NCAP BRAKING

CONSUMER BRAKING INFORMATION

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NHTSA SAFETY PERFORMANCE STANDARDS

SAE GOVERNMENT INDUSTRY MEETING

WASHINGTON, DC

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INTRODUCTION

- Concerns about developing brake system rating focus on variability of:
  - Vehicle
  - Test driver
  - Test surface

PROGRAM SUMMARY

- 1998 – 1999 Initial testing at Aberdeen Test Center
- 1999 – 2000 Round-robin testing at Aberdeen, MGA, TRC
- 2001-2002 Additional vehicle testing, to be determined

1998 ABERDEEN TEST PROGRAM

- OBJECTIVES
  - Test a variety of light vehicles
  - Limit test conditions to reduce variability
  - Use only ABS-equipped vehicles
  - Perform statistical analyses of stopping distance results

VEHICLES TESTED

- 10 ABS-EQUIPPED VEHICLES
  - 5 Passenger cars (including control vehicle)
  - 2 Minivans
  - 1 Sport Utility Vehicle
  - 1 Full-Size Van
  - 1 Full-size Pickup (Rear wheel only ABS)

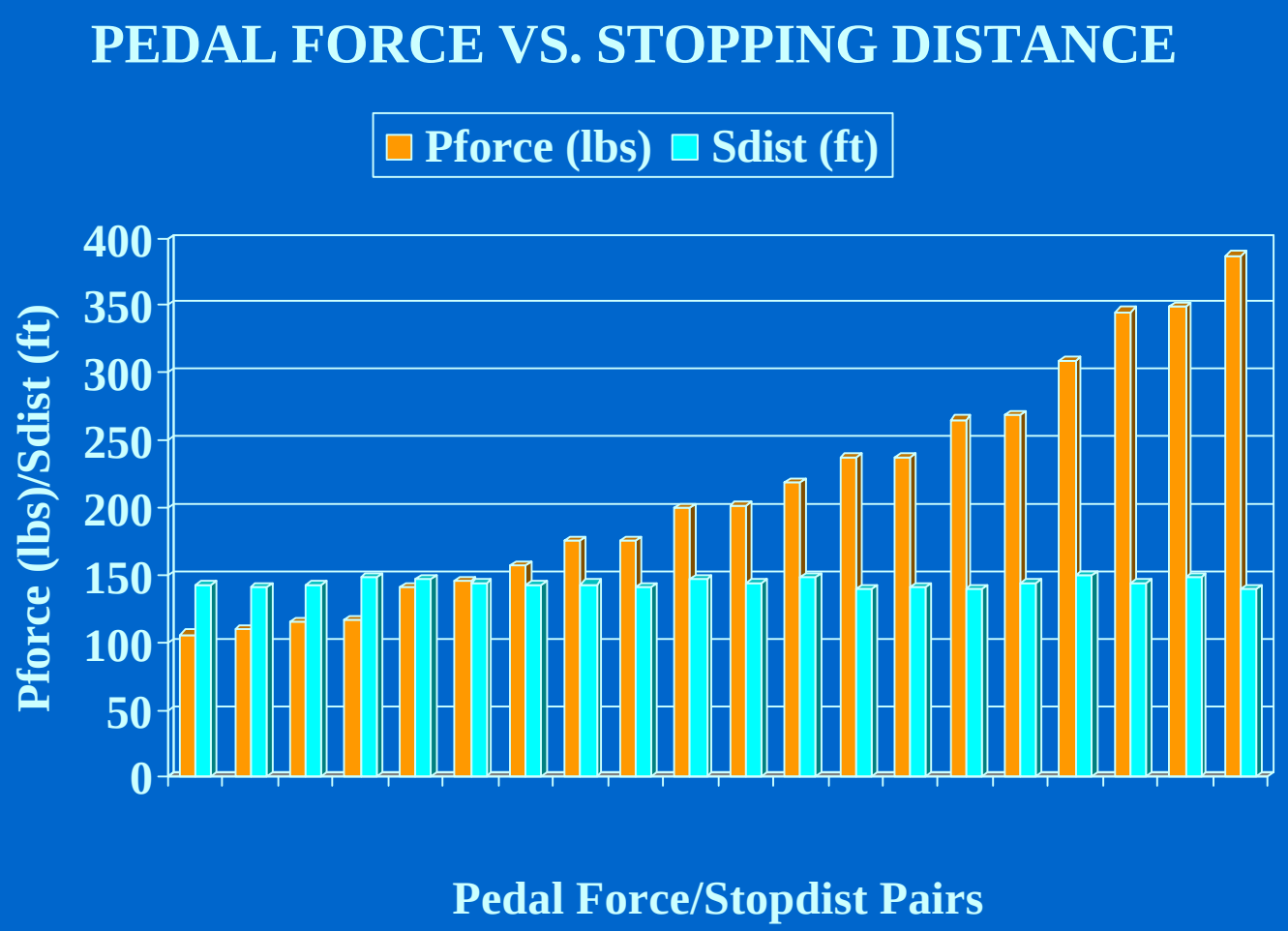
VEHICLE TEST CONDITIONS

- Straight line stops
- Dry Asphalt
- Wet Asphalt
- Test Speed - 100 km/h (62 mph)
- Loaded and unloaded conditions
- 10 brake stops per test condition

