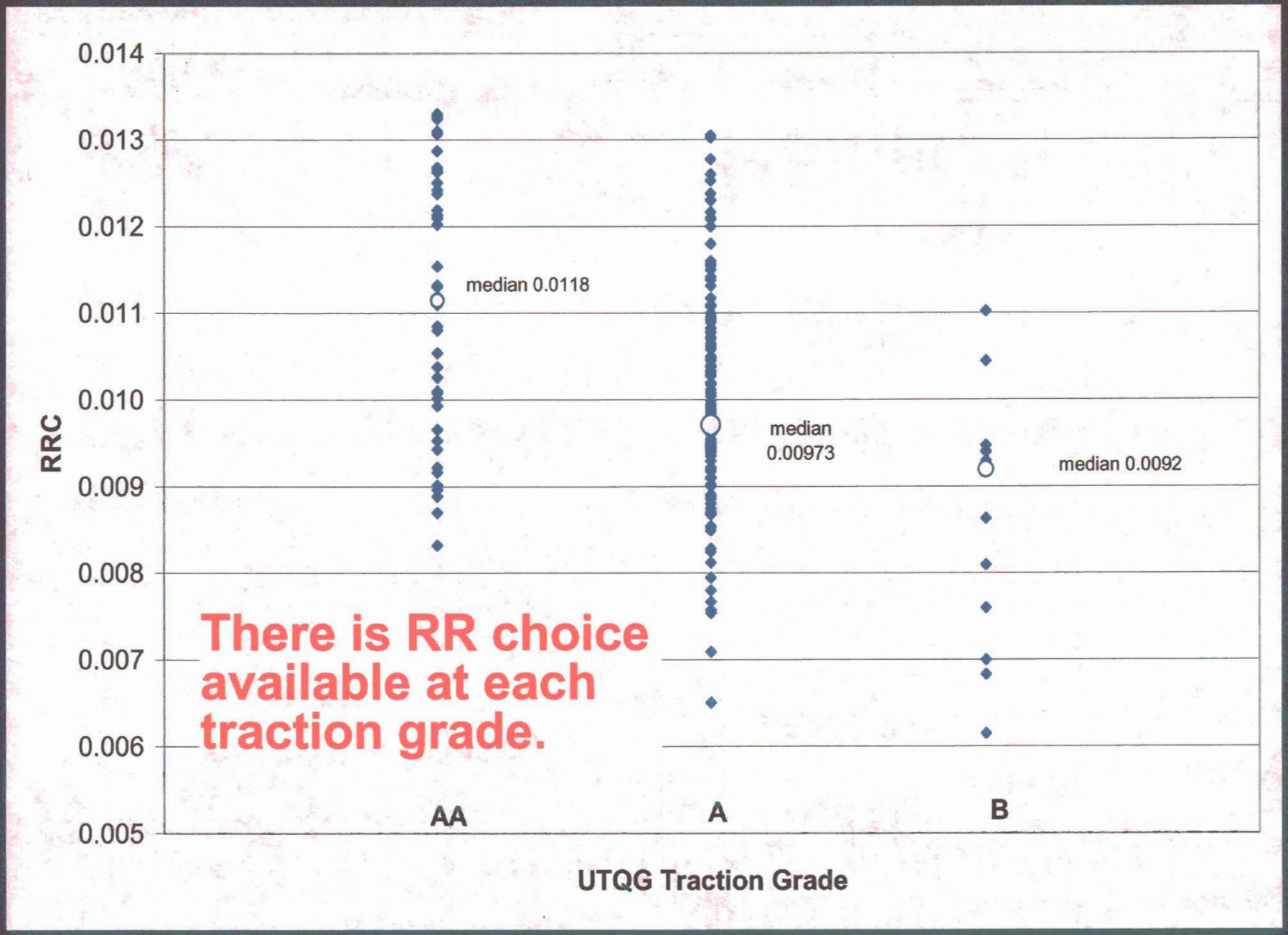
3. EFFECT ON TIRE WEAR LIFE UNCLEAR: *BECAUSE ROLLING RESISTANCE CAN BE REDUCED IN DIFFERENT WAYS*

- **Tread compound and mass are major determinants of rolling resistance**
- **Promising: Improved tread compounds that reduce rolling resistance without reducing wear life.**
- **Not promising: Building tires with less tread material is not a good idea in general.**

4. TRACTION CHARACTERISTICS MAY BE AFFECTED, BUT SAFETY CONSEQUENCES UNDETECTABLE

- Changes are routinely made to tires that can affect traction to some extent.
- Few studies/data available linking large changes in tire traction capability with crashes. Thus, not possible to detect the impact of incremental changes in traction associated with changes to reduce rolling resistance.
- Reducing RRC and maintaining generally acceptable traction is feasible

RRC by UTQG Traction Grade



5. REDUCING AVERAGE RR OF REPLACEMENT TIRES PROMISES NET SAVINGS TO CONSUMERS

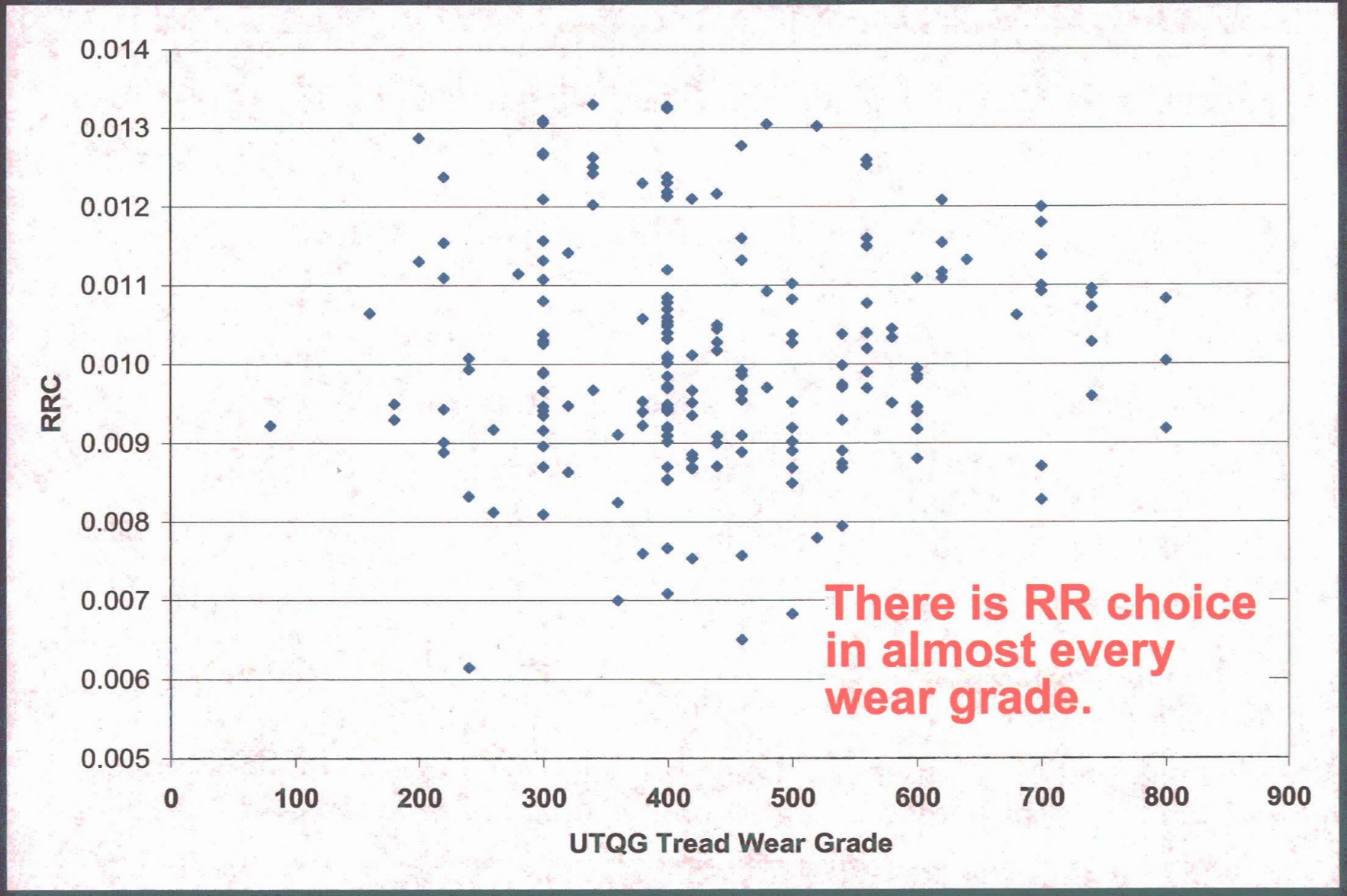
- 1 to 2% savings in fuel = $18 to $36 per year in avg. fuel savings. $3 to $6 billion nationally.

  The $ numbers are based on $3 per gallon fuel. ??!

- New technologies may add $1 to $2 per to price of a tire. Increase consumer tire spending by $1 to $2 per year.

- Important that tire wear life is not shortened in the current tire industry business model due to the choice of RR reduction technologies.

All passenger tires



RECOMMENDATION

- Congress should authorize and provide resources to NHTSA to:
  - **Gather and report information on the influence of passenger tires on vehicle fuel economy.**
  - **Information should be made widely available and easy to understand by tire buyers and sellers.**
  - **It should cover a large portion of passenger tires sold with respect to sizes, models, and types.**

Recommendation Details

- Consult with EPA on ways to convey the information to consumers.
- Seek participation by entire tire industry.
- Periodically review the initiative's:
  - Utility to consumers
  - Industry cooperation
  - Contribution to national energy goals
- Accompanied by efforts to promote tire inflation maintenance.

HOW WILL CONSUMERS RESPOND?

- **ROLLING RESISTANCE INFORMATION IS NOT AVAILABLE TO TIRE CUSTOMERS TODAY.**
- **The committee didn't know how individual tire purchasers will respond.**
- **No major price differences observed among similar tires with different RR. The committee hoped that this will spur interest in buying lower RR tires.**


Thanks,
Any Questions?

Energy Efficient Tyres: Improving the On-Road Performance of Motor Vehicles - An IEA Workshop 2005

Alan Meier

Lawrence Berkeley National Laboratory

akmeier @ lbl.gov

Background to Workshop

- G8 to IEA: "tell us how to save energy"
- Transport: find areas that would benefit from international collaboration
- Focus on "off-test" fuel consumption
- Series of workshops
  - Tires
  - Cooling cars with less fuel (AC)
  - Trucks

Over 50 Participants

- Tire manufacturers
- Manufacturers associations
- Other related industries (Rhodia, Schrader)
- Governments (US DOE, CEC, European Union, France, Germany)
- NGOs, Universities, Consultants

Developments

- Largest presentation of rolling resistance data from manufacturers, governments, NGOs
- Two separate tire markets, OE and replacement
  - Difference greater in USA than in Europe (for now)
  - European regulations allow greater wiggle-room on new cars
- Labeling
  - Several schemes proposed and demonstrated to be technically feasible
  - Individual efforts by manufacturers unsuccessful
- No independent data on costs of achieving further reductions in rolling resistance

Tire Rolling Resistance Measurements

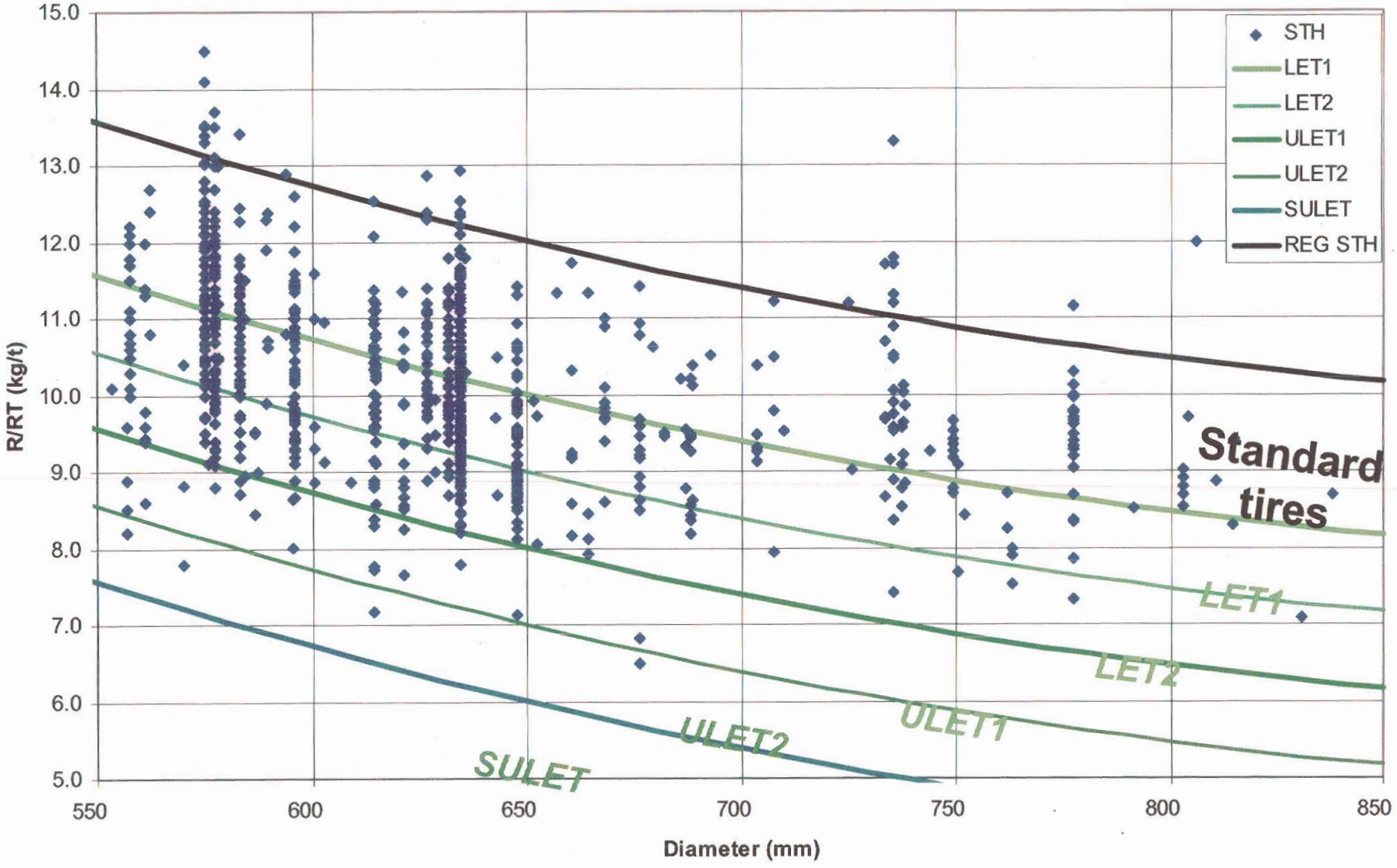
	Rolling Resistance (kg/tonne)	
Passenger Cars (For new cars & Replacements)	14	7
Trucks & Busses	8.5	5.5

Notes: Measurements made in EU countries

RR for average tire is probably around 12

Source: Michelin (at IEA workshop)

Low Energy Tires Definition



Sense of Group

- Internationally harmonized test method for rolling resistance was within grasp
- Some manufacturers supported establishing mandatory efficiency levels
- Manufacturers should not be forced to create fuel-efficient tires by sacrificing other performance characteristics
- Incremental cost of low RR tires probably recovered in fuel savings
- Responsibility for fuel-efficient tires is so dispersed that it could be called a “regulatory failure”

Impacts

- EU's efficiency plan (2006) "…*The Commission will issue a mandate for a recognised European Norm and possible international standard for maximum rolling resistance limits and labelling for road vehicle tyres….*"
- European manufacturers support standards for rolling resistance (but linked to TPRMs)
- National Academy Study

SAE Rolling Resistance Task Group Overview

December 7, 2007

Task Group Charter

- Initiated by a report to SAE: Highway Tire Forum Committee April 4, 2006
  - Pottinger, M.G. and Luchini, J.D., "Comparison of and Issues Between the SAE Rolling Resistance Test Recommended Practices," International Tire Engineering Conference, Akron, OH, Sept. 2006
- Task Group Created April 4, 2006 by action of HTFC
- Group Membership
  - Dr. James A. Popio - Chairman
  - 23 participating task group members
  - 19 organizations
- Charter
  - Task Group to investigate the fidelity and application of SAE J1269 and J2452
    - Identify and address any discrepancies in and between J2452 & J1269
    - Single Point Testing
  - Identify and form subgroups as required
  - Propose any updates or revisions

SAE Recommended Practice J1269

- ***Foreword***—This SAE Recommended Practice provides methods for determining rolling resistance of passenger car, light truck, and highway truck and bus tires under controlled conditions.
  - The procedure is intended to provide a way of gathering data on a uniform basis, to be used for various purposes (for example, tire comparisons, determination of load or pressure effects, correlation with test results from fuel consumption tests, etc.).
- ***Scope***—This SAE Recommended Practice applies to the laboratory measurement of rolling resistance of
  - Pneumatic passenger car
  - Light truck
  - Highway truck and bus tires.

SAE Recommended Practice J2452

- ***Foreword***—This SAE Recommended Practice establishes a laboratory method for determination of tire rolling resistance of Passenger Car and Light Truck tires.
  - Provides a standard for collection and analysis of rolling resistance data with respect to vertical load, inflation pressure, and velocity.
  - Intent is for estimation of the tire rolling resistance contribution to vehicle force applicable to SAE Vehicle Coastdown recommended practices J2263 and J2264.

- ***Scope***—This SAE Recommended Practice is applicable to pneumatic Passenger Car "P" Type, Light Truck Metric, and Light Truck High Flotation tires, or similar tires approved by bodies other than Tire & Rim Association.
  - The methodology is applicable within normal operating ranges of vertical load and inflation pressure, and for velocities between 115 km/h and 15 km/h (71 mph and 9 mph) during a relatively short duration event such as a coastdown.
  - This procedure is applicable only to operation in the free-rolling mode at zero slip and camber angle for ambient temperatures between 20 °C and 28 °C (68 °F and 82 °F) and for surfaces with diameters of 1.2 m (48 in) diameter or greater.

Task 4 Rolling Resistance Testing:

California Energy Commission's Fuel Efficient Tire Program

Workshop on The Fuel Efficient Tire Program

Bruce Lambillotte

07December07

Smithers Scientific Services, Inc.

Rolling Resistance Testing:

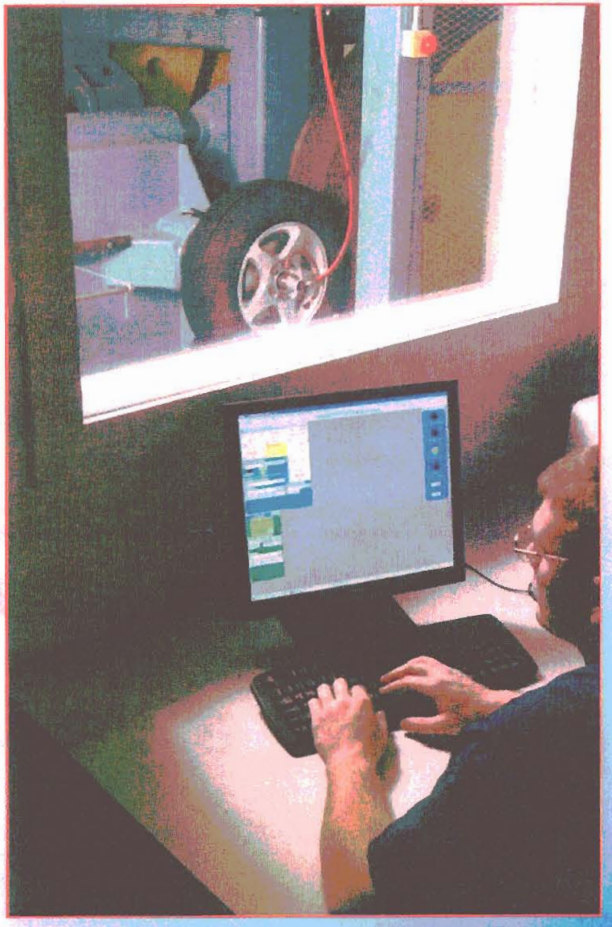
California Energy Commission's Fuel Efficient Tire Program

- **Discussion**

  → Task 2: Selection of Testing Protocol

  → Task 3: Tire Selections for Task 4

  → Task 4: Rolling Resistance Testing
  - Goals
  - Results
  - Tire Size Impact Study



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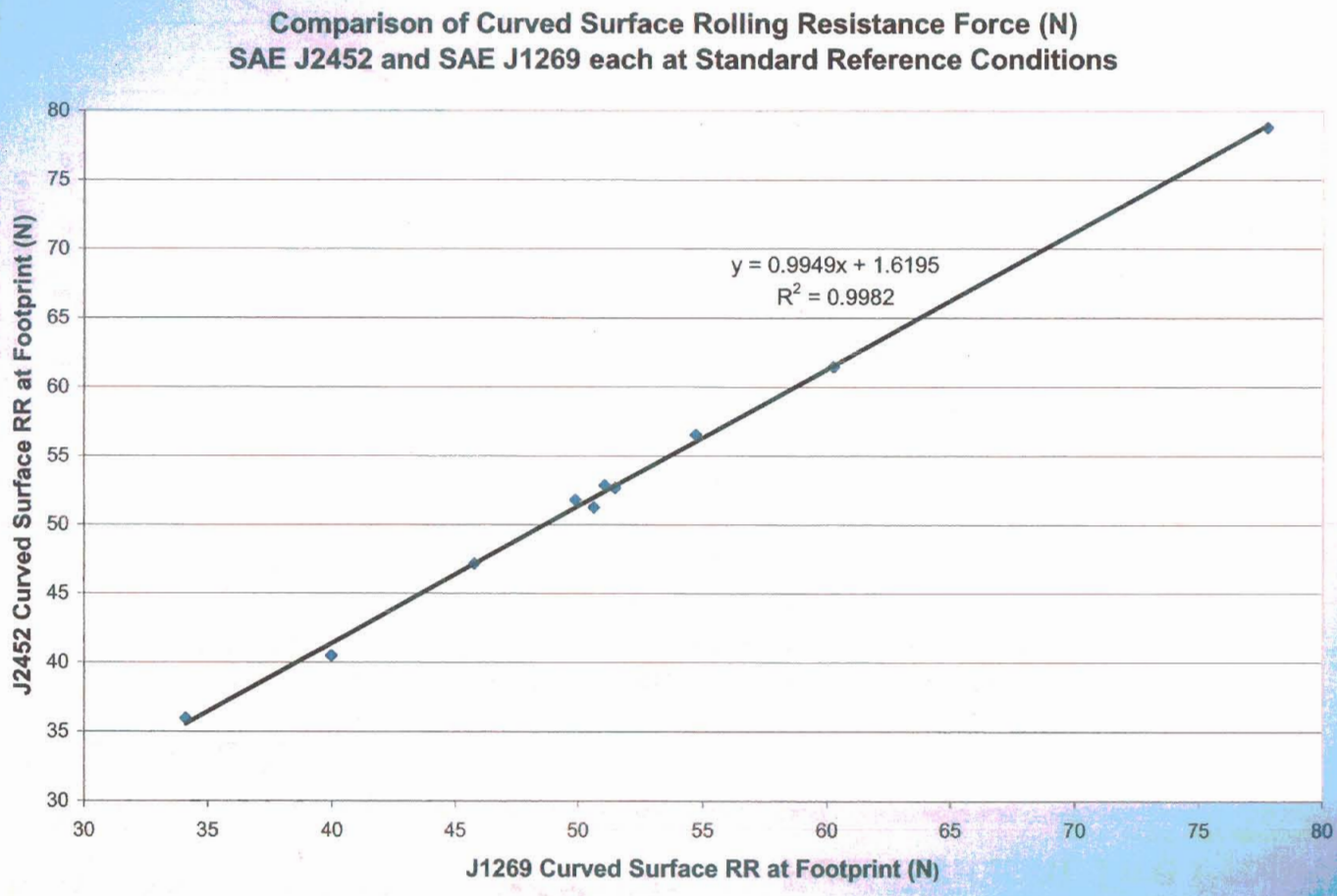
Rolling Resistance Testing: California Energy Commission's Fuel Efficient Tire Program

