

Boat Tails – Searching for a Solution

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Presentation Objective

- Review possible options to allow the installation and use of longer boat tails in Canada, in light of the NRC research study

Relevant Legislation



- *Motor Vehicle Transport Act (MVTA):*
 - Permits regulation of motor carriers that operate commercial motor vehicles beyond the limits of a province / territory

- *Motor Vehicle Safety Act (MVSA):*
 - Permits safety regulations of new vehicles sold in Canada
 - Canada Motor Vehicle Safety Standards (CMVSS)

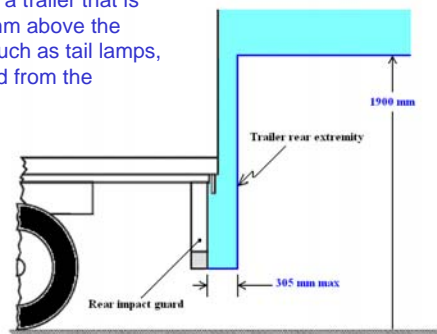
CMVSS 223 - Rear Impact Guard

- Rear extremity definition:

“rear extremity” means the rearmost point on a trailer that is [...] below a horizontal plane located 1 900 mm above the ground [...], with non-structural protrusions such as tail lamps, rubber bumpers, hinges and latches excluded from the determination of the rearmost point

- Configuration requirement:

223. (8) [...] the horizontal member shall be located as close as practicable to a transverse vertical plane tangent to the rear extremity of the trailer, and no more than 305 mm forward of that plane [...]





Underride Guards Provide Rear Impact Safety



Honda Civic Impact at 56 km/h

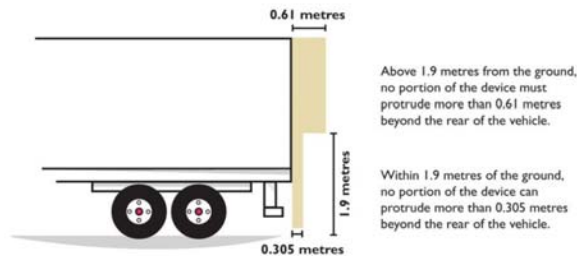




Background - Boat Tail Issue in Canada

- In April 2008, VW&D TF agreed to work towards permitting rear aerodynamic technologies on semi-trailers with extensions up to 0.61 m (2 ft) with a 1.9 m notch

Figure 13: Length allowance for trailer rear fairing⁹



Allowable boat tail dimensions in Canada
(figure from NRCan's fleetmart website)

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US Federal Highways Administration

- Boat tails must meet FHWA requirements to be exempted from length measurement :
Title 23, Part 658, § 658.16:
 1. The device must not be capable of carrying cargo
 2. The device does not extend beyond 5 feet from the rearmost point of the trailer/semi-trailer end
 3. The device does not "obscure tail lamps, turn signals, marker lamps, identification lamps, or any other required safety devices, such as hazardous materials placards or conspicuity markings"
 4. The device has "neither the strength, rigidity nor mass to damage a vehicle, or injure a passenger in a vehicle, that strikes a trailer so equipped from the rear"
- FHWA exemption is provided on an individual basis
- ATDynamics TrailerTails® was exempted from U.S. FHWA requirements based on van crash test

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ATDynamics TrailerTail®

- ATDynamics TrailerTail® was the first approved boat tail meeting FHWA exemption requirements
- Due diligence - Evidence included a crash test of a van into the rear of a trailer equipped with TrailerTail® at 56 km/h (Karco Engineering, LLC)



Source: Figure 12, Karco's report



Source: Figure 22, Karco's report



Background - Smartway



- U.S. EPA SmartWay Transportation Program and California legislation:
 - California legislation is requiring SmartWay certified fuel saving devices for 53-foot trailers as of January 1, 2010
 - Carriers have options of various SmartWay certified aerodynamic products including certified boat tails
 - Canadian carriers will need to comply with California regulation if they want to operate in the state



Background - Boat Tail Issue in Canada

- In 2009 CTA requested TC Compliance/Audit Group to allow any boat tail up to 5-feet meeting FHWA exemption requirements
- TC Compliance/Audit Group replied to CTA that boat tails do not fall under CMVSS 223 non-structural protrusion exemption
 - A blanket exemption from meeting CMVSS 223 was not provided
 - Thus not possible to install boat tails on new trailers without 1.9 m height clearance and meet CMVSS 223

