

Truck Sideguards for Vision Zero

Review and technical recommendations for Safe Fleet Transition Plan pilot deployment

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Executive Summary

Volpe, The National Transportation Systems Center (Volpe) partnered with the New York City (NYC) Department of Citywide Administrative Services (DCAS) in establishing recommendations for implementing large truck side underride protection as part of the landmark [Vision Zero](#) program. This report details findings and recommendations from the study.

Large truck crashes are more likely to result in a pedestrian or bicyclist fatality than crashes involving passenger vehicles and more likely to be side-impact crashes. Sideguards are vehicle-based safety devices that prevent pedestrians and cyclists, and in some instances motorcyclists, from falling into the exposed space between the axles of trucks with high ground clearance.

Volpe's review of available information related to sideguard design and crash outcomes in countries requiring these safety devices for up to three decades indicates that the safety effectiveness of sideguards has been well established. The fatality rate for bicyclists and pedestrians colliding with the side of a truck decreased by 61% and by 20%, respectively, following a national sideguard requirement in the United Kingdom in the 1980s.

Volpe reviewed regulatory and voluntary sideguard precedents, as well as existing international technical specifications, to develop a foundation for New York City-based sideguard standards. With input from the City's Fleet Federation, the Fleet Specifications Committee, and constituent DCAS fleets, Volpe tailored the recommendations to focus on the most relevant types of vehicles in NYC's municipal fleets. These recommendations build upon existing European and United Kingdom sideguard standards and are intended to advance the Safe Fleet Transition Plan for DCAS fleet vehicles, the largest potential truck sideguard pilot deployment for bicyclist and pedestrian safety in the U.S. The recommendations may also inform future regulatory requirements.

Recommended dimension and strength requirements for DCAS's pilot sideguard program are depicted in Figure 1. If a sideguard regulation is also adopted, it should define the maximum ground clearance, the minimum strength requirement, and define the areas of installation in accordance with Figure 1, or as refined based on an evaluation of the pilot program. Consistent with recent National Transportation Safety Board's Safety Recommendations for sideguards, Volpe recommends that trucks over 10,000 pounds be subject to sideguard requirements. Furthermore, Volpe recommends a maximum 13.8 inch (350 mm) ground clearance and a minimum 440 lbs. (2 kN) impact strength. These are more stringent requirements than the European minimum requirements to further improve crash safety.

Recognizing the large diversity of truck types, Volpe identified four vehicle types that may be exempted from sideguard requirements:

- Special purpose vehicles where side protection is impractical;



- Street sweepers;
- Fire engines;
- Car carriers

To maximize public safety benefits, vehicle exemptions under the “Special purpose” category should be considered a last resort, and innovative foldable or stowable sideguard solutions should be considered first.

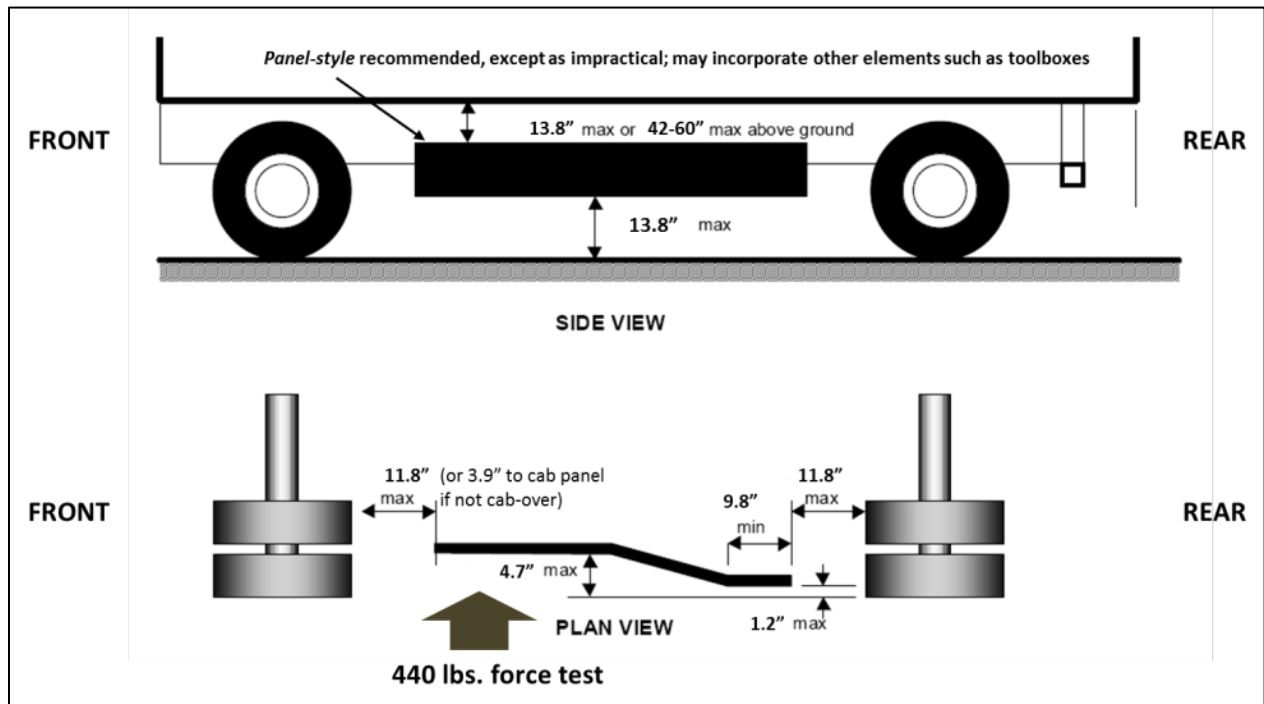


Figure 1. Recommended sideguard dimensional and strength requirements for the NYC fleets, based on EU and UK standards and on published and Volpe recommendations.

Market research identified a limited number of existing North American-based retrofit suppliers, but Volpe also engaged Mack/Volvo, a major OEM supplier to DCAS that already integrates sideguards on its vehicles for European, Asian, and South American markets. A process of long-term OEM sideguard integration into the vehicle fleet may be expected to follow the initial period of pilot vehicle retrofits.

Sideguards are one part of a larger suite of truck safety countermeasures that merit additional study and potential pilot implementation and evaluation. Pending additional agreement, Volpe may partner with DCAS and NYC DOT to expand upon this initial pilot and to establish a comprehensive program evaluation that will assess the effectiveness of a comprehensive suite of truck safety technologies for saving lives and advancing the goals of Vision Zero.



I. Introduction

Approximately 4,000 New Yorkers are seriously injured and more than 250 are killed each year in traffic crashes, rivaling the annual homicide count of the City. Vision Zero, the inter-agency plan to eliminate traffic fatalities in NYC, includes 63 recommendations that fall into three main categories: enforcement, education and engineering. Recommendation #58 charges the New York City (NYC) Department of Citywide Administrative Services (DCAS) with “recommend[ing] safety related devices and designs, such as high visibility vehicles, back-up cameras, and rear wheel **side guards**, for City vehicles and other vehicles under City regulation.” Therefore, the DCAS will be a critical contributor to this pioneering program.¹ DCAS preliminary vehicle safety recommendations in response to the Action Plan are to be finalized and submitted in summer 2014.

Large trucks are disproportionately represented in bicycle and pedestrian fatalities. While large trucks comprise 4% of the U.S. vehicle fleet,² they are associated with 7% of pedestrian fatalities (297 annually) and 11% of bicyclist fatalities (76 annually).^{3,4} In New York City, trucks, which account for 3.6% of vehicles, accounted for an average of 12.3% of pedestrian fatalities (14.8 deaths annually) in 2002-2006⁵ and 32% of bicyclist fatalities (7.4 deaths annually) in 1996-2003.⁶ Truck and bus crashes account for an annual average of 31 bicyclist and pedestrian fatalities in New York City and are nearly three times more likely to result in a pedestrian fatality than crashes involving passenger vehicles.⁷



Current federal regulations require rear impact guards for the wheels of trailers and semi-trailer trucks

¹ NYC Vision Zero. <http://www.nyc.gov/html/visionzero/pages/home/actions.html>

² Bureau of Transportation Statistics, Table 1-11: Number of U.S. Aircraft, Vehicles, Vessels, and Other Conveyances

http://www.rita.dot.gov/bts/sites/rita.dot.gov/bts/files/publications/national_transportation_statistics/html/table_01_11.html

³ National Transportation Safety Board, “Safety Study NTSB/SS-13/01: Crashes Involving Single-Unit Trucks that Resulted in Injuries and Deaths”, pp 69-70 <http://www.nts.gov/doclib/safetystudies/SS1301.pdf>

⁴ NTSB Safety Recommendations to NHTSA, April 3, 2014. www.nts.gov/doclib/recletters/2014/H-14-001-007.pdf

⁵ Pedestrian Safety Study & Action Plan, 2010.

http://www.nyc.gov/html/dot/downloads/pdf/nyc_ped_safety_study_action_plan.pdf

⁶ Bicyclist Fatalities and Serious Injuries in New York City, 2005.

<http://www.nyc.gov/html/doh/downloads/pdf/episrv/episrv-bike-report.pdf>

⁷ Pedestrian Safety Study & Action Plan, 2010.

http://www.nyc.gov/html/dot/downloads/pdf/nyc_ped_safety_study_action_plan.pdf



to reduce the number of deaths and serious injuries occurring when passenger vehicles crash into the back end of a truck. However, there are currently no national regulations concerning side underride protection or sideguards to protect pedestrians and bicyclists from the risk of falling under the sides of trucks and being caught under the wheels. As shown in Figure 2, sideguards, also referred to as “lateral underride protection” and “side underrun protection” devices, work by shielding pedestrians and cyclists, and in some instances motorcyclists, from the open space between the axles of most types of large trucks.



Figure 2. A large truck without sideguards (left) typically has an exposed space, often exceeding four feet in height, between the axles. During a crash with the truck, vulnerable road users can fall into the exposed space and suffer fatal crushing injuries. Sideguards (right) are designed to cover these exposed spaces.

Sideguards are currently required on certain motor vehicles, trailers and semi-trailers in Japan, in European Union countries, the United Kingdom, and elsewhere. Additionally, some sideguard variants may provide environmental benefit in the form of improved fuel efficiency by reducing aerodynamic drag of trucks in certain types of driving conditions.

NYC owns or leases almost 27,000 municipal fleet vehicles, of which over 6,000 vehicles are Class 3 trucks or above (over 10,000 lbs.), including sanitation trucks, the fleet truck type most commonly involved in bicyclist/pedestrian fatalities. Vision Zero calls for “a broad legislative and regulatory agenda,” including “improving standards for vehicle design and technology” for trucks operated in NYC.⁸

Trucks comprise only **3.6%** of vehicles in NYC yet account for **12.3%** of pedestrian and **32%** of bicyclist fatalities.

Volpe, The National Transportation Systems Center (Volpe) has supported DCAS’s critical role in advancing Vision Zero by reviewing and synthesizing the state of the practice for truck side underride protection for cyclists and pedestrians. This review incorporates both regulatory and voluntary precedents for truck sideguard deployment, available safety data, and existing technical specifications. Volpe also performed market

⁸ NYC Vision Zero. <http://www.nyc.gov/html/visionzero/pages/legislation/legislation.html>



research to identify relevant suppliers and OEMs, and presented at the City's Fleet Federation and Fleet Specification Committee meetings; target fleets were interviewed for detailed feedback to inform recommendations. In this report, Volpe's findings are synthesized into recommendations for sideguard deployment on city-owned vehicles, with a focus on the types of vehicles most prevalent in NYC's fleet.



2. Core sideguard research

2.1 Truck sideguard safety effectiveness

Volpe performed a high level review of existing data on the safety impacts of truck sideguard deployment for pedestrians and bicyclists in crashes with large trucks. The scan drew primarily on international crash data, with the goal of establishing a benchmark for future data collection on the safety impacts of U.S. truck sideguard deployment.

Approximately **half** of all bicyclists and **one-fourth** of all pedestrians killed by trucks first impact the side of the truck.

	Bicyclists	Pedestrians
Tractor-trailer	55%	29%
Single-unit	44%	25%

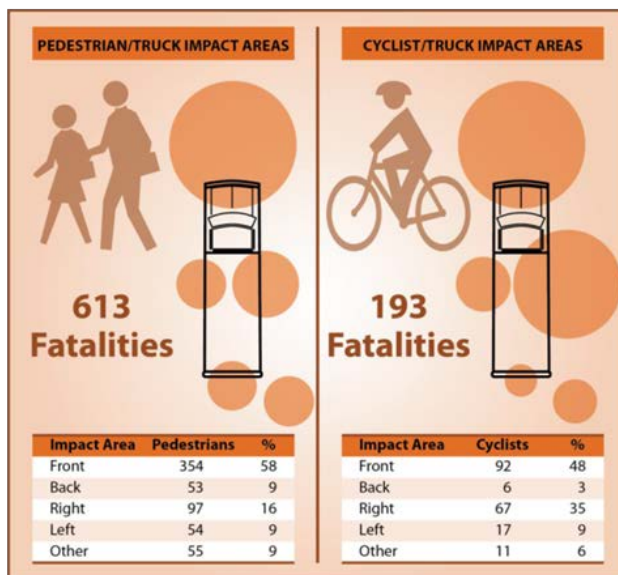


Figure 3. Top: Percent of bicyclist-truck and pedestrian-truck fatalities that follow initial impact on the side of the truck. Bottom: the initial impact breakdown for single-unit trucks.

The introduction of sideguards in the UK, European Union, and Japan over the past three decades was intended to prevent bicyclists and pedestrians from falling into the space between the axles of a passing large truck and being run over by the rear wheels. Sideguards are primarily designed to be effective in overtaking or glancing side impact crash types, for example, during turns. According to the National Transportation Safety Board, the prevalence of these types of crashes ranges as high as 25% for pedestrians with single-unit trucks to 55% for bicyclists with tractor-trailers (Figure 3).⁹

The safety effectiveness of sideguards on large trucks was demonstrated by a UK study, which showed significant reductions in the number of bicyclist fatalities for the relevant crash types from before the sideguards were introduced to after the sideguards were introduced.¹⁰ The different injury distributions before and after the nationwide installation of sideguards are shown in Figure 4.

