



# ***NHTSA's 2005 ESC Research Program: An Overview***

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# *Presentation Overview*

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

# *Program Objectives*

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

- **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

# ***Background (continued)***

- Midway through 2004, NHTSA 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

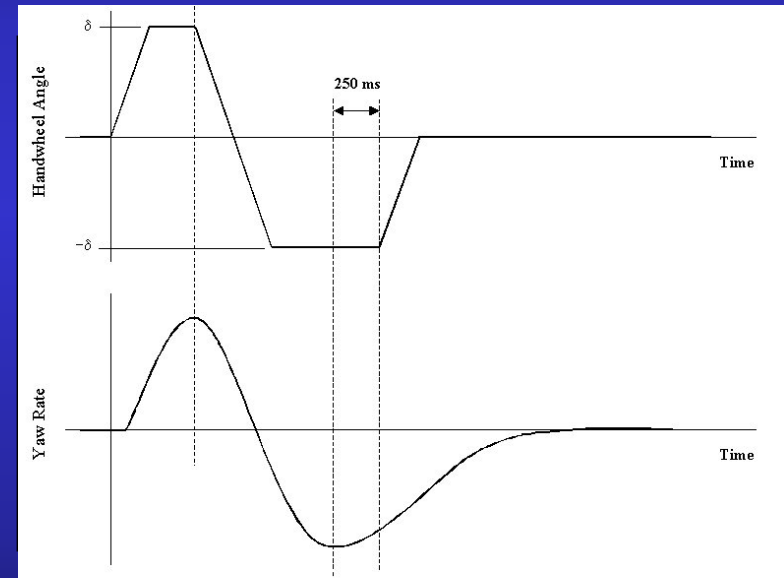
- **A vehicle with an effective ESC should:**
  - **Not spinout\***  
*(lateral stability measure)*
  - **Be able to achieve a minimum lateral displacement\***  
*(responsiveness measure)*
  - **Not produce two-wheel lift**
  - **Not produce rim-to-pavement contact or tire debanding**
- **These criteria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

*\* discussed in this presentation*



# Test Maneuvers Performed With A Steering Machine

- **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**



# Test Conditions

- **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



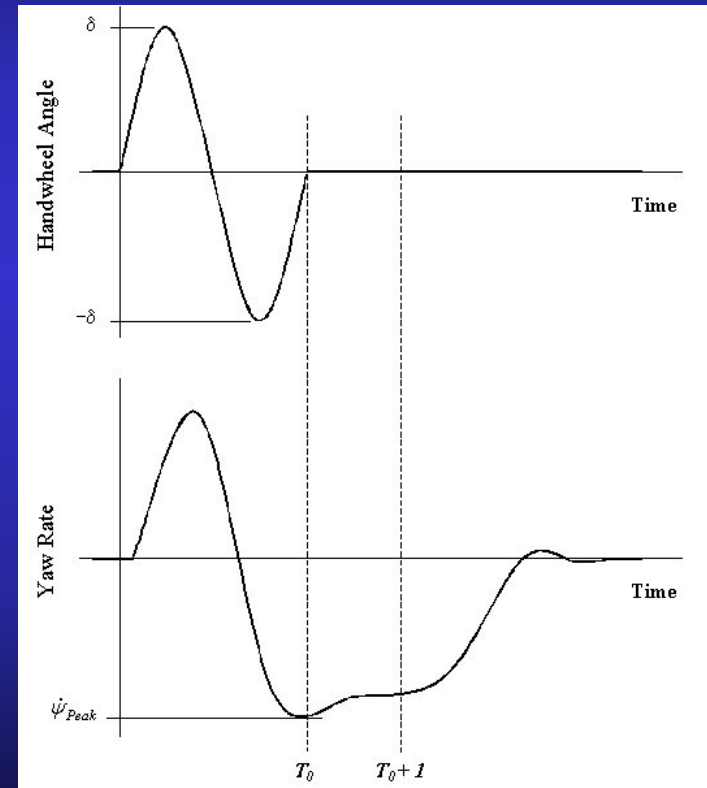
# What is a “Spinout”

