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NHTSA's 2005 ESC Research Program: An Overview

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Presentation Overview

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- Program Objectives
- Background
- ESC Effectiveness Research
- Government and Industry Cooperation
- Conclusions
- Sources for Additional Information

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Program Objectives

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- Validate and refine NHTSA's proposed ESC identification criteria
- Work with industry to collaboratively gather data

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Background

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- 2004 Research Objectives:
  - Perform research supporting the development of maneuvers capable of objectively assessing handling
- Results from the handling tests would supplement NCAP rollover ratings
- Five diverse test vehicles used
  - Evaluated with ESC enabled / disabled

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Background (continued)

- Midway through 2004, NHSTA expressed an increased interest in ESC effectiveness
- Focus of maneuver development changed from handling to ESC effectiveness
- By late 2004, NHTSA had isolated a reduced suite of test maneuvers and proposed ESC effectiveness criteria

ESC Research
Effectiveness Criteria

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- **A vehicle with an effective ESC should:**
  - **Not spinout***
    (lateral stability measure)
  - **Be able to achieve a minimum lateral displacement***
    (responsiveness measure)
  - **Not produce two-wheel lift**
  - **Not produce rim-to-pavement contact or tire debeading**
- **These criteria must be satisfied during one of four specialized maneuvers presently being evaluated**

** discussed in this presentation*

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Test Maneuvers
Performed With A Steering Machine

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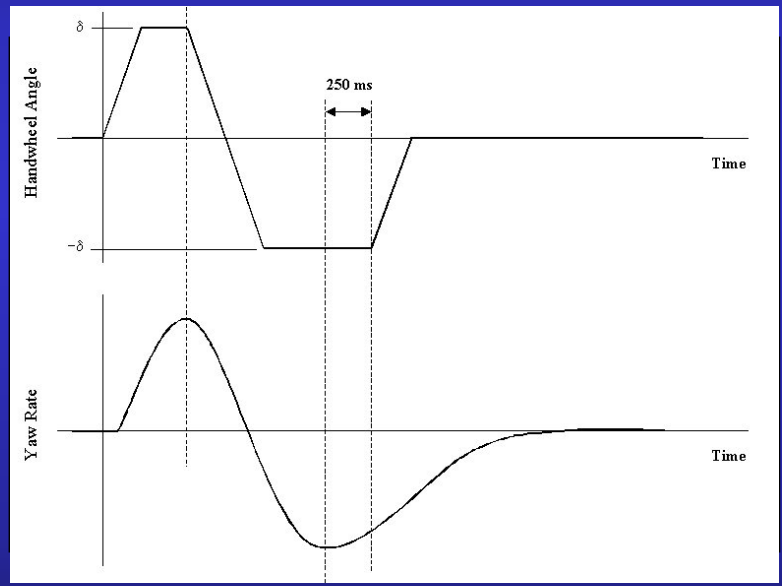
- **Slowly Increasing Steer**
  (for characterization use only)
- **0.7 Hz Sine with Dwell**
- **0.7 Hz Increasing Amplitude Sine**
- **500 deg/s Yaw Acceleration Steering Reversal**
- **500 deg/s Yaw Acceleration Steering Reversal w/Pause**



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Test Conditions

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- ESC enabled and disabled
- Test surface
  - Dry, high-mu asphalt
  - Maneuvers initiated while vehicle is being driven up a 1% grade
- Nominal load
  - Driver
  - Instrumentation
  - Outriggers if vehicle is an SUV, pickup, van, minivan, station wagon, or crossover vehicle

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What is a "Spinout"
Preliminary Definition