TEST RESULTS

- Pedal forces higher than target (112 lbs) by 3X
- Higher pedal forces did not affect stopping distance results
- Rate of pedal application seems most important
- On Control Vehicle
  - Shortest stop: 139 ft with 237 lbs pedal force
  - Longest stop: 150 ft with 309 lbs pedal force

BRAKE PEDAL FORCE



STATISTICAL ANALYSIS METHOD

- Average of 10 braking stops
- Standard Deviation
- 95th percentile: 95% of the time vehicle would stop within this distance. Also measures stopping performance consistency.

STATISTICAL ANALYSIS

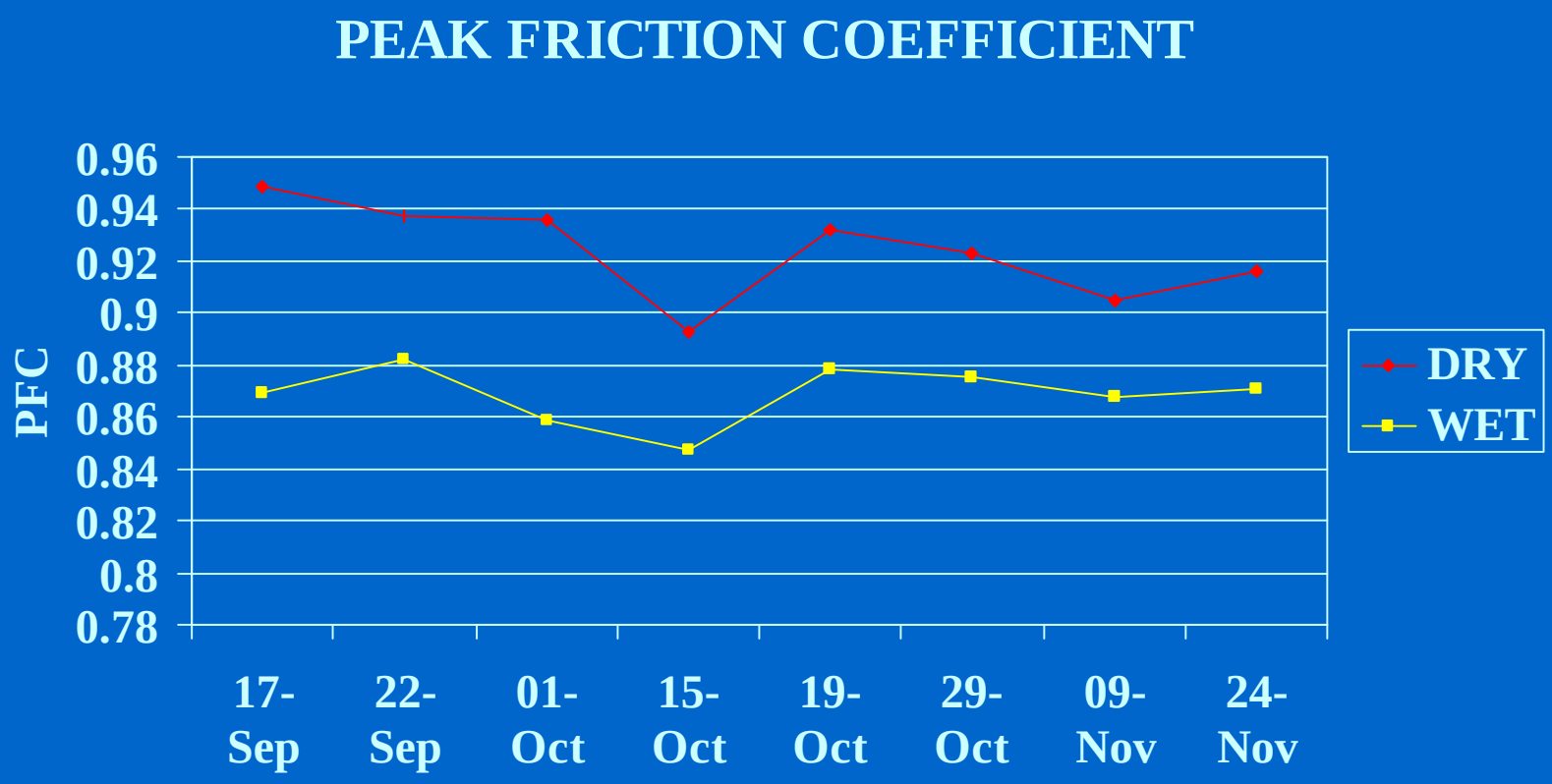
	Vehicle A	Vehicle B
– Ave:	171.5 ft	174.1 ft
– SD:	8.5 ft	1.5 ft
– 95th:	185.5 ft	176.6 ft

- Vehicle A: better braking using average
- Vehicle B: shorter 95th percentile, hence is more consistent in stopping performance.
- Agency has not determined if rating system can be applied.