## Preliminary Definition

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

Set  $t = t_0 + 1$

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



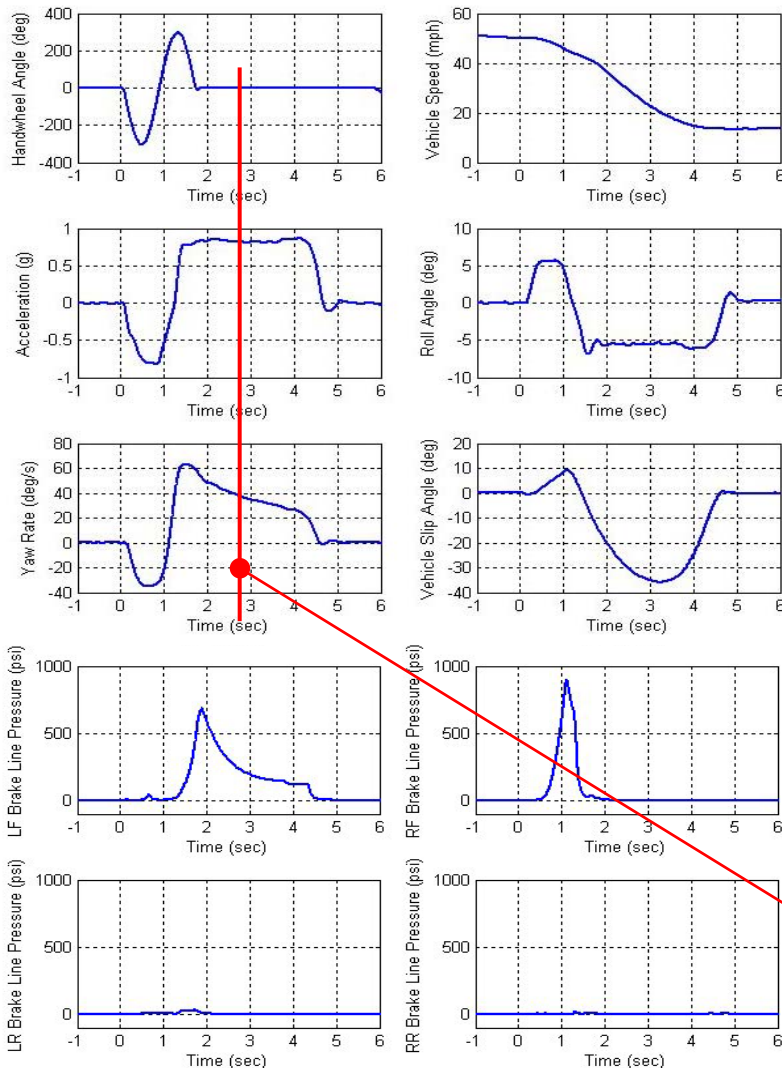
# What is a "Spinout" Threshold Example

*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

*0.7 Hz Sine with Dwell*

2004 Volvo XC 90  
ESC Disabled  
SWA = 120 degrees

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

*Threshold not exceeded*

2004 Volvo XC 90  
ESC Disabled  
SWA = 130 degrees

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

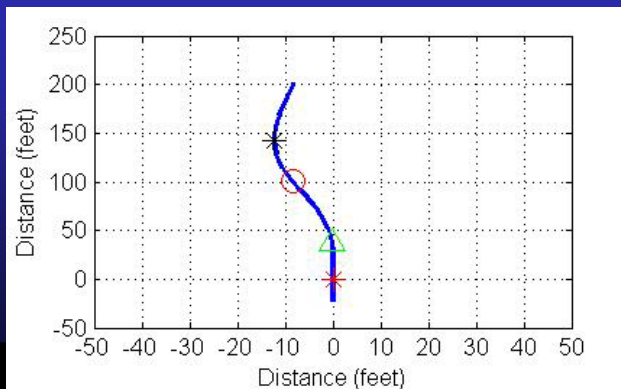
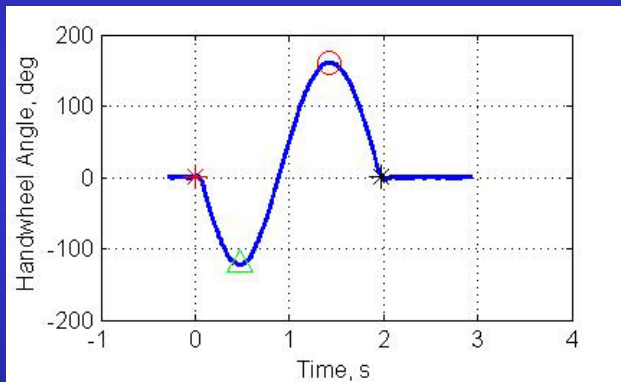
*Threshold exceeded*

# *Lateral Displacement*

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

# Lateral Displacement Threshold Example

*0.6 Hz Increasing Amplitude Sine,  
Lateral Displacement = 12.2 ft*

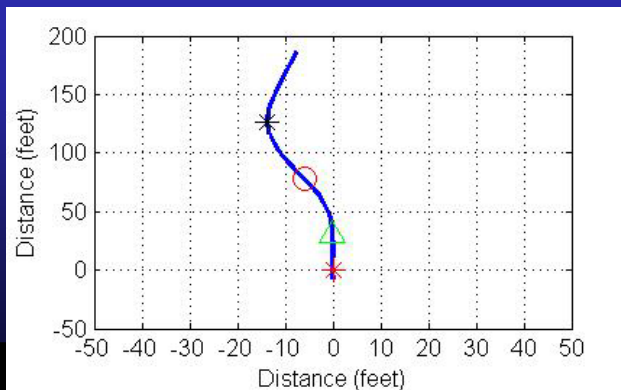
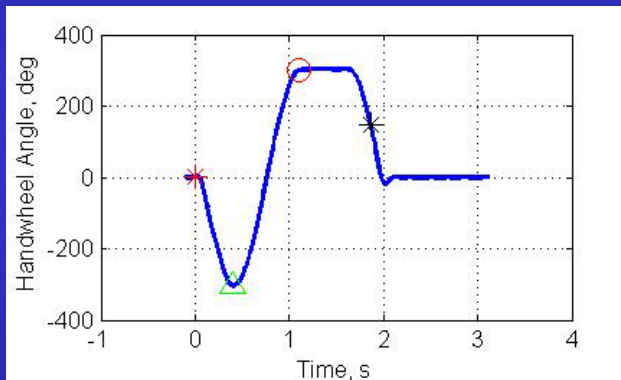


**2004 GMC Savana  
ESC Enabled  
SWA = 160 degrees**

# Lateral Displacement

## Effects of an RSC

*0.7 Hz Sine with Dwell,  
Lateral Displacement = 13.7 ft*



**2004 Volvo XC 90**  
**ESC Enabled**  
**SWA = 300 degrees**

# Government and Industry Cooperation

- **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



# Conclusion

- **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**



# *Additional Information*

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