



Study Group Position Paper: 2021-1

(S.18) Automated & Electric Vehicles Study Group

Recommendations Regarding Inspection and Enforcement for Automated Commercial Vehicles

Developed by the Technology & Maintenance Council's (TMC)
(S.18) Automated Commercial Vehicle Inspection and Enforcement Task Force

ABSTRACT

ATA's Technology & Maintenance Council (TMC) recommends that the industry consider the Commercial Vehicle Safety Alliance (CVSA) Option 7 framework as a model for enhanced pre-trip inspections model for Automated Commercial Vehicles (ACMVs). TMC believes this approach, which seeks to eliminate en-route stops for roadside inspections, represents the most logical framework for inspections of ACMVs that have no human occupants onboard. TMC also suggests all stakeholders continue discussions in order to address inhibiting factors identified in this paper so as to operationalize this model, and to delineate the technical and maintenance requirements for its various elements.

INTRODUCTION

This position paper was developed by TMC's S.18 Automated and Electric Vehicle Study Group through its Automated Commercial Vehicle Inspection and Enforcement Task Force, whose scope and objective is to develop information reports, position papers and recommended practices to assist commercial fleets in addressing the unique inspection and enforcement needs of SAE J3016 Level 4 and Level 5 ACMVs (see **Figure 1**). To accomplish this goal, TMC seeks to use this the Task Force to engage TMC members — including fleets, original equipment manufacturers (OEMs),

suppliers, maintenance and telematics service providers — with the ACMV developer community along with governmental stakeholders including the Federal Motor Carrier Safety Administration (FMCSA) and law enforcement, as represented by CVSA. All of these groups must work to reach consensus on inspections and enforcement processes for ACMVs, but more importantly all must grow to be comfortable with both how ACMVs are maintained and inspected, and with how ACMVs can actively communicate their inspection and operational status to enforcement officials.

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	SAE LEVEL 0™	SAE LEVEL 1™	SAE LEVEL 2™	SAE LEVEL 3™	SAE LEVEL 4™	SAE LEVEL 5™
What does the human in the driver's seat have to do?	You are driving whenever these driver support features are engaged – even if your feet are off the pedals and you are not steering			You are not driving when these automated driving features are engaged – even if you are seated in “the driver’s seat”		
	You must constantly supervise these support features; you must steer, brake or accelerate as needed to maintain safety			When the feature requests, you must drive	These automated driving features will not require you to take over driving	

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	These are driver support features			These are automated driving features		
What do these features do?	These features are limited to providing warnings and momentary assistance	These features provide steering OR brake/acceleration support to the driver	These features provide steering AND brake/acceleration support to the driver	These features can drive the vehicle under limited conditions and will not operate unless all required conditions are met	This feature can drive the vehicle under all conditions	
Example Features	<ul style="list-style-type: none"> • automatic emergency braking • blind spot warning • lane departure warning 	<ul style="list-style-type: none"> • lane centering OR • adaptive cruise control 	<ul style="list-style-type: none"> • lane centering AND • adaptive cruise control at the same time 	<ul style="list-style-type: none"> • traffic jam chauffeur 	<ul style="list-style-type: none"> • local driverless taxi • pedals/steering wheel may or may not be installed 	<ul style="list-style-type: none"> • same as level 4, but feature can drive everywhere in all conditions

Figure 1

BACKGROUND

The advent of ACMVs has the potential to dramatically improve the safety of commercial vehicle operations. The National Highway Traffic Safety Administration (NHTSA) estimates that more than 90 percent of crashes are caused by human error. Therefore, the technology developed for ACMVs, when properly inspected and maintained, could play a significant role in improving roadway safety to the extent that it can meet or exceed human operator capabilities. Additionally, the system data generated by ACMVs could play a transformative role in the commercial vehicle inspection process.

During the last few years, CVSA began the process of developing recommendations for how to conduct roadside inspections of trucks equipped with varying levels of driver assistance and automation. The first phase of this process culminated in CVSA’s *Automated Commercial Motor Vehicle Working Group Final Report*, released in September 2020.

[ATA and TMC staff acted in a liaison role in the discussions contributing to this report.]