⁹ NTSB, Crashes Involving Single-Unit Trucks that Resulted in Injuries and Deaths, 2013 <http://www.nts.gov/doclib/safetystudies/SS1301.pdf>

¹⁰ National Research Council Canada, Side Guards for Trucks and Trailers Phase 1: Background Investigation, 2010.



The injury severity distribution for bicyclists colliding with the side of a truck changed substantially, with a 61% reduction in fatalities, as shown in Figure 5. This conclusion was reported in a 2005 UK Transport Research Laboratory (TRL) analysis¹¹ and cited by National Research Council Canada in a 2010 national sideguard study report.¹²

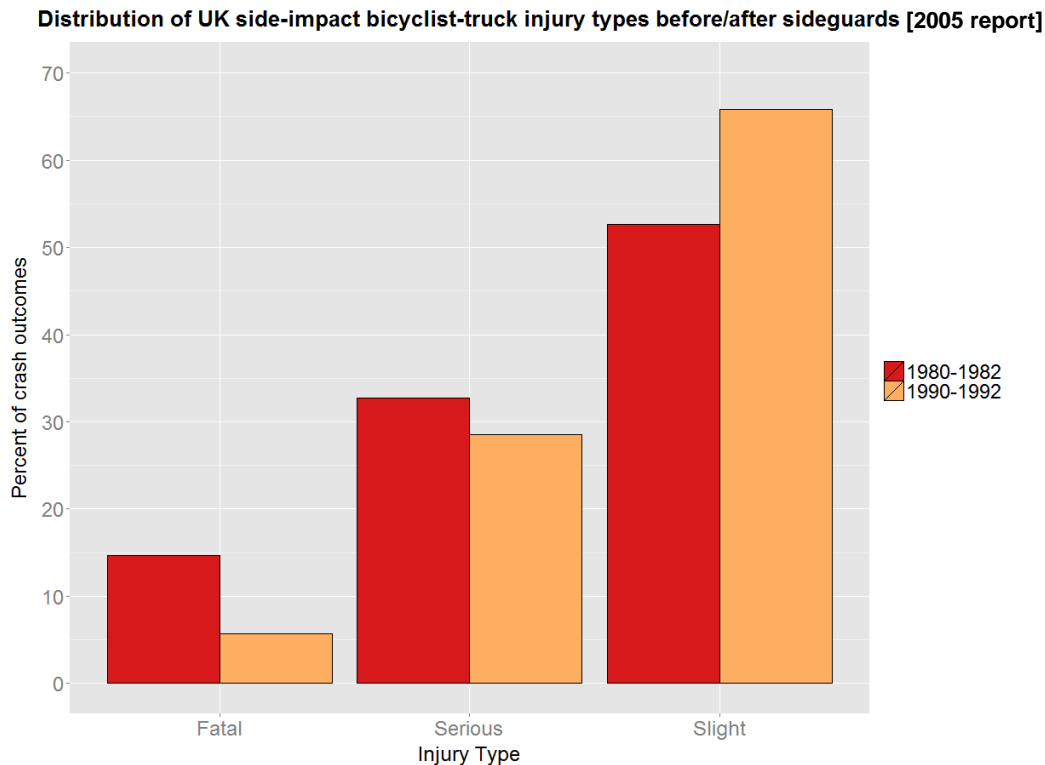


Figure 4. Fatality and injury distribution of bicyclists in side impacts with trucks 4-6 years before and 4-6 years after the mandatory introduction of sideguards in the UK. (74 crashes in 1980-82 and 66 crashes in 1990-92)

The statistical data revealed there was a greater reduction in severe injuries and death for bicyclists than for pedestrians during the reporting period. Still, **the fraction of fatal pedestrian casualties in the side-impact crash type decreased 20%**, compared to the 61% observed for bicyclists. A 2010 follow-up TRL report¹³ comparing crash data from 2006-2008 confirmed the continued decline in side-impact fatality rates compared to the pre-sideguard 1980-1982 period. Case studies from the fatal and TCIS databases in the UK suggested that the reason for this difference might be that the crash mechanisms are different for pedestrians walking into the side of vehicles rather than falling against them.¹⁴

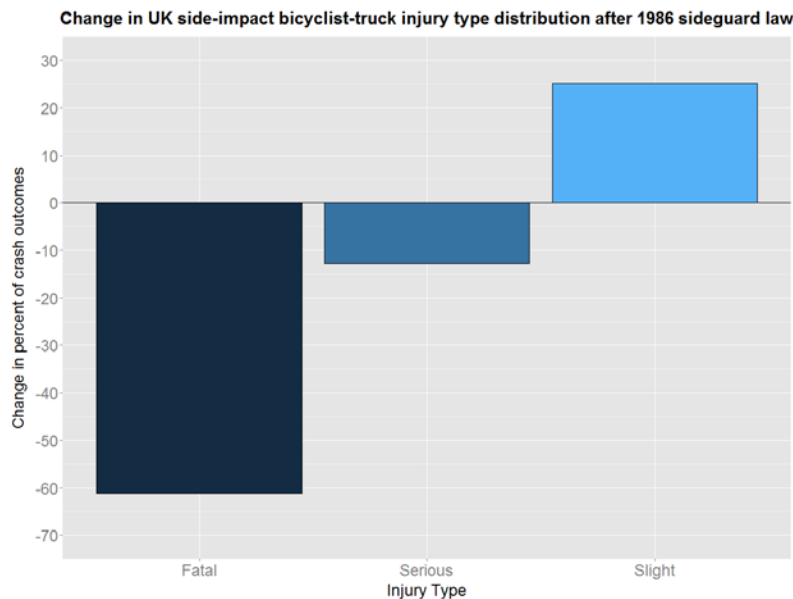
¹¹ Knight, I., Dodd, M., Bowes, D., Donaldson W. et al, Integrated safety guards and spray suppression – final summary report, 2005. <http://www.trl.co.uk/reports-publications/report/?reportid=5450>

¹² National Research Council Canada, Side Guards for Trucks and Trailers Phase 1: Background Investigation, 2010.

¹³ R Cookson and I Knight, Sideguards on heavy goods vehicles: assessing the effects on pedal cyclists injured by trucks overtaking or turning left. 2010.

¹⁴ Knight, I., Dodd, M., Bowes, D., Donaldson W. et al, Integrated safety guards and spray suppression – final summary report, 2005. <http://www.trl.co.uk/reports-publications/report/?reportid=5450>





“The effectiveness of the sideguards on heavy vehicles has been demonstrated by a UK study, which showed significant reductions in the number of bicyclist fatalities from before the sideguards were introduced to after the sideguards were introduced.”
- National Research Council Canada, 2010

Figure 5. Decrease in fatality and serious injury rates following sideguard implementation in the UK. (74 crashes in 1980-82 and 66 crashes in 1990-92)

In addition to comparing the before-and-after crash outcomes with regard to the sideguard phase-in between 1983 and 1986, the 2010 TRL report¹⁵ compared the crash outcomes involving British trucks that are exempt and non-exempt from the sideguard regulation.¹⁶ The fatality rates in bicycle left-hook collisions during 2006-2008 in the UK (equivalent to right-hook collisions in the US) when sideguard equipped and sideguard exempt trucks were involved are compared in Table 1. **Whereas only one in four bicyclists was killed or seriously injured in crashes when the truck was equipped with a sideguard, two out of three bicyclists were killed or seriously injured when the truck was exempt and not equipped with a sideguard.**

Table 1. Crash severity distribution in truck-bicycle left turn collisions in the UK when the truck was either exempt or not exempt from sideguard installation. (KSI = killed or seriously injured)

	Fatal	Serious	Slight	% fatal	% KSI
Exempt	9	21	15	20%	67%
Not exempt	7	8	44	12%	25%

¹⁵ R Cookson and I Knight, Sideguards on heavy goods vehicles: assessing the effects on pedal cyclists injured by trucks overtaking or turning left. 2010.

¹⁶ An advantage of this comparison is that it considers crashes over the same time period, eliminating potential confounding factors that may have occurred between 1982 and 1990. A different confounding factor could exist if exempt vehicles were inherently more fatal in side-impact crashes for unknown reasons that are not related to the presence of sideguards. However, both the time-series and the exempt/not exempt safety analyses are qualitatively consistent and show reduced fatality rates among sideguard-equipped large trucks.



2.2 Review of current sideguard regulations and standards

In this section, sideguard regulations and regulatory trends are reviewed, compared for applicability to vehicle types, and synthesized for DCAS's Safe Fleet Transition Plan. Volpe leveraged its MIT Library partnership in support of this regulatory review, which included both U.S. regulations and international regulations. In addition to technical specifications set forth by regulations, a review of voluntary standards was also performed. However, no relevant SAE, ISO, or other applicable voluntary standards for sideguards could be identified. The most fruitful source of specifications and standards proved to be international regulations, particularly those of Great Britain and the European Union, with more limited insights identified from Japan and Brazil.

2.2.1 U.S. regulations

In the U.S., Federal Motor Vehicle Safety Standard (FMVSS) 223 applies to Rear Impact Guards, an example of which shown in Figure 6; there is no corresponding Side Impact Guards FMVSS.¹⁷ The National Highway Traffic Safety Administration (NHTSA) rejected adding sideguard requirements to the FMVSS in 1991.



Figure 6. Rear impact guard, currently required on trailers by Federal Motor Vehicle Safety Standard 223.

However, those sideguards were proposed in a very different context, for protecting passenger car occupants rather than pedestrians and bicyclists.¹⁸ Thus, the sideguards considered at that time would have been significantly larger and heavier than the ones discussed in this report, since they would have been designed to deflect a motor vehicle rather than a person.

¹⁷ <http://www.nhtsa.gov/cars/rules/import/FMVSS/>

¹⁸ Jeya Padmanaban, "Estimating Side Underride Fatalities Using Field Data." *Ann. Adv. Automotive Med.* Sep 2013; 57: 225–232. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3861811/>



2.2.1.1 National Transportation Safety Board

The National Transportation Safety Board (NTSB) issued two related Safety Recommendations to NHTSA, in July 2013 and April 2014, for the development of national performance standards and for requiring nationwide the installation of sideguards on single-unit trucks over 10,000 lbs. gross vehicle weight rating (GVWR), trailers over 10,000 lbs., and truck tractors over 26,000 lbs.¹⁹ In addition, the Safety Recommendations call for developing performance standards and requiring “visibility enhancement systems to compensate for blind spots.” These systems are cited as necessary to “improve the ability of drivers of large trucks to detect vulnerable road users, including pedestrians and cyclists, in their travel paths.”

H-13-13

Develop performance standards for side underride protection systems for single-unit trucks with gross vehicle weight ratings over 10,000 pounds.

H-13-14

Once the performance standards requested in H-13-13 have been developed, require newly manufactured single-unit trucks with gross vehicle weight ratings over 10,000 pounds to be equipped with side underride protection systems meeting the performance standards.

Figure 7. Excerpt from the 2013 NTSB Safety Recommendation for medium- and heavy-duty truck sideguards.

2.2.1.2 Regional, state, and local regulations

Although no national sideguard regulations currently exist, Volpe identified two municipal regulatory or procurement-based requirements. Washington, DC and Boston, MA appear to be the only cities to date in the US that have required sideguards on municipal heavy-duty vehicles, in 2008 and 2013 respectively. The 2008 DC regulation²⁰ was not initially funded but is now being implemented as of 2014. Boston has retrofitted 19 Public Works vehicles and changed its procurement requirements to require sideguards on all future applicable trucks. Additionally, RFPs for city service contracts such as waste hauling have been amended to require sideguards on city-contracted trucks, which is expected to accelerate adoption. Portland, OR implemented a pilot program on its municipal truck fleet in 2008, with about 12 vehicles fitted. As of 2014, Cambridge, Somerville, and Newton, all in Massachusetts, have also implemented pilot programs on their municipal truck fleets.

¹⁹ NTSB Safety Recommendations to NHTSA, July 3, 2013 and April 3, 2014. [H-13-011 through -019 - H-13-011-019.pdf](#) ; [www.nts.gov/doclib/reclatters/2014/H-14-001-007.pdf](#)

²⁰ Bicycle Safety Enhancement Act of 2008. [http://www.dcbac.org/legislation/bike_safety_act.pdf](#)



Municipal sideguard implementations in North America have been increasing since at least 2008 following crashes that resulted in cyclist and pedestrian deaths. The Portland City Council and Washington, D.C. City Council provide precedents for a resolution and an ordinance respectively for city-owned trucks. At the same time, the New York City Council introduced in 2014 a sideguard bill modeled on the 2011 landmark convex crossover mirror law in NYS, which requires conventional cab trucks over 26,000 lbs. operating in NYC to install crossover mirrors to reduce the forward blind spot, a factor in many pedestrian fatalities. The 2011 NYS mirror law is cited by the NTSB in its 2013 single-unit truck crash study.²¹ In October 2014, Boston adopted the nation's first ordinance requiring sideguards on city-owned and city-contracted trucks.²²

2.2.2 International regulations and standards

Sideguards are a mature technology. The European Union has legislatively required sideguards for nearly three decades with no known critical implementation issues in various climatic, roadway, and urban conditions. Nations in Asia (e.g., Japan) and South America (e.g., Brazil) have also maintained national sideguard regulations for a number of years.

The European Union has legislatively required sideguards for nearly three decades with no known critical implementation issues.

2.2.2.1 European Union

Sideguards have been required on most trucks in the European zone since 1989. The requirement was updated in 1995 as Regulation No 73 of the Economic Commission for Europe of the United Nations (UN/ECE) — Uniform provisions concerning the approval of goods vehicles, trailers and semi-trailers with regard to their lateral protection.

