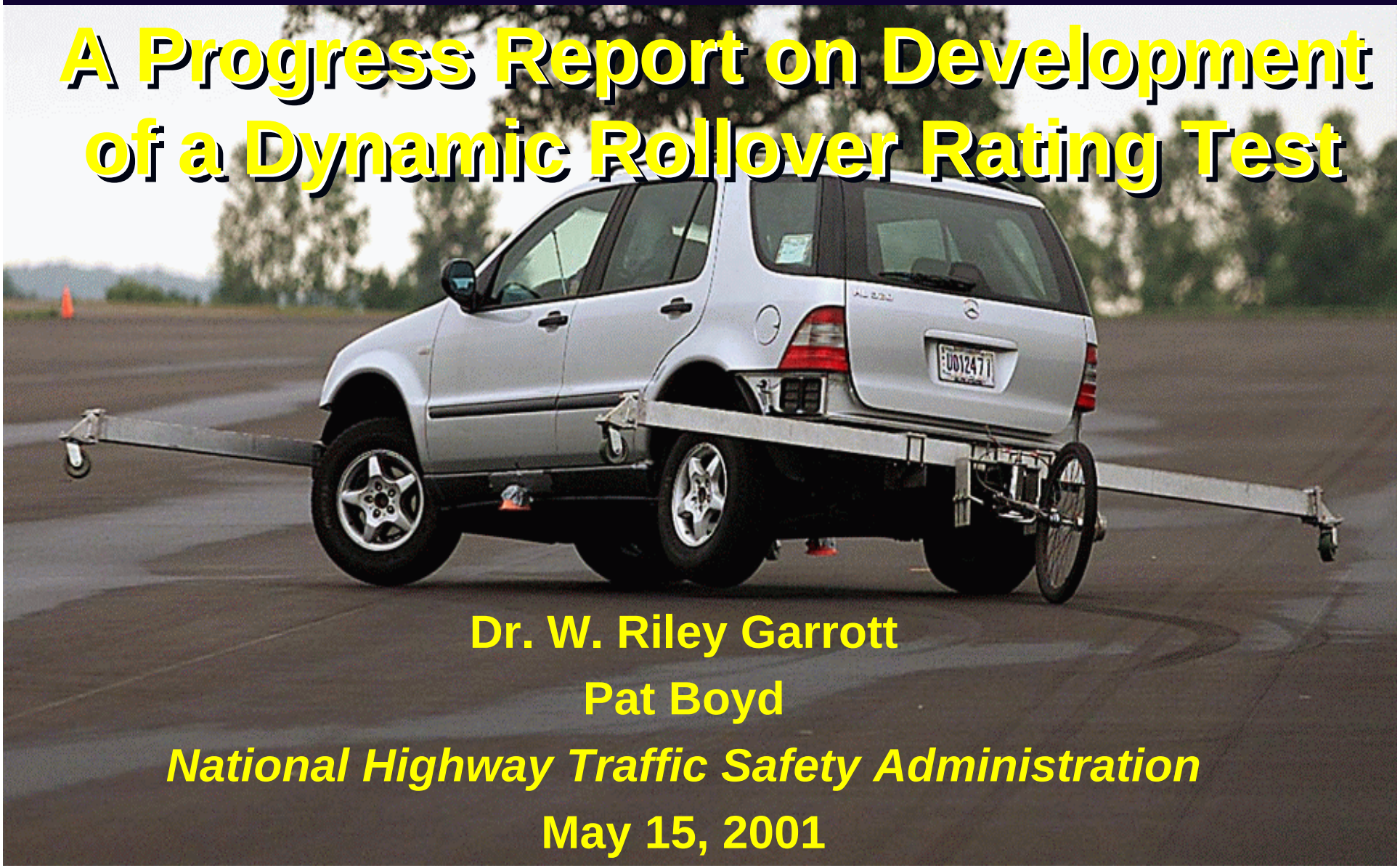
NHTSA

Research and Development
Safety Performance Standards

A Progress Report on Development of a Dynamic Rollover Rating Test



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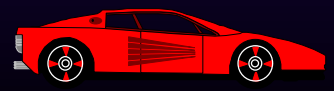
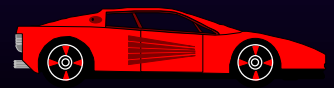
May 15, 2001