Through this process, CVSA identified several possible inspection policy options for both SAE Level 1-3 advanced driver assistance system (ADAS)-equipped CMVs, and SAE Level 4 and 5 ACMVs. At its April 2019 Workshop, CVSA adopted its “Option 7” recommendation as a framework for inspecting SAE Level 4 and 5 ACMVs when no human is present in the driver’s seat. Specifically, Option 7 states:

“[CVSA’s recommended inspection protocol] would limit roadside inspection of these vehicles to situations where an imminent hazard is observed or during a post-crash investigation, and instead focus on an origin/destination (terminal) inspection model. The vehicle would be required to communicate to enforcement while in-motion that it had passed the origin/destination inspection, that its ADS systems (as a whole) were functioning, and that it is operating within its ODD.”

NOTE: Since Option 7 was adopted, CVSA has moved away from the terminal inspection terminology, and now prefers enhanced pre-trip.

TMC encourages industry to operationalize CVSA's policy recommendations, and create a sound technical foundation for ATA's future policy development in cooperation with FMCSA and CVSA that will enable a path forward on ACMV inspections and enforcement, and the role of fleet maintenance operations in this process. Such a cooperative effort can facilitate the safe deployment of these vehicles in the coming years.

DISCUSSION OF CVSA OPTION 7

TMC considers an enhanced pre-trip inspection model that eliminates en-route stops for roadside inspections represents the most logical framework for inspections of ACMVs that have no human occupants onboard.

NOTE: CVSA's recommendation suggests that a SAE Level 4-capable truck being driven by a human would be subject to traditional inspection protocols.

Eliminating routine roadside inspections for ACMVs would not mean that ACMVs will receive a lower-level of scrutiny than traditional CMVs. In fact, the opposite is the case. ACMVs will need to undergo an enhanced pre-trip inspection and electronically provide roadside inspectors with near real-time vehicle safety data that should give law enforcement a high level of confidence regarding the safety of ACMVs, well beyond what current technology can provide.

Additionally, law enforcement officials would maintain their authority to stop an ACMV should they:

- identify an obvious safety violation or imminent hazard,
- identify a CVSA North American Standard Out-of-Service violation while an ACMV is driving down the highway,

- have a need to stop an ACMV for traffic control purposes, or;
- have any other probable cause to stop a vehicle.

Alongside enhanced pre-trip inspections, future ACMVs are expected to have access to self-diagnostic capabilities which will be entering the commercial vehicle marketplace in the next 5-10 years; these vehicles would hold an advantage over "legacy" vehicle systems when coupled with an automated driving system (ADS).

Consistent with the SAE J3016 standard, a system failure in a Level 4 or 5 ADS that would prevent the ADS from reliably driving the vehicle as intended should be subject to a self-diagnosis, and trigger an appropriate action to mitigate any unreasonable safety risk, including achieving a "Minimal Risk Condition" as defined by SAE J3016 — if necessary. Notwithstanding these capabilities, TMC recognizes law enforcement's continuing role in safeguarding the motoring public through roadside enforcement of ACMVs should an imminent hazard be observed or as part of a post-crash investigation.

CVSA'S ISSUE PARKING LOT

When CVSA adopted Option 7, it also identified a number of critical "Parking Lot" issues that merit future attention from law enforcement, regulators, and industry. CVSA also developed a priority list of issues regarding ACMV inspection and enforcement to address. This section discusses the two Parking Lot issues that deal with Level 4 and 5 ACMVs.

NOTE: CVSA Parking Lot Issue 1, which considers the development of a Malfunction Indicator for SAE J3016 Level 1-3 CMVs, is not included in this section.

Parking Lot Issue 2: Enhanced Pre-Trip Inspection

In Option 7, CVSA proposed that SAE Level

4 and 5 ACMVs primarily be inspected via an enhanced pre-trip inspection protocol, based on an enhanced Canadian *NSC Daily Vehicle Trip Inspection*.

This proposed inspection would:

- occur once per dispatch, when a new load is picked up and a new bill of lading is created,
- be required no more than once per 24 hours, though every new trailer would need to be inspected individually when added to a tractor-trailer combination,
- include all the elements in the Canadian Daily Vehicle Trip protocol, plus an element where the ADS would undergo a pass/fail check that encompasses all ADS-relevant items, including computer, software, and hardware status,
- be conducted by an authorized representative of the carrier or truck operator. CVSA is considering developing a training program that could ensure consistency across enhanced pre-trip inspections, and;
- provide a means such that enforcement officials shall be able to confirm while the ACMV is in-motion that the enhanced

pre-trip inspection was satisfactorily conducted within the required timeframe.