- Applies to most vehicles in the European Union over 3.5 metric tons (7,700 lbs.); several attribute-based exemptions
- Can be met by vehicle design or sideguards
- Sideguards can use horizontal rails or continuous flat surface:
 - Flush with vehicle, smooth face, maximum ground clearance 550 mm / 21.7"
 - Standards for strength (1 kN or 220 lbs. horizontal static force)

2.2.2.2 United Kingdom

Sideguards began to be implemented in the UK in 1983 and were nationally mandated by the Road Vehicles (Construction and Use) Regulations of 1986, an Act of Parliament. The UK Freight Transport

²¹ NTSB, Crashes Involving Single-Unit Trucks that Resulted in Injuries and Deaths, 2013
<http://www.nts.gov/doclib/safetystudies/SS1301.pdf>

²² <http://www.cityofboston.gov/news/default.aspx?id=14853>



Association Sideguard Compliance Guide²³ provides a detailed overview of required sideguard fitment, including for cargo tank trucks, sleeper cabs, and stabilizer arms.

- Applies to most vehicles in the UK over 3.5 metric tons (7,700 lbs.), with categorical exemptions
- Can be met by vehicle design or sideguards
- Sideguards can use horizontal rails or continuous flat surface:
 - Flush with vehicle, smooth face, maximum ground clearance 550 mm / 21.7"
 - Standards for strength (2 kN or 440 lbs. horizontal static force)

2.2.2.3 Japan

Japan has a policy of harmonizing vehicle standards with international standards such as EU R73, but current side guard regulations in Japan are also outlined in two documents: Safety Regulations for Road Vehicle (Ministerial Ordinance) and its subordinate regulation (Announcement). These documents refer to sideguards as "Pedestrian Protecting Side Guards." The Japanese regulations apply to trucks over 8 tons and require a maximum ground clearance of 450 mm (17.7 in.) when the vehicle is unladen.

2.2.2.4 Brazil and other countries

As of January 1st, 2011, trucks in Brazil are required to install sideguards, with the goal of protecting Brazil's large population of motorcyclists.²⁴ In view of this, there are significant differences in the sideguard regulations in Brazil: they must withstand a load of 500 kg (1,102 lbs.), while the European and UK sideguards must only withstand a load of 100 or 200 kg (220 or 440 lbs.), respectively.

China appears to also require sideguards on large trucks²⁵, and the devices are in common use in other Latin American countries.

The Australian Trucking Association has published an Advisory Procedure to aid manufacturer compliance with EU Regulation 73, although manufacturers are not required to comply.²⁶

2.2.2.5 International regulatory comparisons and published recommendations

Volpe compiled the key specifications of the UK, European, and Japanese sideguard regulatory standards, as well as published recommendations for improving upon these standards from Transport Research Laboratory (TRL) in the UK and from Monash University in Australia. These findings are

²³ www.cintec.nl/include/downloadFile.asp?id=103

²⁴ <http://randon.com.br/Content/Informativos/EN/110/tendencias2.html>

²⁵ <http://www2.thedenverchannel.com/web/kmgh/news/underride-guards-metal-barriers-on-back-of-large-trucks-often-fail-to-protect-drivers>

²⁶ Australian Trucking Association, "Side Under Run Protection," Industry Technical Council Advisory Procedure, Forrest, 2012.



summarized in Table 2 and Table 3. Volpe adapted these previously published recommendations and in collaboration with DCAS and with fleet stakeholder input has synthesized additional recommendations in this report for the specific needs of the New York City DCAS fleets.

The dimensional and strength requirements of the EU regulation are schematically shown in Figure 8, while the identical EU/UK dimensional requirements for trailers are shown in Figure 9.

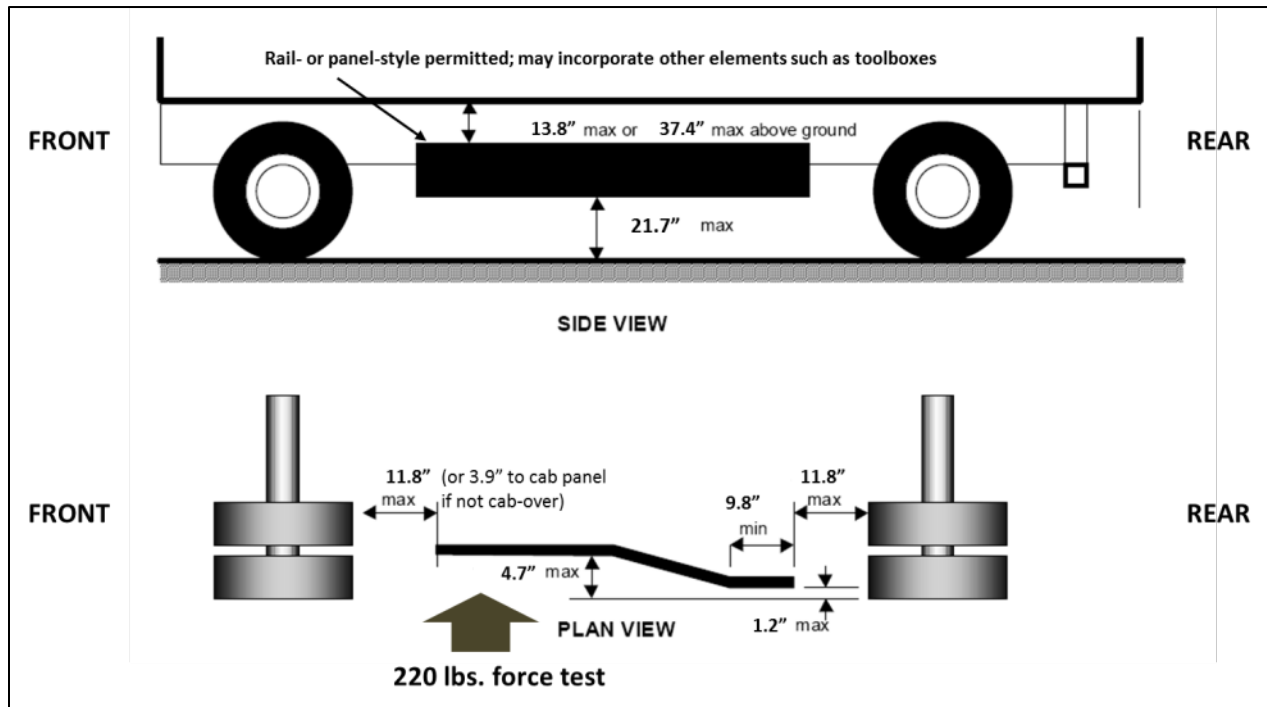


Figure 8. Schematic of the main European Union Regulation 73 sideguard dimensional and strength requirements.

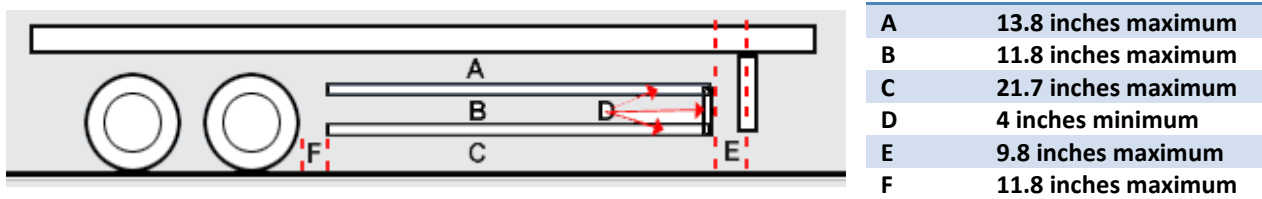


Figure 9. UK/EU dimensional requirements for trailer sideguards.²⁷

²⁷ <http://www.transportsfriend.org/road/guards.html>



Table 2. Summary of existing EU, UK, and Japan sideguard standards.

	EU and UK Standards	Japan Standard
Vehicles covered	Trucks over 3.5 tons	Vehicles over 8 tons
Exemptions	Special purpose vehicles for which fitment is not feasible. Exemption for long-load vehicles (e.g. timber) has been repealed. UK provides additional exemptions for tipping and refuse trucks, military vehicles, and street sweepers.	Buses
Strength requirement	1 kN (220 lbs.) horizontal static force, max. deflection of 30 mm (1.2 in.) for the rearmost 250 mm (9.8 in.) and max deflection of 150 mm (5.9 in.) elsewhere Note: 2 kN (440 lbs.) test in UK	-
Max. ground clearance	550 mm (21.7 in.)	450 mm (17.7 in.) when vehicle unladen
Height for top of sideguard	No more than 350 mm (13.8 in.) below lower edge of vehicle body, or up to 950 mm (37.4 in.) [at least 1-1.5 m (39-59 in.) for UK] above ground level if vehicle has no load platform	At least 650 mm (25.6 in.) when unladen, and no more than 550 mm (21.7 in.) below lower edge of vehicle body
Gap between sideguard and wheels	Max. gap longitudinally is 250-500 mm (9.8 -19.7 in.) in front, depending on vehicle type (typically 300 mm (11.8 in.)); for conventional cabs, EU max forward gap to cab panel is 100 mm (3.9 in.); in rear, max 300 mm (11.8 in.)	-
Designs allowed	Flush panel or rail-style. Rails must be less than 300 mm (11.8 in.) apart and each rail at minimum 50-100 mm (2-4 in.) in height.	-
Other vehicle components	OK to integrate vehicle components such as fuel tanks and toolboxes as long as dimensional requirements met. May not attach other components to a sideguard, however.	-
Requirement to be flush with vehicle & present smooth outer surface	Cannot increase overall width of vehicle. Outer surface of sideguard may be no more than 120 mm (4.7 in.) inboard of outermost plane of vehicle; and no more than 30 mm (1.2 in.) inboard for the rearmost portion (at least 250 mm (9.8 in.)) of the sideguard. Note: UK requires 30 mm (1.2 in.) maximum inboard distance for entire guard. Specific requirements for rounded edges and overlapping sections. Gaps between sections allowed up to 25 mm (1 in.); 10 mm (0.4 in.) allowance for slightly protruding bolt/rivet heads.	-



Table 3. Summary of published sideguard recommendations.

	Monash Univ. study recommendations	TRL study recommendations
Vehicles covered	Vehicles over 3 tons	-
Exemptions	Notes that most buses and car-carriers would not need sideguards due to vehicle designs' low ground clearance	Most UK exemptions are not required for technical reasons; recommends reducing exemptions and considering adjustable guards before exempting
Strength requirement	Recommends 2 kN (440 lbs.) test	-
Max. ground clearance	Recommends 350 mm (13.8 in.); argues that 550 mm (17.7 in.) is too high to ensure that ped/cyclist is kept out of wheel path	Cites UK crash database countermeasure guidance recommending 300 mm (11.8 in.) maximum clearance to “eliminate the incidence of pedal cyclists being run over” when cyclists fall onto the truck side. ²⁸
Height for top of sideguard	-	-
Gap between sideguard and wheels	-	-
Designs allowed	Recommends only using flat panels due to possibility of ped/cyclist being caught on rails	-
Other vehicle components	Cites this approach with approval	-
Requirement to be flush with vehicle & present smooth outer surface	-	-

2.2.3 Existing exemptions

In contrast to light-duty vehicles, medium and heavy-duty vehicles involve very diverse body styles, dimensions, and uses. Certain truck types may be more challenging to equip with sideguards or may

²⁸ R Cookson and I Knight, Sideguards on heavy goods vehicles: assessing the effects on pedal cyclists injured by trucks overtaking or turning left. 2010.



require sideguard modifications. Volpe researched the existing vehicle exemptions in EU Regulation 73 and the UK Construction and Use regulation to develop a baseline for potential exemptions for DCAS fleets. In addition, Volpe reviewed and assessed published assessments from a detailed 2004 TRL report²⁹ on the technical justifiability of the UK sideguard exemptions, that is, whether a unique physical configuration, unique operational requirements, or minimal exposure to pedestrians and cyclists support exempting the vehicle. The EU and UK exemptions and Volpe’s assessments of whether these existing exemptions are technically justified are summarized in Table 4.

Volpe research showed that the UK Construction and Use regulation, which predates the EU regulation, includes a substantially larger number of vehicle exemptions. One of these exemptions has been removed. Others may also be removed in the near future³⁰ since, as discussed in Section 2.1, a disproportionately large fraction of cyclist/pedestrian fatalities in London have involved sideguard-exempted vehicles.³¹ Therefore the EU regulation appears to be a more robust starting point for considering exemptions in NYC.

The EU sideguard regulation does not apply to:

- Tractors for semi-trailers
- Trailers specially designed and constructed for transporting “very long loads of indivisible length, such as timber, steel bars, etc.”
- “Vehicles designed and constructed for special purposes where it is not possible, for practical reasons, to fit such lateral protection.”

Also, there are four specific derogations in the EU language:

- An *extendable trailer* shall comply with all the dimensional and strength requirements when closed to its minimum length; when the trailer is extended, however, the gap between the sideguards and either the forward or rear tire can be greater than normal.
- *Cargo tank* trucks provided with hose or pipe connections for loading or unloading must be fitted with sideguards “which comply so far as is practicable with all the [dimensional and strength] requirements of paragraph 7; strict compliance may be waived only where operational requirements make this necessary.”
- On a vehicle that has *extendable legs*, for example a crane, to provide additional stability during loading, unloading or other operations, the sideguard can have additional gaps to permit extension of the legs.
- On a vehicle equipped with anchorage points for *roll on-roll off* transport, gaps are permitted within the sideguard for fixing ropes.

²⁹ T L Smith and I Knight, Review of Side and Underrun Guard Regulations and Exemptions, 2004.

³⁰ <https://www.gov.uk/government/news/dft-and-mayor-announce-plans-to-tackle-hgv-safety-and-support-londons-cycling-revolution>

³¹ <https://www.london.gov.uk/media/mayor-press-releases/2013/09/mayor-pledges-new-safer-lorry-charge-to-protect-cyclists-in>



Table 4. Summary of vehicle types exempted from sideguard fitment under EU or UK regulations. Volpe reviewed published recommendations and reviewed the DCAS fleet master inventory to assess whether each exemption is technically justified and can be recommended for NYC.