Presentation Overview

- **Background**
- **Dynamic Rollover Testing Issues**
- **Planned Testing**
  - **Testing Overview**
  - **Test Vehicles**
  - **Initial Test Maneuvers**
- **Preliminary Rollover Rating Ideas**
- **Current Status**

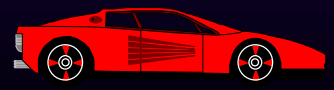


Background



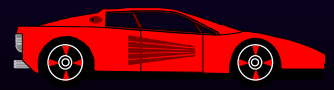
Rollover Crash Statistics

- **10,142 people were killed in light vehicle rollovers during 1999 (FARS)**
  - **8,345 were killed in single-vehicle rollovers**
  - **80 % were not wearing a seat belt**
  - **55 % of occupant fatalities in light, single-vehicle crashes involved rollover**
    - **46 % of fatalities for passenger cars**
    - **63 % of fatalities for pickup trucks**
    - **60 % of fatalities for vans**
    - **78 % of fatalities for sport utility vehicles**



Rollover Crash Statistics

- **27,000 serious injuries per year due to light vehicle rollovers (NASS, 1995 – 99 average)**
  - **19,000 in single vehicle crashes**
- **253,000 light vehicle rollovers per year (NASS, 1995 – 99 average)**
  - **205,000 in single vehicle crashes**
  - **178,000 occurred after vehicle had left roadway**

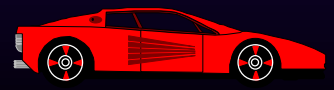


NHTSA Action to Prevent Rollover

- **NHTSA includes rollover resistance ratings as part of its New Car Assessment Program**
  - **Ratings based on Static Stability Factor (SSF)**
    - **SSF equals one-half of a vehicle's Track Width divided by its Center of Gravity Height**
  - **Ratings range from one to five stars**
  - **Rating program official as of January 12, 2001**

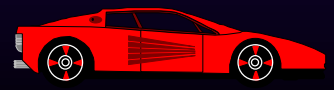
NHTSA Action to Prevent Rollover

- **Rollover resistance ratings based on SSF are controversial**
  - **Some believe that the influence of vehicle factors on rollover is so slight that vehicles should not be rated for rollover resistance**
  - **Others believe that SSF is a useful predictor of rollover but should be supplemented by dynamic driving tests**



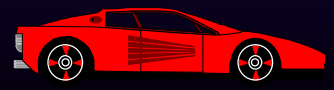
Response to Controversy About SSF

- **Congressionally-mandated National Academy of Sciences' study to assess validity of SSF based rollover resistance ratings and to compare SSF to dynamic tests**
- **TREAD Act requirements for dynamic rollover resistance ratings**



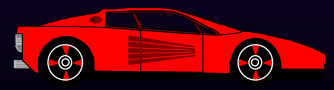
Requirements of TREAD Act

- **SEC. 12. Rollover Tests.** No later than 2 years after enactment, the Secretary shall: (1) develop a dynamic test on rollovers of light vehicles for the purposes of a consumer information program; and (2) carry out a program of conducting such tests. As the Secretary develops a rollover test, the Secretary must conduct a rulemaking to determine how best to disseminate test results to the public.

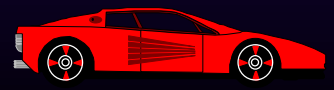


Response to TREAD Act

- **Met with representatives of several organizations to gather ideas**
  - **Alliance of Automobile Manufacturers**
  - **Consumers Union**
  - **Daimler-Chrysler (next week)**
  - **Ford Motor Co.**
  - **Nissan Motor Co.**
  - **Toyota Motor Co.**
  - **University of Michigan Transportation Research Institute**
- **Received useful suggestions about dynamic testing approaches**