Task 2: Results



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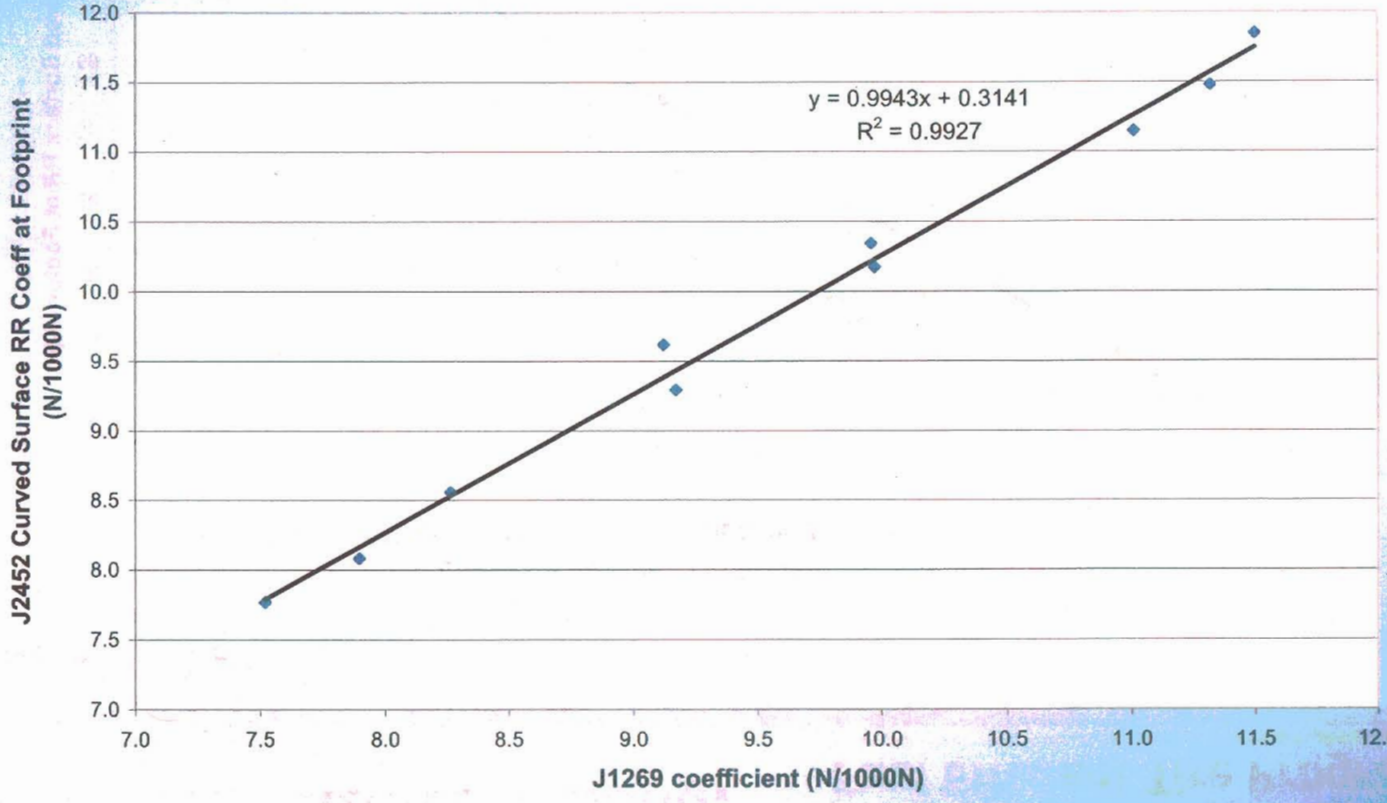
Rolling Resistance Testing: California Energy Commission's Fuel Efficient Tire Program

Task 2: Results

Comparison of Rolling Resistance Coefficients (N / 1000N)
SAE J2452 and SAE J1269 each at Standard Reference Conditions



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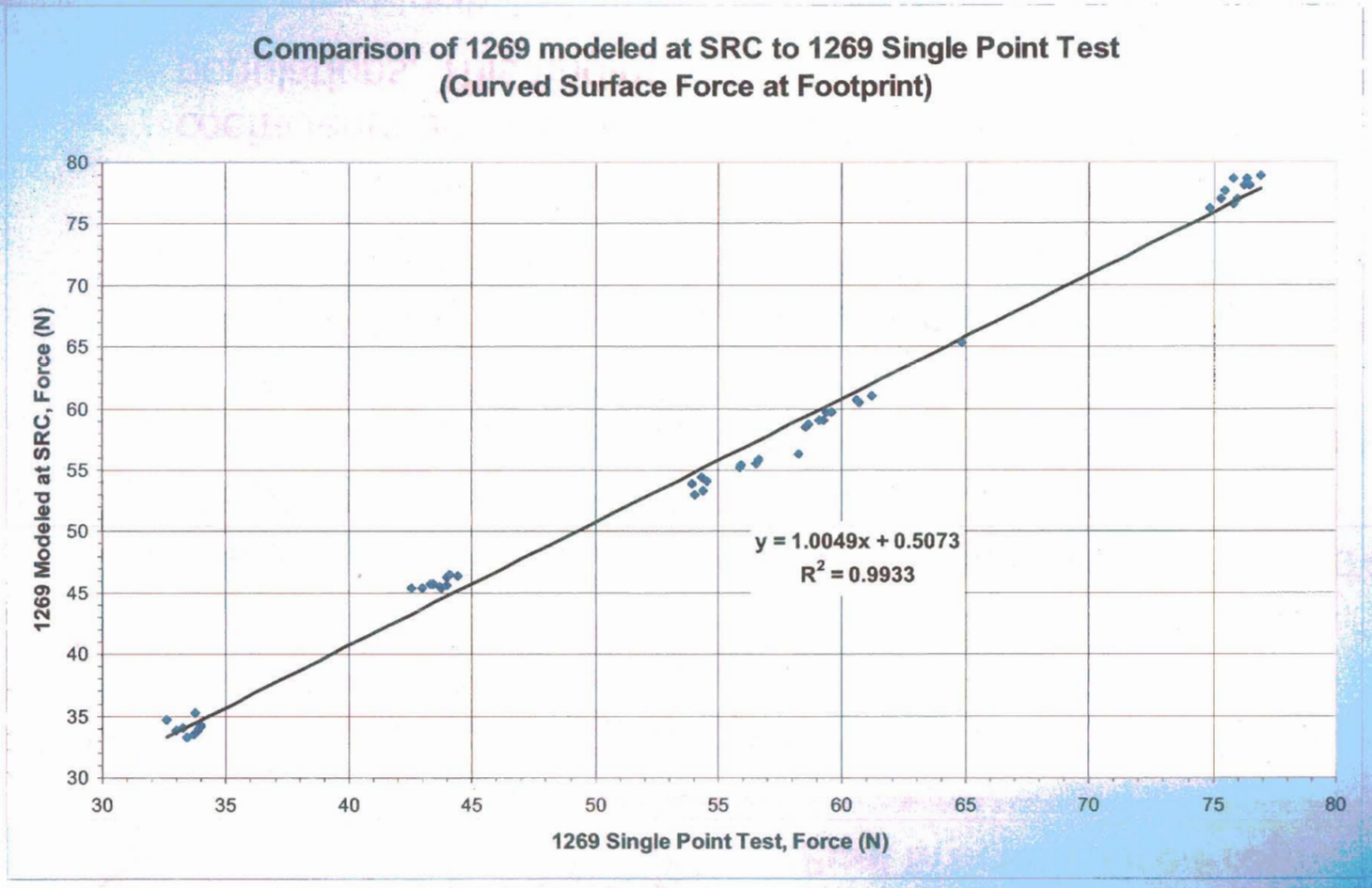
Rolling Resistance Testing: California Energy Commission's Fuel Efficient Tire Program

Task 2: Results



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- Task 2: Selection of testing protocol

  →Findings

  - The SAE J1269 and SAE J2452 results were well correlated for the populations of tires used for the subject study.
    - Rolling resistance forces correlated well between the two tests.
    - Calculated rolling resistance coefficients correlated well between the two tests.
  - Rolling resistance force values and rolling resistance coefficients did not mutually correlate for diverse tire populations. This finding was true for both SAE test protocols.
  - Test reproducibility, as based upon comparisons of coefficients of variations, indicated good reproducibility and similar levels of reproducibility between the two tests.

- Task 2: Selection of testing protocol

  → Findings (continued)

  - Within the confines of the design of the Task 2 test program, neither test revealed any key technically discriminating issues that would represent a deciding factor in its selection or rejection as the preferred protocol to be used in Task 4.
  - Both protocols offer the opportunity to narrow the procedure scope to standard reference conditions, which would allow significant test efficiencies to be achieved.
  - Decision: select single-point test guided by SAE J1269 for Task 4.

Rolling Resistance Testing: California Energy Commission's Fuel Efficient Tire Program

- Task 3: Tire selection phase for Task 4 rolling resistance studies;

  Selection Criteria

  - regular production
  - OE and replacement
  - include all commonly-available speed ratings
  - include all commonly-available market types
    - ✔ touring
    - ✔ all season
    - ✔ high performance; etc
  - broad variety of manufacturers
  - U.S. and international manufacturers
  - two major sizes selected for 80% of Task 4 testing
  - tire size impact study criteria:
    - ✔ broad market replacement tires
    - ✔ standard all season
    - ✔ many sizes available

Rolling Resistance Testing: California Energy Commission's Fuel Efficient Tire Program

- Task 3: Tire selection phase for Task 4 rolling resistance studies;

Test Plan Summary

→ Test Schedule: 740 Tires Total

- Size A: P195(195)/65R15
  - 76 groups of manufacturer/design combinations
  - 5 tires per group
- Size B: P265(265)/70R17
  - 44 groups of manufacturer/design combinations
  - 5 tires per group
- Tire size impact study
  - all primary sizes (28 sizes) from a single manufacturer
  - 5 tires per size

Task 4: Rolling Resistance Studies

→Goals

- generate a broad rolling resistance data base representing two example sizes
- provide direction for the question: "With the large number of tire designs available in the marketplace for a given size, what can be expected as a distribution of rolling resistance values?"
- can the consumer relate basic, external tire characteristics (i.e. tire weight, outside diameter, UTQG treadwear ratings, tread depth, price) to rolling resistance?
- how do original equipment (OE) vs. replacement market tires compare for rolling resistance?
- how do size differences within a single manufacturer's product line compare for rolling resistance?

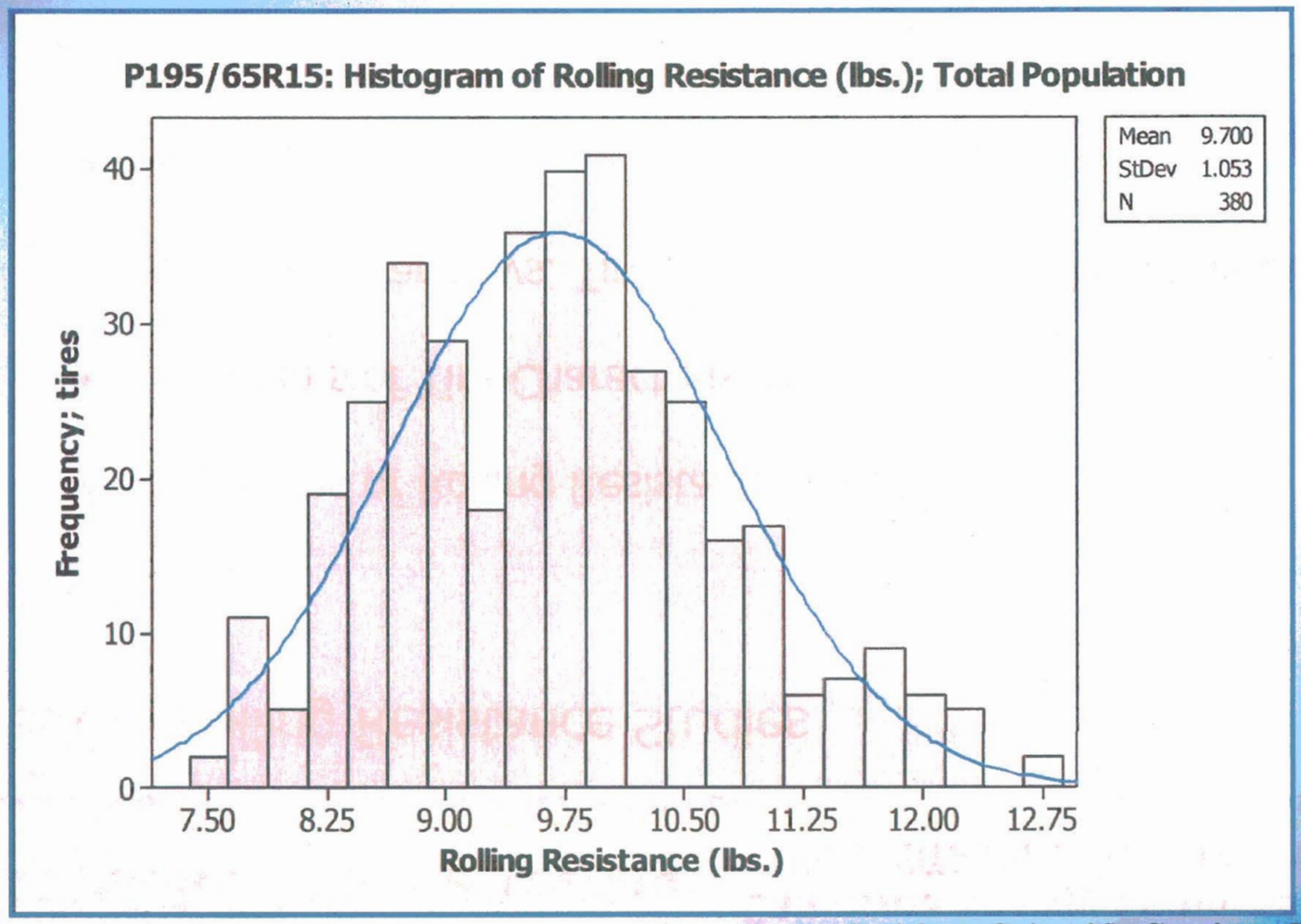
- Task 4: Rolling Resistance Studies

→Results

- Histograms of Rolling Resistance Values
- Histograms of Tire Characteristics
- Rolling Resistance vs. Tire Characteristic Correlation Studies
- Size Impact Study

Rolling Resistance Testing: California Energy Commission's Fuel Efficient Tire Program

- **Task 4: Results- Histograms of Rolling Resistance Values**



Rolling Resistance Testing: California Energy Commission's Fuel Efficient Tire Program

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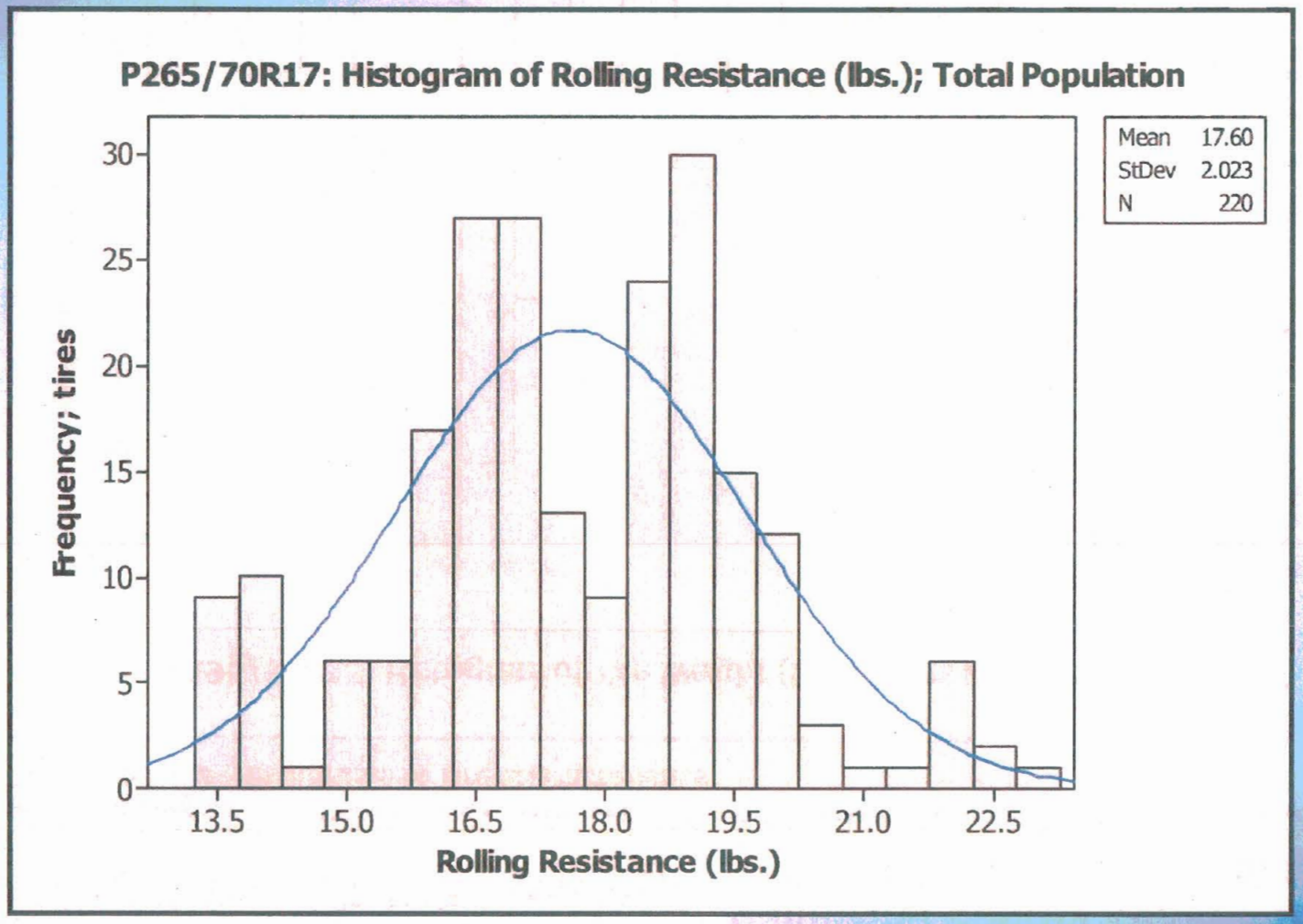

Rolling Resistance Testing: California Energy Commission's Fuel Efficient Tire Program

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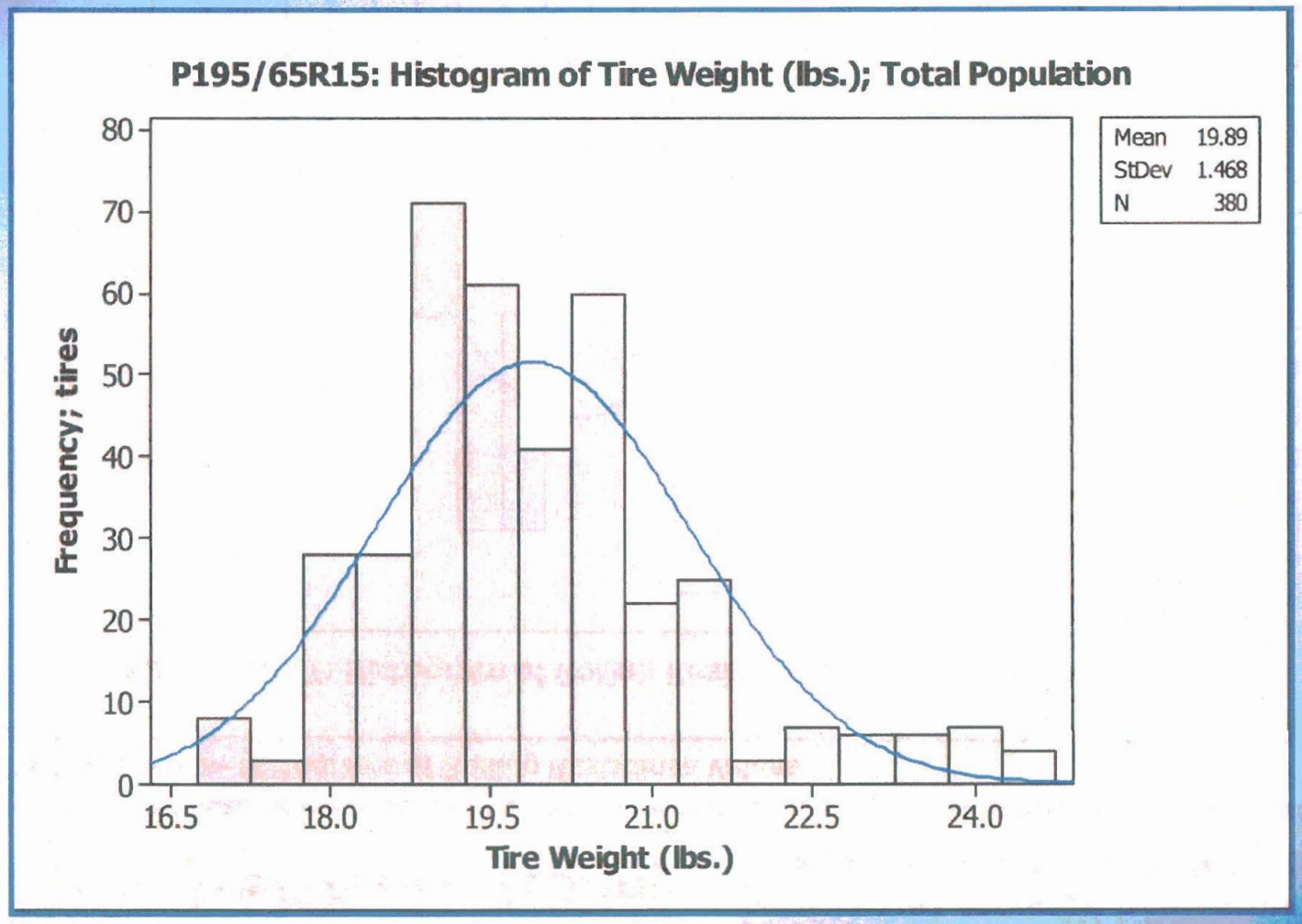