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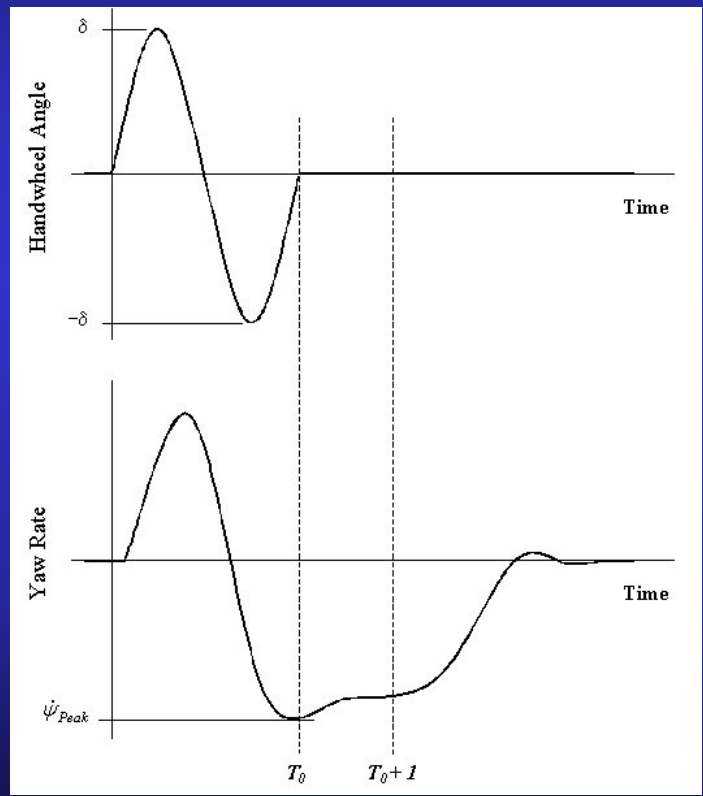
$$Percent\ \dot{\psi}_{Peak} = 100 * \left(\frac{\dot{\psi}(t)}{\dot{\psi}_{Peak}} \right)$$

$$Set\ t = t_0 + 1$$

$$Spinout\ occurs\ if\ \ Percent\ \dot{\psi}_{Peak} \geq 60\%$$



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What is a "Spinout"
Threshold Example

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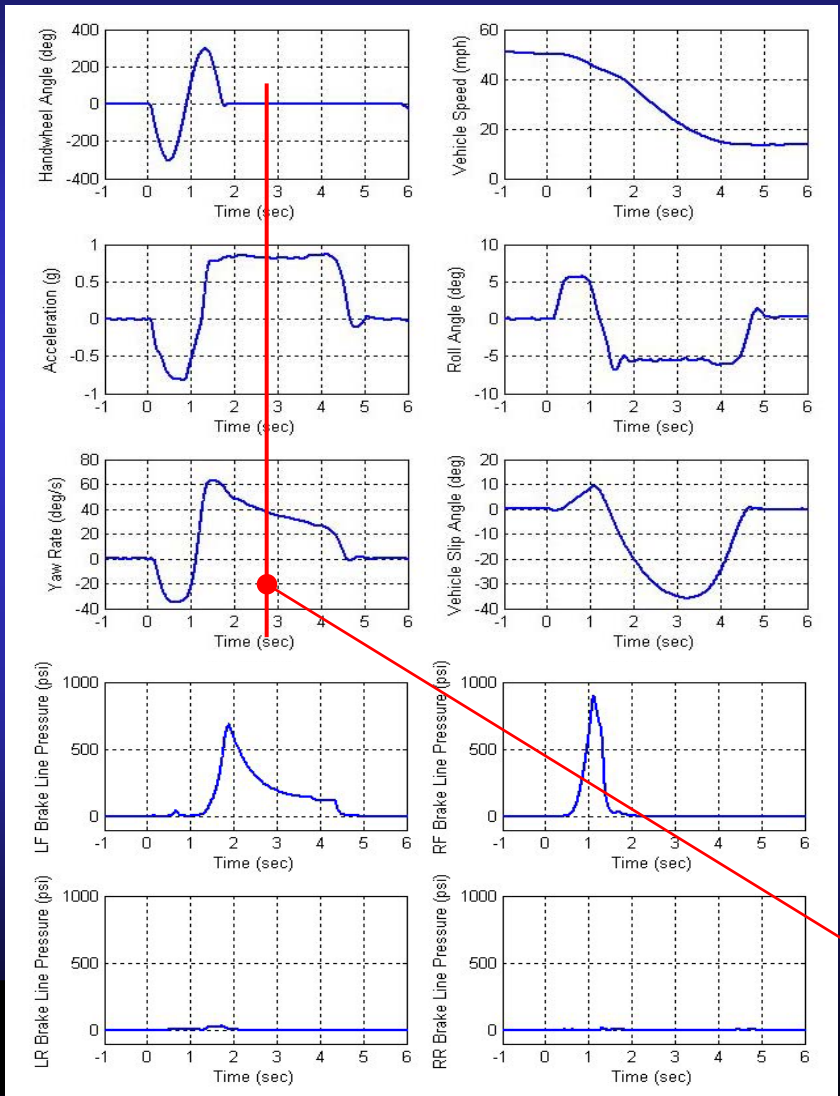

