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
Background

- 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
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.
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*
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

\[ \text{Percent } \dot{\psi}_{\text{Peak}} = 100 \times \left( \frac{\dot{\psi}(t)}{\dot{\psi}_{\text{Peak}}} \right) \]

Set \( t = t_0 + 1 \)

Spinout occurs if Percent \( \dot{\psi}_{\text{Peak}} \geq 60\% \)
What is a “Spinout”
Threshold Example

0.6 Hz Sine Steer, SWA = 300 degrees

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

$t = t_0 + 1$
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 \( \dot{\psi}_{\text{Peak}} \) = 18.9

Threshold not exceeded

2004 Volvo XC 90
ESC Disabled
SWA = 130 degrees

At \( t_0 + 1 \), Percent \( \dot{\psi}_{\text{Peak}} \) = 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 $\delta_{\text{max}}$
- 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](http://dms.dot.gov/search/searchFormSimple.cfm)
  - Number 19951

- **VRTC ESC Website**