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Background - Boat Tail Issue in Canada

- Mid 2009 - TC Regulatory Division tasked to review boat tail safety and compliance with CMVSS 223
 - Engaged NRC to complete aerodynamics and dimensional analysis
 - Presentation VW&D TF meeting - Nov 2009
- On June 29, 2010 - Transport Canada met with interested stakeholders to present NRC results and to present a proposed clearance zone
- In October 2010 - NRC draft report and clearance zone proposal were sent to stakeholders to seek comments

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NRC Research Study

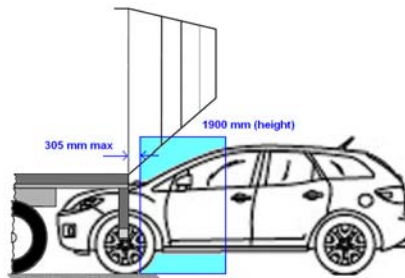
➤ Wind Tunnel

- to evaluate the aerodynamic effect of different boat tail parameters (length, height, panel angle, etc.)



➤ NRC Vehicle dimension analysis

- to evaluate what percentage of vehicles would first strike a boat tail and determine location on the vehicle
- to define rear impact zone without compromising safety



Wind Tunnel Testing

Evaluation of Environmental Benefits - Experimental

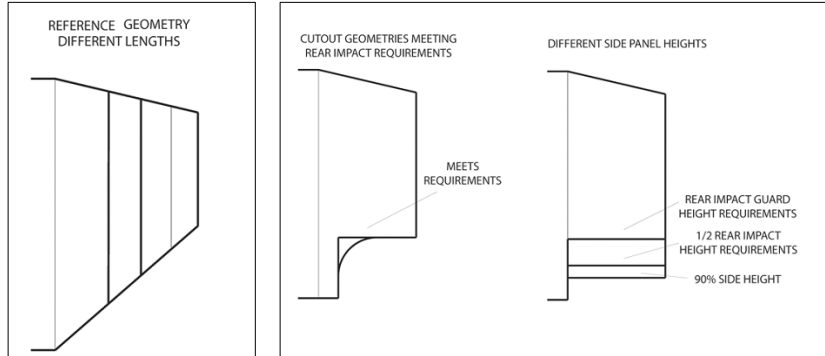
- Scale 1:10 representative truck and trailer model with medium side skirts and gap sealing
- Calculate drag reduction and estimate fuel savings and emissions benefits by comparing different boat tail configurations





Wind Tunnel Testing

- Determine if panels with length of 2 ft and longer provide improved aerodynamics
- Determine the effect of different side panel geometries (height and shape design)
- Examine the effect of the bottom panel in different configurations



Wind Tunnel Testing Results

- Boat tails are effective fuel saving devices – from 7% to over 11% reduction in drag
- After 0.91 m (3 ft) in length, efficiency gains are much less significant
- Minimal or no gains after 1.21 m (4 ft) in length of boat tail

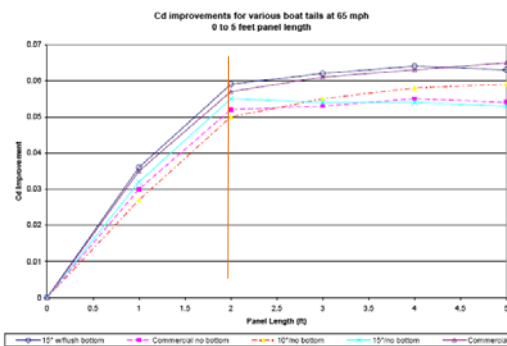


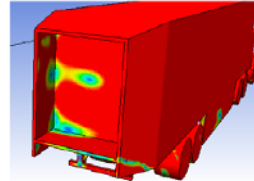
Figure 29 - Improvements in C_d for various panel lengths (0 to 5 feet)



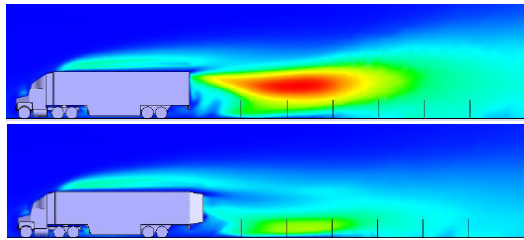
Computer Simulation

- Computer modeling (Computational Fluid Dynamics)
Benefits & Risks due to aerodynamics - Qualitative data :