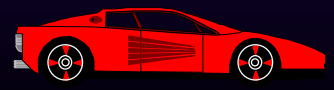


Dynamic Rollover Testing Issues



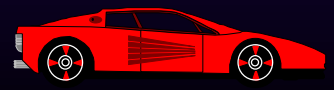
Dynamic Rollover Testing Issues

- **Maneuver(s) to use for rollover ratings**
- **Ensuring that cannot get good rollover rating by degrading vehicle handling**
  - **By putting tires with poor traction on a vehicle, can prevent two-wheel lifts in these maneuvers**
  - **Safety may be degraded because cannot turn as sharply**



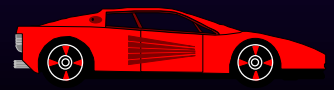
Dynamic Rollover Testing Issues

- **Use of two-wheel lifts as safety-relevant measure**
  - **Minor two-wheel lifts may not be safety issue**
  - **Requiring major two-wheel lifts may cause test driver safety problems**
- **Outrigger effects**
  - **Must have for safety, prevention of test surface damage**
  - **How do they change a vehicles rollover propensity?**



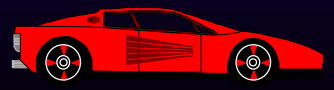
Dynamic Rollover Testing Issues

- **Tire wear**
  - **How much testing can be performed on a set of tires before wear effects become significant**
- **Tire debeading**
  - **What to do if tires debead while performing rollover rating testing**



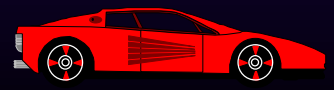
Dynamic Rollover Testing Issues

- **Longer-term repeatability**
  - **Effects of weather of results**
    - **Summer versus winter**
  - **Changes to the same test surface with time**
- **Reproducibility**
  - **Effects of testing on different test surfaces**



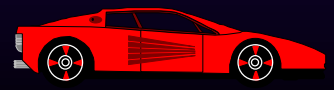
Planned Testing

Phase IV of NHTSA's Light Vehicle Rollover Research Program



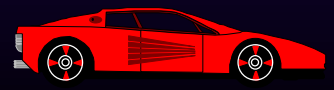
Phase IV Rollover Research

- Comprehensive test program designed to build on earlier NHTSA efforts, suggestions received from interested parties
- Attempts to take comprehensive look at identified issues



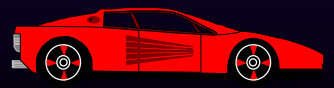
Overall Phase IV Plan

- **Rating System Development Testing 1 – Spring 2001**
- **Hot Weather Effects Testing – Summer 2001**
- **Outrigger Effects Testing – Summer 2001**
- **Tire Wear Effects Testing – Summer 2001**
- **Rating System Development Testing 2 – Fall 2001**
- **Fully Automated Vehicle Controller Testing – Fall 2001**
- **Rating System Development Testing 3 – Fall 2001**
- **Cold Weather Effects Testing – Winter 2002**
- **Rating System Development Testing 4 – Spring 2002**
- **Surface Effects Round Robin – Spring and Summer 2002**



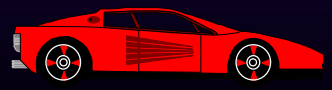
Test Vehicles

- **Four Sport Utility Vehicles:**
  - **2001 Chevrolet Blazer (no YSC)**
  - **2001 Ford Escape (no YSC)**
  - **1999 Mercedes ML-320**
    - **YSC enabled**
    - **YSC disabled**
  - **2001 Toyota 4Runner**
    - **YSC enabled**
    - **YSC disabled**



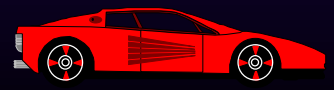
Test Vehicles

- **Each vehicle will be tested in multiple configurations:**
  - **Nominal vehicle**
  - **Raised center of gravity height**
    - **Weights placed on roof above c.g. so as to decrease SSF by 0.05**
  - **Modified handling**
    - **Load to GVWR, load as far to rear as possible, larger or smaller tires**



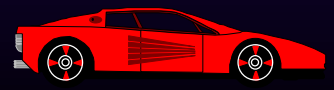
Test Maneuvers

- **Testing broad array of maneuvers during Phase IV**
- **Two broad categories**
  - **Open-loop. Handwheel steering angle is specified function of time**
    - **Characterization Maneuvers**
    - **J-Turns with and w/o Pulse Braking**
    - **Some Fishhooks**
    - **Open-Loop Pseudo DLC**