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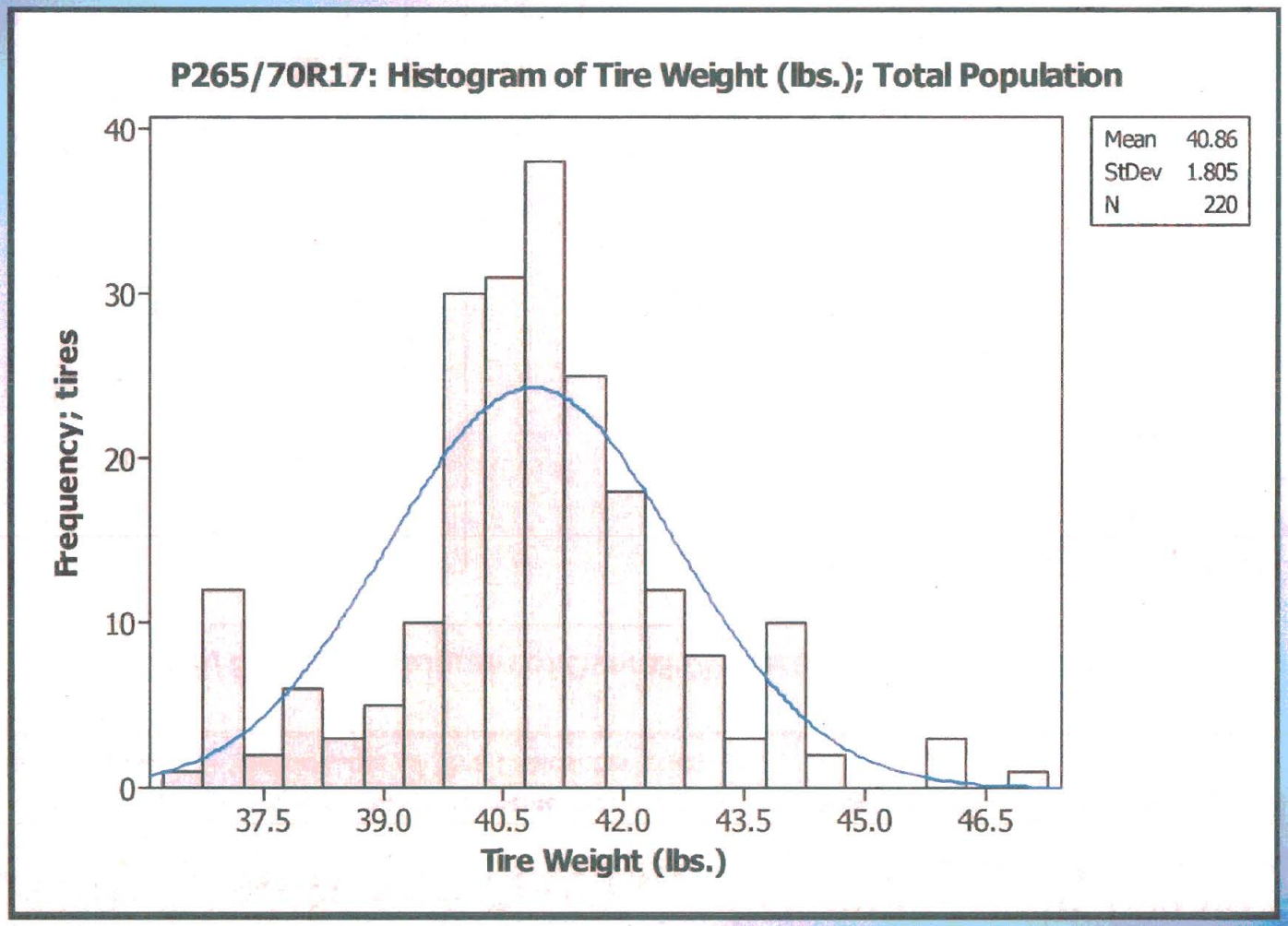

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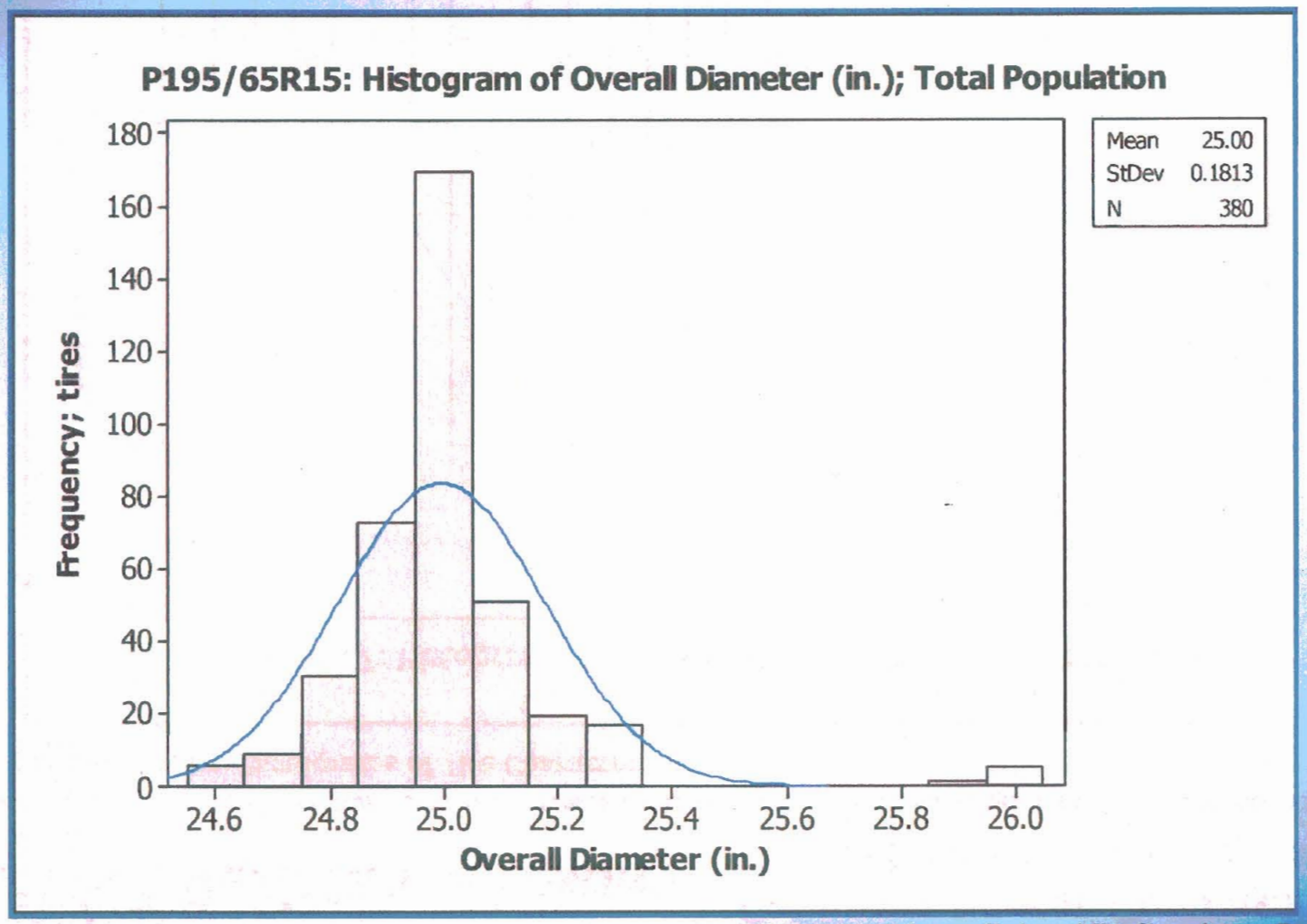

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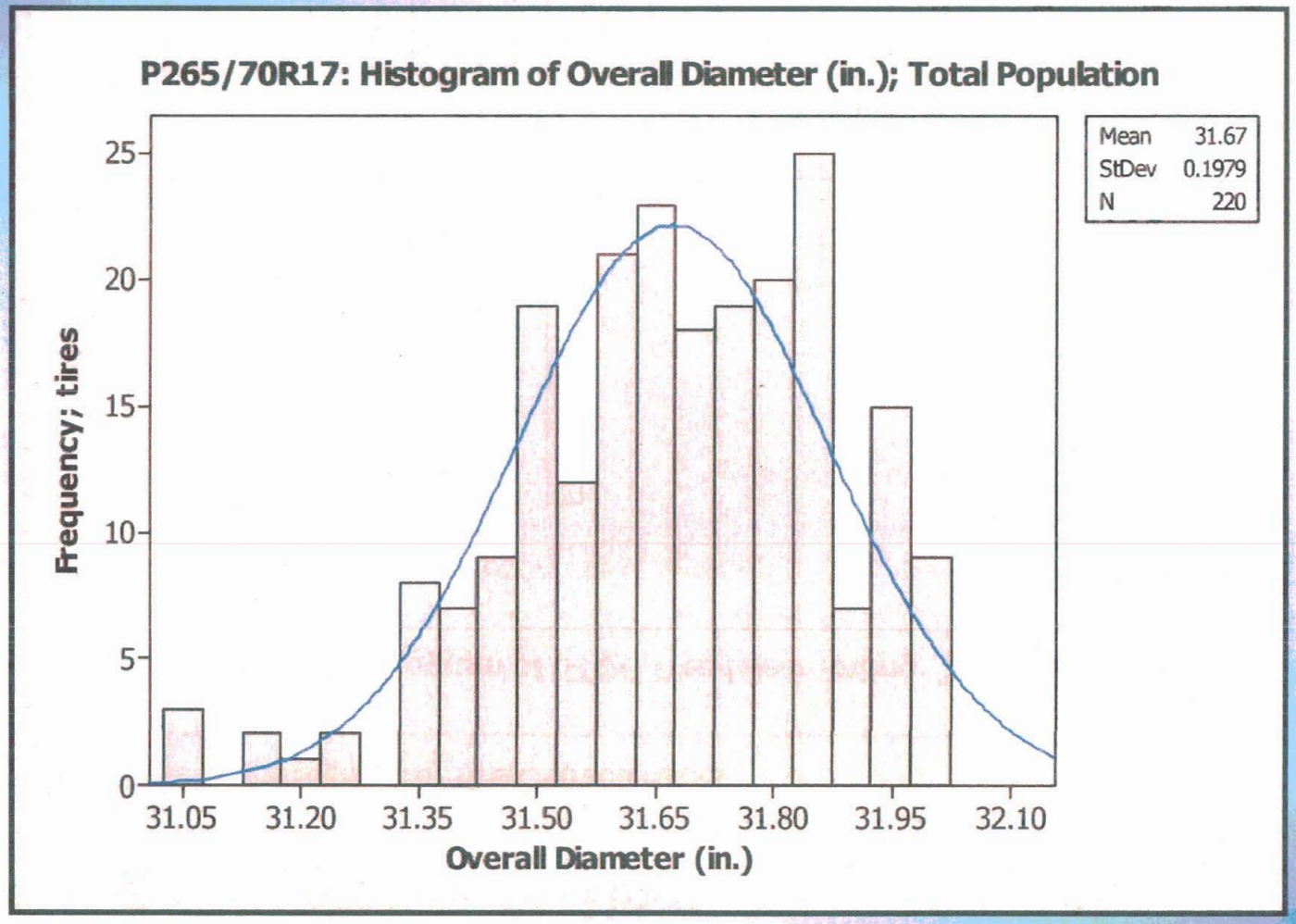

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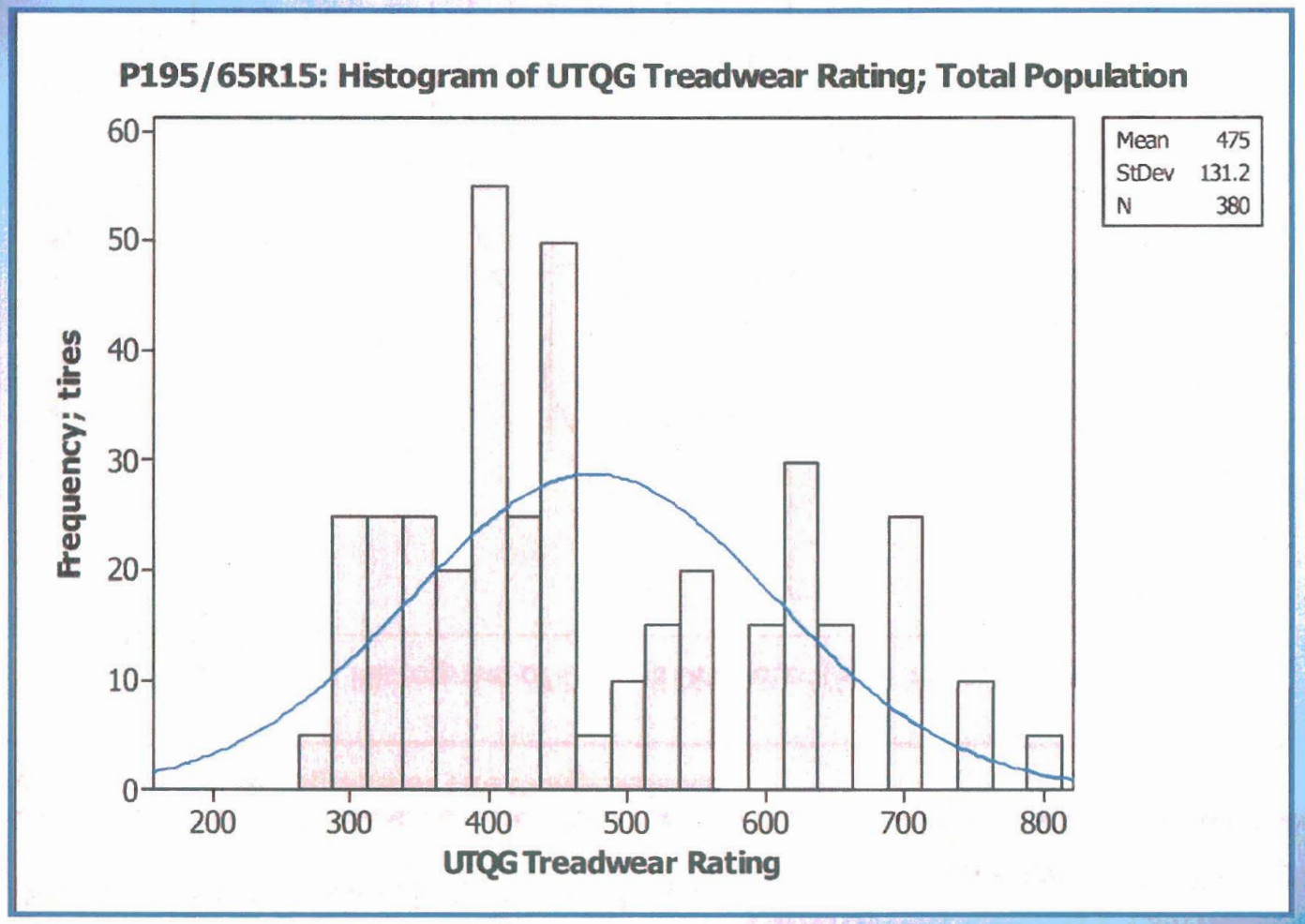

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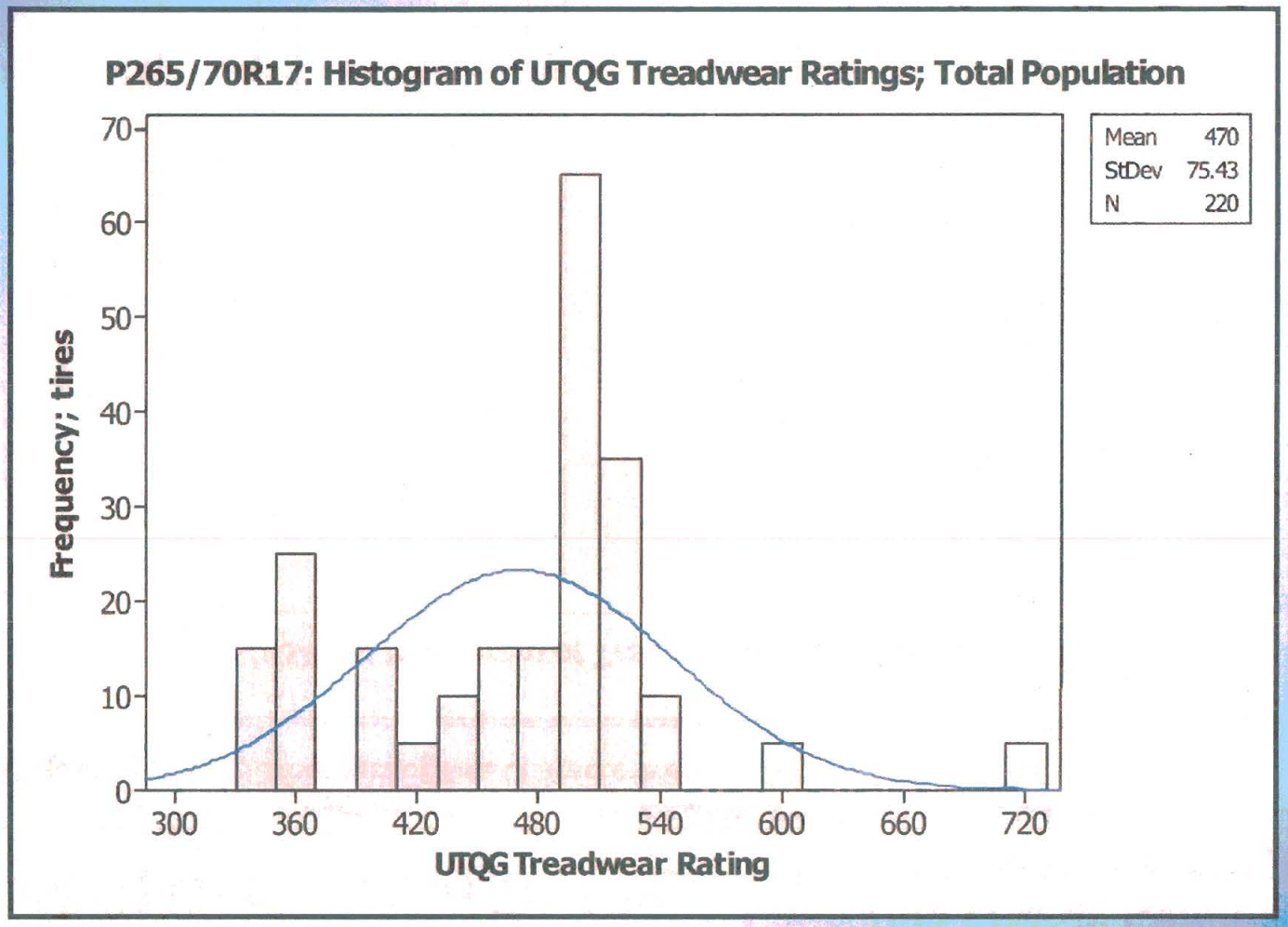

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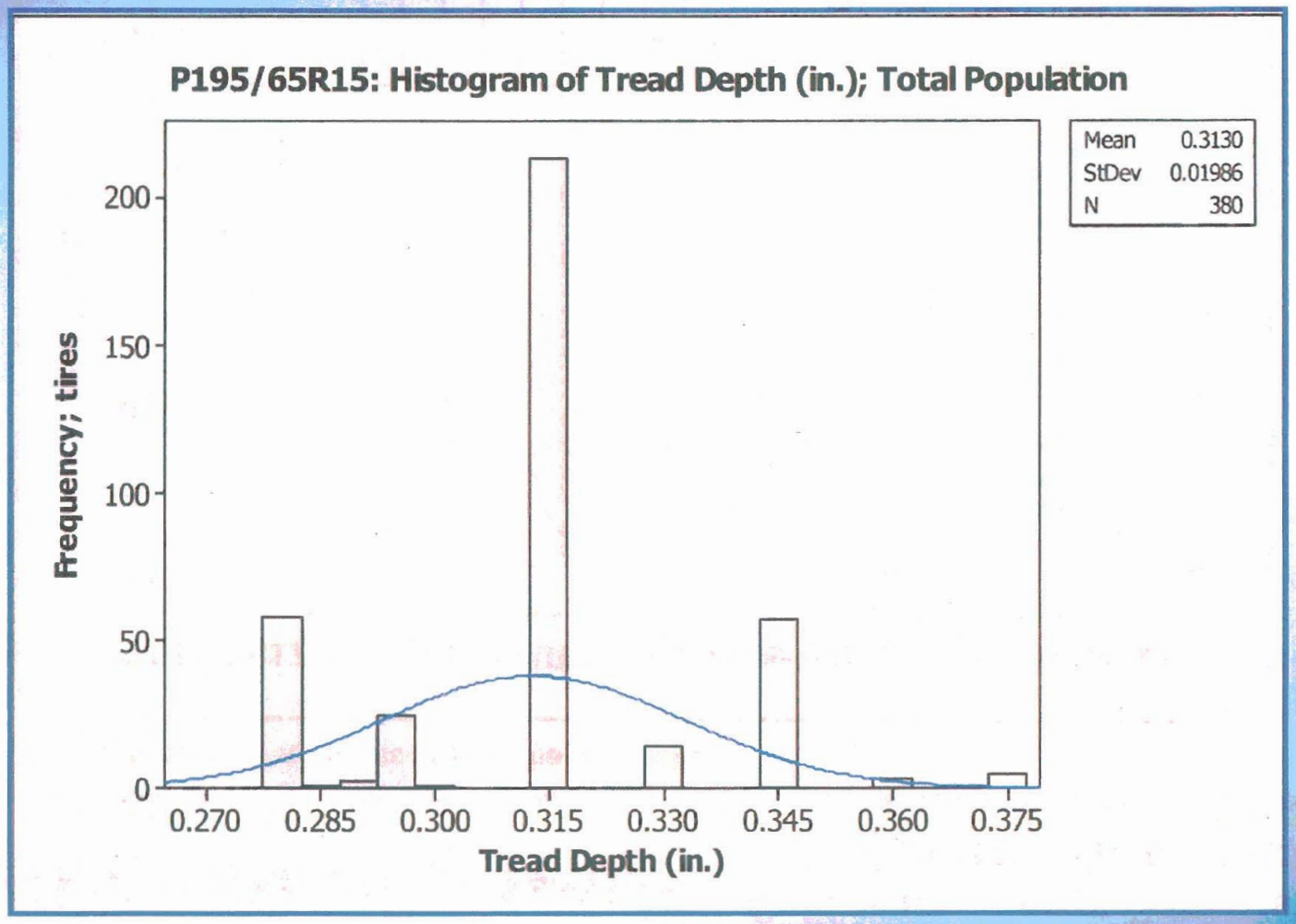

