

NHTSA Role in The Future of Automated Vehicles

August 27, 2013

Chris Monk
Chief, Human Factors Division
Office of Vehicle Safety Research

NHTSA's Mission



**David L. Strickland,
NHTSA Administrator**

Save lives, prevent injuries and reduce economic costs due to road traffic crashes, through education, research, safety standards and enforcement activity.

What is an Automated Vehicle?

Automated vehicles are those in which some aspects of a safety-critical function (e.g. steering, throttle, or braking) occur without direct driver input.

- **Automated vehicles may use: on-board sensors, cameras, GPS, and or telecommunications**

The Benefits of Automated Vehicles

- **Improving highway safety**
 - **Reduction of crashes, injuries and fatalities**
- **Expanding mobility**
- **Reducing traffic congestion**
- **Creating new opportunities for jobs and investment**
- **Reducing overall business operating costs**
- **Increasing environmental benefits**

Reduction in:

- ✓ **fuel consumption**
- ✓ **greenhouse gas emissions**



NHTSA Levels of Automation

Level 0 (No-Automation):

- driver is in complete and sole fundamental control of the primary vehicle controls at all times (brake, steering, throttle, motive power)

Level 1 (Function-specific Automation):

- driver has overall control
- involves one or more specific control functions
- if multiple functions are automated, they operate independently from each other
- driver can choose to cede limited authority over primary control (as in adaptive cruise control)

NHTSA Levels of Automation

Level 2 (Combined Function Automation):

- **shared authority**
- **automation of at least two primary control functions**
 - Example: adaptive cruise control used in combination with lane centering
- **driver cedes active primary control but, responsible for monitoring and safe operation**
- **driver expected to be available at all times**
 - Note: With no advanced warning the automated system can relinquish control

NHTSA Levels of Automation

Level 3 (Limited Self-Driving Automation):

- driver can cede full control authority under certain traffic and environmental conditions.
- driver expected to be available for occasional control.
- designed so driver is not expected to constantly monitor roadway.

Level 4 (Full Self-Driving Automation):

- human provides destination or navigational input, but is not expected to be available for control.
- responsibility for safe operation rests solely on the automated vehicle systems.

Recommendations for Self-Driving Vehicles

I. For Licensing Drivers during testing

- A.** Ensure that the driver understands how to operate a self-driving vehicle safely

II. State Regulations for Testing of Self-Driving Vehicles

- A.** Ensure that on-road testing of self-driving vehicles minimizes risks to other road users
- B.** Limit testing operations to roadway, traffic and environmental conditions
- C.** Establish reporting requirements to monitor the performance during testing

Recommendations for Self-Driving Vehicles

III. Basic Principles for Testing of Self-Driving Vehicles

- A.** Ensure that the process for transitioning from self-driving mode to driver control is safe, simple, and timely
- B.** Test vehicles have the capability of detecting, recording, and informing the driver of system malfunction
- C.** Ensure that installation and operation of technologies does not disable any federally required safety features or systems
- D.** Ensure that test vehicles record information about the status of the automated control technologies in the event of a crash or loss of vehicle control

Recommendations for Self-Driving Vehicles

IV. Regulations for Vehicle Operation For Purposes Other than Testing

- **NHTSA does not recommend that states authorize the operation of self-driving vehicles for purposes other than testing at this time**

Current Status

- **16 States have introduced driverless vehicle legislation**
- **CA, NV, FL, and the District of Columbia have enacted laws allowing driverless vehicles on roadways for testing.**



NHTSA's Research Plan

Focus Areas for Highly Automated Vehicles (Levels 2-4)

Human Factors Research

- Initial research started to evaluate key issues.
- Will inform policy decisions and develop initial Driver-Vehicle Interface (DVI) recommendations.

Electronic Control Systems Safety

- Research focus on ensuring the safety of complex electronic control systems and cybersecurity.

System Performance Requirements

- Evaluate key operational use cases and constraints.
- Develop test and evaluation methods.
- Develop basic performance tests/criteria.

NHTSA Current Research

Human Factors Evaluation of Level 2 and Level 3 Automated Driving Concepts

Key Research Questions:

- 1. Can drivers safely interact with and operate vehicles that offer automation Level 2 and Level 3 systems, e.g. what is the driver performance profile over length of time in continuous or sustained automation?**
- 2. What are the system performance risks from driver involvement with and interruption from secondary tasks (such as portable electronic device use) that could arise when operating Level 2 or Level 3 automated vehicle system?**
- 3. What are the most effective hand-off strategies between the system and the driver including response to faults/failures?**

NHTSA Current Research

Human Factors Evaluation of Level 2 and Level 3 Automated Driving Concepts

Key Research Questions:

4. How do drivers engage, disengage, and reengage with the driving task in response to the various states of Level 2 and Level 3 automation?
5. How do drivers perform under various operational concepts within Level 2 and Level 3 automation, such as systems intended for everyday driving on open roadways in mixed traffic or systems intended for dedicated roadway-vehicle applications (e.g. automated lanes, remote highways)?
6. What are the most effective human-machine interface concepts, guided by human factors best practices, which optimize safe operation of Level 2 and Level 3 systems?

NHTSA Future Steps

Vehicle:

- Technological research
- Testing and development
- Research in support of potential motor vehicle regulations & standards

Behavioral:

- Behavioral research
- Public information, education and outreach
- Model licensing guidelines & laws
- Administrative guidance (to address licensing, vehicle registration, liability)

Questions?

Chris Monk

chris.monk@dot.gov