Vehicle Type	UK / EU Status	TRL Study Findings	Exemption Technically Justified?	Implications for NYC
Tractor for semi-trailer	Exempt from EU standard	Fuel tanks and other structures often fill the space between axles, but no real reason to maintain exemption. Flat panel sideguards would be beneficial.	No	
Special purpose vehicles where side protection is impractical	Exempt from EU standard	Catch-all category that is too open to subjective interpretation	Unclear	Case-by-case basis for special exceptions recommended. Would likely apply to front loaders, zipper truck, compactors, pavers, graders, etc.
Trailers designed for very long loads	Previous EU exemption has been repealed; UK exemption remains	Continued exemption warranted when distance between axles is extremely long. These vehicles also move at low speed, often with police escort.	Yes	Does not apply to NYC fleet inventory.
Low speed vehicle (max. 15 mph)	Exempt from EU standard	Exemption is not warranted based on speed alone (as distinct from vehicle type)	No	Would include pavers, compactors, etc. already covered by “special purpose” exemption
Tipping / Dump Truck	Additional UK exemption	Exemption is generally not warranted . Sideguards do not interfere with hydraulics and vehicles seldom require extreme off-road capabilities. Ground clearance is already limited by other vehicle components.	No	May consider designs with an extra, stowable lower panel that exceeds minimum requirements. This would be used while on-road and then folded away during any off-road use (e.g. construction site).
Refuse / collection trucks	Additional UK exemption	Exemption is generally not warranted . Ground clearance is already limited by bodywork and equipment, so sideguards do not pose an issue and are generally compatible with operation.	No	Will need to evaluate during pilot whether rail-style or panel-style sideguards are more compatible with operation
Street sweepers	Additional UK exemption	Fitting sideguards could interfere with operations, though a stowable sideguard could work.	Unclear	Arguably not a high priority for sideguards due to their design and operations. Also typically low speed and conspicuous.



Military vehicles	Additional UK exemption	Continued exemption is warranted given the range of use for these vehicles, even though not always technically justified.	Yes	Likely not relevant to NYC (possible exception of some NYPD tactical vehicles)
Fire engines	Additional UK exemption	Typical design meets dimensional requirements. In cases where it does not, sideguards are indicated except when used off-road.	Unclear	Need to review vehicle uses and ground clearance requirements in cases where ground clearance of vehicle is not already low.
Car carriers	Additional UK exemption	Vehicle design generally already has very low ground clearance.	Unclear	Flatbed tow trucks are car carriers but typically have high ground clearance and arguably should not be exempt.

Due to flexibility in the regulations’ language, if the sides of the as-built vehicle or a combination of appropriately located toolboxes, fuel tanks, etc. already meet the dimensional and strength requirements of sideguards, they are regarded as replacing the sideguards.

Street sweepers are among the UK exempt vehicles, due to their “ancillary equipment” and possibly due to their low top speed. They are probably good candidates for exempting in NYC as well. The TRL report is ambivalent about whether sweepers should be exempted or whether they should have removable guards—though the report acknowledges the added complexity.

The TRL report³² is definitive however in its assessment that refuse collection trucks are not a technically justified exemption. The off-road capability of collection trucks is generally limited and existing devices and structures mounted under the body typically limit the ground clearance between the wheels, so there is no ground clearance justification for an exemption. In New York City, according to DSNY input, off-road is not part of normal collection and waste transfer operations. Diesel particulate filters (DPFs) on DSNY collection vehicles are mounted on the exhaust stacks, not under the vehicle bodies, so DPF placement is also not an impediment to sideguard fitment. The equipment mounted between collection vehicle axles can be positioned such that the controls are accessible from between the rails of a rail-style sideguard design (see Figure 28, Figure 29, and Figure 30) or the controls may be surface mounted in a panel-style sideguard (Figure 10). Given all of these factors, Volpe does not recommend the exemption of collection trucks in the DCAS Safe Fleet Transition Plan.

As discussed in Section 2.1, exempted trucks have been found to be overrepresented in vulnerable road user fatalities. The predicted benefits of ending the exemptions from the UK sideguard regulations have

³² T L Smith and I Knight, Review of Side and Underrun Guard Regulations and Exemptions, 2004.



been estimated by TRL as preventing about 6% of bicyclist fatalities and close to 1% of pedestrian fatalities.³³

2.2.4 Innovative designs that exceed requirements or offer co-benefits

In Volpe’s review, a number of sideguard designs were identified that exceed the standards required by current laws and in certain cases provide co-benefits unrelated to safety.

2.2.4.1 Integrated designs

As discussed in section 2.2.2, the side underride protection may be provided by a rail-style sideguard, a solid panel-style sideguard, or by an integrated vehicle design in which toolboxes, the side wall, and even wheel covers are built into the bodywork, as shown in Figure 10. While this is primarily an OEM and future procurement solution, the installation of solid panel-style sideguards could be retrofit with access hatches and in such a way as to frame existing toolboxes and bins, which may need to be moved outboard to be flush with the tire sidewall along with the sideguard.



Figure 10. A panel-style sideguard with integrated toolboxes and hydraulic controls.

³³ Knight, et al. “Integrated Safety Guards and Spray Suppression—Final Summary Report,” 2005. <http://trid.trb.org/view.aspx?id=1226732>



A computer simulation performed by TRL compared the injury sustained by bicyclists and pedestrians falling against the side of a truck moving in a straight line and equipped with either traditional rail type sideguards or smooth integrated sideguards.³⁴ The results of the computer simulation showed that a rail-style sideguard design was very effective at preventing the upper body of vulnerable road users from being run over by the rear wheels but less effective than the smooth design at preventing the lower limbs from being run over. The simulation of the integrated guard designs predicted that vulnerable road users would typically suffer smaller impact forces and reduced injury compared with the rail design. However, translating the predicted benefits in terms of load and injury criteria to predicted reductions in the number of fatal and serious casualties in road accidents is challenging. According to the report, “although it is clear from the simulation that [integrated guards] have the potential to offer substantial benefits to pedestrians, an analysis of fatal accidents estimated that fitting such integrated sideguards could prevent up to 3% of pedestrian fatalities,” as shown in Table 5.

It can be seen that there are benefits to adopting panel-style sideguards. However, the marginal benefits over introducing sideguards in the first place, regardless of the design, are relatively small.

Table 5. Predicted decreases of all bicyclist and pedestrian fatalities or serious injuries in crashes with UK trucks if smooth sideguards were univesally implemented rather than rail-style. Low and high ends of TRL’s simulation results are shown.³⁵

		Fatalities		Serious Injuries	
		Low	High	Low	High
Fit smooth sideguards	Bicyclists	-0.7%	-5.0%	-3.9%	-3.9%
	Pedestrians	0.0%	-3.0%	0.0%	0.0%

2.2.4.2 Stowable or foldable designs

Certain vehicles operate on city streets but occasionally require off-road access, for example, dump trucks, cement trucks, and sanitation vehicles operating in natural areas or performing snow plowing. An innovative solution for these cases is to install a folding or removable lower sideguard underneath a fixed sideguard. The folding lower guard is stowed for off-road operation when higher clearance is required (for example, the maximum 550 mm/21.7 inches allowed in Europe) but remains deployed for

³⁴ Knight, et al. “Integrated Safety Guards and Spray Suppression—Final Summary Report,” 2005. <http://trid.trb.org/view.aspx?id=1226732>

³⁵ Knight, et al. “Integrated Safety Guards and Spray Suppression—Final Summary Report,” 2005. <http://trid.trb.org/view.aspx?id=1226732>



extra safety during city operation. The London cement truck shown in Figure 11 illustrates this adjustable sideguard solution.



Figure 11. Panel sideguard on cement mixer with flip-up rail sideguard for city operation; also includes sensor and alarm (UK).

2.2.4.3 Aerodynamic fuel savings potential

Smooth panel-style sideguards offer the potential to reduce air drag and increase fuel economy for trucks, depending on the body style and drive cycle speeds. Air drag increases with speed, so potential fuel savings would be greatest for vehicles that travel at highway speeds—in the range of 4-7% for aerodynamic side skirts mounted under trailers.³⁶ One trailer side skirt manufacturer, Laydon, claims that its aerodynamic devices have been verified to comply with the European Union sideguard standard.³⁷

Significant fuel savings on the order of 1-3% could potentially be realized by single-unit trucks (see Figure 12) as well as by trucks whose drive cycles mix city and highway mileage. This is an opportunity that appears to have seen no U.S. research and only limited international research. Since sideguards

³⁶ EPA Smartway Program. <http://epa.gov/smartway/forpartners/technology.htm>

³⁷ National Academy of Science, “Technologies and Approaches to Reducing the Fuel Consumption of Medium- and Heavy-Duty Vehicles” (2010). www.nap.edu/catalog.php?record_id=12845



and side skirts have been adopted in the U.S. for entirely unrelated purposes and on dissimilar truck fleets (over-the-road versus urban), the two technologies have not converged. Therefore, the potential to combine aerodynamic fuel savings at lower than highway speeds with the safety benefits of sideguards deserves further attention and Volpe recommends identifying best use cases and considering including and evaluating aerodynamic sideguards in the Safe Fleet Transition Plan pilot.



Figure 12. Examples of aerodynamic side skirts that could also provide side underrun protection.

2.3 Sideguard vendor review

Volpe performed preliminary market research to identify existing retrofit sideguard suppliers in North America (see Table 6) and, to a limited extent, overseas suppliers. Overseas suppliers based in the UK were deemed challenging for procurement. Domestic market limitations will likely pose a major initial challenge for scaling up the procurement of retrofit sideguards. However, the visibility of Vision Zero and the Safe Fleet Transition Plan pilot is expected to stimulate manufacturer interest within New York City as well as elsewhere in the U.S.

Table 6. Example North American sideguard retrofit suppliers identified by preliminary market research.

Company	Headquarters	Design type
Air Flow Deflector	Montreal, QC	Solid panel, removable
Laydon Composites	Oakville, ON	Solid panel, aerodynamic
Shu-Pak Corporation	Cambridge, ON	Rail-style

Volpe invited all three identified existing North American sideguard companies to attend the May 22, 2014 Annual Truck and Equipment Show. One of these vendors, Air Flow Deflector, attended the event and demonstrated a removable solid panel sideguard, which is being deployed on a number of Montreal-area Public Works trucks. Estimated costs for fitting a single-unit truck with sideguards, based on discussions with the identified vendors, ranges from \$600 to \$2,500. The lower end of this range is



comparable to the \$847 average implementation cost per single-unit truck or trailer in Europe.³⁸

In addition, Volpe engaged corporate leadership at a major OEM, Mack/Volvo, one of three primary OEMs that supplies DCAS, to launch coordinated discussion about the feasibility of directly incorporating sideguards into vehicles supplied to the New York City market. Since the company already outfits its trucks with sideguards for world markets outside of North America (see example in Figure 13), the OEM path to sideguard deployment is the recommended long-term strategy for DCAS fleets. In a future project phase, Volpe is prepared to engage leadership at the two other major OEMs to help coordinate long-term sideguard specifications and assure compatibility with evolving vehicle designs.



Figure 13. Mack/Volvo sideguard equipped collection vehicle currently manufactured for non-U.S. markets.

³⁸ National Research Council Canada, Side Guards for Trucks and Trailers Phase 1: Background Investigation, 2010.



2.4 Findings from U.S. sideguard programs

Interviews with the City of Boston Director of Central Fleet Maintenance concerning the Boston sideguard pilot, which was initiated in May 2013, provide two key insights for the DCAS pilot.

First, winter operations over the unusually snowy 2013-14 winter season experienced no reported issues on the 19 sideguard-equipped vehicles, such as the collection truck shown in Figure 14. None of the vehicles performed snowplowing, but Director of Maintenance Jim McGonagle stated that this should not matter since the trucks still executed turns through snowbanks.



Figure 14. One of 19 retrofitted Boston Public Works collection trucks, with steel mesh sideguards mounted to both the body and the frame rail.

Second, several of the sideguard equipped trucks have underbody diesel particulate filters and no reported operational issues. The DPFs are spaced one foot from the frame rails. McGonagle stated that he would potentially be concerned about reduced air flow with panel-style sideguards, but with the rail types, inadequate air flow and high temperatures have not been an issue.



Figure 15. A Boston DPW collection truck with frame-mounted rail-style sideguards



3. Fleet stakeholder input

3.1 Educational outreach

Volpe partnered with DCAS to develop and deliver an introductory briefing at the Fleet Federation Meeting on May 15, 2014, kicking off a 90-day period during which Volpe briefed fleets on existing international sideguard standards and interviewed them to collect input, including technical questions, suggestions, and operational insights.

Volpe also attended the 26th Annual Truck and Equipment Show on May 22, 2014 to meet with specification writers, to document DCAS vehicles, and to connect fleets with sideguard vendor demonstrations (see Figure 16). The input collected through this fleet stakeholder engagement largely shaped the recommendations in this report.

The questions posed by Fleet Federation members at the May 15 meeting are further recorded and addressed in Appendix C.



Figure 16. Volpe coordinated a sideguard vendor demonstration (left) and examined vehicle body compatibility for sideguards (right) at the NYC Truck and Equipment Show (May 22, 2014).

3.2 Engagement with Specifications Committee and focus fleets

Based on the research summarized in the previous chapter, Volpe briefed the DCAS Specifications Committee on July 9, 2014 via webinar. At the end of the briefing, general questions were fielded. Volpe followed up with each of seven prioritized fleets, as identified in discussions with DCAS, to solicit detailed input from each fleet on the preliminary sideguard recommendations described in the briefing.



Appendix B shows the questionnaire template used in these interviews, including a prioritized summary of sideguard candidate vehicles the Volpe identified belonging to each fleet. The objective of these follow-up interviews was to ensure that the unique needs and missions of the fleets would be fully accounted in the final recommendations presented in this report.

The fleets that Volpe interviewed following the Specifications Committee briefing were:

1. Sanitation
2. NYC DOT
3. Parks and Recreation
4. Education
5. NYPD (non-uniformed)
6. Environmental Protection
7. Corrections

Key findings from the fleet interviews, which were considered in the development of final sideguard recommendations, are described in the following sections.

3.2.1 Department of Sanitation

Feedback on target vehicles

- Retrofits will have to be integrated with Mack/Volvo collection vehicles that have approximately 30 different body and equipment configurations depending on model year and assembler.
- DSNY acquires 300 new collection trucks per year, on a 7-year lifecycle, significantly shorter than the 10-12 years for other types. This suggests that collection vehicles are particularly well suited to an OEM-driven sideguard solution.
- Roll-off vehicles should also be considered for sideguards.

