HEAVY VEHICLE STABILITY CONTROL

NHTSA Policy Issues

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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???