0.6 Hz Sine Steer, SWA = 300 degrees

$At\ t_0 + 1, Percent\ \dot{\psi}_{Peak} = 60.6$

$t = t_0 + 1$

What is a "Spinout"
Sample Video

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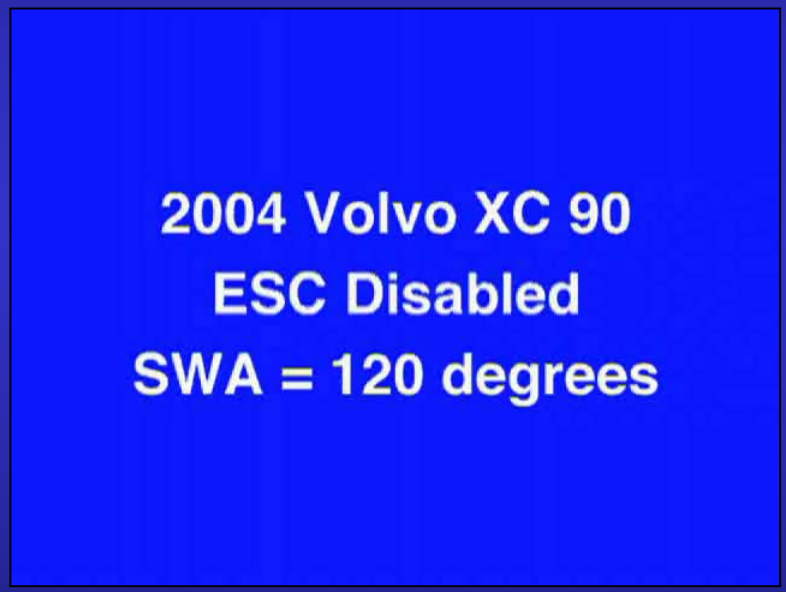
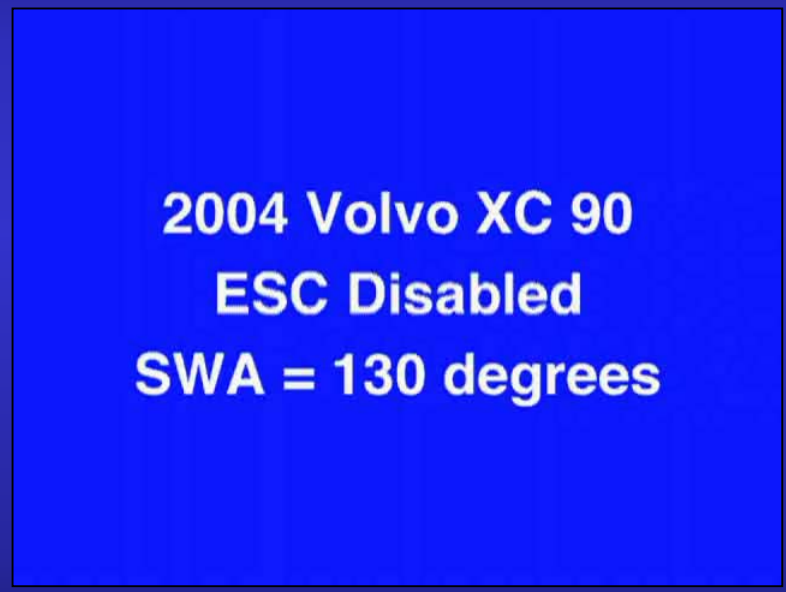
0.7 Hz Sine with Dwell



$At\ t_0 + 1, Percent\ \dot{\psi}_{Peak} = 18.9$

Threshold not exceeded



$At\ t_0 + 1, Percent\ \dot{\psi}_{Peak} = 84.1$

Threshold exceeded

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Lateral Displacement

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- **An effective ESC should not impede responsiveness**
  - **Proposed minimum lateral displacement: 12-ft**
  - **Must be achieved prior to completion of a maneuver performed with δ_{max}**
- **Measured via GPS during testing**
  - **Referenced to pre-maneuver heading**
- **NHTSA's evaluation criterion will not penalize vehicles equipped with rollover mitigation technology**

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Lateral Displacement
Threshold Example