Feedback on operations and maintenance

- Snow is the primary concern for panel-style sideguards, but not for rail-style sideguards.
- During snow events, tire chains are mounted on the collection fleet for plowing. Sideguards should allow clearance and/or be robust enough to allow for tire chain segments that may break loose.
- Access is needed approximately every two months to service fuel filters and air dryers.
- In addition to 5,474 DSNY vehicles, DSNY maintains 1,072 vehicles from other fleets (Mental Health and Hygiene, Education, Environmental Protection, and Parks and Recreation)

Feedback on specifications

- Recommend as simple as possible and minimal maintenance.
- Recommend clearance testing for hilly street terrain, but do not need clearance to roll over trash at transfer stations.



Other considerations

- DSNY has engaged Mack/Volvo in parallel with Volpe for input on specifications to make sure vehicle warranties will continue and that specifications are compatible with current models.
- Salt spreaders require cleaning after snow events. Sideguards should be designed to allow cleaning access to de-salt these vehicles.
- Aluminum is highly susceptible to salt corrosion. Preferable sideguard materials include stainless steel and plastic composite.

3.2.2 Department of Transportation

Feedback on target vehicles

- Any of the listed vehicles are good sideguard candidates, but especially rack and tanker trucks because they have open frame rails.
- In addition to vehicles listed in the DCAS inventory, DOT has trailers has approximately 35-40 trailers that should be considered for sideguards. DOT is already in discussion with Trailer King about incorporating sideguards and with Brigade Electronics for a turn alarm system. The purchase of trailers that are currently leased presents an opportunity to add sideguards.
- Recommend targeting trailers and developing guidance for trailer sideguards
- DOT is prioritizing newer vehicles over older vehicles for retrofit.

Feedback on operations and maintenance

- Do not foresee any O&M challenges or expect any new safety issues related to sideguards.

Other considerations

- DOT is investigating and interested in further guidance for safety lighting, mirrors, lenses, sensors, and cameras, as well as understanding the human factors element of driver overload—what are the thresholds when more input does not produce safer output?

3.2.3 Department of Parks and Recreation

Feedback on operations and maintenance

- Do not anticipate any operational or maintenance problems. However, it will be important to make sure that sideguards are securely attached to the vehicle and do not detach.
- Ideally the fleet will have the opportunity to retrofit different kinds of sideguards on different kinds of vehicles and evaluate them on different driver routes.

Feedback on specifications

- An estimated 10% of Parks trucks occasionally operate off-road. There may be a higher clearance requirement and reduced need for sideguard protection in natural areas.



- Folding or stowable sideguards for these off-road vehicles would be desirable to protect the device when operating in natural areas, while still providing protection on city streets.

3.2.4 Department of Education

Feedback on target vehicles

- Fleet consists of standardized equipment without unusual operating conditions.

Feedback on operations and maintenance

- No operational issues foreseen.

Feedback on specifications

- 350mm (13.8-inch) sideguard clearance is *not* expected to present problems for DOE's vehicles. Only for very long wheelbase vehicles would a low ground clearance be a concern, as experienced by low-bottom trailers on railroad tracks.

3.2.5 New York Police Department

Feedback on target vehicles

- In addition to Volpe-identified vehicles, NYPD has trailers, but these are almost all stationary, for example, bomb squad and horse trailers.

Feedback on operations and maintenance

- No operational or vehicle access issues foreseen. DPFs could require future maintenance, but NYPD expects to be able to work around the sideguards. Maintenance staff may also need to access fuel filters on the side, however most are located under the hood.

Feedback on specifications

- Recommend accounting for fact that when a truck is loaded with cargo, a sideguard mounted to the body rather than to the chassis will become lower and could potentially become too low.
- NYPD trucks do not normally travel off-road but did during Superstorm Sandy, so recommend foldable sideguards for at least certain vehicles to be able to go off-road in an emergency.
- Available sideguard space for mounting more emergency lights is desirable.
- Personnel unloading a rack truck may step onto a rail-style sideguard. The sideguard design therefore should either prevent or account for this use. Bystanders may also be tempted to hitch rides on a rail-style sideguard on a rack truck, so solid panel sideguards would be preferred for rack trucks.



3.2.6 Department of Environmental Protection

Feedback on target vehicles

- Much of DEP fleet does not have a long wheelbase or high clearance. Many vehicles have equipment installed on the sides. Hydrant repair trucks already ride low. Sewer clean vacuum frame rail is already outfitted and equipment is immovable—recommend removing from list.
- Dump trucks are good candidates, as are boom trucks.

Feedback on operations and maintenance

- No O&M red flags foreseen.
- Most heavy-duty maintenance work is performed by DSNY.
- No off-road operations in the city. However, certain dump trucks may go off-road and would require a certain ground clearance when serviced in Upstate New York.

Feedback on specifications

- Generally prefer rail-style design, both for additional air flow and because panel-style not expected to offer fuel economy benefits; also interested in stowable designs.

3.2.7 Department of Corrections

Feedback on target vehicles

- Water tanker, heavy-duty wrecker, collection, and rear loader trucks are not in the DOC fleet.
- Most vehicles (dump trucks, salt spreaders, wrecker, pumpers) operate only on Riker's Island, where there is negligible exposure to pedestrians and bicyclists.
- The 24' box trucks and rack trucks are the most appropriate sideguard candidates since they have exposed frame rails and operate most on city streets.
- The existing wrecker already has low sidewalls.
- Dump trucks are used for on-island construction and may require a certain ground clearance.
- There is a need to ensure that inmates cannot more easily escape by hiding under the vehicle body.

Feedback on operations and maintenance

- No issues expected, since all filters, brakes, etc. will remain serviceable.



4. Translating to the DCAS fleets

Volpe reviewed the DCAS vehicle inventory Excel spreadsheet as well as a partial photographic vehicle inventory to identify suitable vehicles for sideguard installation.

4.1 Unlikely target vehicles for sideguards

Volpe identified at least 3,725 vehicles candidates from the master inventory that do not appear to require sideguards. This assessment is based on the body styles of these vehicles, which indicate that they already have low ground clearance and in many cases short wheelbases. The most numerous of these vehicles are shown in Table 7.

Table 7. Most common fleet vehicles that are not expected to require sideguards.

Vehicle description	Quantity
VAN, PASSENGER	893
PICKUP, STANDARD 4WD	778
SWEEPER, MECHANICAL	407
PICKUP, CREWCAB 4WD	266
PICKUP/MPV, RMP MARKED	234
PICKUP, UTILITY BODY	186
PICKUP, STANDARD 2WD	172
MARKED CARGO VAN	125
P.E.D. 12 PASS VANS	88
BUS, 28 PASSENGER	76
PICKUP, CREWCAB 2WD	61
UNMARKED 12 PASS VANS	61
BUS, 32 PASSENGER	34
SWEEPER, HYDRAULIC	29
COMMAND POST VAN	27
BUS, UNDER 24 PASSENGERS	25
PICKUP/MPV	22





Figure 17. Example DCAS vehicles that are not expected to require sideguards.

4.2 Probable target vehicles for sideguards

Volpe identified at least 4,734 vehicles from the medium- and heavy-duty vehicle inventory that are expected to benefit from sideguards. This assessment is based on the body styles of these vehicles, which indicate that they may have large exposed spaces between the axles due to high ground clearance and in some cases extended wheelbases. The most numerous of these vehicles are shown in Table 8.



Table 8. Most common fleet vehicles that are expected to benefit from sideguards.

Vehicle description	Quantity	Main Agencies	Notes
COLLECTION, REAR LOAD	1766	DSNY	
COLLECTION, 25 CUYD	406	DSNY	
TRUCK, SALT SPREADER	400	DOT, Corrections	
DUMP TRK, 15+ CUYD	328	DOT, DSNY	
TRUCK, RACK BODY	203	DEP, DCAS, DOT	
PUMPER, 1000GPM/500GAL	139	FDNY	Fire vehicle -- assess compatibility
DOT HEAVY DUTY RENTALS	120	DOT	Variety of leased vehicles in this category includes Mack 813 and Ford F-550
LADDER, 100FT/REAR MOUNT	116	FDNY	
TRUCK, CLOSED BODY	109	Parks, DCAS, Corrections	Unclear whether this is a consistent designation
TRUCK, TRACTOR	109	Parks, DSNY, DOT	Are there associated trailers?
PUMPER, 2000GPM/CMU	106	FDNY	Fire vehicle -- assess compatibility
DUMP TRK, 4-4.5 CUYD	99	DOT, FDNY, Parks	
COLLECTION,FRONT LOAD	95	DSNY, Parks	
DUMP TRK, UNDER FOUR CUYD	86	Parks, DSNY	
LADDER, 75FT/TOWER	68	FDNY	
DUMP TRK, 5-6 CUYD	59	Parks, DCAS, DEP	
RACK TRUCK W/ATTENUATOR	56	DOT	
COLLECTION, ALLEY	52	DSNY	Check configuration versus rear-load
TRUCK, BOOM	31	DSNY, Parks	Check stabilizer locations
TRUCK, MOUNTED WELDER	30	DSNY	
DUMP TRK, 11-15 CUYD	28	DEP, Parks	
DUMP TRK, 7-10 CUYD	28	DEP, Parks	
DUMP TRK, BACKUP/REAR	28	DEP, Corrections	
TRUCK, FUEL TANKER	26	DOT, DSNY	Confirm location of wetlines
TRUCK, MOUNTED CRANE	23	Parks, DCAS, DEP	
COLLECTION,REAR 20CU YD	21	DOT, FDNY, Parks	
LADDER, 100FT TRACTOR TR	21	FDNY	
LADDER, 95FT TOWER	18	FDNY	
TRUCK, WATER TANKER	16	DOT, Parks	
TRACTOR TRUCKS	14	NYPD	
TRUCK, AC TANK/SPRAYER	12	DOT	
TRUCK, CARGO BODY W/LIFT	12	DOT	
PUMPER,CMYCX 1000GPM;500G	10	FDNY, Corrections	





Figure 18. Example vehicles that are most expected to benefit from sideguard retrofits.

One question raised by fleet stakeholders is the temperature compatibility of diesel particulate filters (DPFs) and sideguards. Specifically, DPFs operate at extremely high temperatures and are often mounted under a truck body. In Europe, where sideguards continue to be required by EU R73, strict Euro VI emissions standards have been implemented that require DPFs on trucks to comply starting model years 2012-2013, indicating that compatibility with sideguards is feasible.³⁹ Additionally, as noted in Section 3.3, several of Boston’s sideguard equipped trucks have operated with DPFs and experienced no reported issues. Additionally, on certain DCAS vehicles, such as DSNY collection trucks, the DPFs are located on the exhaust stack, near the top of the vehicle.

³⁹ Euro VI - emissions from heavy duty vehicles
http://ec.europa.eu/enterprise/sectors/automotive/environment/eurovi/index_en.htm



5. Recommendations

This chapter summarizes the Vision Zero sideguard recommendations that Volpe has developed in partnership with DCAS and based on the research and fleet outreach described in this report.

5.1 Proposed specifications

The recommended sideguard specifications for DCAS’s pilot deployment are depicted in Figure 19.

If a side guard regulation is adopted in New York, it should stipulate the maximum ground clearance, the minimum strength requirement, and define the areas of installation as shown in Figure 19 on medium and heavy-duty vehicles above a certain gross vehicle weight rating (GVWR). Based on the 2013 and 2014 NTSB Safety Recommendations, **Volpe recommends that the GVWR threshold for sideguards be defined as 10,000 lbs.**, a value comparable to the existing UK/EU threshold of 3.5 metric tons (7,716 lbs.).

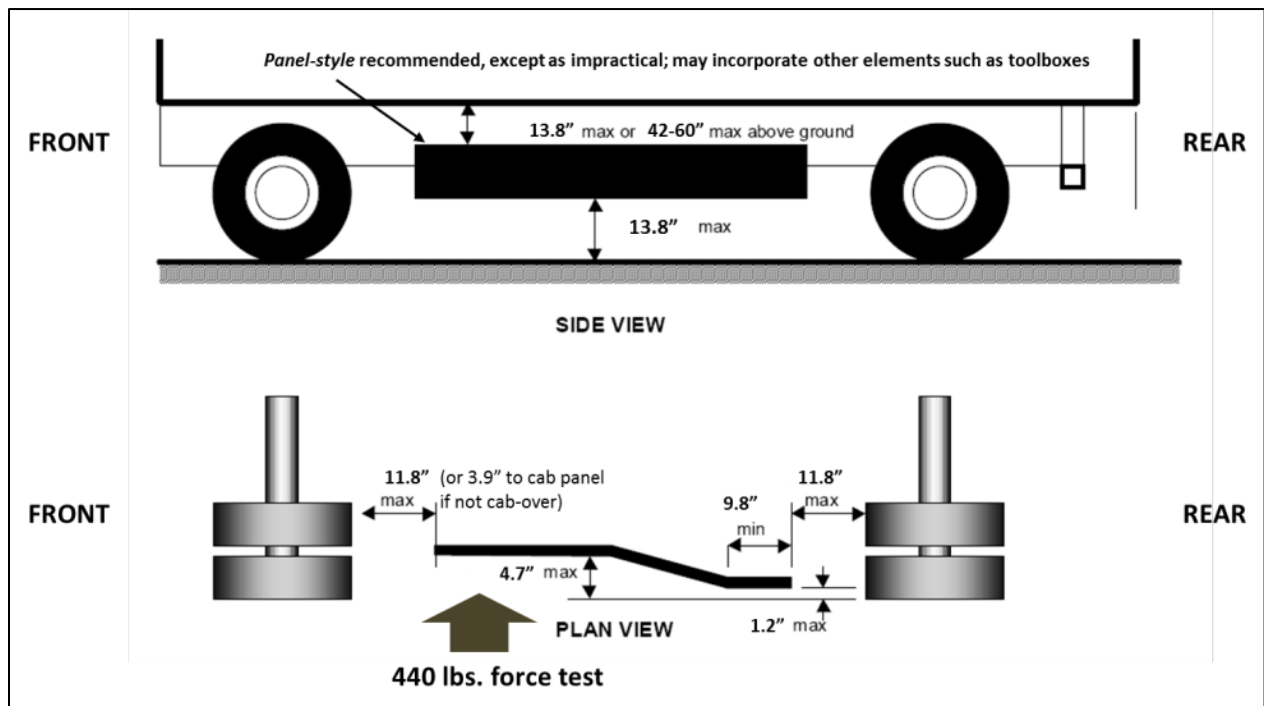


Figure 19. Recommended sideguard requirements for the NYC Safe Fleet Transition Plan pilot deployment.