- **Snow & ice accumulation** : Boat tail bottom panel may increase the risk of particulate accumulation (such as snow and ice)



- **Road spray reduced** : Boat tail provides reduced turbulence compared to baseline configuration

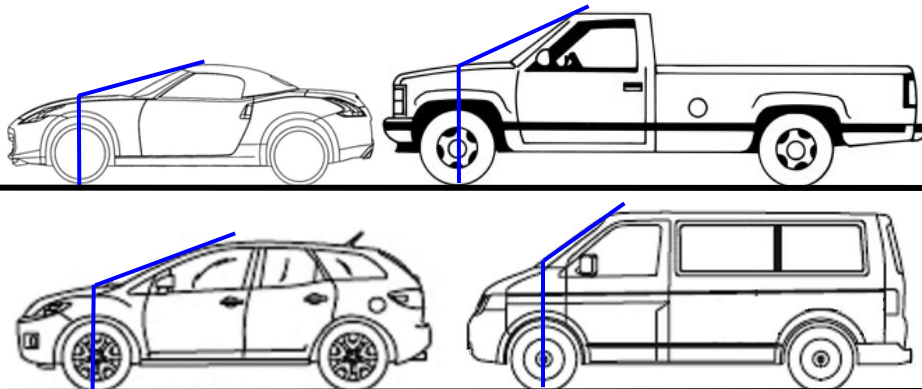


Source: figures from NRC draft report



Vehicle Dimensions Analysis

- Interference of current vehicles on the road with various boat tail geometries

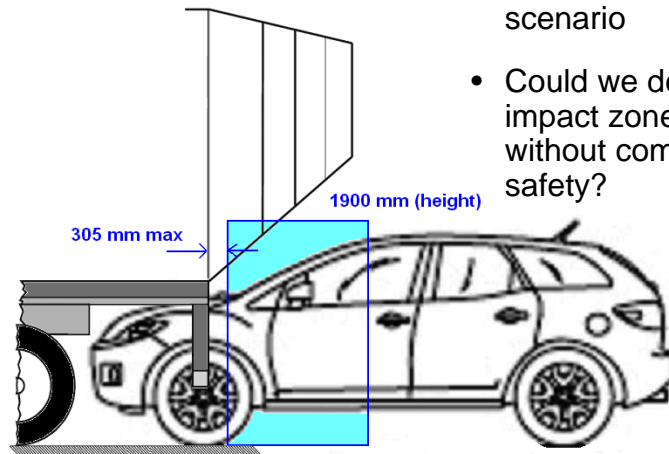




Vehicle Dimensions Analysis

Optimization Model:

- Blend analyses to determine « optimum » scenario
- Could we define the rear impact zone differently without compromising safety?



Dimension Interference Estimates

- The current level of safety for the clearance zone, as defined in CVMSS 223, is 6.43% of windshield/short hood strikes
- Therefore, to maintain the same level of safety, the clearance zone may be extended to value under this level

Collision statistics for various square bottomed boat tail sizes
windshield and short hood strikes

Height	61cm (2 ft)	91cm (3 ft)	93 cm (3 ft)	94 cm (3.1 ft)	111 cm (3.6 ft)	121 cm (4 ft)	152 cm (5 ft)
110 cm	0.61%	8.45%	9.77%	10.15%	30.68%	53.25%	98.38%
120 cm	0.61%	8.45%	9.77%	10.15%	30.68%	53.25%	98.35%
130 cm	0.61%	8.45%	9.77%	10.15%	30.65%	53.15%	97.52%
140 cm	0.61%	8.43%	9.75%	10.13%	28.25%	44.54%	76.34%
145 cm	0.61%	7.83%	9.15%	9.49%	21.75%	32.49%	54.42%
150 cm	0.61%	7.83%	9.14%	9.44%	19.56%	26.33%	44.66%
160 cm	0.56%	7.22%	7.54%	7.81%	16.79%	22.58%	40.97%
170 cm	0.56%	6.79%	7.11%	7.38%	13.00%	15.74%	31.62%
180 cm	0.49%	3.08%	3.18%	3.45%	3.88%	4.21%	16.42%
190 cm	0.48%	2.38%	2.38%	2.38%	2.40%	2.50%	6.43%