ACMV operators would be required to maintain records of every pre-trip inspection for investigative purposes, in line with current regulatory requirements.

TMC recommends that the industry favorably consider CVSA’s proposal for an enhanced pre-trip inspection process based on the Canadian Daily Vehicle Trip protocol.

**Parking Lot Issue 3:
In-Motion Electronic Confirmation**

CVSA Parking Lot Issue 3 focuses on how ACMVs can communicate their inspection status to enforcement officials, and what they should communicate. As an alternative to traditional roadside inspections, ACMVs would confirm to enforcement officials that an enhanced pre-trip inspection was conducted, and that the ADS is operating correctly.

Enforcement officials would maintain their traditional authority to stop a vehicle under any of the conditions identified above. Since this process would be a confirmation of inspection

TABLE 1: CONCEPT FOR ACMV ENHANCED PRE-TRIP INSPECTION CHECKLIST	
<i>Item</i>	<i>Note</i>
<i>IDENTIFICATION, PAPERWORK & CARRIER INFORMATION</i>	
Carrier Name	
Operator Name	
Operator Contact Information	Operator phone number and email so officers can contact the truck operator with questions or issues.
Vehicle Identification Number (VIN)	
License Plate Number	
USDOT Number	
Vehicle Insurance Status	

TABLE 1: CONCEPT FOR ACMV ENHANCED PRE-TRIP INSPECTION CHECKLIST (CONT'D)

<i>Item</i>	<i>Note</i>
<i>ITEMS POPULATED FROM LAW ENFORCEMENT DATABASES</i>	
IFTA Status	
International Registration Plan (IRP) Status	
ISS Score	
Oversize/Overweight Permits	
Last Roadside Inspection	
USDOT Number	
<i>WEIGHT</i>	
Gross Axle Weights	Options for determining weight include: <ul style="list-style-type: none"> • Record weight at time of pre-trip inspections • Weight at weigh station • Check at weigh-in-motion site • Onboard weigh-in-motion
Gross Vehicle Weight	
<i>PRE-TRIP INSPECTION INFORMATION</i>	
Enhanced Pre-trip Inspection Date/Time - Tractor	
Enhanced Pre-trip Inspection Date/Time - Trailer	
<i>ADS STATUS & INSPECTION INFORMATION</i>	
In-motion Confirmation GPS Coordinates	The truck's GPS coordinates at the time of an in-motion confirmation request.
In-motion Confirmation Time	The time of an in-motion confirmation request.
ADS Operation Status	Whether ADS is operating at time of query. NOTE: If the ADS on an ADS-equipped CMV is <i>not</i> operating, the truck will be subject to roadside inspections.
ADS Health Status	See below for definition.
Truck Operational Status	See below for definition.

status, it does not require creating a new type of CVSA inspection. Such an in-motion process will include the ability to transmit, at a minimum, the data elements included in the *Safety Data Message Set* elements presented in **Table 1**.

TMC supports industry development of an in-motion inspection confirmation process. Most critical in the *Safety Data Message Set* are the *ADS Health Status* and *Truck Operational Status* elements. A vehicle would report a

“Green” ADS Health Status only if the following conditions are true:

- the CMV is safe to complete the current ADS-driven trip without any in-vehicle human assistance, and;
- the ADS, comprised of both hardware and software, is functioning within its acceptable operating specifications for ADS operation (including its Operational Design Domain).

A vehicle will report a “Green” Truck Operational Status only if:

- the truck’s tractor and trailer passed the enhanced pre-trip inspection, and;
- the CMV equipment unrelated to the ADS that is monitored by the ADS is functioning within the operating specifications for which the ADS was designed.

The proposed requirement that CMV equipment unrelated to the ADS be functioning within operating specifications means that an ACMV must assume a “Minimal Risk Condition” should the ADS detect that CMV equipment unrelated to the ADS goes out-of-service. It also lays the groundwork for future work on CVSA Level VIII Concept Electronic Inspections, rather than in-motion inspection confirmations.

TMC considers it reasonable that this in-motion inspection confirmation will occur at roadside inspection locations, and may involve the use of existing weigh station bypass technologies, but not solely provided by external indicators on the vehicle itself. As new wireless inspection technologies become available, TMC recommends revisiting how, when, and where inspection confirmations can occur.