TEST SURFACE PFC

- Dry Asphalt PFC: 0.89 - 0.95
- Wet Asphalt PFC: 0.85 - 0.88
- Variability low, magnitude high
- PFC measured with skid trailer using:
  - ASTM Method E1337-90
  - ASTM E1136 Standard Reference Test Tire

VARIABILITY OF PFC



1999 ROUND-ROBIN TEST PROGRAM

- Further evaluate the effects of surface variability
- 4 vehicles tested at 3 different test sites, and again at first site
- Surface friction measured at each site during testing
- Analyzed and compared vehicle stopping distance performance at each test site

1999 ROUND-ROBIN TESTING
Results Summary

- PFCs are different at each test track.
  - Some wet surfaces have friction as high as some dry surfaces
  - TRC had “ideal” PFCs, Aberdeen and MGA had aggressive pavements due to weathering and little use
- Brake application rate is important - 100 lbs in 0.2 seconds is achievable.

NON-ABS VEHICLES

Problems with testing non-ABS vehicles:

- Stopping distance is dependent on driver skill
- Driver brake pedal modulation results in larger deviations between test runs
- These stopping distance values would be less useful to consumers

TEST REPORTS AVAILABLE

- www.nhtsa.dot.gov

- Car Safety
  - Problems and Issues
    - Safety Studies
      - »Consumer Braking Information Initiative

U.S./JAPAN TEST CONDITIONS COMPARISON

U.S. NCAP Research

- Test speed: 100 km/h
- Lane width: 3.7 m
- IBT: ≥65°C ≤100°C
- Transmission: In gear
- Pedal force: 500 N in 0.25 sec.
- Number of stops: 10
- 180 kg load

Japan NCAP

- Test speed: 100 km/h
- Lane width: 3.5 m
- IBT: ≥65°C ≤100°C
- Transmission: In neutral
- Pedal force: 500 N in 0.25 sec. for ABS
- Number of stops: 5
- 110 kg load

ROAD SURFACE CONDITIONS COMPARISON

U.S. NCAP Research

- Dry PFC 0.90-0.95
- Wet PFC 0.80-0.85
- Water depth: ≤ 3 mm
- PFC measured using ASTM 1337-90 with SRTT ASTM 1136-93
- Specify surface temperature

Japan NCAP

- Surface specified as a flat, clean, asphalt-paved road
  - dry road surface, temperature of 25 – 45 C
  - wet road surface, temperature of 22 – 32 C

RECOMMENDATIONS

- ABS-equipped vehicles only
- Test Surface
  - Dry PFC 0.90 - 0.95
  - Wet PFC 0.80 - 0.85 (water depth $\leq$ 3 mm)
- Loading: Lightly-loaded weight with 180 kg
- Pedal Force - 500 Newtons in 0.25 sec.
- Number of stops - 10 per vehicle
- Surface Temperature:
  - Dry: 25°C - 45°C (77°F - 113°F)
  - Wet: 22°C - 32°C (72°F - 90°F)
- Data: Average and/or 95th percentile

Near-Term Action

- Publish Request for Comments in Federal Register
  - Test Procedure
  - Request Comments on Test Procedure, Presenting Data to Consumers
  - Public Meeting Announcement

Near-Term Action

- Determine suitability of using NHTSA's San Angelo UTQG facility for NCAP Braking
  - NHTSA would provide test area and skid trailer measurements
  - Contract testing of NCAP vehicles
  - Open for testing as for UTQG
  - Ideal for winter testing


U.S. DEPARTMENT
OF TRANSPORTATION
Uniform Tire Quality
Grading Facility
SAN ANGELO, TEXAS

Near-Term Action

Surface Temperature Issue

Limited information indicates lower surface temperature may provide higher PFC

- Round 1 vs. Round 4 of Aberdeen Testing
- Notation in Japan NCAP Brochure

In Conclusion...

- Driver and surface variability should be minimized to make the program viable

- Minimize driver variability by:
  - Testing ABS-equipped vehicles
  - Specifying brake pedal apply rate, steady-state force
  - Performing straight-line stops only

In Conclusion...

- Minimize surface variability by:
  - Specifying moderately-high coefficient of friction; narrow range for PFC
    - Dry PFC 0.90 – 0.95
    - Wet PFC 0.80 – 0.85
- Investigate surface temperature range specification

In Conclusion...

- NHTSA expects that NCAP braking will provide requested braking information to consumers
- Vehicle manufacturers will improve foundation brakes, tires, and ABS to minimize variability and provide good results under NCAP braking