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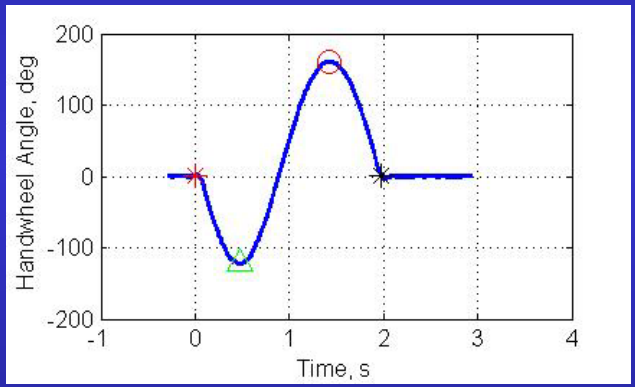
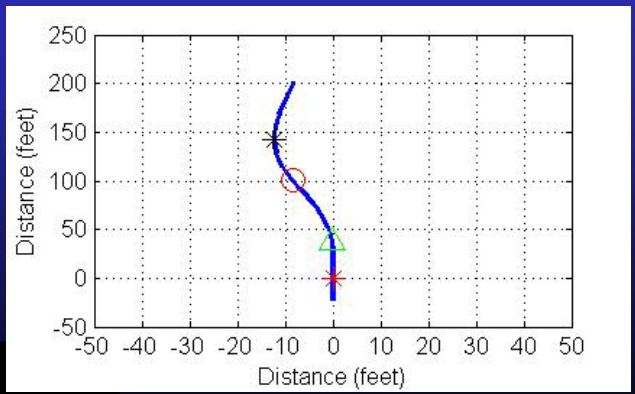
0.6 Hz Increasing Amplitude Sine,
Lateral Displacement = 12.2 ft





2004 GMC Savana
ESC Enabled
SWA = 160 degrees

Lateral Displacement
Effects of an RSC

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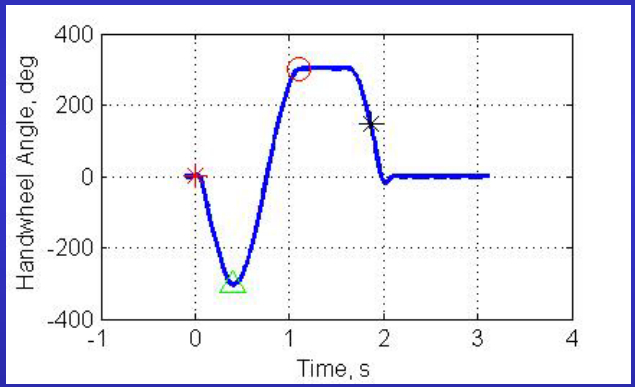
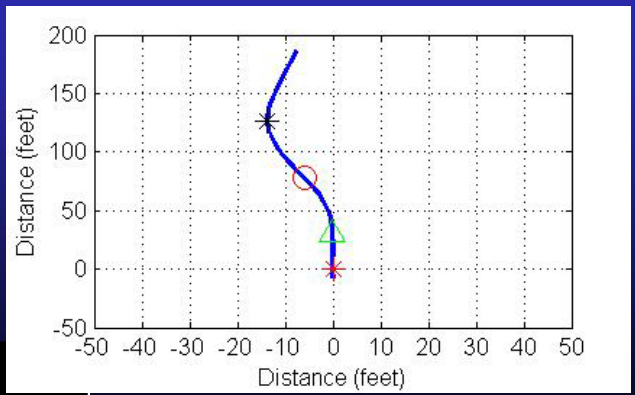
0.7 Hz Sine with Dwell,
Lateral Displacement = 13.7 ft





2004 Volvo XC 90
ESC Enabled
SWA = 300 degrees

Government and Industry Cooperation

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- **NHTSA hopes to collect data from 50 vehicles in 2005**
  - Will help select the most efficient maneuver capable of determining whether a vehicle is equipped with an ESC
  - Used to improve the robustness of the spinout model
  - Will help assess the lateral displacement capability of ESC-equipped vehicles
- **A cooperative testing effort between NHTSA and industry is underway**
  - Test data from industry-evaluated vehicles is critical

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Conclusion

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- ESC research is a top priority for NHTSA
- Preliminary ESC effectiveness criteria have been identified
- A cooperative testing effort between NHTSA and industry is underway

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Additional Information

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- **ESC Docket**
  - http://dms.dot.gov/search/searchFormSimple.cfm
  - Number 19951
- **VRTC ESC Website**
  - http://www-nrd.nhtsa.dot.gov/vrtc/ca/esc.htm

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