FACILITATORS AND INHIBITORS

In the process of designing and testing ACMVs, developers are able to work closely with OEMs and suppliers in incorporating sensors, telematics and analytics in a holistic approach to vehicle specification that will enable the self-diagnostic capabilities necessary to meet

the objectives of the Option 7 framework. ACMVs can take advantage of state-of-the-art sensing and control systems such as smart hubs, tire pressure monitoring and automatic inflation systems, advanced vehicle stability control systems, brake pad wear, engine and transmission control and diagnostics, vehicle lighting status and the like.

TMC notes that on-road operational testing of ACMVs facilitates advancements in the operational design of ADS, in the effectiveness of pre-trip inspections and in real-time detection of conditions on the vehicle that impact its operational status. This real world experience also facilitates an understanding of and unique preventive maintenance needs for ACMVs and the utilization of analytics in predictive maintenance practices to identify and correct developing problems. Both TMC and SAE International have recognized that trailers pose the most significant inhibitor to the objectives of the Option 7 model. Both organizations are working with their respective domains to overcome these challenges.

Currently a very small (less than five) percent of in-service trailers are “smart” and there is yet to be extension of ADAS technologies into the trailer. Furthermore, retrofitting is either technically difficult or prohibitive expensive. The challenge is exacerbated by the trailer’s long service life. Refrigerated trailers generally have a 10-year life, dry vans a 20-year life and bulk tank trailers a 30-year life. What’s more, many trailers are leased, rather than owned by motor carriers. Current trailer telematics are limited and for the most part do not address out-of-service conditions that may occur during a trip, such as load securement issues, door ajar, damaged trailer components (e.g., mudflaps or trailer boat tails), tire damage or wheel end conditions.

While advancement in trailer sensing and control systems is rapid and concurrent with those being deployed on power units, and available

in new trailer designs in the next 5-10 years, these systems also pose increased demands for power and data bandwidth across the tractor/trailer connection.

Both TMC and SAE International have task forces seeking to harmonize approaches to the physical connectivity and architecture of combination vehicles. In parallel to this TMC's S.12 Onboard Vehicle Electronics Study Group is engaged in a robust debate regarding messaging standardization from different technology providers across the vehicle network. All of the above must be taken into account to enable the ACMV developer to identify and react to potential non-ADS out-of-service conditions as contemplated in the Option 7 model.

Within its S.5 Fleet Maintenance Management Study Group, TMC has initiated a task force to create a recommended practice regarding the use of TMC's Vehicle Maintenance Reporting Standard (VMRS) codes in developing data sheets for health ready componentry in conjunction with SAE JA6268 International Health Ready Component Signaling practice, and is conducting an exploratory meeting to consider the future of Integrated Vehicle Health-Ready Maintenance Systems (IVHM).

CONCLUSIONS

Based on the continuing work of S.18's Automated Commercial Vehicle Inspection and Enforcement Task Force, and with additional input and commentary from TMC members, ATA policy and Council technical staff, TMC makes the following conclusions:

1. Industry should consider the CVSA Option 7 framework as a model for enhanced pre-trip inspections for ACMVs.
2. An enhanced pre-trip inspection model which eliminates en-route stops for roadside inspections represents the most logical framework for inspections of ACMVs that have no human occupants onboard.

3. Industry should favorably consider CVSA's proposal for an enhanced pre-trip inspection process based on the modified Canadian Daily Vehicle Trip protocol.
4. Industry should favorably consider an in-motion inspection confirmation process. As new wireless inspection technologies become available, TMC recommends re-visiting how, when, and where inspection confirmations can occur.

NEXT STEPS

Beyond this, TMC recognizes that significant work needs to continue in order to operationalize an enhanced pre-trip inspection process that can be practically applied to daily fleet maintenance and fleet operations, as well as meet the safety compliance needs of the enforcement community.

Next steps for TMC in this process include:

- Continuing discussions within TMC's S.18 Automated Commercial Vehicle Inspection Task Force.
- Identifying ACMV-specific preventive maintenance inspection processes and possibly developing new and/or modifying existing TMC RPs.
- Resolving trailer-related factors identified as potential inhibitors to the CVSA Option 7 model.
- Fostering close cooperation with and support of ATA's regulatory policy to operationalize these recommendations.

REFERENCES

SAE J3016, *Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles*, SAE International, Warrendale, Pa.

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