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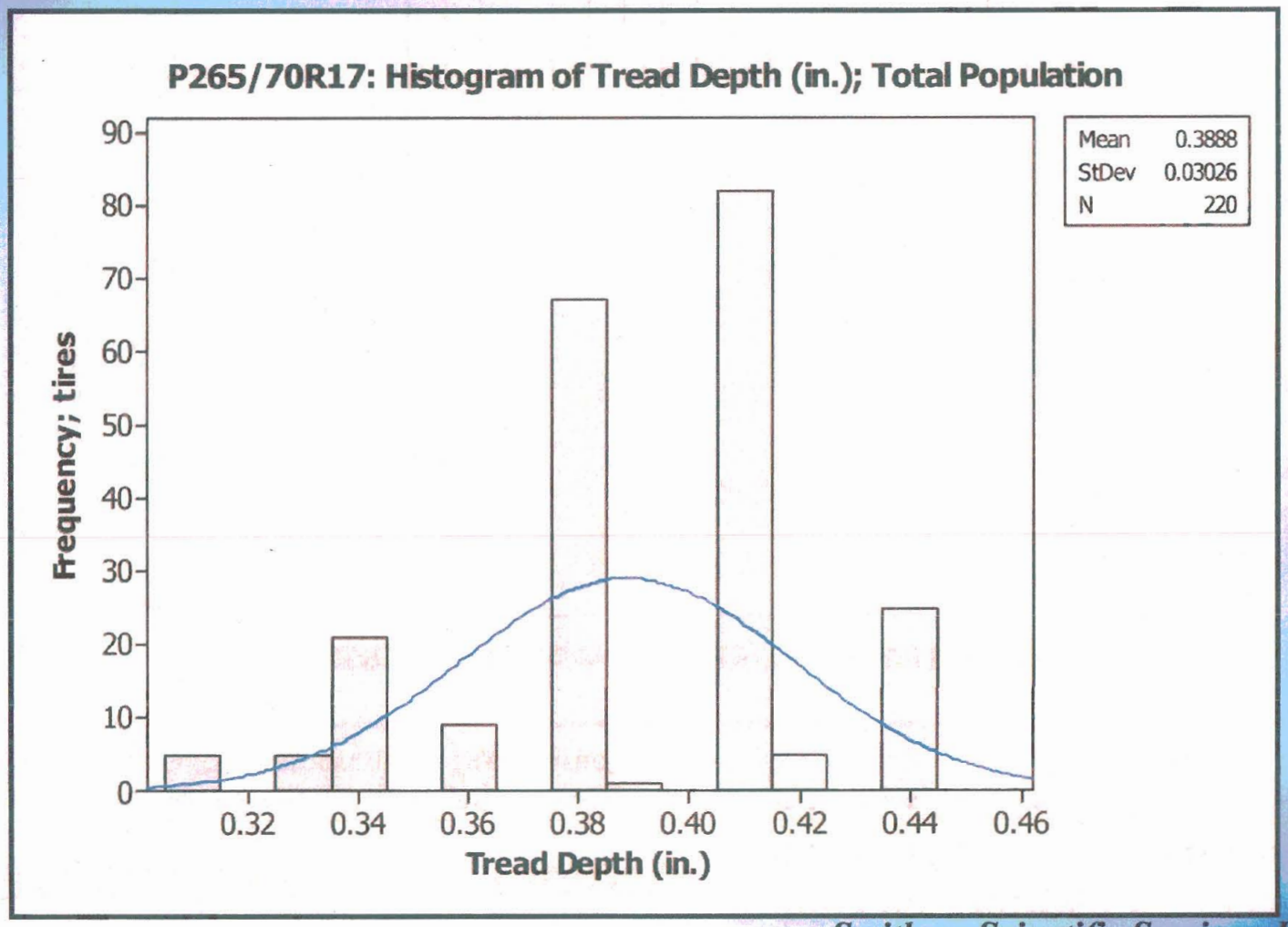

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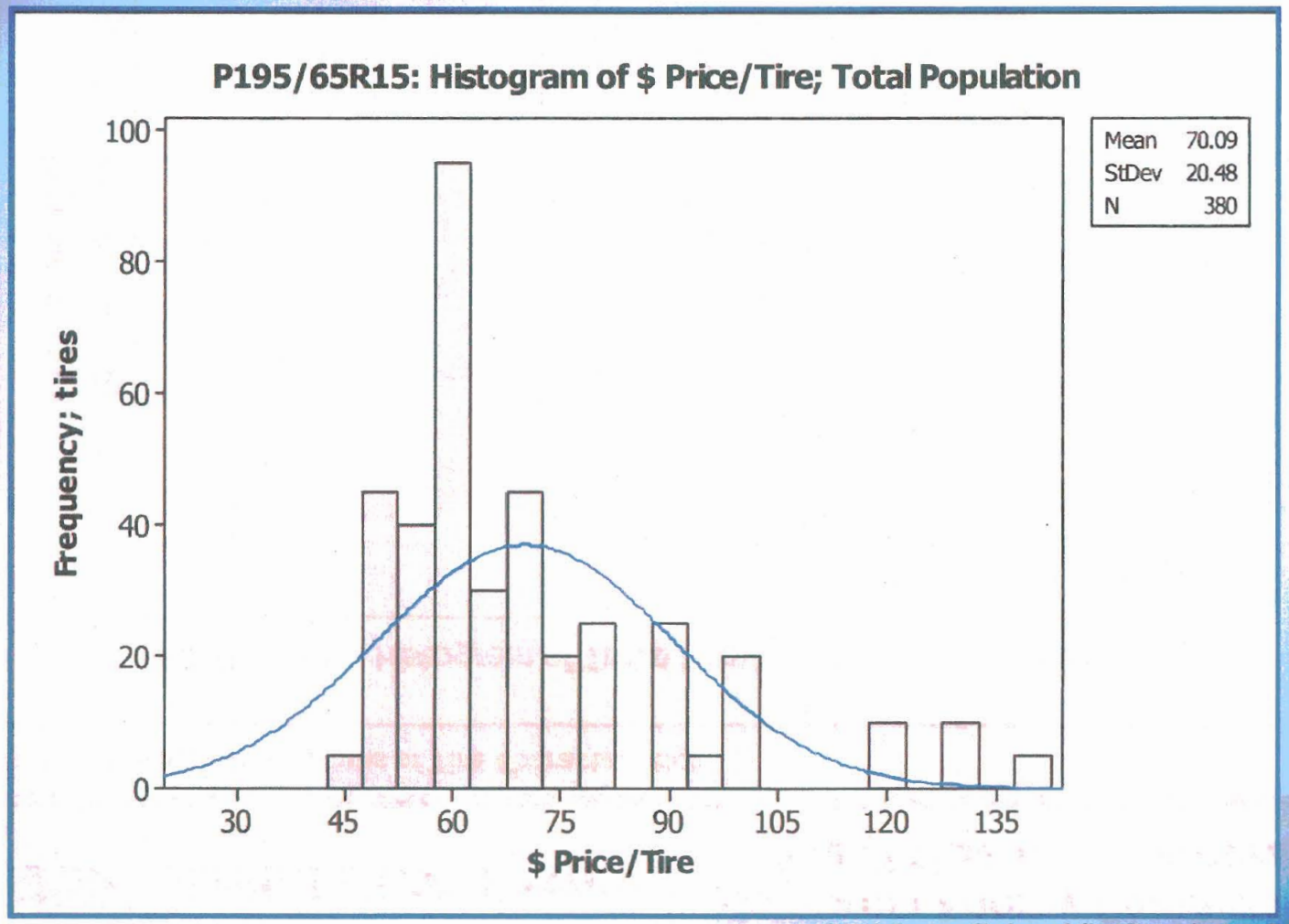

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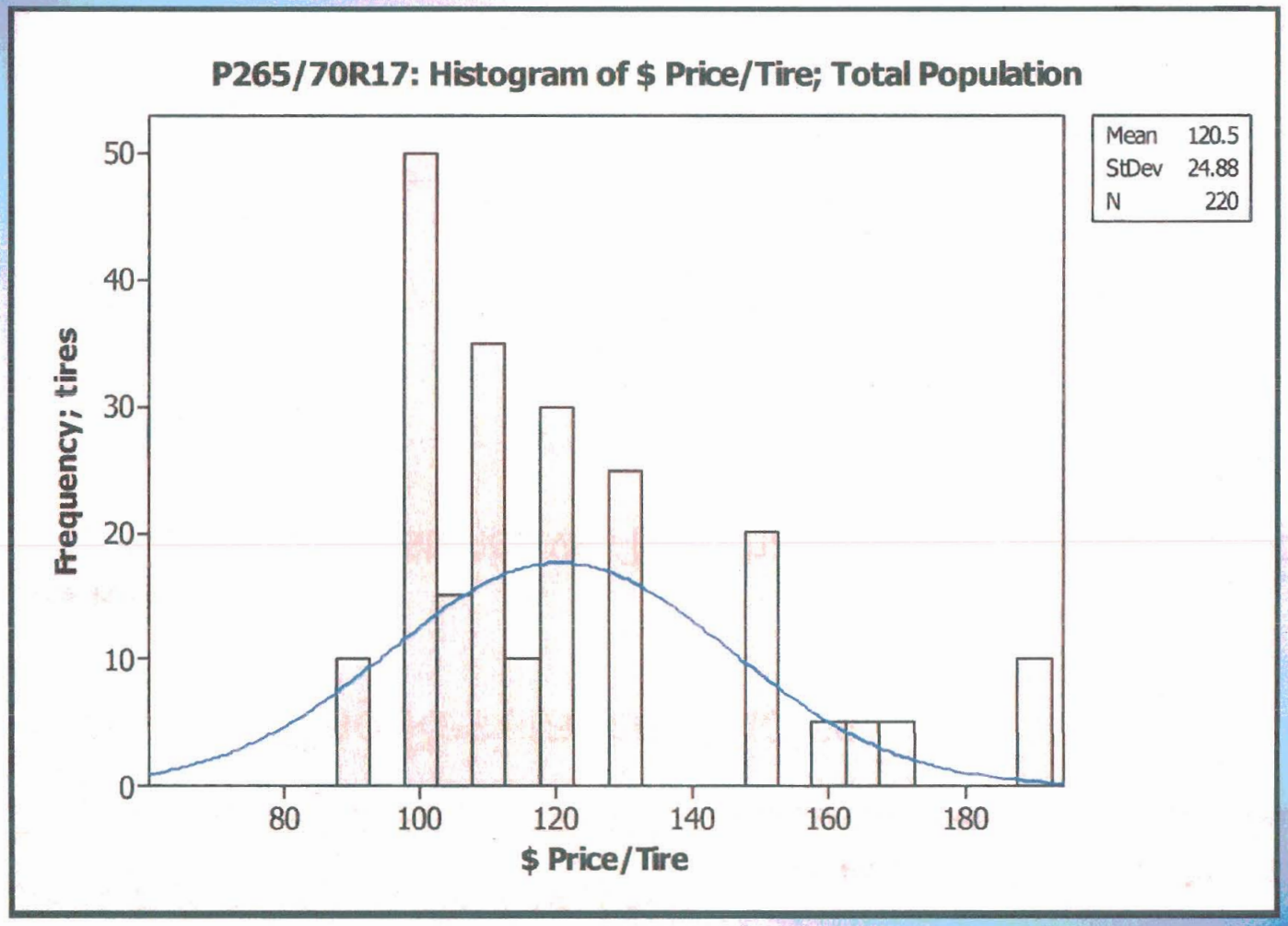


Rolling Resistance Testing: California Energy Commission's Fuel Efficient Tire Program

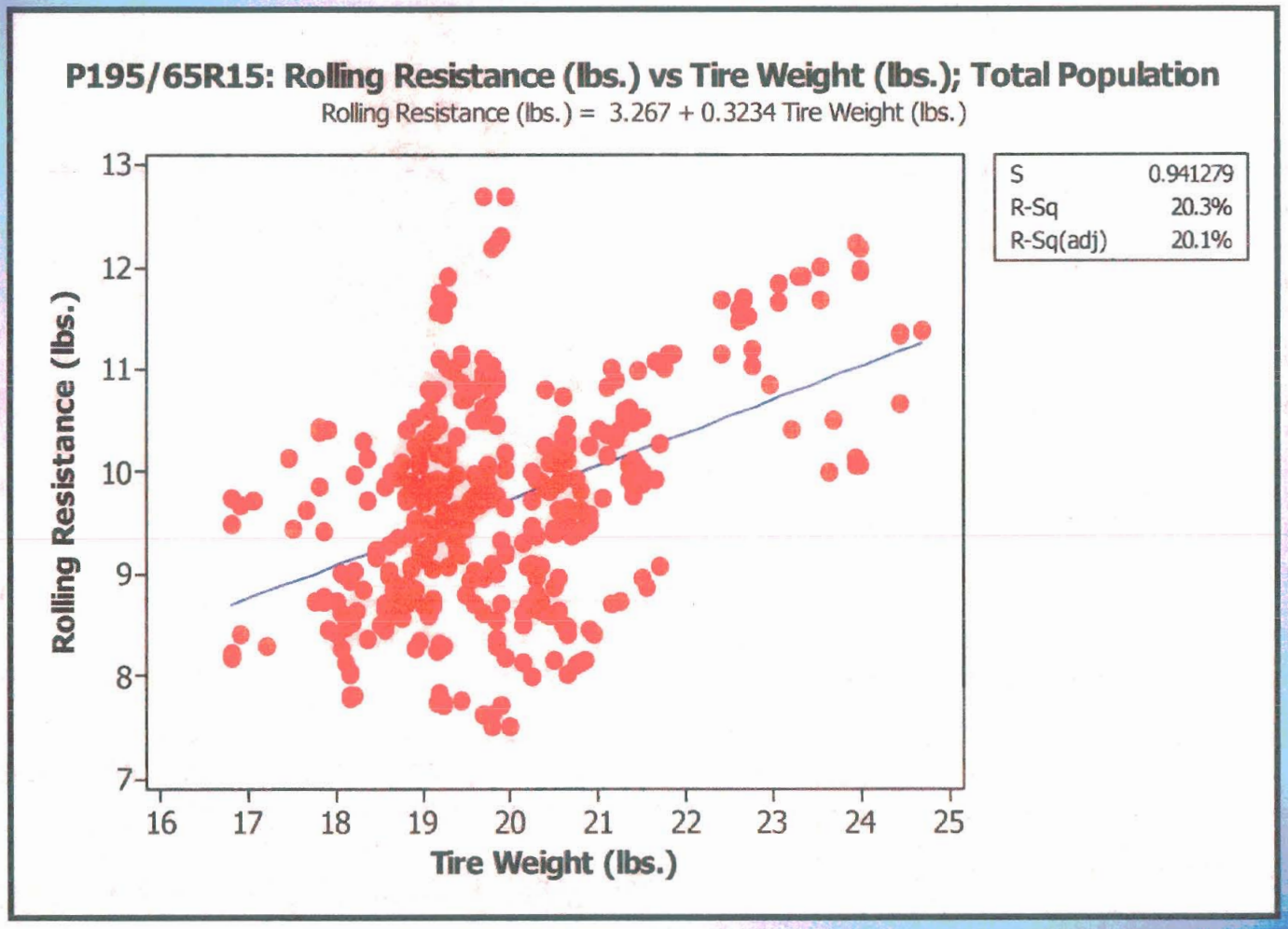
- Task 4: Rolling Resistance Studies

  → Results

  - Rolling Resistance vs. Tire Characteristic Correlation Studies

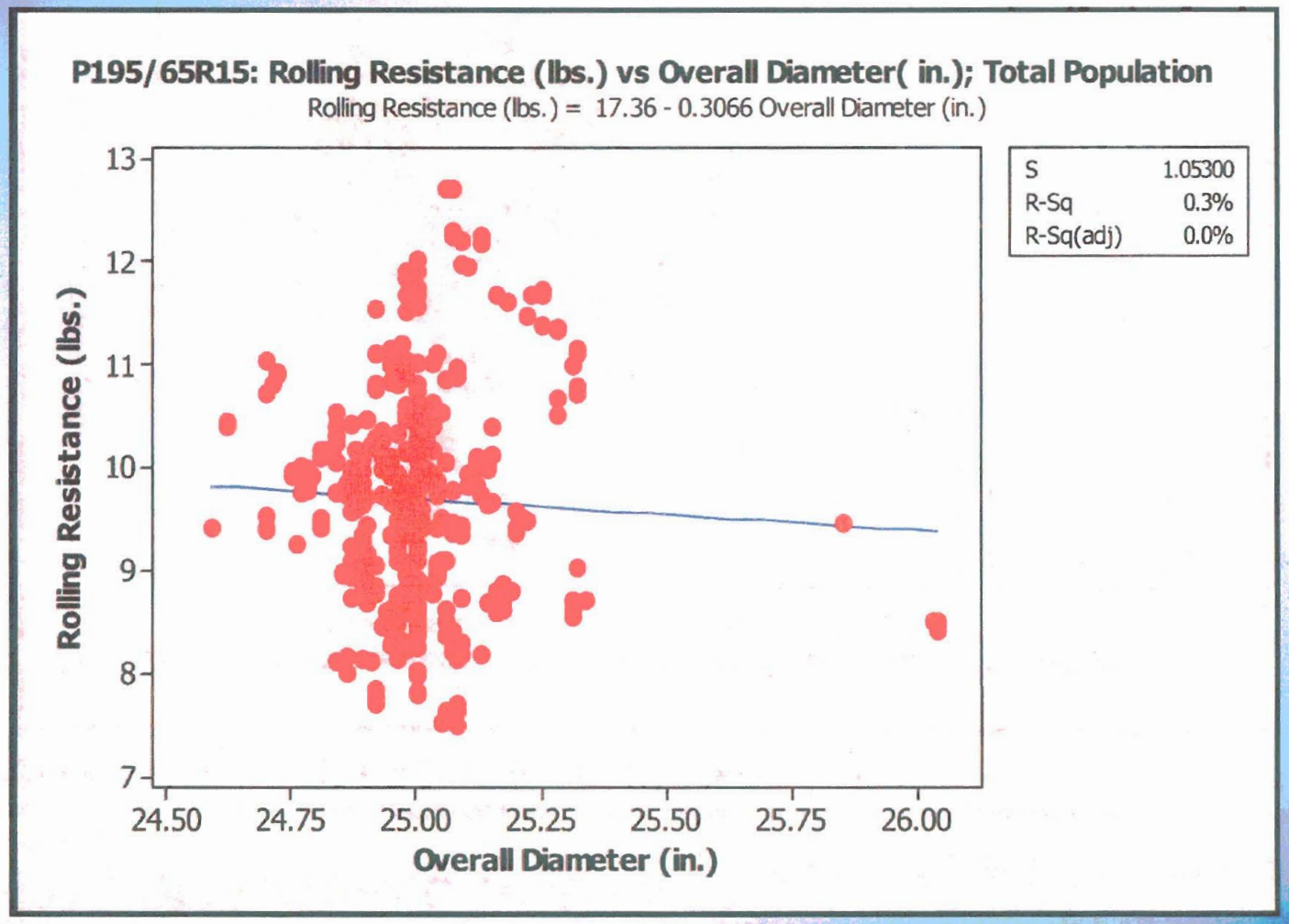
Rolling Resistance Testing: California Energy Commission's Fuel Efficient Tire Program

- **Task 4: Results- Rolling Resistance vs Tire Characteristics**



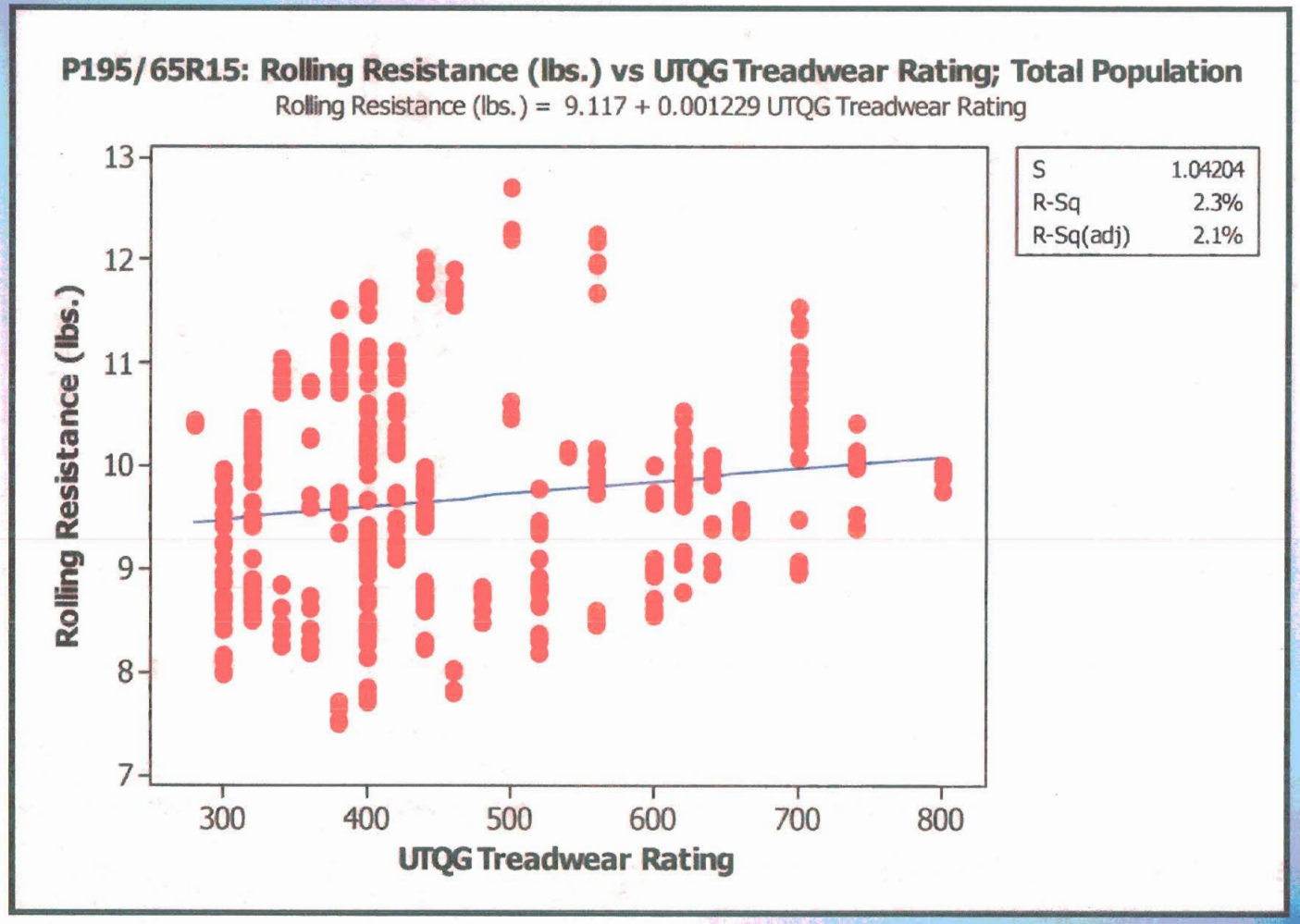
Rolling Resistance Testing: California Energy Commission's Fuel Efficient Tire Program

- **Task 4: Results- Rolling Resistance vs Tire Characteristics**



Rolling Resistance Testing: California Energy Commission's Fuel Efficient Tire Program

- **Task 4: Results- Rolling Resistance vs Tire Characteristics**



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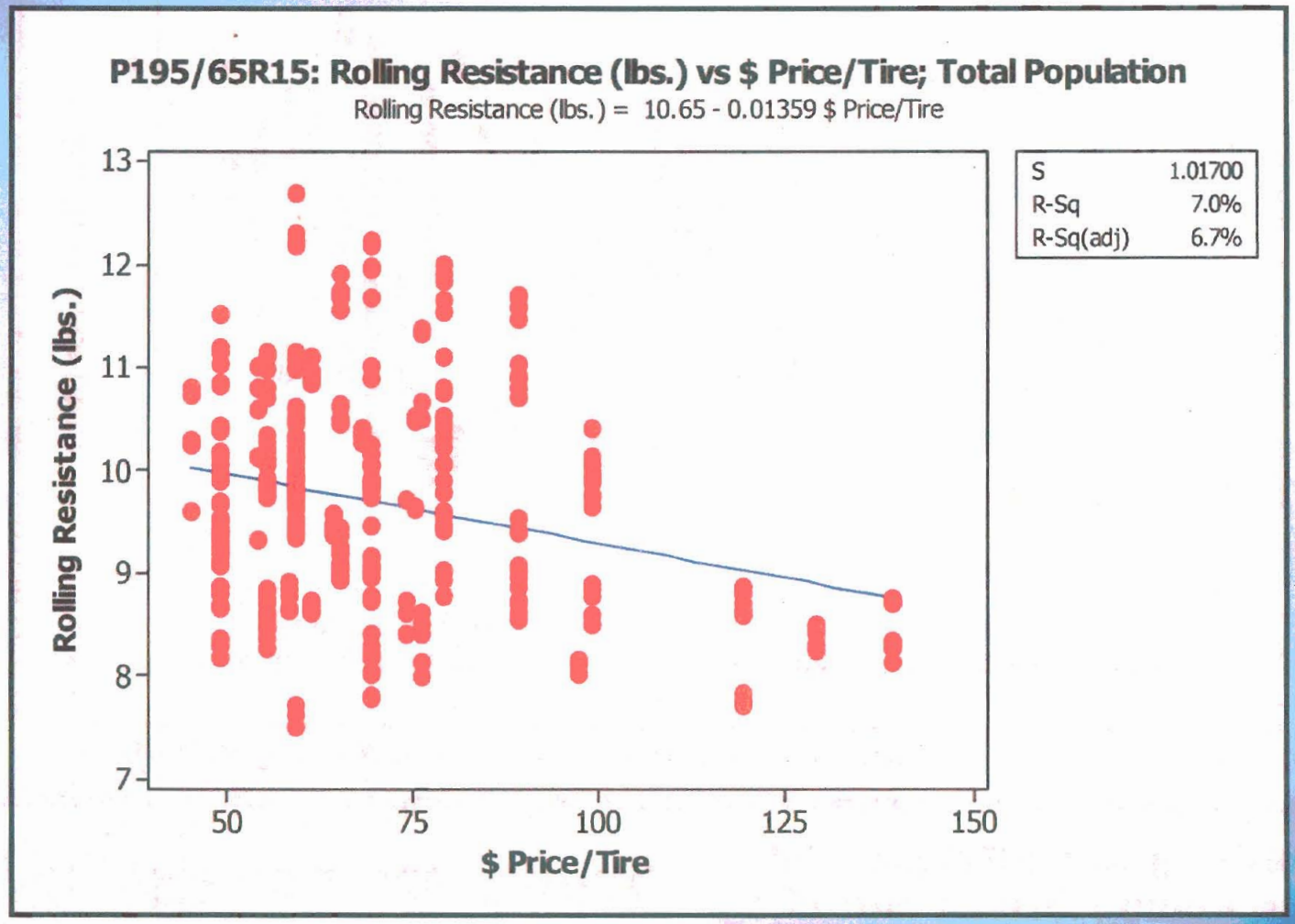

