HEAVY VEHICLE STABILITY CONTROL

NHTSA Policy Issues

George Soodoo
U.S. DOT/NHTSA

2011 TRB Annual Meeting
Committee on Truck and Bus Safety
Washington, DC
January 25, 2011
Background

• Stability Control systems automatically apply selective brakes to mitigate rollover and/or loss-of-control.

• NHTSA has evaluated two types of Stability Control systems:
  - Roll Stability Control (RSC): reduces roll instability.
  - Electronic Stability Control (ESC): reduces roll instability and directional loss-of-control.
Background

• NHTSA is working on several analyses on heavy vehicle stability control technology
  
  ❖ First Group includes truck tractors and motorcoaches
  
  ❖ Second Group includes single unit trucks and other buses
Types of Stability Control Systems

• Roll Stability Control (RSC)
  ❖ Designed to help mitigate on-road, untripped rollovers

• Electronic Stability Control (ESC)
  ❖ Designed to assist drivers in mitigating vehicle directional loss-of-control and untripped rollover crashes
How Do Stability Control Systems Work?

- **RSC**
  - Includes electronic control unit (ECU) to monitor vehicle speed, lateral acceleration, and vehicle load
  - ECU estimates roll stability threshold and detects when lateral acceleration is likely to cause a rollover
  - If lateral acceleration exceeds threshold, RSC intervenes by decreasing power and applying drive-axle and trailer brakes

- **ESC**
  - Incorporates same system inputs as RSC, plus steering wheel angle and vehicle yaw rate
  - Response to roll instability is same as for RSC except that ESC can respond earlier due to steering wheel sensor, and decelerates vehicle at a higher rate due to addition of steer axle brake actuation
  - Response to yaw instability includes application of selective brakes to create a yaw moment to turn vehicle back to its steered direction
Summary of NHTSA Research

• Vehicles tested
  - 3 truck tractors: Freightliner with ESC and (separate) RSC; Volvo with ESC; and Sterling with RSC
  - 6 trailers: 1 tanker; 2 box vans; and 3 flatbeds

• Test maneuvers evaluated
  - J-turn; Double Lane Change; Slowly Increasing Steer; Ramp Steer Maneuver; and Sine with Dwell

• Research Findings
  - Stability Control systems improved both roll and yaw stability of vehicle compared with no stability control
  - Tractor-based stability control systems were able to mitigate trailer wheel lift at higher speeds than trailer-only systems
  - Of all trailer types tested, box van trailers achieved highest test speed before wheel lift occurred; tanker trailer was similar to box van in terms of test speeds that produced wheel lift
Stability Control - Federal Regulations

• Current Federal Regulation
  ❖ FMVSS 126: applies to light vehicles with GVWR of 10,000 lb or less
  ❖ Mandatory Effective date: September 1, 2011
  ❖ Light Vehicle ESC Standard includes
    • equipment requirement - Functional Definition
    • performance requirement – Sine with Dwell maneuver at 50 mph
      • Pass/fail: 1) yaw rate decay; and 2) lateral responsiveness

• Development of Heavy Vehicle Proposed Requirements
  ❖ We are considering both equipment and performance requirements to address both roll instability and yaw instability
ESC Functional Definitions in Other Standards

• ESC definitions
  - SAE Recommended Practice J2627 includes functional definition
  - ECE Regulation 13: includes definitions of rollover control and directional control
  - Desired functional definition attributes: senses lateral acceleration, yaw rate and steering input; has capability to modulate the brakes
    • Similar, but not identical, to definition in light vehicle standard in FMVSS 126

• FMVSS 126 Equipment Requirement
  - Performance-only requirement is not able to address the multitude of maneuvers a driver could use in real-world crash-threatening situations where ESC might activate
Potential Metrics to Measure Stability Control System Performance

• Similar Metrics used in FMVSS 126
   Yaw rate decay used to evaluate “spinout” (yaw) propensity
   Lateral displacement used to evaluate vehicle responsiveness

• Other Potential metrics
   Lateral acceleration reduction used to evaluate “rollover” propensity
   Engine torque data used to verify automatic engine torque reduction
   Trailer brake pressure measured to verify automatic trailer brake application
Docket Number

• Agency opened a Docket for submissions on Heavy Vehicle Stability Control

• Docket Number is: NHTSA-2010-0034
QUESTIONS???