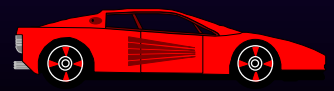
Test Maneuvers

- **Closed-loop. Handwheel steering angle varies according to actions of vehicle**
  - **Driver closes feedback loop**
    - **Double Lane Changes**
  - **Instrumentation closes feedback loop**
    - **Fishhook with Roll Rate Feedback**



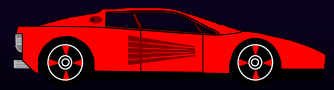
Test Maneuvers

- **Characterization Maneuvers**
  - **Pulse Steer – As per Phase II**
  - **Sinusoidal Sweep – As per Phase II**
  - **Slowly Increasing Steer – As per Phase II**
  - **Slowly Increasing Speed – Improved version of Phase II maneuver**
  - **Response Time Tests – 0.2 g and 0.5 g severity J-Turns at 50 mph. Performed with straight and curved (0.3 g) lead-in**



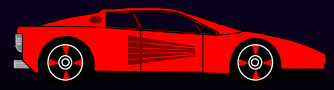
Test Maneuvers

- **J-Turn Maneuvers**
  - **J-Turn – As per Phase II**
  - **J-Turn with Pulse Braking – Improved Phase II maneuver**
    - **Improvements to Phase II maneuver discussed in earlier presentation**



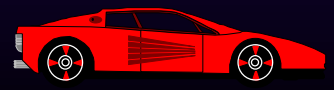
Test Maneuvers

- **Fishhook Maneuvers**
  - **Fishhook 5 – Improved Phase II Fishhook 1**
  - **Fishhook 6 – Fishhook with roll rate feedback**
    - **Idea discussed in previous presentation**
  - **Nissan Fishhook – Fishhook using Nissan technique for determining timing**



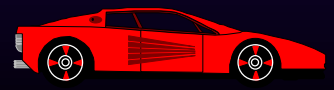
Test Maneuvers

- **Double Lane Change Maneuvers**
  - **Ford DLC – Perform closed loop DLC per Ford's procedure. Use Ford's path-correction technique to calculate limit behavior**
  - **VDA (Modified Moose Test) DLC**
  - **Consumers Union Short Course DLC**
  - **Open Loop Pseudo-DLC – New maneuver being developed by VRTC**

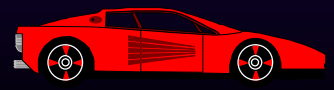


Planned Phase IV Testing

- **Have received many valuable suggestions about Phase IV testing**
  - **Comments greatly appreciated!**
- **Encourage additional suggestions**
  - **May revise Phase IV research plan in response to comments**

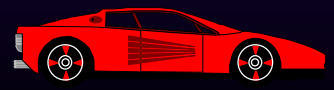


Preliminary Rollover Rating Ideas



Rollover Resistance Score

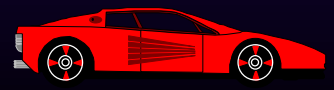
- Star Ratings derived from a vehicle's Rollover Resistance Score
- Rollover Resistance Score quantifies vehicles performance in tests
  - Would go from 0 to 100 (100 = best)
- Table relates Rollover Resistance Scores to Star Ratings



Rollover Resistance Score

- **Composed of multiple parts:**
  - **Handling Score**
  - **Limit Maneuver Score**
  - **Suggestion made by speaker at National Academy of Sciences meeting:**

Include Static Stability Factor!



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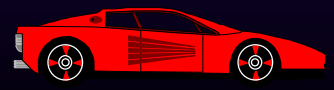

Current Status

- **Test vehicles purchased and instrumented**
- **Testing in progress**
  - **Vehicle characterization and limit maneuver testing underway**
- **Request for Comment to be published soon**
  - **Comments on this work are appreciated!**
- **NHTSA will review comments received**
  - **May revise Phase IV research plan in response to comments**