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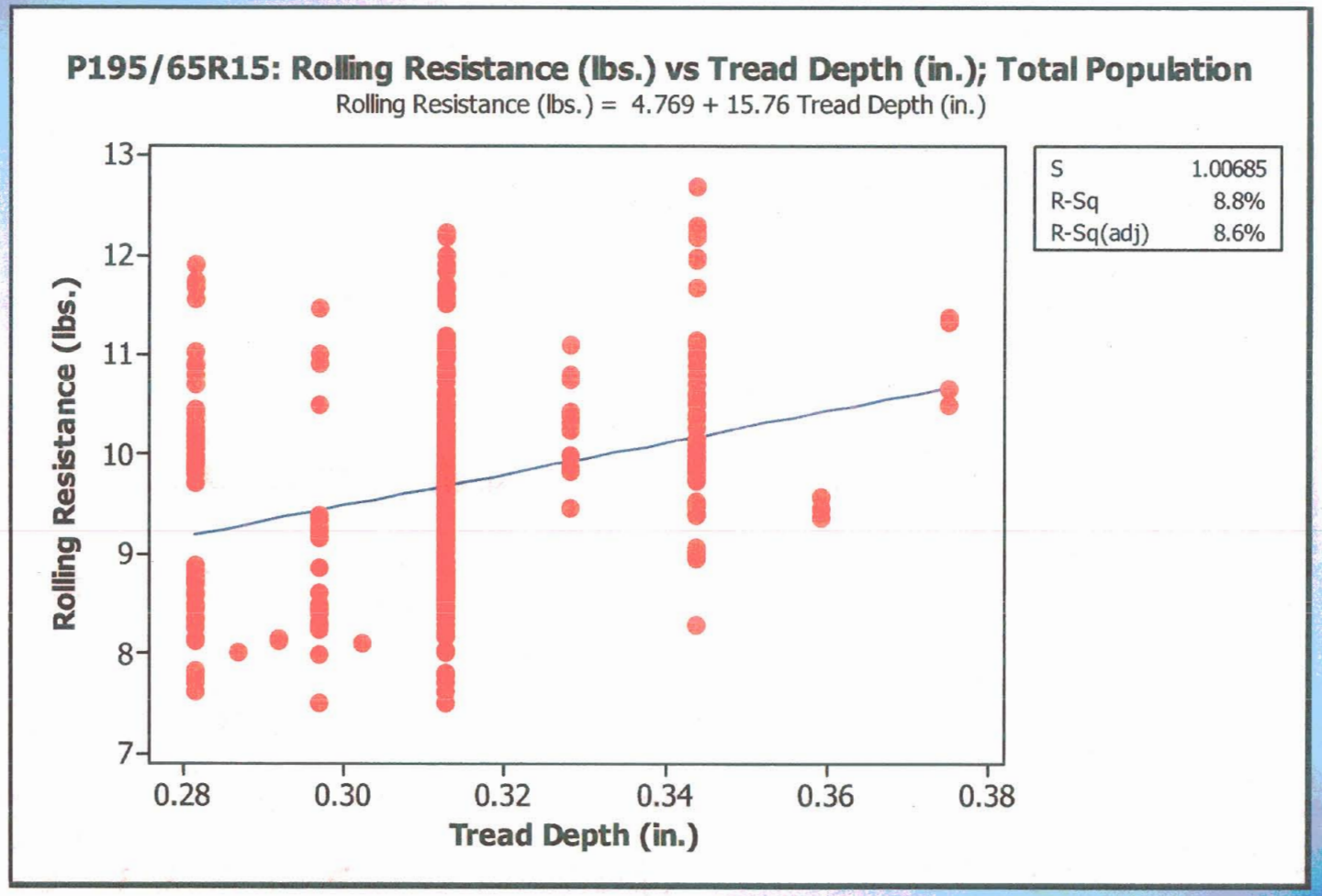


Rolling Resistance Testing: California Energy Commission's Fuel Efficient Tire Program

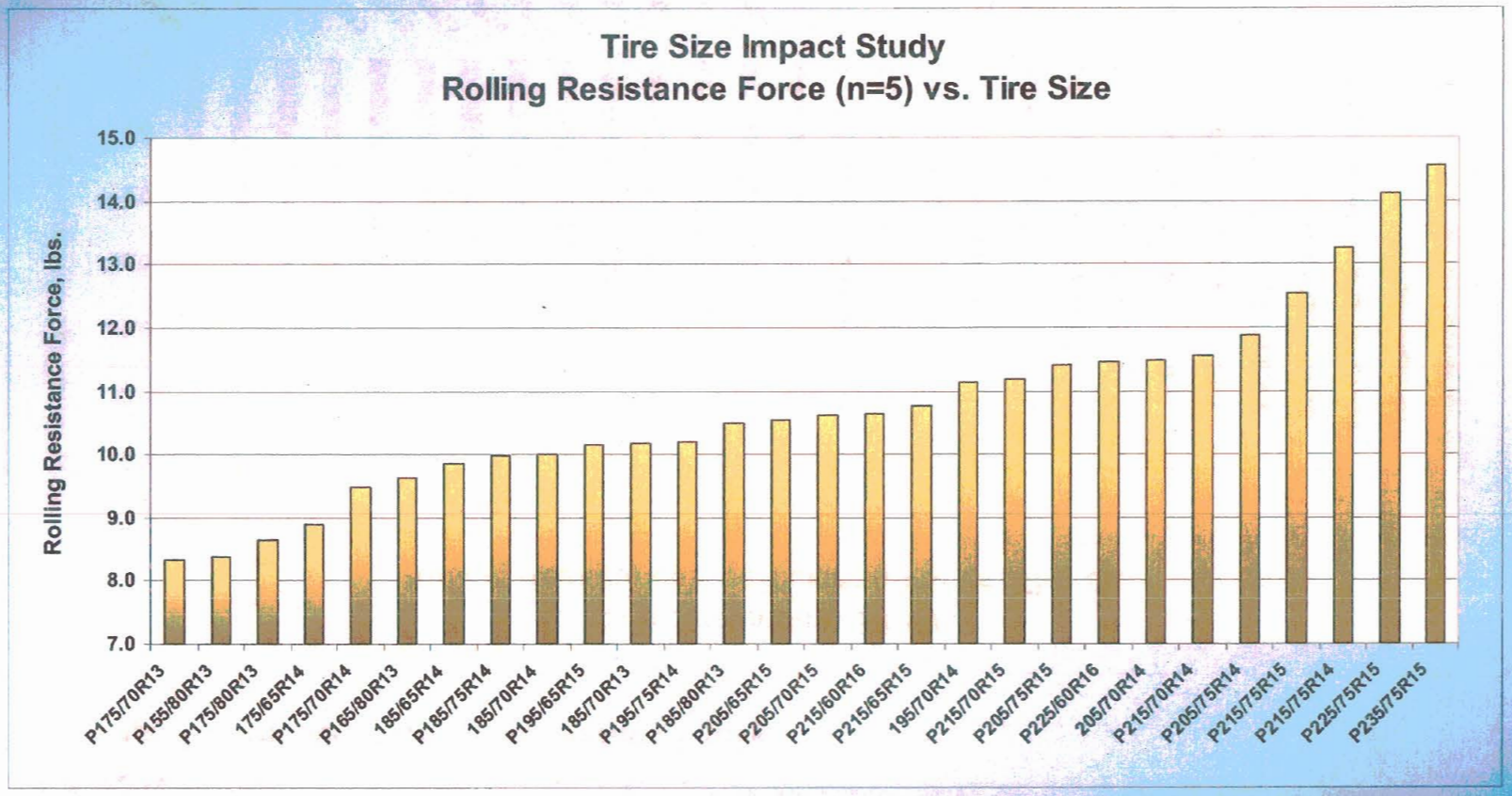
- Task 4: Rolling Resistance Studies

  → Results

  - Size Impact Study

Rolling Resistance Testing: California Energy Commission's Fuel Efficient Tire Program

- **Task 4: Results – Tire Size Impact Study**



Smithers Scientific Services, Inc.

Rolling Resistance Testing: California Energy Commission's Fuel Efficient Tire Program

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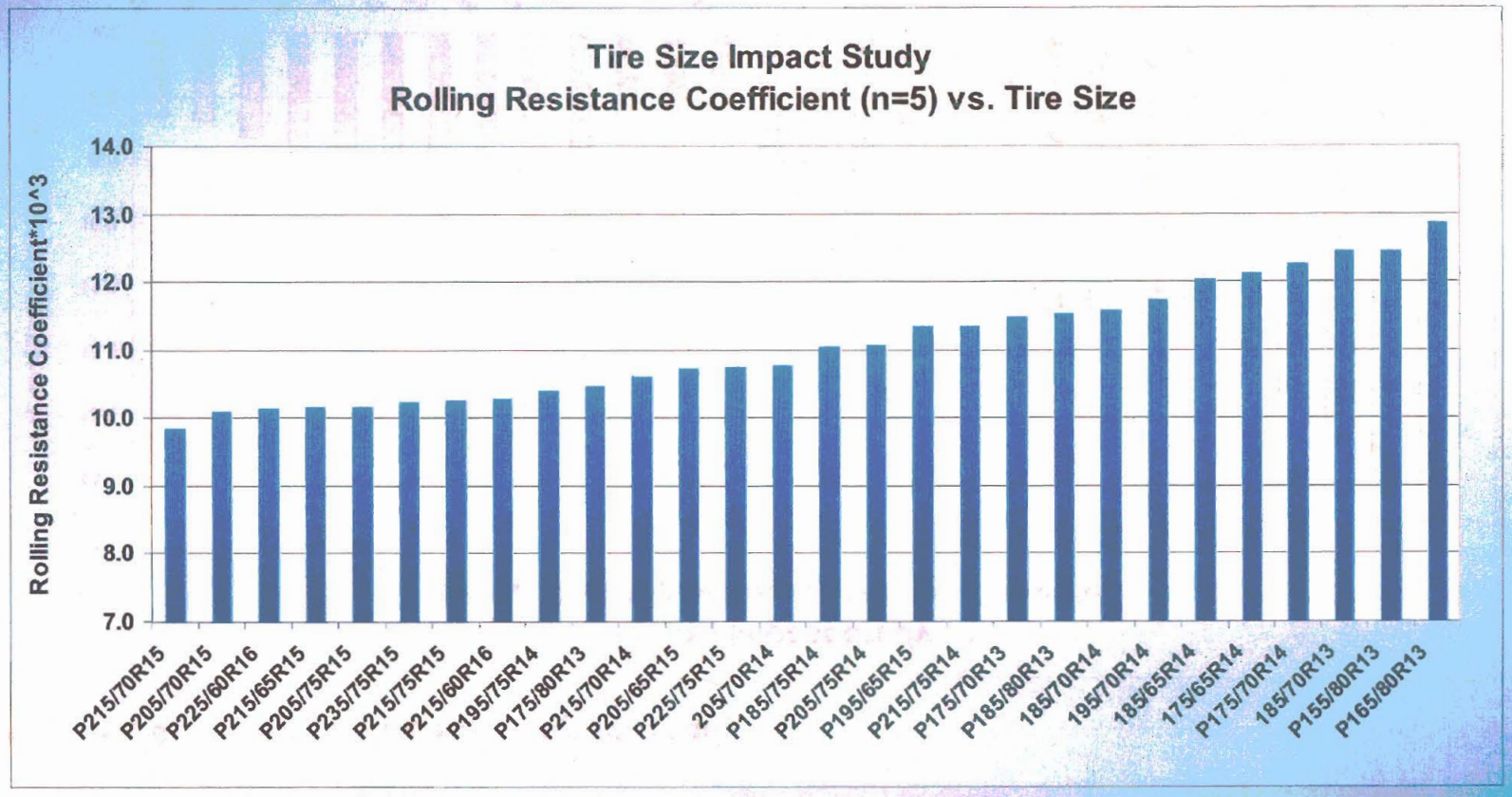

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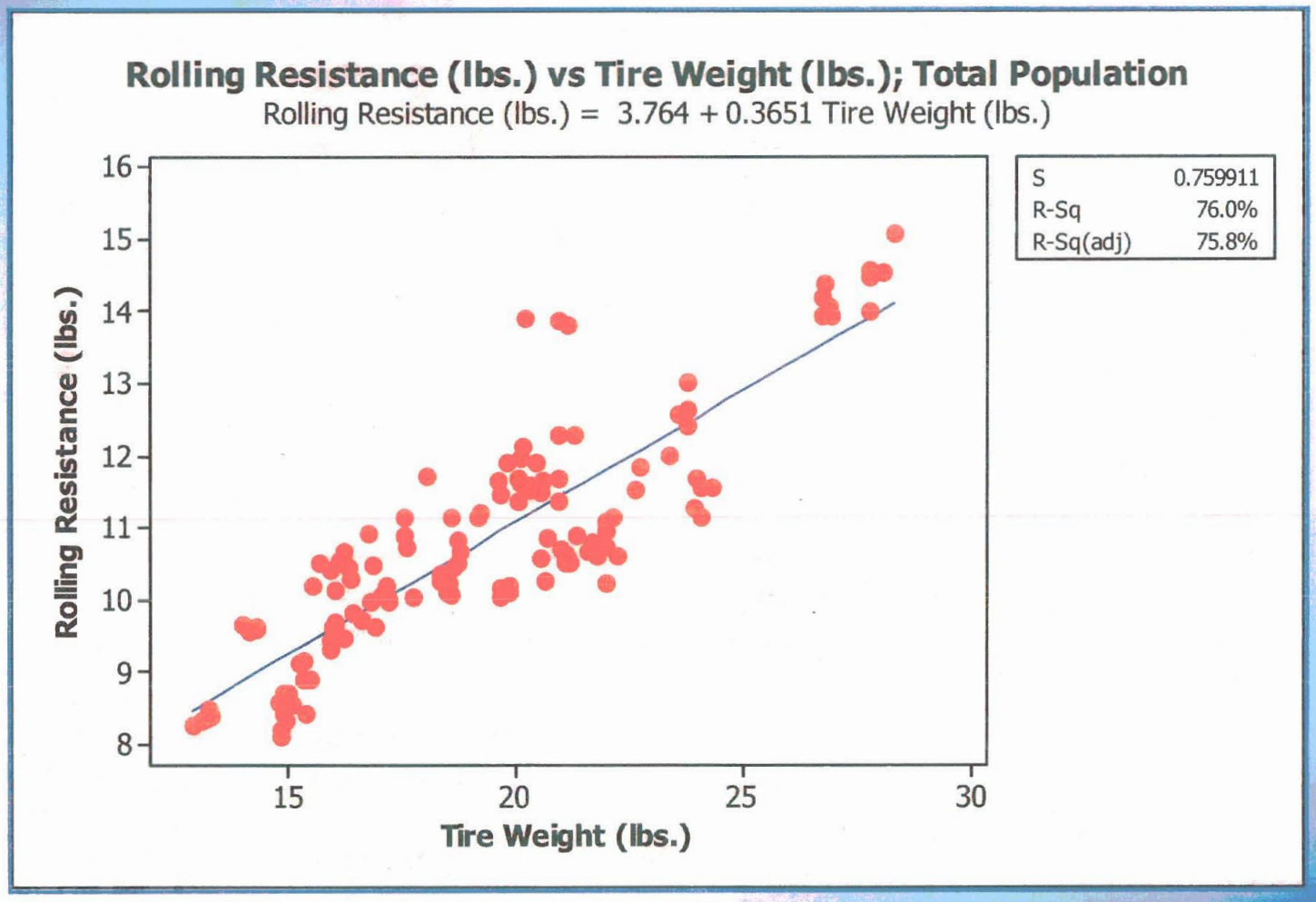

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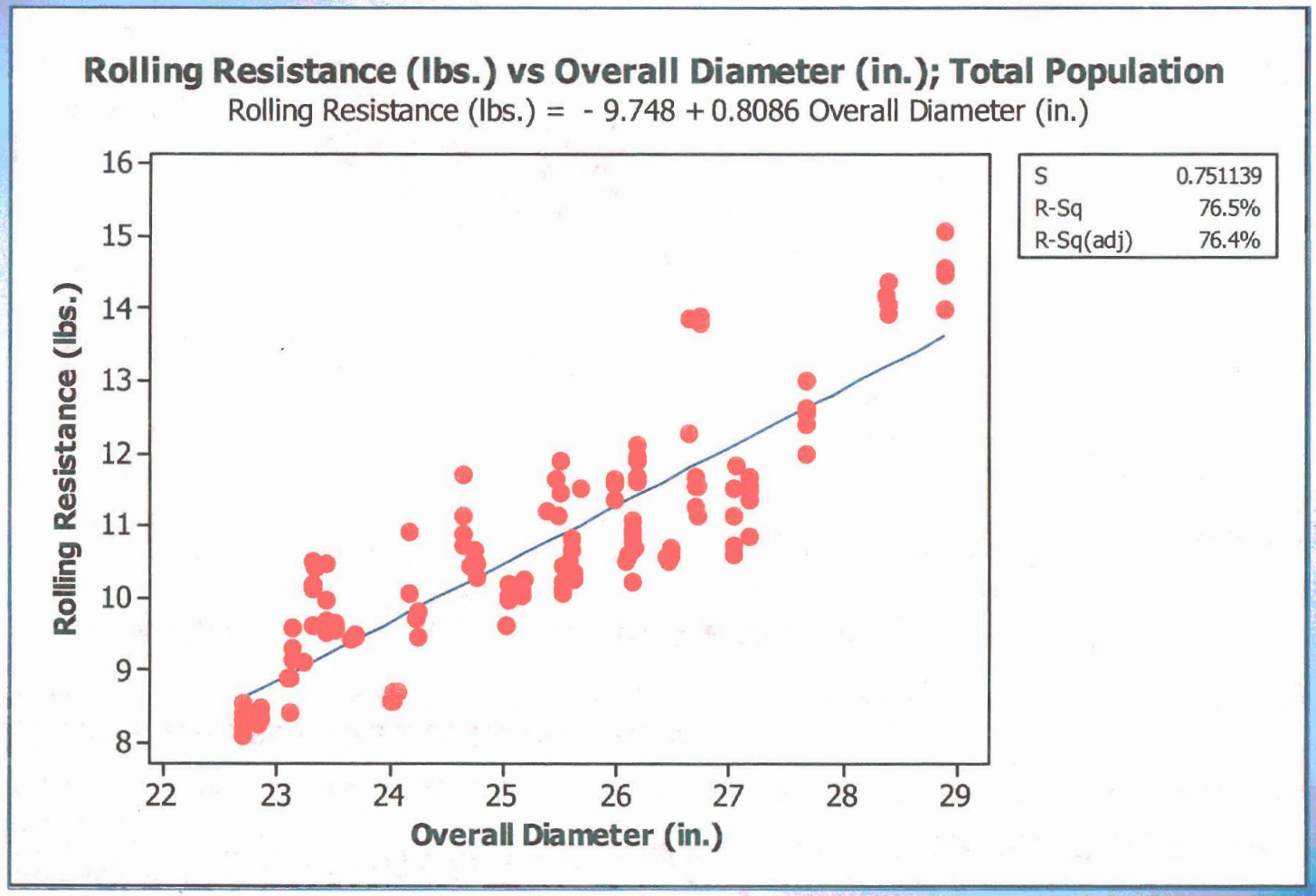

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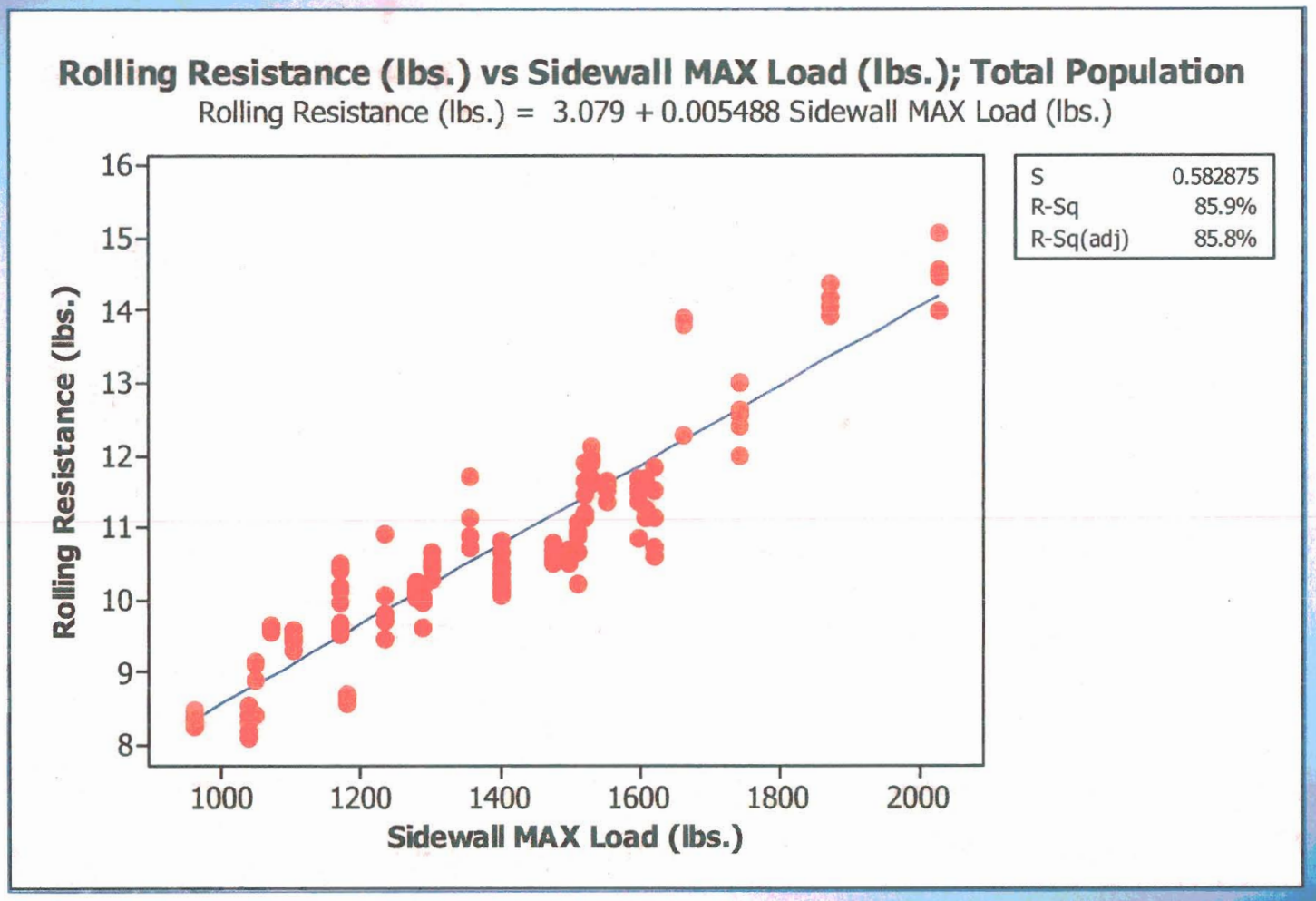