Source: NRC results, draft report, Table 12



NRC Vehicle Dimension Interference Estimates

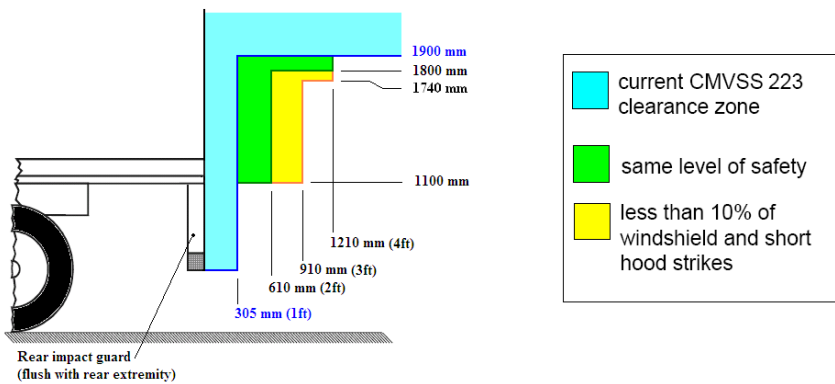
Less than 10% of vehicles would strike the boat tail in the windshield area before striking the rear of the trailer if the boat tail was 121 cm (4 ft) long and had more than 1 740 mm of ground clearance over the last 30 cm (1 ft)

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Possible Rear Clearance Zone

- To maintain the equivalent level of safety, the clearance zone may be extended

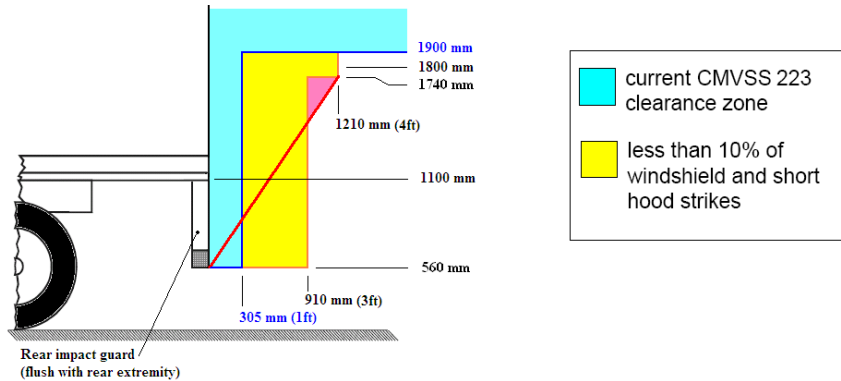


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Possible Rear Clearance Zone

- Definition of a rear area : inclined plane



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Potential Options

1 Amend Rear Clearance Zone

- Extend the boat tail clearance without significant safety reduction

2 Exempt boat tails providing certain requirements, such as

- Do not carry a load
- Flexible
- Collapsible
- Others...

3 Develop Performance Test

- Test that determines if a boat tail design can be considered a non-structural protrusion

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Options 1 - Amend Rear Clearance Zone

Advantages

- + Non complicated option
- + Could harmonize the provincial/territorial and federal requirements
- + No significant reduction in safety
- + Easily enforceable on the road for provinces/territories

Disadvantages

- Products currently available on the market do not in all cases meet the clearance zone
- May limit future designs

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Option 2 - Exempt Boat Tails Meeting Defined Requirements

Advantages

- + Non complicated option
- + Could harmonize the provincial/territorial and federal requirements
- + Products currently available on the market would meet the criteria

Disadvantages

- Need to agree on requirements (enforcement feasibility)
- Safety risk unknown for new designs

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Option 3 - Develop Performance Test

Advantages

- + Not design restrictive

Disadvantages

- Significant cost and time to develop and produce a repeatable test
- High compliance testing cost
- Not enforceable on the road for provinces/territories

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Stakeholder Position – ATD Suggestion

- Over short term, exempt “non-rigid” boat tails that are flexible and collapsible
 - Deflect, deform or collapse under a force of 175 lbf
 - Up to 5ft in length
 - Permit for the entire height of the trailer
- Proposed clearance zone would apply to “rigid” boat tails
- Over longer term, performance requirements for all boat tails

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Final Thoughts

- Expect a growing demand for fuel saving technologies such as boat tails
- Boat tails provide significant positive environmental benefits by reducing drag coefficient
- CMVSS 223 was developed before boat tails were introduced, thus they were not considered at that time
- No real world data showing that boat tails will increase risk of vehicle occupant injury