One of the few significant differences between the UK and EU standards, which were the starting points for the current recommendation, is that the UK minimum strength requirement is 2 kN (440 lbs.), twice as strong as the EU’s 1 kN (220 lbs.) requirement. Consistent with recent increases in the Assumed



Average Weight Per Person adopted by the Coast Guard⁴⁰ and by Federal Transit Administration⁴¹, and to allow a safety factor for the larger body mass of an average American pedestrian compared to average European pedestrians, **Volpe recommends implementing at least the 440 lbs. strength requirement.** Consistent with EU and UK requirements, **Volpe recommends a maximum allowed deflection of 1.2 inches for the rearmost 9.8 inches of the sideguard and a maximum allowed deflection of 5.9 inches along its remaining length** when 440 lbs. of perpendicular force is applied on any part of the outside surface of the sideguard.⁴²

Following both recommendations by Monash University and UK guidance on the effectiveness of improved sideguards,⁴³ as well as based on input from fleets, **Volpe recommends implementing a maximum 13.8 inch (350 mm) ground clearance.** This maximum clearance is preferred for NYC because it provides greater protection for vulnerable road users while not impeding on-road truck operations.

Sideguards should be designed with the aim of safety, strength, weight and ease of operations and maintenance. To minimize salt corrosion and maximize lifespan, materials such as stainless steel and plastic composites are strongly preferred over aluminum construction.

To minimize the risk of spearing a bicyclist or pedestrian during a crash, the forward edge of the side should either be installed flush against a permanent vehicle structure, such as a wheel arch or the cab (Figure 20); or if there is a gap greater than four inches, the forward sideguard edge should be turned inward with a rounded, continuous outer surface, as shown in Figure 21. Additionally, any gap between the cab and the top of the sideguard exceeding 350 mm (13.8 in.) should be filled with an additional rail or panel of equal strength to the sideguard.

Volpe generally recommends the panel-style sideguard over the traditional rail-style. As discussed in Sections 2.2.2.5 and 5.3, there is evidence for the increased safety of smooth, panel-style guards, or at least of guards in which the “rails” are broad and the gaps are narrow (see Figure 30). Interviews with NYPD indicate that personnel would be likely to make unauthorized use of rail-style guards as access ladders, particularly on rack trucks; panel-style guards avoid this issue. Panel-style guards also offer improved visibility, road spray suppression, ease of cleaning, and arguably offer better aesthetics.

⁴⁰ Federal Register / Vol. 75, No. 239 / Tuesday, December 14, 2010 / Rules and Regulations
<http://www.uscg.mil/hq/cg5/cg5212/docs/fr12142010.pdf>

⁴¹ USA Today, March 21, 2011. http://usatoday30.usatoday.com/yourlife/fitness/2011-03-21-busweight21_ST_N.htm

⁴² Volpe recommends use of either of the specified EU R73 deflection testing methods for strength compliance: (1) an engineering calculation, or (2) apply the maximum perpendicular force to multiple areas of the sideguard’s external surface by the center of a ram the face of which is circular and flat, with a diameter no greater than 220 mm (8.7 in).

⁴³ R Cookson and I Knight, Sideguards on heavy goods vehicles: assessing the effects on pedal cyclists injured by trucks overtaking or turning left. 2010.



However, certain vehicle designs may make panel-style guards impractical. In those cases, rail-style guards should be used, with careful attention paid to the dimensions, smoothness, and spacing of the rails. (For example, the cage-style retrofit sideguards in the Boston pilot program would be unlikely to meet all of the specifications proposed here.)



Figure 20. When the forward edge of the sideguard falls under the cab, any gap between the cab and the top of the sideguard exceeding 350 mm (13.8 in.) should be filled with an additional rail or panel of equal strength.



Figure 21. The forward edge of the sideguard should have a continuous surface that turns inwards for at least 100 mm (4 in.) This front continuous vertical outer surface and turn-in is optional when the front edge of the sideguard is within 100 mm (4 in.) of a permanent structure of the vehicle (vehicle cab/wheel arch).



5.2 Proposed vehicle exemptions

Volpe recommends that vehicle exemptions be minimized as much as possible to achieve the largest possible safety benefits from the pilot and from any future deployments. Four technically justified vehicle types are recommended as potential exemptions. The first exemption category, “special purpose vehicles where side protection is impractical,” includes any vehicles such as the DOT zipper truck that operate exclusively on limited-access highways and that do not interact with bicyclists and pedestrians.

If a vehicle does not fall under these exemption types yet sideguard installation is still deemed to be problematic due to operational needs such as off-road access, Volpe recommends that stowable or folding lower sideguards be fully considered before granting an exemption. Recognizing the needs of special-purpose vehicles, sideguard requirement derogations based on the four derogations that are included in EU Regulation 73 and summarized in Section 2.2.3 are still recommended for flexibility on vehicles with stabilizer legs, wetlines, anchorage ropes/chains, or similar equipment.

Exemptions for vehicle types not included in Table 9 should not be generally permitted, and **use of the “special purpose vehicle” exemption for vehicles that operate on city streets should be considered only when no practical alternative is available.** Any such vehicle exemptions should be documented in detail to demonstrate that sideguard fitment is technically impractical.

Table 9. Potential technically justified sideguard exemptions applicable to NYC DCAS.

Exempted Vehicle Type
Special purpose vehicles where side protection is impractical
Street sweepers
Fire engines
Car carriers

5.3 Questions to address in the pilot program

It is important to be able to assess the effectiveness of the pilot program through a systematic approach to data collection. The following is not intended to be an exhaustive list but to serve as a starting point for pilot evaluation.

Vehicle serviceability and operability requirements should be documented through service records and staff interviews. After a year of operation, at least the following should be assessed and channeled into



specification refinement as needed:

- Salt corrosion susceptibility of sideguards of various materials and on various bodies
- Effects on access to frequently or infrequently accessed vehicle components
- Continued strength and solid attachment of sideguards

Data on safety outcomes should be analyzed from improved crash data that integrates fields for reporting presence of sideguards (and crossover mirrors) in coordination with NYPD and NYC DOT. For example, these types of incidents may help to address the following unresolved questions:

- Bystander injured when struck by excessively rigid sideguard on turning vehicle
 - Are maximum *and* minimum deflection criteria required?
- Bystander still suffers underride in crash with sideguard
 - Is the maximum allowed ground clearance still sufficient?
 - What is the influence of sideguard design and material (rail, panel, stainless, plastic composite) on safety outcomes?
- How do point of impact and other crash characteristics impact safety?

In addition, the retrofitting of appropriate existing vehicles and future vehicles as the fleet is replaced raises strategic questions that should be considered:

- What is the most effective method to accelerate design innovations (procurement flexibility versus regulatory standards)?
- When is the most appropriate time to fully transition from retrofits to comprehensive OEM specifications for all new vehicles?

5.4 Beyond the pilot

Pending additional agreement once the present sideguard recommendations are adopted, Volpe may partner with DCAS and NYC DOT to expand the scope of the deployment beyond city-owned and regulated fleets. This next phase would support DCAS and DOT in establishing and sustaining a sideguard program evaluation to quantitatively assess effectiveness in preventing fatalities and injuries; analyze detailed crashes using in-house NHTSA databases to evaluate and recommend a comprehensive suite of truck safety technologies; and achieve continuous improvements in safety, operability, and cost.

Sideguards are one part of a larger suite of commercial vehicle safety measures that deserve additional study and potential pilot implementation and evaluation. As a possible starting point, it may be helpful to consider the results of the UK's HVCIS fatal crash database. In this national database, countermeasures are assigned to each crash along with the estimated probability that it would have prevented the fatality. The probability estimation is based on review of evidence in the police crash



report files as well as on published guidance about the efficacy of the various countermeasures.⁴⁴ The estimated number of lives that would have been saved in bicycle-truck collisions by specific countermeasures provides a possible roadmap beyond basic rail-style sideguards for safety technology evaluation on New York City trucks.

Table 10. Relative influence and effectiveness of CMV countermeasures in preventing UK bicyclist-truck fatalities. Source: HVCIS fatal 1997-2006.

Countermeasure	Total estimated lives that would have been saved by countermeasure (1997-2006)
Improve forward vision	8
Improve side vision	21
Install stronger and lower sideguards*	13.25
Install aerodynamic sideguards*	21
Provide bicycle lane	34.25
Other	9.75

*This is the **additional** projected benefit of **improved** sideguards, not the overall benefit from sideguards, since they are already required in the UK.

One side vision blind spot countermeasure underway in London is the distribution of free TruckView wide-angle lenses to thousands of truck operators by Transport for London.⁴⁵ The clear, thin, plastic lenses, which are press-fitted to the door window, provide the driver with a downward view close to the truck's passenger door, where there is normally a blind spot. Another side vision countermeasure is the installation of stationary "Trixi" mirrors installed on intersection masts, designed to allow truck operators stopped at a traffic light to see cyclists or pedestrians who are waiting adjacent to the cab.⁴⁶ Additionally, new classes of blind spot mirrors are being installed on European truck cabs, and 360-degree camera systems and ultrasonic sensors such as Brigade are being tested. Except for cameras, most of these countermeasures have not been studied in the United States and would be prime candidates for pilot evaluation in New York City's urban environment.

There is sufficient test data from around the world to conclude that flush side fairings/skirts on heavy vehicles/trailers improve aerodynamics via a reduction in the trailer's coefficient of drag.⁴⁷ The amount of the reduction in drag depends highly on the installation, the vehicle, and the speed at which the vehicle is travelling. Most DCAS trucks are unlikely to realize fuel savings due to their operation at low

⁴⁴ R Cookson and I Knight, Sideguards on heavy goods vehicles: assessing the effects on pedal cyclists injured by trucks overtaking or turning left. 2010.

⁴⁵ <http://www.commercialmotor.com/latest-news/truckview-lens-focuses-on-uk>

⁴⁶ This blind spot situation at intersections may be similarly common in New York City as it is in London and other European cities, since all prohibit vehicles from turning on red.

⁴⁷ R Cookson and I Knight, Sideguards on heavy goods vehicles: assessing the effects on pedal cyclists injured by trucks overtaking or turning left. 2010.



speeds in urban traffic. However, as long as the weight is comparable to rail-style sideguards, there should not be a fuel economy penalty over rail-style sideguards on low-speed vehicles.⁴⁸ In addition, as shown in Table 10, there are predicted incremental safety benefits over rail-style guards that deserve study in the DCAS pilot and in future, potentially regulatory-driven, deployment.

In the potential next partnership phase between DCAS and Volpe, enhanced crash data collection will be needed, via close collaboration with the NYPD Collision Investigation Squad and the Department of Motor Vehicles. Program evaluation using Volpe GIS capabilities and crash analysis of both NYPD and newly available DCAS CANceiver telematics data would allow the safety impacts of sideguards and other recommended truck safety features, including crossover mirrors, to be assessed. With support from NYC DOT Freight Mobility, the effectiveness of truck safety technologies overlaid with features of the rapidly evolving bicycle and pedestrian infrastructure of the City could be analyzed for safety interactions and lead to recommendations. At the same time, Volpe anticipates working with the remaining two major OEMs that supply DCAS fleets to facilitate a smooth transition to integrated sideguards and other technologies for the Safe Fleet Transition Plan.

⁴⁸ NRC Canada 2010



Appendix A: Representative sideguard installations



Figure 22. Sideguards installed around a fuel tanks (top and bottom right) and a stabilizer leg (bottom left). Each sideguard is mounted to the frame rails.





Figure 23. Retrofit sideguards mounted to underbody by vertical stanchions (UK), including around a refrigeration unit (top) and with conspicuous warning signage to bicyclists (bottom left). Bottom right: detached underbody-mounted sideguards.



Figure 24. Sideguards on diesel particulate filter-equipped with Euro VI emissions standard compliant trucks, demonstrating compatibility of the two devices.





Figure 25. Sideguard-equipped UK rack tracks, including one with a boom.





Figure 26. Rail-style sideguards on snow plows in the UK and Europe, indicating operational compatibility.





Figure 27. Panel-style sideguard on snow plow.



Figure 28. Rail-style sideguards on German collection truck.





Figure 29. Rail-style sideguards on collection trucks.





Figure 30. Panel-style sideguards on collection trucks





Figure 31. Panel-style sideguard with integrated toolboxes and control panel on UK roll-on-roll-off truck.



Figure 32. Sideguard accommodation of underbody spare wheel (left) and integration of reflectors/lights for conspicuity (left and right); integration of both a permanent upper and a flip-up lower sideguard that can be stowed for off-road access.





Figure 33. Rail-style trailer sideguards on Japanese (top left), Chinese (top right), and UK (bottom left) vehicles. Bottom right: OEM integrated panel-style sideguards on UK trailer.



Figure 34. OEM integrated sideguards on single-unit trucks.



Appendix B: Fleet interview questionnaire and vehicle rosters

Safe Fleet Transition Plan: Truck Sideguard Pilot Program Questions for Fleet Specification Writers

Volpe, The National Transportation Systems Center (USDOT), is assisting the New York City Department of Citywide Administrative Services (DCAS) in developing a common specification for vehicle sideguards as part of the Safe Fleet Transition Plan for Vision Zero. Your responses to the following questions will help us better understand and account for the needs of your fleet.

Please respond to the questions below, referring to the list of candidate vehicle types that we have identified in your fleet. As you answer each question, please specify the vehicle type(s) that pertain to each issue.