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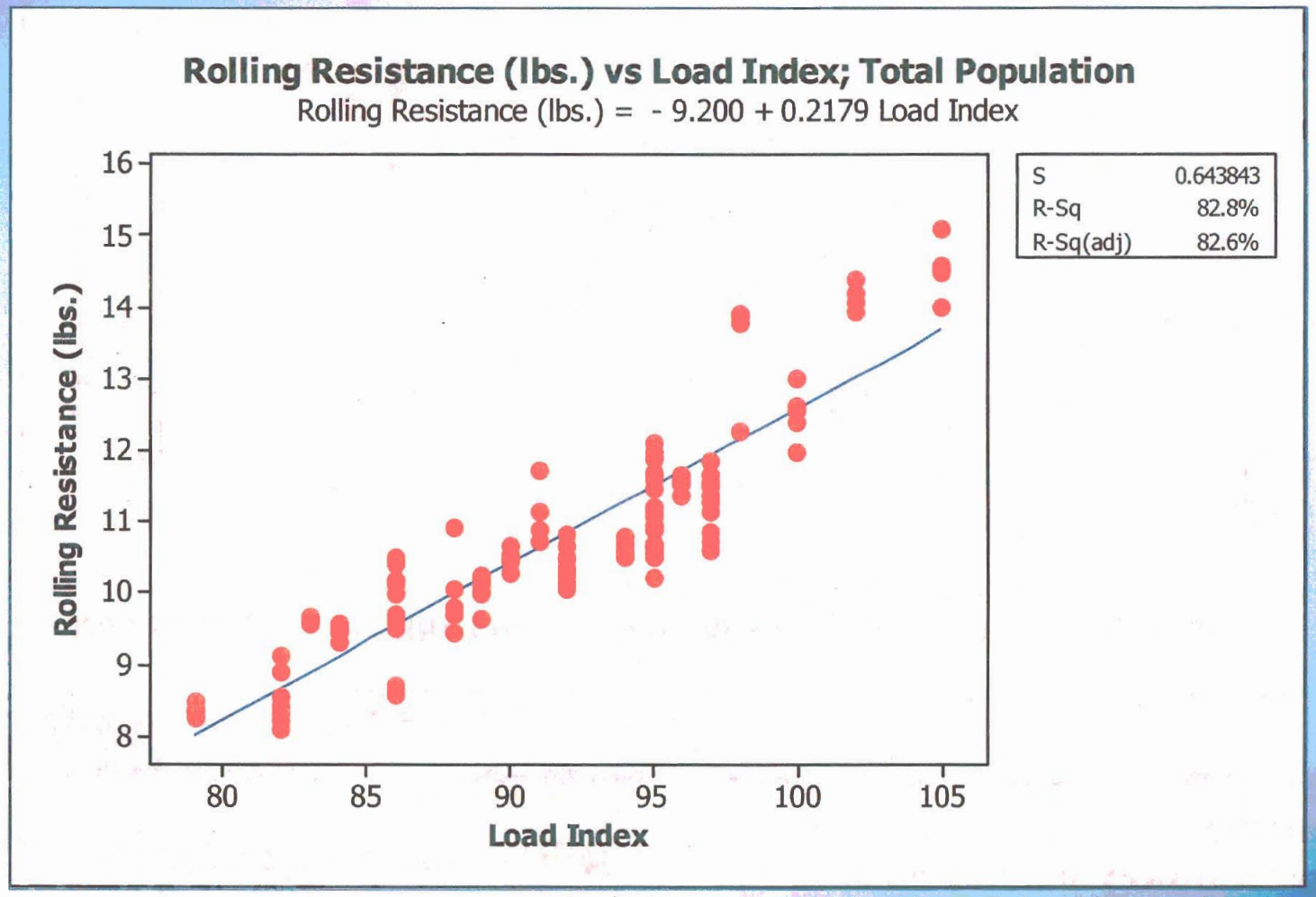


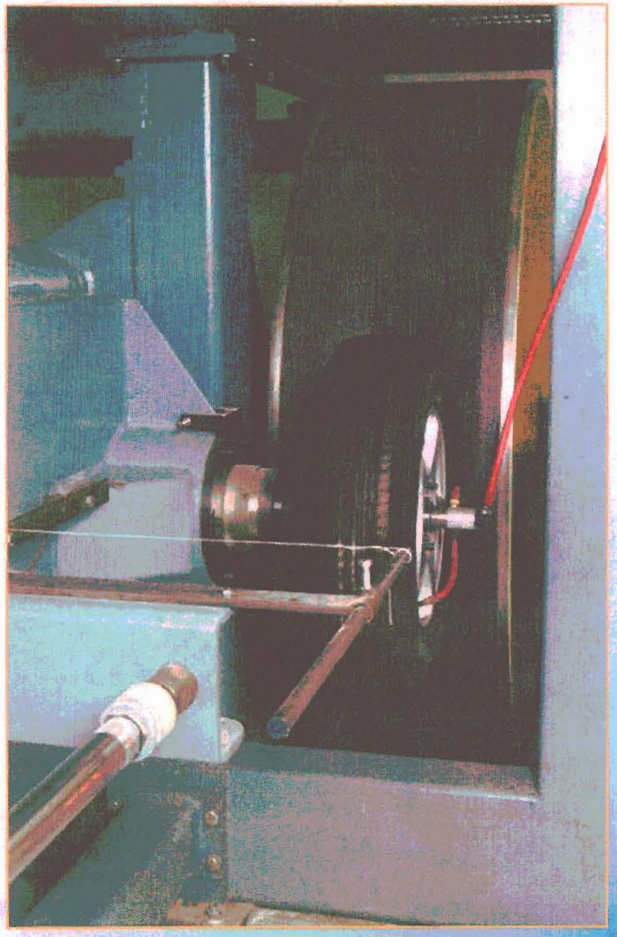
Task 4: Results – Tire Size Impact Study

Correlation	R^2;%
Tire Weight and Rolling Resistance Forces	76.0
Tire Outside Diameter and Rolling Resistance Forces	76.5
Tire Load Indices and Rolling Resistance Forces	82.8
Tire Max. Sidewall Load Capabilities and Rolling Resistance Forces	85.9
Tire Weight and Rolling Resistance Coefficients	47.4
Tire Outside Diameter and Rolling Resistance Coefficients	55.8
Tire Load Indices and rolling Rolling Resistance Coefficients	53.6
Tire Max. Sidewall Load Capabilities and Rolling Resistance Coefficients	49.8

Rolling Resistance Testing: California Energy Commission's Fuel Efficient Tire Program

- Task 4: Rolling Resistance Studies

  → Findings



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Task 4: Rolling Resistance Studies

→ Findings

- Examinations of the results from the P195/65R15 size tires indicated:
  - Rolling resistance responses were normally distributed and ranged from about 7.5 lbs. to 12.7 lbs. (rolling forces), which correlated to a range of rolling resistance coefficients of approximately 8.4x10-3 to 14.2x10-3.
- Examinations of the results from the P265/70R17 size tires indicated:
  - Rolling resistance responses were normally distributed and ranged from about 13.3 lbs. to 22.8 lbs. (rolling forces), which correlated to a range of rolling resistance coefficients of approximately 7.5x10-3 to 12.9x10-3.

Rolling Resistance Testing: California Energy Commission's Fuel Efficient Tire Program

- Task 4: Rolling Resistance Studies
  - → Findings
    - Linear correlation studies of rolling resistances with the basic parameters of tire weight, overall diameter, tread depth, and UTQG treadwear rating did not generate correlations that could be considered to represent useful tools to the consumer for predicting rolling resistance qualities of tires.
    - After subdividing into speed rating subcategories, linear correlation studies again failed to generate useful tools for predicting rolling resistances from the parameters measured.
    - The lack of quality linear correlations between rolling resistances and the basic parameters investigated suggested that if the researcher is investigating manufacturer/tire design differences within a tire size, other more complex aspects of the tire will need to be considered.

- Task 4: Rolling Resistance Studies
  - → Findings
    - Results from the Tire Size Impact Study indicated the following:
      - Rolling resistance responses ranged from about 8.1 lbs. to 15.1 lbs. (rolling forces); rolling resistance coefficients ranged from approximately 9.4x10-3 to 12.9x10-3. Rolling resistance rolling forces and rolling resistance coefficients did not correlate.

- Task 4: Rolling Resistance Studies
  - → Findings (Tire Size Impact Study)
    - Linear correlation studies
      - Correlations of rolling resistance values with external tire characteristics yielded higher R^2 coefficients documented during for the Tire Size Impact Study
      - These stronger correlations were largely attributable to greater differences in tire weights and dimensions than observed during the within-size correlation studies. Within-tire characteristics not studied in this investigation, such as component hysteresis levels and tire architecture, were expected to be more standardized due to the single manufacturer/design constraint.

Michelin's Green Meters

October 30, 2007
Berlin – New York – Paris – Shanghai

Press Kit

www.michelin-green-meter.com

For Additional Information in North America,
including high resolution photos and broadcast quality video,
visit www.michelinmedia.com

To obtain high-resolution, formatted-for-TV images and photographs of the Michelin green meters in the four cities, go to: www.thenewsmarket.com/michelin. If you are visiting this site for the first time, you will need to sign in to download the videos. For assistance, contact: journalisthelp@thenewsmarket.com

MICHELIN
A better way forward

Contents

MICHELIN'S "GREEN" METERS PAINT THE SKY WITH GLOBAL FUEL EFFICIENCY STORY

Each second, around the world, Michelin green energy saving tires help reduce fuel consumption and lower CO_2 emissions

NEW YORK CITY (Oct. 30, 2007) – Beginning today, Michelin will project meters in four major cities around the world—Berlin, New York City, Paris and Shanghai. These meters will show the fuel savings and reductions in CO_2 emissions since 1992—when this revolutionary technology was first introduced—thanks to Michelin green energy saving tires.

Michelin green energy saving tires include a variety of passenger car, light truck and commercial truck tires that are optimized for fuel economy by reducing their rolling resistance and weight without compromising other key performance factors such as traction, grip and tread wear. Reducing rolling resistance also reduces CO_2 emissions.

Featuring the world-famous Michelin Man, the meters will be projected at 7 p.m. local time on the façade of the Park Inn Hotel in Berlin; on the NASDAQ and Reuters boards in Times Square, New York City; in the Port de Suffren at the foot of the Eiffel Tower in Paris; and on the City Group Mansion tower, across from the Bund, in Shanghai.

In 15 years, compared to conventional tires on the road, the **570 million** Michelin green energy saving tires sold worldwide have reduced fuel consumption by an estimated **2.38 billion gallons**, resulting in a reduction of CO_2 emissions of **25 million tons**, the equivalent of the amount absorbed by **880 million** trees in one year. This means that each second **11.6 gallons** of fuel are saved and **240.6 pounds** of CO_2 are not released into the atmosphere. These figures will be on display to millions of people around the world. Full details of the Michelin Green Meter are available at www.michelin-green-meter.com.

As a responsible citizen, Michelin seeks to build awareness among people around the world of the contribution that Michelin green energy saving tires can make to the environment.

That's because choosing the right tire can have a significant impact on the environment. This is especially important today when experts agree that road transport is a major source of CO_2 emissions, one of the greenhouse gases responsible for global warming.

Fully aware of this challenge, Michelin, which allocates nearly 4 percent of its annual net sales to research and development, has made the design of green energy saving tires a key component of its innovation strategy. So that consumers may integrate "green" criteria into their choice of tires, Michelin is highlighting the impact of tire choice on fuel consumption and on the environment. For Michelin, this initiative truly represents "a better way forward."

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For more information, visit www.michelinmedia.com or contact:

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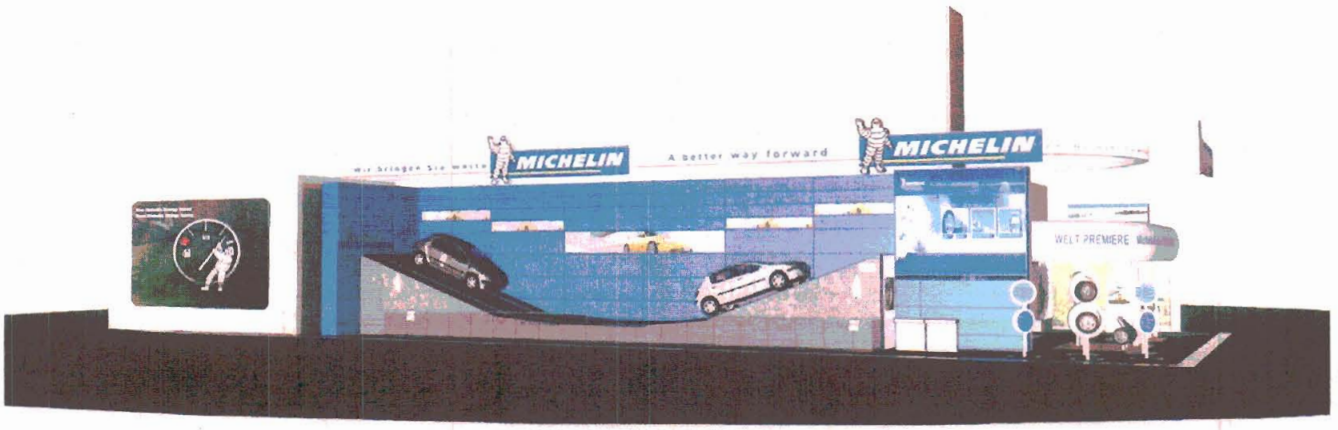
While many drivers are in favor of more environmentally positive mobility, most are unaware of how tires can reduce a vehicle's environmental impact by improving its energy performance. In a recent survey[1] by Michelin, tires are mentioned as a source of pollution by only 24 percent of those surveyed. In fact, due to rolling resistance, tires can have a significant impact on vehicle fuel economy and the environment in general.

- **What is rolling resistance?**

With each rotation of the wheel, the shape of the tire changes slightly under the weight of the vehicle as the tire makes contact with the road. As its structure changes, the tire's components heat up and some of the energy transmitted by the engine is lost. This is the phenomenon known as rolling resistance. Since energy is needed to keep a vehicle moving forward, lowering a tire's rolling resistance makes it possible to reduce fuel consumption and, consequently, lower emissions of CO_2 and other greenhouse gases.

Rolling resistance is one of the five forces a vehicle must overcome in order to keep moving. The others are: 1) air resistance (which depends on vehicle speed), 2) significant inertia forces when accelerating (such as in city driving), 3) gravity when driving uphill, and 4) internal friction (involving the transmission, for example).



- **Visible differences in performance**

When it comes to rolling resistance, all tires are not equal, with differences of up to 50 percent on tires designed to equip the same vehicle.
To highlight these differences, Michelin demonstrated, at the 62nd Frankfurt Auto Show in September 2007, the phenomenon of rolling resistance and its impact on fuel consumption to the public. The test involved a concave 72-foot track and two Peugeot 308s automobiles that were

[1] Survey of 5,061 Web users age 18 to 65 conducted online by Michelin and LH1 2 from Feb. 27 to March 10, 2006. The sample comprised 1,061 French, 1,000 Chinese, 1,000 Japanese, 1,000 Americans and 1,000 Germans using the quota method of sampling.

identical except for their tires. One was fitted with Michelin Energy Saver tires and the other with tires whose rolling resistance was the same as the market average[2] (see illustration above). Released from a height of 10.5 feet on a 20 degree slope, the two vehicles rolled forward and backward, propelled only by their weight. The car equipped with Michelin Energy Saver tires, which offer less rolling resistance, continued to move significantly longer than the other vehicle. This illustrates that the car requires less energy to cover the same distance as another equipped with different tires, because of the benefits provided by Michelin Energy Saver tires.

[2] ISO test conducted by TÜV SÜD Automotive in 2007 on a representative market sample of 195/65R15 and 205/55 R16 tires.

I. Michelin's Green Meters: A worldwide event for a global environmental challenge

Berlin, New York, Paris and Shanghai are four major cities around the world whose growth has been driven by the mobility of goods and the millions of people who come and go every day. That's why Michelin chose these four locations to launch a truly unique event whose objective is to focus the public's attention on the environmental and energy issues involved in choosing the right tire.

Beginning Oct. 30, 2007, these four cities will play host to Michelin's green meters. People passing by the City Group Mansion tower in Shanghai, China; the façade of the Park Inn Hotel in Berlin; the Port de Suffren at the foot of the Eiffel Tower in Paris; and the NASDAQ and Reuters boards in Times Square, New York City will see the reductions in fuel consumption and lower CO_2 emissions generated by Michelin's "green energy saving" tires since their launch in 1992. The meters will continue to count, in real time, the ever-increasing fuel and CO_2 savings as more and more of Michelin's environmentally-positive tires are placed into service on roads around the world.

Michelin green energy saving tires include a variety of passenger car, light truck and commercial truck tires optimized for fuel economy by reducing their rolling resistance and weight of the tire without compromising other key performance factors such as traction, grip and tread wear. Reducing rolling resistance also reduces CO_2 emissions.

Michelin has long been committed to better mobility, meaning mobility that is "sustainable for the planet and society over the long term." Thanks to Michelin's green meters, drivers will now have a better understanding of the environmental consequences at stake when they choose tires for their vehicles.

1. Michelin's green energy saving tires: quantifying the environmental benefits in real time

In each of the four cities, the Michelin green meters will display estimates of:

- Worldwide fuel savings attributable to Michelin green energy saving tires compared to conventional tires on the road since 1992, a total of **2,380,056,909 gallons.**
- The ever-increasing fuel savings, thanks to Michelin green energy saving tires currently on the road, updated at a rate of **11.6 gal./second.**
- The amount of CO_2 not released into the atmosphere since the introduction in 1992 of Michelin green energy saving tires, a total of **25,119,890 tons.**
- The amount of CO_2 not released into the atmosphere updated at a rate of more than **240.61 lbs./second**.

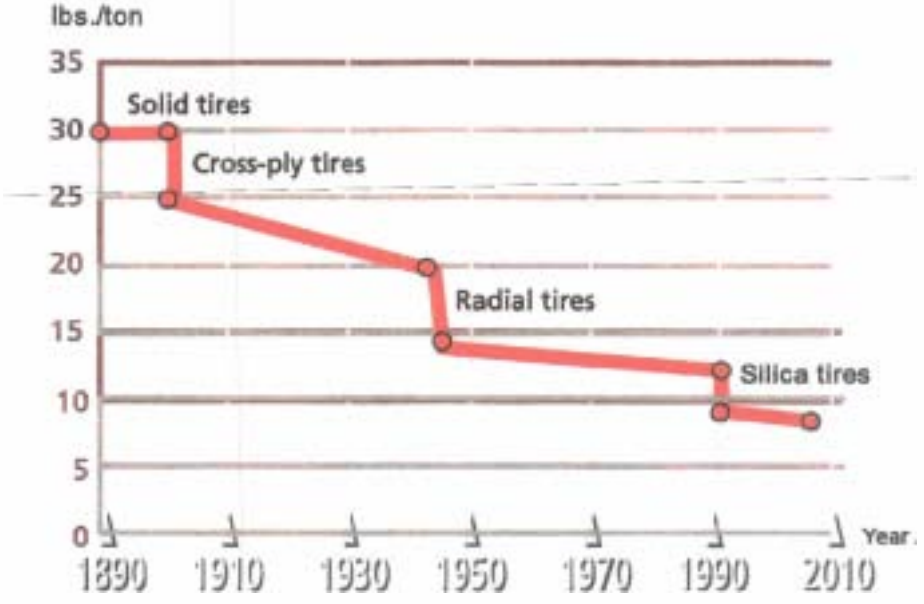
2. The environmental impact of tires: an ignored issue

II. Michelin's environmental commitment: Helping to lower CO_2 emissions

1. Lowering CO_2 emissions: A priority for Michelin's research and development teams

An aggressive commitment to reducing tire energy consumption has guided Michelin throughout its history. The increasing importance of this challenge is illustrated by the fact that the world's current estimated 830 million vehicles, which are responsible for 18 percent of global CO_2 emissions[3], are expected to double by 2030[4]. With its green energy saving tires, Michelin is demonstrating its concern for preserving energy resources. This is particularly critical since at current consumption levels, at least one major authority believes that the world's easily accessible oil reserves could be depleted in an estimated 31 years[5].

A commitment to reducing the environmental impact and fuel consumption of tires is a guiding principle at Michelin



1946: The invention of the radial tire improved performance in a number of different areas, among them rolling resistance. This led to a reduction in fuel consumption.

[3] Source: International Energy Agency
[4] Source: World Business Council for Sustainable Development, a Geneva-based association of 170 international corporations committed to supporting sustainable development
[5] Source: France's Ministry of the Economy, Finance and Industry

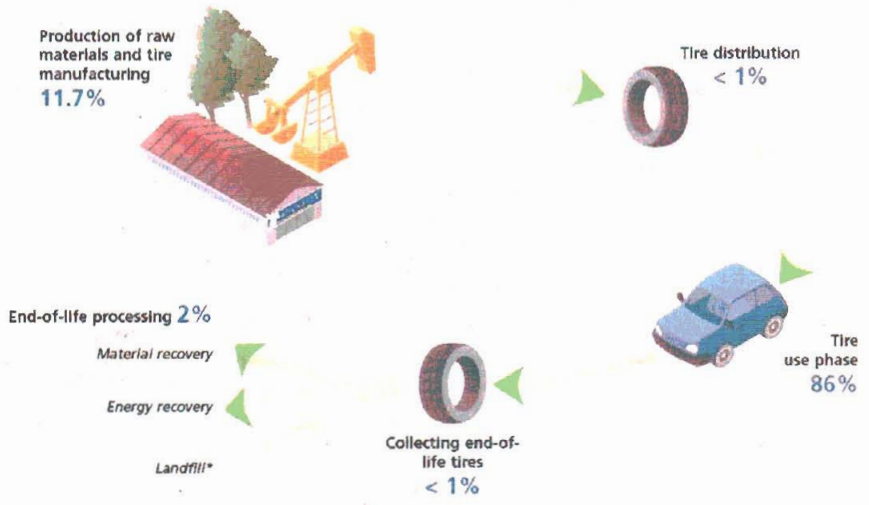
1992: Launch of Michelin green energy saving tires, which integrated silica in the tread as a partial substitute for carbon black. Silica helps to lower rolling resistance without compromising performance in traction, grip (especially on wet surfaces) and tread life. **This innovation made a significant improvement in reducing the energy needed to keep a vehicle moving, enabling a reduction in fuel consumption of .06 gal/1,000 miles.** That's why the "Michelin green energy saving tires" name was chosen—to underscore the dual advantage in terms of fuel savings and lower CO_2 emissions.

