

Safety Study of Double-Decker Motorcoaches with Rear Luggage Compartment

BACKGROUND

Section 5510 of Fixing America's Surface Transportation Act (FAST Act), 2015 required the Secretary of Transportation to conduct a study on the effects of attaching a luggage compartment to the rear of a doubledecker motorcoach, with respect to: 1) safety of vehicle operations, 2) fire suppression capability, 3) tire loads, and 4) pavement impacts. This brief summarizes the approach and results from the study. Table 1 provides an overview of key findings.

STUDY METHOD AND SCOPE

The study was conducted through a combination of analyses and tests with a double-decker motorcoach. State transportation safety and law enforcement officials were consulted, and the study plan was revised according to their comments.

An exemplar motorcoach, a Van Hool TD925, was examined under three loading conditions: a reference condition with ballast to represent a full load of passengers and their normal luggage without a rear luggage compartment; a regulatory loading condition with the same amount of ballast and a rear luggage compartment attached, and a maximum loading condition with the vehicle weighted to its gross vehicle weight rating (GVWR) and with a rear luggage compartment attached. Where possible, the study applied established standards, such as the Federal Motor Vehicle Safety Standards (FMVSSs). The study considered whether the rear luggage compartment inhibited the ability of the vehicle to meet the standards. The industry standards used in this study are test methods that produce data for characterizing the vehicle's performance. Behavior under the two loading conditions with the rear luggage compartment was compared with that under the reference condition without the compartment. Where no standards were available to assess the fire risk, differences in risk and fire suppression capability were documented.



Figure 1. Photo. The subject vehicle for this study was a 2008 model Van Hool TD925 double-decker motorcoach with a rear luggage compartment.

Area of Study	Findings
Safety of Vehicle Operations	The rear luggage compartment did not impair the vehicle's ability to meet any of the FMVSSs or industry consensus standards tested. Its effects on vehicle handling ability, across test conditions, were not measurable or were of minimal significance.
Fire Risk	The rear luggage compartment, which was mounted near the test vehicle's engine, could keep heat from an engine compartment fire close to the rear of the vehicle, which could accelerate a breach of the rear window and allow combustion products into the passenger compartment.
Tire Loads	The tires and rims on the test motorcoach had adequate capacity for their loads.
Bridge and Pavement Damage	Test results show that the loads under all conditions may exceed some State limits with respect to the FHWA Bridge Formula. States must enact limits on tire and axle loads that are consistent with Federal Highway Administration (FHWA) regulations.

Table 1. Key findings across the four major areas of study.



KEY FINDINGS

As shown in Table 2, most safety aspects evaluated in this study were not significantly affected by the addition of a rear luggage compartment.

Table 2.	Key	findings	on	operational	safety.
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Торіс	Summary Finding		
Stopping Distance	The luggage compartment did not affect stopping distance.		
Turning Radius	Repositioning weight increased turning radius by 7 in.		
High-Speed Cornering	The compartment had a minimal effect in the test conditions.		
Lane Change	The compartment had a minimal effect in the test conditions.		
Structural Integrity	The lifetime of the attachment hardware is estimated to be adequate.		
Lighting	Location and activation requirements were met.		
Rear Visibility	The compartment did not interfere with rear visibility.		

With the exception of the extended length of the vehicle, characteristics of the motorcoach that were satisfactory without the rear luggage compartment were also satisfactory with the rear luggage compartment. Loads on pavement that were a concern with the luggage compartment were also a concern for a loaded vehicle without the compartment. The researchers had an unquantified concern that the compartment could contain heat in a severe engine compartment fire and lead to breaching the rear window.

Properties Not Changed by the Rear Luggage Compartment

The safety of vehicle operations of the motorcoach was not significantly affected by the attachment of the luggage compartment to the rear of the vehicle. Stopping distance from 60 mi/h was not impaired. High-speed handling in steady conditions (as on a freeway exit ramp) and dynamic conditions (as in a lane change) were also essentially identical with and without the compartment. The luggage compartment used in this study had lights that met the location and activation requirements specified in FMVSS No. 108. The compartment did not impair required lighting or rearward visibility. The attachment is expected to maintain its structural integrity through the normal service life of the vehicle. The tires and rims that were delivered with the vehicle for testing had adequate capacity for each of the loading conditions.

Properties Changed by the Rear Luggage Compartment

According to the manufacturer's specifications, the length of the test vehicle without the rear luggage compartment is 43 ft, 10 in. The compartment adds 2 ft, 11 in., so the length of the vehicle with the rear luggage compartment is 46 ft, 9 in. 23 CFR 658.13(d) specifies that "*no State shall impose a limit of less than 45 feet on the length of any bus on the [National Network]*." Some States allow only the minimum of 45 ft, and the tested motorcoach with the rear luggage compartment exceeded this length.

If a severe engine fire were to develop, the rear luggage compartment would keep heat near the body of the motorcoach and channel it toward the rear window. If the heat compromised the rear window, smoke and flame would enter the passenger compartment. The aluminum and fiberglass wall of the luggage compartment would resist a small fire. A severe fire could melt the wall and the contents would begin to burn. Firefighters could access the engine compartment through a side door, or they could remove the luggage compartment in about 30 seconds using tools normally carried by suppression crews. The luggage compartment did not block any emergency exits.

Concerns with or without the Compartment

The FHWA Bridge Formula allows a maximum vehicle weight of 54,500 lb for a three-axle vehicle where the first and third axle are 25 ft apart. When an occupant load of 150 lb per person, as in Federal regulations, and a luggage load of 35 lb per person is carried, the total weight of the motorcoach without the rear luggage compartment is 56,000 lb. The test vehicle did not meet the Bridge Formula, even without the rear luggage compartment. Individual and tandem axle loads may exceed the maximum loads allowed in some States.

To read the complete report, please visit: https://www.fmcsa.dot.gov/mission/policy/safety-studydouble-decker-motorcoaches-rear-luggagecompartment-report-congress