1. Based on a review of your agency’s truck inventory, the types/styles listed below appear to be candidates for sideguard implementation.
 - a. Are there other truck types in your fleet for which sideguards should be considered?
 - b. Do you foresee any O&M challenges with sideguards for the truck types listed?
2. Are there any safety concerns for drivers or maintenance staff with respect to sideguards?
3. Are there unique conditions or hazards that sideguards may need to withstand while fitted on your fleet vehicles?
4. Are there certain specifications that you would suggest as “preferred” rather than “required” elements (for example: stowable for off-road use, integrated sensors/alarms, etc.)?
5. Are there any other considerations that we should be aware of as we research and recommend specifications?

Department of Sanitation

COLLECTION, REAR LOAD	1678	TRUCK, TRACTOR	18
COLLECTION, 25 CUYD	405	TRUCK, BOOM	15
TRUCK, SALT SPREADER	379	TRUCK, FUEL TANKER	11
DUMP TRK, 15+ CUYD	203	TRUCK, CLOSED BODY	8
COLLECTION, FRONT LOAD	91	TRUCK, CARGO BODY W/LIFT	3
COLLECTION, ALLEY	51	DUMP TRK, 11-15 CUYD	1
TRUCK, RACK BODY	51	DUMP TRK, 5-6 CUYD	1
TRUCK, MOUNTED WELDER	29	DUMP TRK, UNDER FOUR CUYD	1



Department of Transportation

DUMP TRK, 15+ CUYD	125
DOT HEAVY DUTY RENTALS	120
DUMP TRK, 4-4.5 CUYD	91
TRUCK, TRACTOR	68
TRUCK, RACK BODY	67
RACK TRUCK W/ATTENUATOR	56
TRUCK, SALT SPREADER	17
COLLECTION, REAR 20CU YD	16
DUMP TRK, BACKUP/REAR	15
DUMP TRK, 5-6 CUYD	12
TRUCK, AC TANK/SPRAYER	12
TRUCK, CARGO BODY W/LIFT	9

TRUCK, WATER TANKER	9
TRUCK, FUEL TANKER	8
TRUCK, MOUNTED CRANE	5
TRUCK, PRESSURE WASH	3
TRUCK, VACUUM	3
TRUCK, BOOM	2
COLLECTION, 25 CUYD	1
DUMP TRK, CUTDOWN	1
TRUCK, CONCRETE MIXER	1
TRUCK, MOUNTED GENERATOR	1
TRUCK, OIL TANKER	1
WRECKER, OVER 40 TON	1

Department of Parks and Recreation

COLLECTION, REAR LOAD	86
DUMP TRK, UNDER FOUR CUYD	58
DUMP TRK, 5-6 CUYD	24
DUMP TRK, 11-15 CUYD	22
TRUCK, RACK BODY	19
TRUCK, TRACTOR	19
TRUCK, MOUNTED CRANE	9
TRUCK, BOOM	7

TRUCK, WATER TANKER	6
COLLECTION, FRONT LOAD	4
DUMP TRK, 4-4.5 CUYD	4
DUMP TRK, 7-10 CUYD	4
TRUCK, CLOSED BODY	2
COLLECTION, REAR 20CU YD	1
TRUCK, MOUNTED WELDER	1

Department of Education

TRUCK, CLOSED BODY	13
TRUCK, RACK BODY	4
DUMP TRK, 7-10 CUYD	2

Department of Environmental Protection

DUMP TRK, 7-10 CUYD	22
DUMP TRK, 5-6 CUYD	15
HYDRANT REPAIR TRUCK	12
TRUCK, RACK BODY	11
DUMP TRK, UNDER FOUR CUYD	9
TRUCK, CLOSED BODY	8
DUMP TRK, BACKUP/REAR	7
TRUCK, BOOM	6

DUMP TRK, 11-15 CUYD	5
SEWER CLEAN VACUUM	4
TRUCK, MOUNTED CRANE	4
ENVIRO BOOM TRUCK	3
TRUCK, WELDER MOUNTED	3
WET CONNECTION TRUCK	3
TRUCK, FUEL TANKER	1
TRUCK, TRACTOR	1



Department of Corrections

TRUCK, CLOSED BODY	17
DUMP TRK, UNDER FOUR CUYD	15
DUMP TRK, BACKUP/REAR	4
TRUCK, SALT SPREADER	4
PUMPER,CMYCX 1000GPM;500G	2
COLLECTION, ALLEY	1

COLLECTION, REAR LOAD	1
DUMP TRK, 4-4.5 CUYD	1
TRUCK, FUEL TANKER	1
TRUCK, RACK BODY	1
TRUCK, WATER TANKER	1
WRECKER, OVER 40 TON	1

New York Police Department

TRUCK, RACK BODY	18
TRACTOR TRUCKS	14
P.E.D. 30 TON TOW TRUCKS	7
TRUCK, CLOSED BODY	7
SPREADER	6
ROLLOFF / HOOK TRUCK	4
DUMP TRUCKS	3
FUEL TRUCKS	3
30 TON TOW	2
MARKED FLATBED TOW	2
P.E.D. 25 TON TOW TRUCKS	2
P.E.D. FLATBED TOW TRUCKS	2
SCHOOL SAFETY BOX TRUCK	2
SNOW PLOWS	2
TRUCK, FUEL TANKER	2
P.E.D. DOT RACK TRUCK	1
RACK TRUCK/CRANE	1
UNMARKED FLATBED TOW	1



Appendix C: Q&A from Fleet Federation Meeting

Questions and answers based on Fleet Federation input on May 15, 2014

- What types of vehicles were exempt from the side guard requirements in the UK?
 - See Section 2.2.3.
- How might sideguards impact fuel economy by improving aerodynamics? Are EPA Smartway side skirts (marketed for fuel economy) sufficient to serve as sideguards?
 - For certain vehicles that operate at higher speeds, smooth panel-style sideguards could yield comparable fuel savings to Smartway side skirts. Some but not all side skirts appear to be sufficiently rigid to function as sideguards. Laydon Composites claims to produce a side skirt that meets the European sideguard standard.
- Do you have any information on the safety impacts of cab-over designs as compared to trucks with extended hoods?
 - No studies could be identified, although the cab-over forward blind spot does appear to be smaller than that of most conventional cabs. Additionally, European manufacturer design and a recent act of the European Parliament are moving in the direction of larger, lower cab windows to increase both forward and side visibility beneath the cab.⁴⁹
- Are you aware of any examples where fleets have used some kind of signal or deterrent to prevent bicyclists from passing on the right (e.g. similar to a school bus stop sign, or audible alarm, flashing lights)?
 - Audible warning alarms are in use on certain London trucks. Federal Transit Administration is testing audible and visual turn alarms for transit buses.
- Similarly, are there any examples of regulations that explicitly prohibit cyclists from passing on the right?
 - Forty-four states and the Uniform Traffic Code allow passing on the right by bicyclists.
- Have you looked into the implications for a snow plow truck with a long wheel base? I.e., would a side guard be an issue when turning over a snow bank?
 - Boston and multiple countries in Europe have experience with sideguards on trucks through snowy winters. No issues reported in Boston (see section 2.4).
- Would retractable sideguards be an option?
 - Yes, see 2.2.4.
- How might sideguards impact performance and safety during crosswinds? Would the increase in free board make it harder to drive/handle?

⁴⁹ MEPs approve rules for safer lorry designs in EU, April 2014. <http://www.bbc.com/news/world-europe-27032476>



- Fleet feedback about panel-type sideskirts (similar aerodynamic properties to panel sideguards) is *improved* handling in crosswinds.
- In places where sideguards have been implemented, were they 100% effective, or is side underride still a possibility? Is the 21.7" maximum clearance allowed in the EU too high?
 - Side underride is still a possibility at that height
 - Monash study recommends 350 mm
 - Japanese standard is 450 mm unladen
 - UK crash analysis countermeasures guidance recommends 300 mm
- What other safety measures were implemented in the UK along with sideguards that might also explain the observed reduction in injuries?
 - None identified in the 1980s-1990s, however in the 2000s Trixi mirrors and additional bike infrastructure have been installed.
- Has the EU revised its specifications on sideguards over time?
 - Yes, see exemptions chapter.
- Does the EU require diesel particulate filters on trucks? How can a sideguard be installed on a vehicle that already has a DPF in its underbody gap?
 - Yes, Euro VI emissions standards require DPFs on trucks starting MY 2012-2013.
- What material is used for the sideguards in Brazil that can sustain greater than 1 kN?
 - Brazilian sideguards were not a focus of this study, however regulations require them to withstand 5 kN.
- Are there any potential negative impacts from having a sideguard that is too rigid? What are the material choice and weight tradeoffs?
 - This is a good question to investigate in the pilot. No precedent for requirements for a minimum deflection could be identified.
- Is Boston's "cage" style sideguard effective?
 - The welded pipe version has successfully resisted a car impact without damage. However, it does not have a smooth vertical leading edge as required by international standards and as recommended for DCAS in this report.
- Is there a maximum speed above which a sideguard would not be effective as a safety countermeasure?
 - No evidence for this. Note that the speed limit in NYC is 30 mph.



Appendix D: North American sideguard implementation summary

- Montreal, QC DPW fleet: installation on approximately 125 vehicles.



- Newfoundland and Nova Scotia DPW fleets
- Portland, OR resolution (see Appendix E)**
 - 2008 City Council resolution
 - 12 municipal trucks retrofitted
 - < 1% of O&M budget, no issues
 - “Saving one life far outweighs the minimal O&M costs” – fleet manager*



- Washington, DC ordinance (see Appendix E)**
 - 2008 ordinance: Bicycle Safety Enhancement Act
 - 23 vehicles retrofitted as of June 2014; rest of 162 to be equipped through turnover
- Boston, MA pilot**
 - 2013 Public Works Department initiative
 - 19 municipal trucks retrofitted; rest of 168 to be equipped through turnover
 - Supported by Volpe/USDOT
 - Private waste hauling contracts require sideguards effective July 2014 (see Appendix E)





- Cambridge, MA pilot
 - 2013 DPW pilot
 - 6 municipal trucks retrofitted



- Somerville, MA pilot
 - 2014 DPW pilot
 - 1 municipal truck retrofitted
- Newton, MA pilot
 - 2014 DPW pilot
 - 1 municipal truck retrofitted

- New York City [planned 2014]
- Select private sector sideguard installations: Save That Stuff, Boston; EarthWorm, Boston; FoodShare, Toronto.



Appendix E: U.S. sideguard regulation and procurement examples

Portland City Council resolution⁵⁰

Improving Bicycle Safety in Portland Resolution 36565

RESOLUTION No. 3 6 56 5

Accept report Improving Bicycle Safety in Portland outlining initial City policy improvements and engineering enhancements undertaken to increase bicycle safety in response to recent tragic bicyclist fatalities (Resolution)

Whereas, Portland prides itself on providing its citizens with a transportation system with multiple, safe and realistic transportation choices to its users, and;

Whereas, Portland leads the nation in terms of the percentage of its population that relies on the bicycle as their primary means of transportation and the transportation mode used to commute to and from work, and;

Whereas, transportation safety is a paramount concern of life and safety, and;

Whereas, there has been a recent series of shocking and tragic bicycle-automobile collisions that has resulted in at least two bicycle deaths and at least one extended hospital stay, and;

Whereas, the Portland Office of Transportation knows how to reduce the number and frequency of such tragic automobile-bicycle collisions using the engineering, enforcement, education, and equipment improvements, and;

Whereas, Portland City Council has allocated \$200,000 in one-time surplus general funds to address bicycle safety deficiencies in our transportation system, and;

Whereas, Portland City Commissioner Sam Adams has convened a Bicycle Safety Advisory Committee comprised of stakeholders from the Bicycle Transportation Alliance, Bicycle Advisory Committee, City Attorney's Office, Portland Office of Transportation, Portland

⁵⁰ <http://efiles.portlandoregon.gov/webdrawer.dll/webdrawer/rec/2977541/>



Police Bureau, private bicycle attorneys, pedestrian advocates, and other concerned citizens, and;

Whereas, this committee has held multiple meetings, including a public forum open to all concerned members of the community to receive testimony, and met worked to identify specific problems and specific solutions for those problems, the result of which has been a list of suggestions and actionable items to be further investigated and implemented as feasible, and;

Whereas, discussions continue with the Portland Police Bureau to further refine and improve their internal processes for the most effective handling possible of automobile-bicycle crashes, and Commissioner Adams shall return to Council with a follow-up resolution and report outlining the results of said talks.

Now, therefore, be it resolved that the City of Portland City Council hereby accepts the following report to council as Non-binding City Policy. (Refer to exhibits A, B, and C)

Exhibit C. City of Portland Fleet Vehicle Equipment Safety Upgrades⁵¹

With the goal of promoting the safety of all citizens and City workers that travel on Portland's roadways, the City of Portland has installed many safety devices in its heavy equipment fleet. These include additional mirrors, side signal lights, backup cameras, reflective tape, and frenzel-optical [sic] lenses that allow drivers to see through the passenger-side door. These safety items, combined with extensive operator training, significantly improve safety for pedestrians, bicyclists, other vehicle operators, and City workers.

The City has reviewed its dump trucks, street sweepers, aerial tower trucks, boom trucks, vacuum trucks, and equipment trailers to determine if a side guard retrofit will reduce the likelihood that vehicles or people would go under the side of our large trucks in the event of a crash. Almost all of the City's equipment already includes a side protection between the axles. The protection comes from the tool bins mounted to the body or frame of the truck, or, in some cases, the space between the axles is filled with a fuel tank and tool bins.

An assessment of the fleet showed that twelve trucks could benefit from the installation of the side-underrun guards. The cost is about \$4,500 per side, and includes design, fabrication, installation, and wiring of the new lights. Adding one side guard to each of these twelve pieces of equipment would cost the city approximately \$54,000.

A side-underrun guard is typically a barrier that is affixed along the side of the truck. This barrier is present so that in the event of a crash, the vehicle or person crashing with the truck is not able to go under the truck. Vehicle Services is finalizing design

⁵¹ <http://efiles.portlandoregon.gov/webdrawer.dll/webdrawer/rec/2977541/>



and installation plans that are specific to the twelve trucks that do not currently have adequate side-underrun protection.