Today, further advances are still possible. Researchers at Michelin believe that significant additional reductions in rolling resistance, up to 50 percent, are possible within the next 10 to 15 years—a technical challenge to which Michelin is responding with special research programs.

Michelin has focused on rolling resistance because, contrary to common belief, **a tire has its greatest environmental impact—up to 86 percent —when it is in use on the road,** not during manufacture or disposal. The illustration below shows the environmental impact of a tire throughout its life.

Life cycle assessment of an average European passenger car tire

Contribution of the different stages of tire life cycle in the global impact on human health and the environment



Source: May 2001 study conducted by Préc Consultant B.V
** Banned in Europe since 2006*

2. Environmentally friendlier cars, thanks to Michelin green energy saving tires

In 15 years, Michelin has developed no fewer than four generations of Michelin green energy saving tires, clear proof of the importance given to protecting the environment and preserving energy resources.

▪ Three out of four Michelin car tires sold in Europe are green energy saving tires

More than 570 million Michelin green energy saving tires have been sold worldwide since 1992. The environmental impact has been considerable, given that for car tires alone this represents a **gain of more than 1.7 billion gallons of fuel and a reduction of more than 17.6 million tons of CO_2**, the equivalent of what is absorbed by 650 million trees in a year.

The latest addition to the Michelin green energy saving tires lineup was unveiled to the public at the 62nd Frankfurt Auto Show this past September. **Called the Michelin Energy Saver, the new tire makes further significant improvements in a car's energy balance and environmental impact, reducing fuel consumption by nearly 0.2 liter per 100 km and reducing CO_2 emissions by almost 4 g/km.** These represent considerable cost benefits, enabling motorists to save nearly €2 € every time they fill up (for a diesel-powered vehicle with a 50-liter fuel tank that consumes roughly 6 l/ 100 km, and based on an average price of €1.20 € per liter).

Compared with the market average[6], the gains delivered by the Michelin Energy Saver tire are considerable—not only for drivers but also for the environment, when viewed in terms of the total number of cars on the road and total distances traveled. During the entire life of a vehicle, this is close to **one ton of CO_2 not released** into the atmosphere, equivalent to the amount absorbed by 40 trees in a year.

▪ Reconciling environmental protection, safety and road performance

The challenge to which Michelin is responding is to design tires that help reduce fuel consumption while maintaining the same high performance levels in other areas. In this respect, the Michelin Energy Saver tire—the fourth generation of Michelin green energy saving tire since 1992—represents a synthesis of all of Michelin's skills and expertise. Fuel savings are combined with superior grip and safety, as well as the best total mileage in the market.

[6]ISO test conducted by TÜV SÜD Automotive in 2007 on a representative market sample of 195/65R15 and 205/55 R16 tires.

- **Michelin green energy saving tires provide automotive manufacturers with key advantages in meeting future European environmental standards**

The European Commission has reaffirmed its determination "to address energy efficiency and CO_2 emissions from cars."[7] In its "January 2007 package on energy and climate", **the commission emphasized that "further measures to tackle automobile CO_2 emissions from cars will be outlined (...) in order to reach through a comprehensive and consistent approach the target of 120 g CO_2/km by 2012."** In mid-2008, the commission will suggest a legislative framework to the European Parliament in order to achieve this objective.

This will be no easy task. Over the next four years, European carmakers must achieve **a reduction of 20 g/km in the average level of CO_2 emissions** for all their models, from 140 g/km in 2008 to 120 g/km in 2012. That's where the **Michelin Energy Saver** tire can play a crucial role, since **the tire alone can achieve one-fifth of that goal without any other changes being made in today's European vehicles**. For carmakers, this represents a "plug and play" solution.

The technology deployed by Michelin not only reduces the vehicle's environmental impact but also achieves economies of scale for car makers, which are supported by Michelin during the automotive design phase in finding environmental protection solutions. This approach is reflected in the partnership between Michelin and Peugeot during the development of the Peugeot 308 automobile. The Michelin Energy Saver tire contributes to the low fuel consumption of vehicle models fitted with 90hp and 110hp HDi engines.

- **Michelin green energy saving tires continue to deliver value to the passenger car and light truck market in North America**

In the United States, where Corporate Average Fuel Economy (CAFE) standards have been enforced by the National Highway Traffic & Safety Administration (NHTSA) since the mid-1970s, Michelin has supported its vehicle manufacturer customers in reaching these CAFE standards by providing low rolling resistance tires that do not compromise other key performances such as traction and wet handling. CAFE standards are focused on improving the fuel economy of passenger vehicles, which in turn lowers CO_2 emissions.

In both original equipment and replacement tires, Michelin offers consumers fuel efficient tires that save money and help protect the environment. For example, the recently introduced Michelin Latitude Tour HP tire for the fast growing CUV market will save consumers up to $400 in fuel costs (at today's prices) over the life of their vehicle and will also reduce the amount of CO2 emissions by more than one ton over the same period.

3. Promoting the creation of energy-efficiency labeling for tires

Michelin is leading the effort to create an energy efficiency index system for car and truck tires, similar to that used by the automobile industry to rate vehicle fuel consumption and CO_2

[7] Source: European Union, COM (2006) 545

emissions. In a similar fashion, motorists looking to purchase tires will be able to see at a glance the energy performance of the tire they are considering.

Under Michelin's leadership, the entire industry in Europe is working to make this project a reality, reflecting a commitment to inform consumers that tires perform very differently in terms of rolling resistance and, consequently, environmental impact. These differences may be as much as 50 percent for different tire brands produced for the same car. For a car at 40 mpg, a difference of more than 50 percent in rolling resistance can improve fuel consumption by up to 4 mpg and lower CO_2 emissions by up to 10 percent. The classification planned for Europe will range from an A rating for tires with the best energy performance to a low rating (not yet defined) for the least efficient. Tires that fall below the lowest rating will not be allowed for sale in Europe. **The system should be provided in Europe beginning in 2011.**

In the United States, Michelin is aggressively supporting rolling resistance legislation pending before the U.S. Congress that would require the NHTSA, in consultation with the U.S. Environmental Protection Agency (EPA), to devise and implement a consumer information program to give consumers for the first time the ability to know and compare rolling resistance performance characteristics at the point of sale. Similar to the EU effort, this rolling resistance information translates directly into fuel economy and will allow consumers to choose the most fuel efficient tires for their vehicles.

Michelin is also actively working with the state of California to implement regulations to fulfill Assembly Bill 844 (AB844), already passed into law by the state legislature, requiring a rolling resistance grading system for tires sold in the state. **This consumer information system could be in place in the state of California as early as 2009.**

Michelin's efforts to introduce energy efficiency labeling are motivated by the benefits it would provide to consumers as well as by the company's commitment to protect the environment. This can make the consumer's choice of replacement tires an act of responsible environmental stewardship, since in addition to providing overall fuel cost savings, low rolling resistance tires also lower the CO_2 emissions that contribute to global warming.

Michelin's low rolling resistance tires for passenger cars often display a special "Green X" marking on the sidewall.

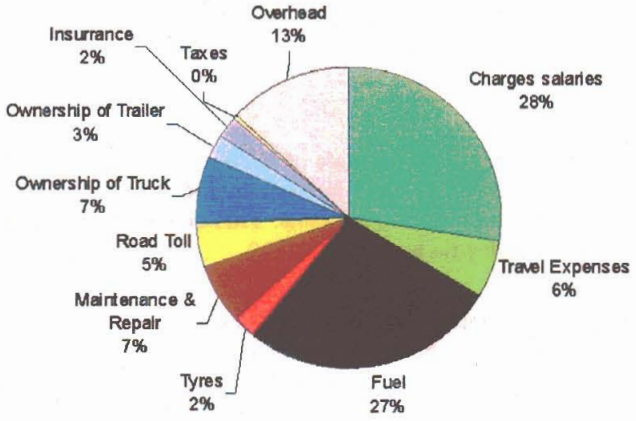
4. Environmental technologies developed for truck tires

For commercial trucking fleets, the cost of fuel and tires can represent more than 25 percent of total operating costs. This accounts for millions of dollars

each year that translate into higher shipping and retail costs for each of us. This is why Michelin transferred its low rolling-resistance technology, introduced in 1992 for passenger car tires, to truck tires in 1994.

While the average passenger car in North America travels approximately 12,000 miles a year, a long-haul truck can rack up the same number of miles each month. And, one fleet can have hundreds or even thousands of vehicles – resulting in millions of dollars in fuel and tire costs. At the same time, energy costs are at historic highs. Diesel fuel has more than doubled in the United States over the last five years and has increased in Europe by 40 percent over the same period. Fuel is second only to labor costs for trucking fleets. With these factors in mind, tire performance and fuel economy are not only major environmental concerns but also major financial issues for the trucking industry. The right tire choice can be the difference in the profitability of a trucking company.

European trucking company expenses



Source: French National Road Haulage Committee (CNR) – 2006

- **Michelin green energy saving truck tires**

Since each axle has its own special requirements, Michelin green energy saving tires in North America comprise three major types:

- Steer axle: **Michelin XZA-1+, XZA2** and **XZA3** tires
- Drive axle: **Michelin XDA Energy, XDA3** and **X One XDA** tires
- Trailer axle: **Michelin XTA Energy, XT-1** and **X One XTA** tires

- **Delivering economic and environmental benefits in Europe**

Because they reduce fuel consumption by approximately two liters per 100 km, Michelin Energy tires provide European trucking companies with a considerable advantage. If consumption is reduced by one liter per 100 km through the entire life of the tire, this translates in to a savings of 60,000 l/year—for a fleet of 50 trucks each covering 120,000 km/year—or €54,000 € based on a price of €0.90 € for a liter of diesel fuel*. And in addition to the financial

benefit for trucking companies, lowering fuel consumption reduces the industry's impact on the environment. Each liter of diesel fuel saved corresponds to 2.66 kg of CO_2 not released into the atmosphere. That's why European legislation now recognizes that tires play a significant role in helping to reduce emissions of harmful pollutants and greenhouse gases.

Source: The Michelin Challenge

▪ The Michelin X One revolution in North America

Launched at the end of 2000, the Michelin X One tire replaces dual tires on commercial vehicles in North America with one wide-based single tire, effectively turning 18-wheelers into 10-wheelers. By comparison, Michelin X One tires will improve the vehicle's fuel economy by around 4 percent and can reduce the weight of a tractor-trailer by as much as 720 pounds. The weight savings allows vehicles to increase their payload, which in turn means fewer trucks are needed to carry the same amount of freight, thus reducing road congestion.

A single long-haul truck, fitted with Michelin X One tires, can save up to 80 gallons of fuel each month, which at today's prices can save each tractor-trailer more than $200 per month in fuel costs. This gives large national fleets the ability to lower their CO_2 emissions while saving millions of dollars in fuel costs each year.

In the seven years since Michelin launched the X One revolution, these wide single tires have collectively saved an estimated 15 million gallons of fuel and reduced CO_2 emissions by more than 165 thousand tons.

And the demand for Michelin X One tires continues to grow, converting more than 1,000 vehicles each month in North America. This is a great example of Michelin Durable Technology research delivering a product that is both environmentally conscious and economically advantageous.

▪ Proven at The Challenge

To demonstrate the benefits delivered by its Energy truck tires, Michelin organized an impartially supervised real-life test in September 2006.

Two identical trucks left Michelin's Ladoux Research Center near Clermont-Ferrand, France on Sept. 25, 2006 for the IAA Motor Show in Hanover, Germany, where they arrived the following day. Both trucks covered the same distance of 777 miles, following the same itinerary, traveling at the same speed and carrying the same load. The only difference was the tires; the first being equipped with new Michelin E2+ tires and the second with new Michelin A2 Energy low rolling resistance tires. The Michelin A2 Energy tires resulted in a fuel savings of 7.6 gallons compared to the Michelin E2+ tires, an average increase of .35 miles per gallon (mpg) for a truck that averages 6 mpg.

The table below shows the average gains observed during a tire's first life (3 percent fuel economy) obtained in actual driving conditions by a fleet with 100 trucks.

Diesel fuel price	$2.95 per gallon*

Fuel savings thanks to Michelin X One tires	3 percent**
Number of trucks in the fleet (example)	100
Average distance traveled by each truck	120,000 miles
Average current fuel economy	6 mpg
Annual savings for a fleet of 50 trucks	**$177,000**
Savings in terms of tires	**420 new steer tires** per year***

** Sept. 2007 reported by the U.S. Dept. of Energy.*
***New Michelin X One tires have a 4 percent fuel economy advantage over dual tires. While the X One maintains an advantage over duals throughout its life, the advantage is more substantial when the tires are new. Therefore, the overall fuel savings have been reduced to 3 percent for calculation.*
****Based on an estimated replacement tire price of $420 per steer tire*

Fuel savings also means a reduced environmental impact, since each gallon of diesel fuel saved represents 22.3 pounds of CO_2 not released into the atmosphere. For the table above, this results in **a reduction in CO_2 emissions of around 223 tons.**

- ## Fuel savings and lower CO_2 emissions thanks to Michelin retreading

In addition to the benefits provided by low rolling resistance technology, Michelin truck tires offer other advantages that reduce fuel consumption and CO_2 emissions. Their architecture is designed so that each tire has multiple lives—the first with the new tire, followed by multiple retreads through Michelin Retread Technologies (MRT).

Michelin retreading delivers performance comparable to Michelin new tires and also helps preserve raw materials. That's because the amount of material needed to retread a tire is only 20 percent to 30 percent of what is needed to manufacture a new tire, since much of the original materials are reused.

- ## Reducing fuel consumption thanks to Michelin's advice and expertise

Fuel efficiency can be improved if tires are used and maintained properly. Michelin has more than 1,300 experts who travel across Europe and North America, visiting truck users and helping them to optimize their fleets and choose, maintain and manage their tires to achieve maximum fuel savings. They also train dealers who then in turn can better serve users by helping them to get the most out of Michelin products.

In Europe:
Intended for large trucking companies in Europe, the Michelin Fleet Solutions offering deploys a unique business model that invoices customers not on tires purchased but on distances driven, again with the goal of optimizing a tire's multiple lives and, in particular, achieving greater fuel savings. For its European trucking company customers, Michelin recently introduced an online calculator (www.michelintransport.com/economiedecarburant) enabling them to determine simulated gains depending on their fleet size.

In North America:
Michelin also offers an online fuel savings calculator for North American fleets that allows them to calculate the savings of specifying Michelin green energy saving tires. This calculator can be found at www.michelintruck.com.

III. Michelin's worldwide commitment to better mobility

"Will we be able to find solutions that enable us to develop mobility while reducing the disadvantages?" asks WBCSD[8] President Bjorn Stigson. As a major mobility player, Michelin has responded with a commitment to better mobility, meaning that it is sustainable for the planet and society over the long term. To fulfill this commitment, the company is backed by a culture of performance and responsibility that has been deployed across the organization, on all continents and in all host countries.

1. Five core values

Since a responsible enterprise that is committed to sustainable development must assess the negative effects of its operations in order to reduce them, Michelin develops its high-performance products from a foundation of core values. This strategy is apparent at each stage of the manufacturing process. Respect for customers, people, shareholders, the environment and facts are the values that will ensure Michelin's responsible, long-term growth.

2. Michelin Performance and Responsibility: Creating the conditions for the company's responsible, long-term growth

Michelin's growth is driven by performance, both **technical**, which enables people to drive safely on our tires, and **financial**, which underpins the company's long-term viability. Michelin is dedicated to constantly improving its performance in both of these areas by assuming its **responsibilities** with regard to the long-term impact of its products and activities on people and the environment.

Introduced in 2002 under the guidance of Edouard Michelin, the Michelin Performance and Responsibility process is designed to put into practice the company's five core values. To enable this approach, the Michelin Performance and Responsibility Charter was published in 2003. This 40-page document has been translated into 15 languages and distributed to all Michelin managers worldwide.

Michelin Performance and Responsibility is built on a number of cornerstones:

- Pursuing a long-standing commitment to operating responsibly.
- Analyzing the challenges with regard to better mobility programs and Michelin's overall performance as a global, market-leading enterprise.
- Identifying the expectations of different stakeholder groups, including customers, employees and shareholders.

[8] World Business Council for Sustainable Development, a Geneva-based association of international corporations committed to supporting sustainable development

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- Measuring impact and monitoring performance through specific indicators that, for example, calculate workplace accident frequency and severity data or the percentage of tires produced in plants certified to ISO 14001 environmental management standards.
- Complying with local legislation in all host countries and, in some cases, adopting international norms for more demanding standards in specific situations.
- Reporting progress to internal and external stakeholders on a regular basis.

3. The Challenge Bibendum: Bringing together mobility stakeholders

In 1998, Bibendum, the world-famous Michelin man, celebrated his 100th birthday. To mark this historic milestone, Michelin created an event that would spotlight the technical progress made by vehicle manufacturers in developing environmentally friendly vehicles, proven in real-world conditions. The result was the first **Challenge Bibendum**, a friendly competition that ran from Clermont-Ferrand, France, the site of the Michelin Group's worldwide headquarters, to the Champs-Elysées in Paris.

The Challenge Bibendum is designed to **spotlight the most significant advances in better mobility.** The idea behind the event is simple: to help people understand the technologies involved through practical demonstrations; and, to see how each technology fits into the overall picture. The approach used is equally direct: give today's opinion leaders, decision-makers and media a clear, impartial, credible view of how the "state-of-the-art" in science and technology can pave the way to the development of sustainable mobility solutions. A real commitment to progress in this crucial area will require decisions impacting all of society. Ultimately, everyone has a role to play, whether government, industry or consumers.

The Challenge Bibendum was created to show that the automobile industry is working toward better mobility, and that it already has some of the technologies needed to reduce pollution and improve safety, without compromising mobility.

Substantial progress has been made in some areas in recent decades. For example, 100 passenger cars in 2003 generated less pollution than a single car back in 1975. But the most effective solutions need to be brought to market faster, and the Challenge Bibendum is one way of assessing and publicizing those solutions.

2000: the second Challenge Bibendum is held in Clermont-Ferrand, France
Beginning the following year, the event becomes annual and more international in scope.
2001: Based in California, on the West Coast of the United States and including with a rally from Los Angeles, Calif. to Las Vegas, Nev.
2002: Returning to Europe, starting in Heidelberg, Germany and heading to Paris, by way of the European Parliament in Strasbourg.
2003: Back to California, this time in the Sonoma Valley and San Francisco.
2004: Eastward bound, more precisely to Shanghai, China.
2005: Once more to the East, to Japan, with the Bibendum Forum & Rally, an event developed from the Challenge Bibendum.

2006: Paris again plays host to the major mobility stakeholders for an update on new advances towards sustainable mobility.
2007: Scheduled to take place Nov. 15-17 in Shanghai.

Appendix 1

Calculation methodology

Quantifying the contribution of Michelin green energy saving tires to fuel savings and lower CO_2 emissions.

The methodology* applied has been approved by the Technical Authority for Automobiles, Motorcycles and Cycles (UTAC).

The two figures to be determined are:
- The amount of fuel saved since the market launch of Michelin green energy saving tires in 1992.
- The amount of CO_2 not released into the atmosphere over the same period.

➢ **Estimating the amount of fuel saved as of Oct. 30, 2007**

The formula consists of aggregating the fuel savings delivered by each Michelin green energy saving tire throughout its lifetime. The calculation involves three steps:

A) Estimate the fuel savings per 100 km thanks to Michelin green energy saving tires.
This is determined by the difference in rolling resistance between Michelin green energy saving tires and the market average of conventional tires on the road (as measured by Germany's TÜV SÜD Automotive on a representative market sample of tires, including conventional Michelin tires). Then, the consumption gain, proportional to the difference of rolling resistance forces, is calculated using commercially available simulation software common to the automotive industry.

B) Assess the distance traveled with Michelin green energy saving tires sold between 1992 and October 2007.
The total distance traveled* can be calculated by multiplying the average life of the tires sold by the number of vehicles equipped with Michelin green energy saving tires.

C) Calculate the amount of fuel saved.
This is determined by multiplying the gain in consumption per kilometer or mile by the distance traveled.

➢ **Transform the fuel savings into CO_2 not released into the atmosphere**

The estimation of CO_2 not released into the atmosphere is proportional to the amount of fuel saved. The formula used is the following: each liter of fuel consumed results in the release of 2.5 kg of CO_2 into the atmosphere.

**45,000 km, based on calculations made on all tires in the representative market sample.*

➢ **Measuring the gains second by second**

The second-by-second gain (in terms of fuel saved and CO_2 not released into the atmosphere) is calculated from the gains measured between Oct. 1 and Oct. 30, 2007, divided by 30 (days) then by 24 (hours), and lastly by 3,600 (seconds).

- **Calculation variables**

  The methodology is the same for car tires and truck tires, although calculations are based on the number of vehicles equipped with Michelin green energy saving tires for cars and on the number of axles fitted with Michelin green energy saving tires for trucks.

- **Additional information on the calculations & data**

  Additional information on Michelin green energy saving tires, including more in-depth information on the calculations and data can be found online at: www.michelin-green-meter.com.

Appendix 2:

Mobility challenges of the future

To promote and support discussions about sustainable mobility, Michelin, along with other global companies from the transportation industry, took part in the Sustainable Mobility Project organized by the World Business Council for Sustainable Development (WBCSD). The goal was to take an inventory of mobility initiatives around the world, to analyze the challenges ahead and to determine future objectives to meet those challenges.

A key driver of economic and social development, road transport of people and merchandise has been steadily increasing for decades. Today, more than 80 percent of all transportation of people is on roads. Between 1950 and 2003, the total number of road vehicles worldwide increased from 50 million to more than 830 million. According to WBCSD[9] estimates, this figure will double by 2030, while distances traveled to transport people are expected to increase by nearly 80 percent between 1995 and 2020. This increase in people mobility will be particularly dramatic in emerging countries such as China and Latin American countries, with certain studies forecasting average annual growth of 3 percent for the period 2000-2030.

Behind these figures, however, access to mobility varies greatly from one region to another. According to the WBCSD, the average annual distance traveled by an American in 2000 was 12 times greater than that traveled by an African. More than 75 percent of all motor vehicles are found in developed countries and access to mobility remains a problem for the disadvantaged, the elderly and the handicapped.

The increase in road traffic has created major problems for today's society in three areas:

- **A significant rise in the number of road accidents,** which result in 50 million injuries and 1.2 million deaths every year. Of the total, more than 85 percent are in developing countries where the situation is getting worse, while it has stabilized in developed countries (source: Organization for Economic Cooperation and Development). In developing countries, road accident victims are mainly pedestrians or cyclists, while in industrialized countries most casualties are motorists.

- **An increase in the environmental impact** of pollutants at the local level, such as carbon monoxide, nitrogen oxides and volatile organic compounds, as well as greenhouse gasses such as CO_2 that cause global warming. According to the International Energy Agency (IEA), transportation accounts for 26 percent of all CO_2 emissions. Another illustrative figure is that transportation accounts for roughly 65 percent of all oil consumption in industrialized countries. The IEA forecasts that oil consumption to meet transportation needs could double in the next 25 to 30 years. Lastly, another area of concern is reducing noise levels, especially in urban and suburban areas.

- **Traffic flows.** According to the World Bank, more than 50 percent of the global population will live in urban areas by 2008, compared with less than 30 percent in 1950. In developing

[9] World Business Council for Sustainable Development, a Geneva-based association of 170 international corporations committed to supporting sustainable development

countries, this rapid urban growth is not always supported by infrastructure improvements, leading to chronic congestion on road arteries.

US Tire Industry Perspective on AB 844 Implementation

Tracey Norberg
Rubber Manufacturers Association

California Energy Commission
Workshop on the Fuel Efficient Tire Program
December 7, 2007

RMA Tire Company Members

Bridgestone Americas
Michelin North America
Continental
Pirelli
Cooper
Toyo Tires
Goodyear
Yokohama

RMA Perspective Summary

- Supports moving forward with AB 844 rating system and consumer information program
- CEC testing data provides good foundation to characterize the market
- RMA has collected supplemental data to augment CEC data
- RMA has begun analysis to characterize market using all available data (CEC + RMA)
- RMA supports use of SAE J1269 single point test

AB 844 Components

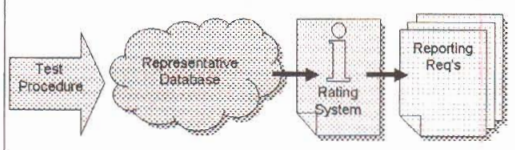
- Consumer Information and Related Requirements
- Performance Standards and Related Requirements
- Our understanding is that focus today is on consumer information only

AB 844 Consumer Information Section Requirements

Develop and adopt:

- A *database of a representative sample* of tires sold in the state based on *test procedures adopted by the commission*
- *Based on database, develop rating system* for energy efficiency of tires sold in state
- *Based on test procedures and rating system, requirements for tire manufacturers to report energy efficiency of tires* sold in state

AB 844 Process Shorthand



Step 1: Select a Test Procedure

- RMA recommends SAE J 1269 single point test as appropriate reference test procedure for AB 844 work
- CEC conducted correlation work comparing SAE J1269 single point test to SAE J2452 test
  - CEC found that tests were highly correlated
  - SAE J 1269 single-point test is most efficient and cost-effective test existing today

Global Test Procedure Development

- Global tire industry developing global single point test procedure through ISO process
- ISO test is designed for regulatory development and compliance purposes with earliest adoption in 2009
- Industry would support migration to ISO global single point test method for use in CA when ISO test method is adopted
- This should not negatively impact the CEC AB 844 process but would harmonize industry testing and data collection globally
- RMA will keep CEC apprised of ISO developments

Step 2: Establish a Database of a Representative Sample of Tires

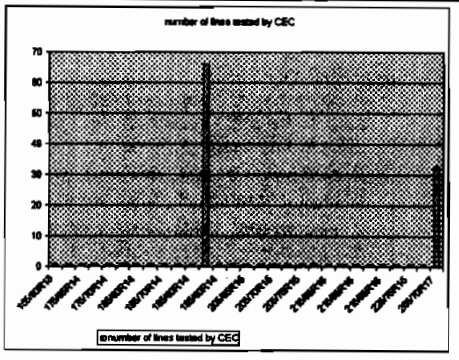
- Available Data Sources on US Tires
  - CEC database currently includes CEC/Smithers test data
  - Other data
    - Ecos/Greenseal Data
    - NRC Report Data
- RMA intends to supplement current data with additional data on 600+ tires

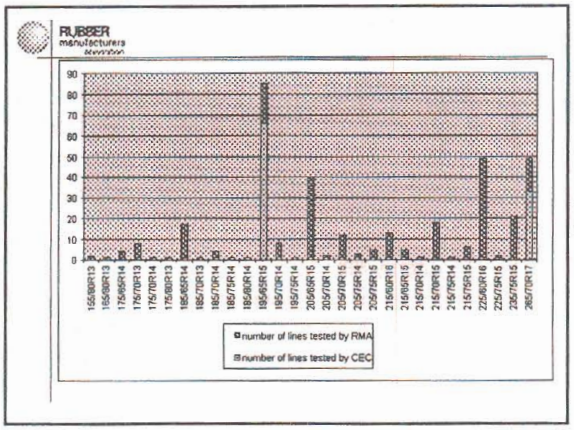
CEC Study Data

- CEC conducted a $400,000 study to assess rolling resistance of tires in CA
- Tested two tire sizes selected by evaluation of most popular vehicles in CA (2004 data)
  - P195/65R15 (e.g., Honda Accord, Toyota Corolla, Dodge Status, Nissan Altima, Pontiac Sunfire, Saturn L Series)
  - P265/70R17 (e.g., Ford F150, Chevy Silverado, Chevy Avalanche, Cadillac Escalade, Dodge Ram Pickup 1500 Series, Ford Expedition, GMC Sierra Pickup, GMC Yukon)
- One complete tire line of 28 tire sizes also tested (Firestone FR 380)
- Total of 149 tire models tested (5 replicates each)

CEC Study Data

- CEC study designed to form basis for establishing a database of a representative sample of tires
  - Tested tires in a broad range of brands, speed ratings and service types in two popular tire sizes on both ends of the tire size spectrum
  - Explored size effects on rolling resistance by evaluating one complete tire line
- These data can be supplemented to establish a database of representative sample of tires



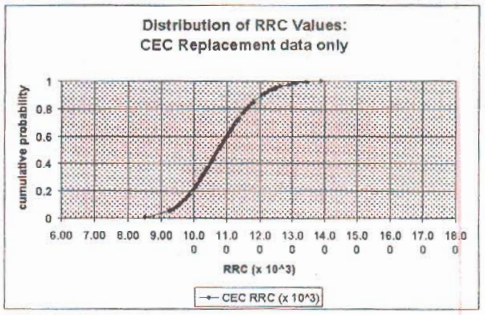


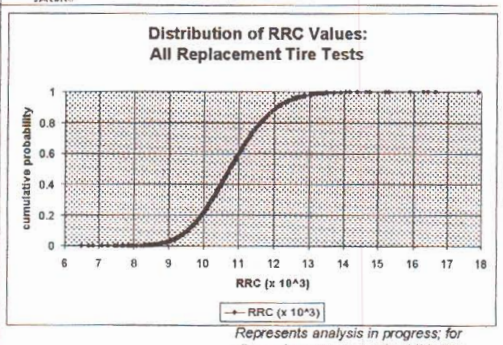
Other Data Sources

- Ecos/Greenseal
  - Limited utility due to incomplete information about the tires tested
- NRC Report Database
  - Data on 162 tires
- RMA Data
  - Data on 627 tires
  - RMA data includes NRC tires

Step 3: Create a Rating System

- Use representative database (CEC + RMA) to characterize marketplace
  - Use tested rolling resistance coefficient (RRc) data
  - Use other descriptive data about tested tires (UTQG ratings , speed rating, service type, etc.)
  - Use industry data on size popularity and tire shipments
  - Use CA vehicle registration data to determine popular vehicles
  - Use statistical modeling to characterize the tire market in terms of rolling resistance
- Segment marketplace into performance categories for rating tire fuel efficiency (rolling resistance)





Represents analysis in progress; for discussion purposes only at this time.

About Tire Efficiency Ratings

- Should be meaningful to consumers
- Should be easily understood by both tire "buyers and sellers" (TRB Report, 2006)
  - Limited number of rating categories
  - Accompanying explanatory literature
- This is an area ripe for statistical analysis and policy dialogue

Step 4: Develop Tire Efficiency Reporting System

- According to AB 844, tire efficiency reporting should be *based on rating system and established test procedure*
- Tire manufacturers would report to CEC energy efficiency ratings for applicable tires marketed in CA
- Ratings would also be provided to tire retailers and dealers through marketing and sales processes, as UTQG information is provided currently
- RMA member tire manufacturers would develop mechanisms to provide CA tire energy efficiency ratings on website(s)
- Tire manufacturers would certify data and be open to periodic audits to assure compliance

RMA Supports National Tire Efficiency Information Program

- RMA supports federal legislation that would establish national tire efficiency rating system and consumer information program
- Provision included in Senate-passed version of Energy Bill
- Provision also included in new compromise Energy legislation passed by House yesterday
- Bill under consideration in Senate today

RMA Supports National Tire Efficiency Rating System

- Provision includes preemption provision that preempts states other than California from enacting different tire efficiency rating and information program
- CEC and NHTSA potentially will both be developing tire efficiency rating systems
- Consistency between these two programs would best serve consumers
- RMA is committed to facilitating maximum coordination in the development of both programs

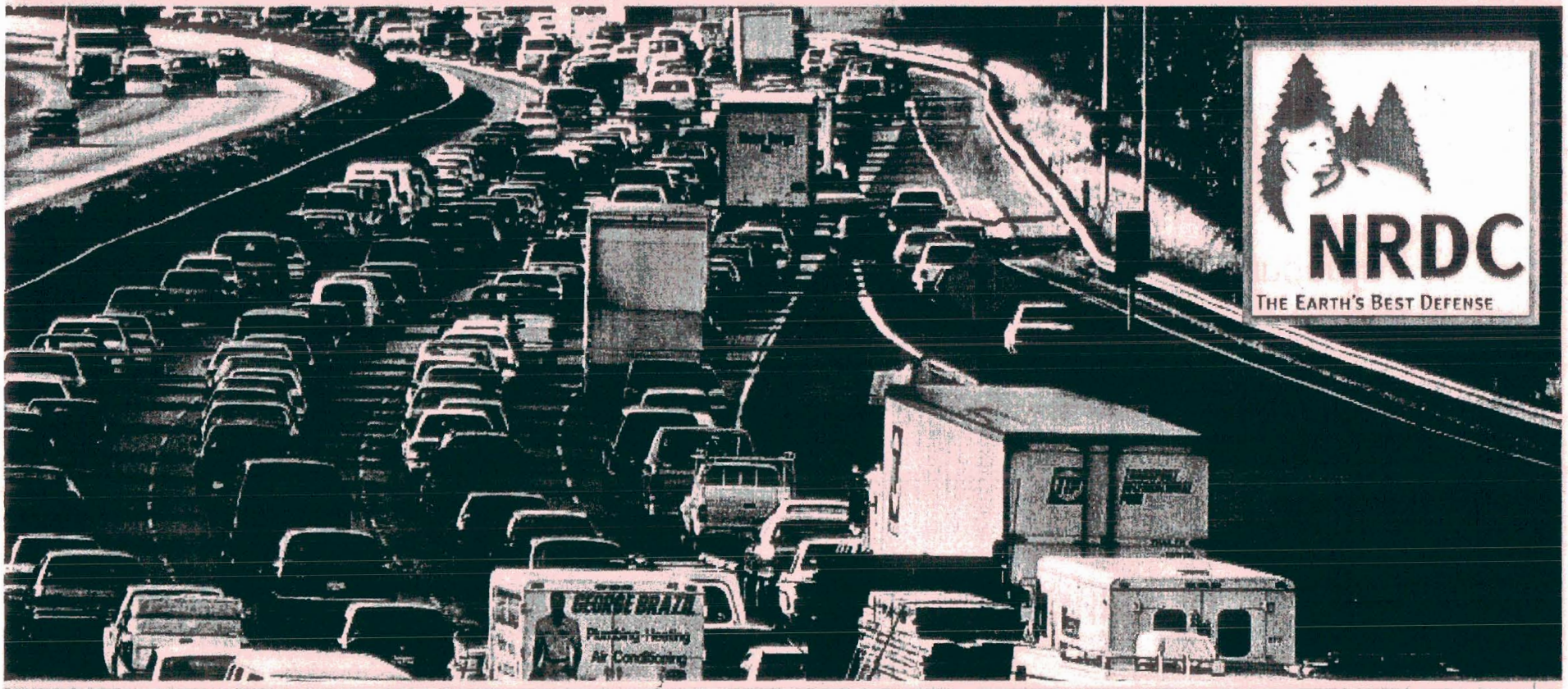
EU Developments

- European Commission is also developing tire efficiency rating system and consumer information
- US tire industry is interested in exploring synergies among CA, national and EU systems

RMA Recommendations for Moving Forward

1) Adopt SAE J1269 single point test as reference test
2) Use CEC data plus RMA data to characterize marketplace
3) Begin formal dialogue among stakeholders to develop rating system
4) Establish rating system so that tire manufacturers have structure to begin providing consumers with tire efficiency information
5) Establish reporting mechanism

Moving Forward with California's Tire Efficiency Program



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CEC Fuel Efficient Tire Program
Committee Workshop
Sacramento, CA
December 7, 2007

Statutory Obligations and State Targets Compel State Action on Tire Efficiency

NRDC
THE EARTH'S BEST DEFENSE

- AB 844 (Nation, 2003)
- CA Strategic Objectives
  - Decrease petroleum dependence:
    - CEC AB 2076, 2007 IEPR, AB 1007 Alternative Fuels Plan
  - Reduce emissions of global warming pollutants:
    - AB 32, AB 1007 Alternative Fuels Plan
- National tire efficiency information program
  - CA leadership helps define information program; CA first in standards
- Market is already advancing
  - Michelin Green Meter
  - Yokohama low-rolling resistance model in Japan

➡ *CEC should capitalize on the momentum for improving tire efficiency and provide leadership in program implementation.*

Significant CA Fuel and GHG Savings in 2020

NRDC
THE EARTH'S BEST DEFENSE

- Fleet turnover to more efficient models by 2020 is feasible
  - Typical tire life 3-4 years; Replacement tires are 75-80% of the light-duty market
- Tire wear cannot be sacrificed so savings should apply to the life of the tire
- 2020 Benefits Potential: Reductions in Gasoline Use and GHG Emissions

Tire Fuel Economy Improvement	Gasoline (Million Gallons)	GHG (Million Metric Tonnes CO2e)
2%	213	2.5
3%	317	3.7
4%	419	4.9

Assumes 2020 light-duty vehicle population of 30 million with 75% using fuel-efficient replacements. Baseline on-road fuel economy is 24.8 mpg (2007 IEPR), WTW GHG per gallon gasoline is 11.7 kgCO2e/gal (AB 1007 Alternative Fuels Plan). Annual VMT is 12,000 miles.

Tire Efficiency Technical Potential Is Likely Higher than 4%

NRDC
THE EARTH'S BEST DEFENSE

- NAS Panel: Rolling resistance among tires in today's market with same size, traction and speed ratings can vary by as much as 20%, which could result in fuel economy benefits of 4%.

- Michelin Green Meter Press Kit, October 10, 2007:

  - "Today, further advances are still possible. Researchers at Michelin believe that significant additional reductions in rolling resistance, up to 50 percent, are possible within the next 10 to 15 years—a technical challenge to which Michelin is responding with special research programs."

  - "Under Michelin's leadership, the entire industry in Europe is working to make this project a reality, reflecting a commitment to inform consumers that tires perform very differently in terms of rolling resistance and, consequently, environmental impact. These differences may be as much as 50 percent for different tire brands produced for the same car. For a car at 40 mpg, a difference of more than 50 percent in rolling resistance can improve fuel consumption by up to 4 mpg and lower CO2 emissions by up to 10 percent."

Fuel Savings Are Cost-Effective

NRDC
THE EARTH'S BEST DEFENSE

- NAS Panel assumed $1 - $2 per year incremental cost to consumer
- Net Savings to Consumer for Using Fuel Efficient Tires

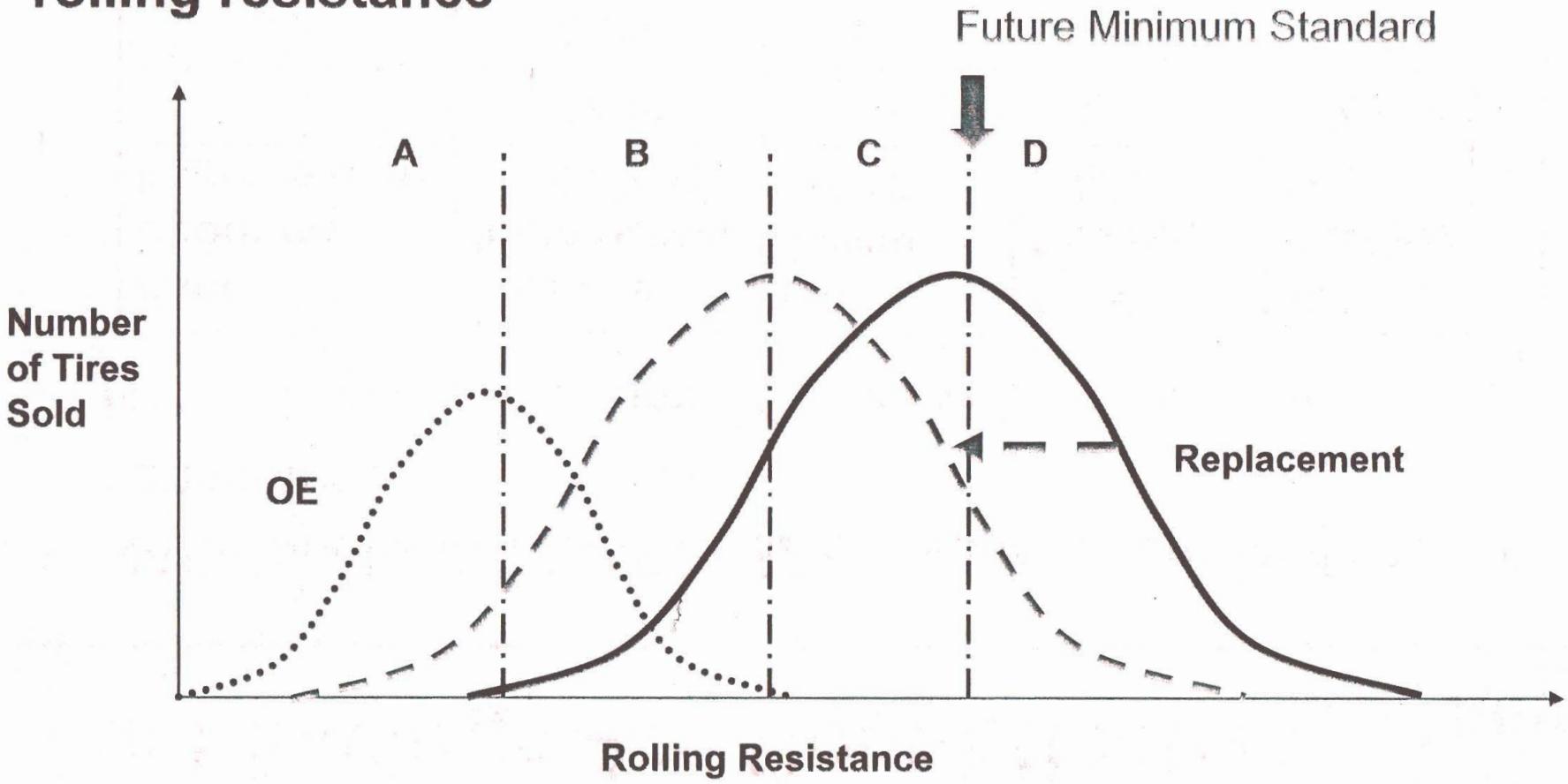
Fuel Economy Improvement	F.E. Tire Incremental Cost ($/yr)	Fuel Savings (gal/yr)	Fuel Savings ($/yr)	Net Savings ($/yr)
2%	$2.00	9.5	$23.72	$21.72
3%	$2.00	14.1	$35.23	$33.23
4%	$2.00	18.6	$46.53	$44.53

Assumes $2.50/gallon gasoline; baseline on-road fuel economy is 24.8 mpg (2007 IEPR); and annual VMT is 12,000 miles. Significant net benefits to consumers also found in CEC Consultant analysis "California State Fuel-Efficient Tire Report: Volume II," Consultant Report 600-03-001CR Volume II. January 2003.

Ratings and Standards Transform the Replacement Tire Market

NRDC
THE EARTH'S BEST DEFENSE

Illustration: Ratings and standards shift market to lower rolling resistance



Tire Efficiency Reporting and Rating Program Design Principles

NRDC
THE EARTH'S BEST DEFENSE

- Protect industry leaders and assist consumers with data accuracy
- Standardize test procedure to ensure comparison across manufacturers' products
  - Precise and repeatable
  - Third party, independent test facility with proper certification
- Rating and testing system sustainability
  - Fully funded for on-going analysis, data compilation and accuracy checking
  - Master database maintenance
  - Random testing to ensure products continue to meet assigned rating
- Labels: Simple-to-understand and widely available at point of sale and for pre-sales research
- Challenge process between manufacturers to validate efficiency claims
- Tire dealer and state fleet procurement education

Leverage Existing, Working Models for Testing and Rating Administration

NRDC
THE EARTH'S BEST DEFENSE

- Cool Roofs Rating Council Product Rating Program (www.coolroofs.org)
  - 501(c)(3) non-profit organization that maintains a third-party, independent product rating program
  - Public interest oversight (government agency, NGO, other)

California Energy Commission
Fuel Efficient Tire Program

Implementation of AB844

Ray Tuvell, CEC Staff
Caryn Holmes, CEC Staff Counsel

California Energy Commission Fuel Efficient Tire Program

- Enabling Legislation
  - Assembly Bill 844 (Nation, Chapter 645, Statutes of 2003)

    Directs the Energy Commission to:

    Adopt a test protocol

    Adopt reporting requirements

    Adopt a rating system

    Establish a database

    Adopt energy efficiency standards, subject to meeting specified conditions

California Energy Commission Fuel Efficient Tire Program

- **Applicability:**

  All passenger vehicle and light duty truck tires manufactured for sale in California.

- **Exemptions:**

  Tires for which only 15,000 or less are produced annually,
  Snow tires,
  Motorcycle tires,
  Space-saver tires (i.e. temporary spare tires),
  Tires with a rim diameter of 12 inches or less, and
  Off-road vehicle tires.

California Energy Commission Fuel Efficient Tire Program

- Applicability and Exemptions

Questions/Needs:

1. How to make the definitions clear and commonly understood.
2. Are more detailed definitions necessary?
3. Are there standard industry definitions?
4. How many tires/families of tires are covered?

California Energy Commission
Fuel Efficient Tire Program

Phase I Goals:

- Rolling Resistance Test Protocol
- Reporting Requirements
- Rating System
- Verification and Compliance Procedures

California Energy Commission Fuel Efficient Tire Program

- Proposed Rolling Resistance Test Protocol

  SAE J1269, force method, single point, standard reference conditions

California Energy Commission Fuel Efficient Tire Program

- Proposed Rolling Resistance Test Protocol

Questions/Needs:

1. Is SAE J1269 an acceptable protocol?
2. How to ensure test results from various facilities/labs are comparable?
3. What are the test costs?
4. Are there sufficient test facilities?

California Energy Commission Fuel Efficient Tire Program

• Proposed Reporting Requirements

- Manufacturer
- Brand Name
- Model Name
- SKU
- Size
- Weight
- Diameter
- Tread Depth
- Load Index
- Speed Rating
- Temperature Rating
- Traction Rating
- Treadwear Rating
- Maximum Load
- Maximum Pressure
- J1269 Rolling Resistance
- J1269 Test Load
- J1269 Test Inflation Pressure

California Energy Commission Fuel Efficient Tire Program

- Proposed Reporting Requirements

Questions/Needs:

1. Is the data commonly available?
2. Are there preferred reporting systems?
3. Are there foreseeable reporting problems that need to be considered?

California Energy Commission Fuel Efficient Tire Program

- Rating System

Questions/Needs:

1. What is required for a consumer friendly rating system?
2. What concepts exist for a rating system?
3. Are there any existing models of rating systems that could be applied to tires?
4. If a rating system is based on a "bin/category" concept, how many bins are needed?

California Energy Commission Fuel Efficient Tire Program

- Proposed Verification and Compliance

1. Manufacturers required to submit records to substantiate reported data.
2. Energy Commission to conduct independent tests.
3. Random and selected testing.
4. Testing in response to challenges.

California Energy Commission Fuel Efficient Tire Program

- Proposed Verification and Compliance

Questions/Needs:

1. What steps should be in the process?
2. If a problem is uncovered what are the consequences?
3. How will the costs of verification and compliance be covered?

California Energy Commission
Fuel Efficient Tire Program

Implementation of AB844

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