Washington, DC ordinance⁵²

Bicycle Safety Enhancement Amendment Act of 2008 17-352

AN ACT

IN THE COUNCIL OF THE DISTRICT OF COLUMBIA

To require the Mayor to establish bicycle safety enhancements for District-owned, heavy-duty vehicles and to require bicycle- and pedestrian-awareness training for operators of District-owned, heavy-duty vehicles; and to amend Title 18 of the District of Columbia Municipal Regulations to require that a motor vehicle operator leave a minimum of 3 feet clearance when passing a bicycle and to establish fines for the use of restricted lanes by unauthorized vehicles.

BE IT ENACTED BY THE COUNCIL OF THE DISTRICT OF COLUMBIA, That this act may be cited as the “Bicycle Safety Enhancement Amendment Act of 2008”.

Sec. 2. Bicycle safety enhancements for District-owned, heavy-duty vehicles.

(a) The Mayor shall:

(1) Equip all District-owned, heavy-duty vehicles with the following:

- (A) Blind-spot mirrors;
- (B) Reflective blind-spot warning stickers; and
- (C) Side-underrun guards to prevent bicyclists, other

vehicles, or pedestrians from sliding under rear wheels.

(2) Require that operators of District-owned, heavy-duty vehicles receive bicycle and pedestrian safety training from a curriculum and instructors that are approved by the District Department of Transportation.

(b) The Mayor, pursuant to Title 1 of the District of Columbia Administrative Procedure Act, approved October 21, 1968 (82 Stat. 1204; D.C. Official Code § 2-501 et seq.), shall issue rules to implement the provisions of this section within 180 days of the effective date of this act.

⁵² http://www.dcbac.org/legislation/bike_safety_act.pdf



Sec. 3. Title 18 of the District of Columbia Municipal Regulations is amended as follows:

(a) A new section 2202.10 is added to read as follows: “2202.10 A person driving a motor vehicle shall exercise due care by leaving a safe distance, but in no case less than 3 feet, when overtaking and passing a bicycle.”

(b) Section 2600.1 is amended by adding to the table a new infraction under the caption “Lane or course” to read as follows:

“Improper use of restricted [§ 2220] 100.00”.

Sec. 4. Applicability.

Section 2(a)(1)(C) shall apply upon inclusion of its fiscal effect in an approved budget and financial plan.

Sec. 5. Fiscal impact statement.

The Council adopts the December 16, 2008 fiscal impact statement of the Chief Financial Officer as the fiscal impact statement required by section 602(c)(3) of the District of Columbia Home Rule Act, approved December 24, 1973 (87 Stat. 813; D.C. Official Code § 1-206.02(c)(3)).

Sec. 6. Effective date.

This act shall take effect following approval by the Mayor (or in the event of veto by the Mayor, action by the Council to override the veto), a 30-day period of Congressional review as provided in section 602(c)(1) of the District of Columbia Home Rule Act, approved December 24, 1973 (87 Stat. 813; D.C. Official Code § 1-206.02(c)(1)), and publication in the District of Columbia Register.

Boston waste hauling RFP (excerpt)

Collection and Hauling of Refuse and Recyclables

From the of Districts 2 & 4, District 3 & 7, and District 6 & 8 of Boston

For the Period of July 1, 2014 to June 30, 2019

MANNER OF DOING THE WORK

(a) GENERAL REQUIREMENTS: The Contractor shall on the scheduled collection day (see Section 1(f)) collect and remove all household refuse set out in suitable receptacles (including containers or compactors up to six (6) cubic yards capacity approved by the Official) or securely tied bundles on all public ways and alleys and on private ways and alleys adequate for vehicular traffic. For the recyclables collection work that has been awarded, the Contractor shall collect all designated recyclables, which have been set out in the manner directed by the Official. Empty receptacles shall not be returned so as to obstruct driveways. Buildings occupied by the City may use containers up to 30 cubic yards in size.



(b) **SPILLAGE:** The Contractor shall take all necessary precautions to prevent paper and other refuse or recyclables from falling to the ground or blowing away while loading the trucks. The Contractor shall pick up and dispose of any loose refuse or recyclables that are on the ground before and after he empties the containers. Each truck shall be equipped with a broom and shovel for doing the aforesaid work. This provision will be strictly enforced and failure to comply will invoke the penalties contained in Section 4 of the Specifications.

(c) **SPECIAL CLEAN-UP PERIODS:** In designated areas of the City, the Commissioner of Public Works may, not more than twice each year, order collection of accumulated household trash during special clean-up periods regardless of the amount or manner of putting out.

(d) **SPECIAL COLLECTION PROCEDURES:**

(1) If the Contractor chooses not to collect Bulky material in trucks used for the collection of household refuse the Contractor may use open body trucks for the collection of such material but shall not use a truck as a depot. The collection of such material shall not be later than four (4) hours after the household collection is made. Bulk trucks shall not be used outside the contract district until all the bulky material put out for collection has been removed.

(2) Any hot loads delivered to the designated disposal site shall be dumped in a designated area and when the fire is extinguished the Contractor shall provide a truck to remove the refuse. If the Contractor does not provide this equipment a deduction of \$200.00 shall be made from the monthly payment due him for each violation.

Hot loads dumped on the street (public way or private) shall be removed within four (4) hours or the City shall remove and charge the Contractor as provided under Section 4 of the Specifications.

(3) Any loads containing low levels of radioactive waste shall be delivered to designated area to remove the contaminated waste. Contractor is responsible to hire and contact a health physicist or radiation consultant in order to coordinate these regulatory notifications and approval to remove to specific location or store at disposal facility.

(e) **ROUTES:** The Collection routes for all districts except Districts 1A, 1B & 10 and District 2 & 4, District 3 & 7, and District 6 & 8 shall be laid out for a five (5) day workweek. In Districts 1A a one (1) day workweek. District 1B, 10 four (4) day work week. In District 5 the collection routes shall be laid out for a four (4) day workweek. The routes for the collection of refuse and recyclables shall be satisfactory to the Official or his duly authorized representatives. Collection of it shall be made on such days and during such hours as shall be satisfactory to the Official or his duly authorized representative.



No collection shall commence prior to 7:00am except with written permission of the Official and all collection routes will be completed not later than 2:30pm. The unloading hours at the disposal and processing facilities shall be from 7:00am to 5:00pm for household refuse and recyclables including all legal holidays except for Christmas.

Extension of the collection and dumping hours may be made by the Official at the request of the Contractor during and immediately following severe storms such as blizzards, hurricanes, and during Special Clean-Up Periods.

Contractor's trucks traveling directly to and from the disposal and processing sites shall not travel on residential streets and the routes shall be assigned by and subject to the approval of the Official.

The City shall prepare a map of the district showing the areas to be collected on each working day. The Contractor shall lay out his collection truck routes within these areas to coincide so far as practical with the existing collection routes. These routes shall be revised and adjusted to the satisfaction of the Official within three days after notification of the contract award. The City, at its expense shall notify all residents affected as to the change in collection day for that route. Any subsequent changes, if allowed at the Contractor's request will require notification by the Official at the Contractor's expense.

(f) TRUCK REQUIREMENTS: The Contractor shall provide totally enclosed steel bodies with cart tippers, bicycle guards, park at idle technology of an approved type satisfactory to the Official on all refuse and recycling trucks except thereafter specified.

The contractor shall be permitted to use open-body trucks to collect, separate, such bulky materials as broken furniture, packing cases and similar material that is too large to enter the enclosed body opening. The Contractor shall not be allowed to collect in said open-body trucks any refuse whatsoever set out in containers and/or of such size as to enter the opening of the enclosed body trucks, excepted in such alleys as are designated by the Official in writing to be too narrow to allow the use of an enclosed body truck. No change in the contract price shall be made if the Contractor uses open-body trucks for collection of bulky material or in designated alleys as specified above.

- 1) All diesel solid waste hauler vehicles must have emission control devices installed, such as oxidation catalysts or particulate filters on the exhaust system side of the diesel combustion engine equipment by the start the contract. Failure to do so constitutes a violation of the contract.
- 2) Acceptable Retrofit Emission Control Devices shall consist of oxidation catalysts or other comparable technologies that are (1) included on the US Environmental Protection Agency (EPA) *Verified Retrofit Technology List* and/or the California Air Resources Board (CARB) *Currently Verified Technologies List*; and (2) are verified by EPA or CARB, to provide a minimum emissions reduction of 50 percent for VOCs, 40 percent for CO and 20 percent for PM. Attainment of the required reduction in PM emissions



can also be accomplished by using less polluting Clean Fuels. Verified technologies can be identified on the following websites:

EPA: <http://www.epa.gov/otaq/retrofit/retroverifiedlist.htm>

CARB: <http://www.arb.ca.gov/diesel/verdev/verifiedtechnologies/cvt.htm>

The requirements for providing all refuse and recycling trucks with enclosed, steel bodies shall have been met with if all trucks except those to be used for collecting bulky materials or in designated alleys, are provided with enclosed steel bodies, and with the further exceptions that, in the two weeks following New Year's Day, the contractor, upon written order of the Official, shall use more open-body trucks, in addition to his normal complement of trucks, as are necessary to collect, separately from other refuse, Christmas trees in his Contract district.

The Contractor shall, immediately following the execution of this contract by the City of Boston file, with the Official, a list of all the trucks which he intends to use in performing the work under the contract; the list shall identify each such truck by make, registration number manufacturer's number. subsequent to the filing of such list if the Contractor desires to use other or additional trucks, he shall file a supplementary list with the Official, setting forth the make, registration number and manufacturer's number of the additional or substitute trucks, and also stating and identifying any such truck as he takes it out of service.

Any Contractor having more than one refuse and recyclables collection contract with the City and desiring to shift any truck and crew from one district to another shall first notify the Waste Reduction Inspector in each district and the District Supervisor in each district involved.

The Contractor shall immediately notify the Waste Reduction Office when a truck has for any reason discontinued collecting refuse or recyclables. The Waste Reduction Office will call the Disposal or processing site to take the truck off of the household refuse or recyclables list. The vehicle will not be added again to the list until a Sanitation Inspector has checked it out before returning to the collecting area.

All trucks and men assigned to household collection shall report at 7:00 a.m.

The Contractor shall be required to furnish a truck or trucks with cart tippers of such design as to collect refuse and recyclables from all alleys from which refuse and recyclables are normally collected and which have been designated by the Official as being too narrow for the use of standard packer type trucks. A smaller truck shall also be used where changes caused by construction or other physical changes require the same. These trucks shall be of design satisfactory to the Official and shall be submitted for his inspection and approval prior to the commencement of work under the contract.

The Contractor shall be required to use studded snow tires or chains on tires following ice or



snow storms where in the opinion of the Official it is necessary in order to traverse alleys or steep streets.

No household refuse truck may be used on recyclables at the same time. EXAMPLE: racks or barrels attached to refuse trucks. Contractors must have recycling trucks approved by the Commissioner of Public Works.

Open pick up trucks will not be allowed to collect recyclables on a daily basis in any district except to pick up complaints.

In order to control the use of the Disposal and Processing Facilities furnished by the City the Contractor shall ordinarily use on the work only those trucks which have been listed with the Official and shall not use any truck which has not been listed with the Official all as aforesaid.

All the trucks used on this work shall be numbered on the front and rear with 6" numerals at the top of the body and shall have a permit to transport refuse through the streets of Boston in accordance with City Ordinance Chapter 11 (Clause 282). Each truck shall be marked with a decal reading "Truck being Operated Under Contract With the City of Boston" and the contract district number, all lettering to the subject to the approval of the Official.

The Contractor is required to maintain his trucks in good painted condition and shall repaint any trucks within a three weeks period upon receipt of written directions from the Official.

The Public Works Department requires the Contractor to have recycling signs on his recycling trucks. Recycling trucks shall have signs on both sides of the truck bodies. Recycling signs must be highly visible to the public as the trucks drive down the street. Sign sizes will depend on the truck size and the available truck-body space For example, the 2 truck signs for a packer truck should measure 3'x 6'. Recycling sign artwork must be approved by Public Works. All signs will require Public Works approval.

On the sides of each truck in a suitable location, signboards of a size prescribed by the Commissioner of Public Works will be installed for the purpose of displaying from time to time sanitation posters issued by the City of Boston. The signboards shall be furnished by the City and installed at no expense to the Contractor. With the exception a of City of Boston single stream recycling log, that is to be displayed on recycling collection vehicles

The Contractor shall keep his name and numbers painted on his truck cab, so that they can at all times be plainly seen; shall mark the cubic yard capacity on each vehicle; and shall adjust this marking whenever the capacity is changed; shall keep his trucks neat and clean in appearance; and shall use care in loading and covering trucks. The Contractor shall provide brooms and shovels on each truck and shall



remove all refuse dropped from the trucks or containers; and shall provide open-top trucks with canvass covers two (2) feet wider than the width of the truck and three (3) feet longer than the length of the truck body. No fishtail type of body may be used for rubbish.

Failure to comply with the contract requirements for painting, lettering and numbering within three weeks of being notified of such failure shall result in deduction from the Contractors payments of \$30.00 per truck per day.

BIDDERS EQUIPMENT

Equipment Owned	Number	Total Capacity	Model
Packer Body trucks			
Open Body Trucks			

Equipment Leased	Number	Total Capacity	Owner's Name	Model Years
Packer Body Trucks				
Open Body Trucks				
=====				

The above equipment shall be available for inspection prior to the award of a contract at the following location(s):

Note: This page should be used to list equipment for recycling collection as well as refuse collection.

***All refuse hauling equipment will have cart tippers, bicycle guards installed, Pack at Idle technology inclusive of vehicles designated to collect refuse and recycling from various alleys throughout the City**



Boston ordinance



CITY OF BOSTON • MASSACHUSETTS

OFFICE OF THE MAYOR
MARTIN J. WALSH

September 8, 2014

TO THE CITY COUNCIL

Dear Councilors:

I transmit herewith an Ordinance to Protect Vulnerable Road Users in the City of Boston. This ordinance establishes requirements for protection equipment to be installed on vehicles contracted by the City of Boston, to be constructed and/or equipped as to offer effective protection to unprotected road users against the risk of falling under the sides of the vehicle and being caught under the wheels. In 2013, the City of Boston - a collaboration between the Mayor's Office of New Urban Mechanics and the Public Works Department - undertook the largest municipal pilot of truck side guards in the nation. After over a year of testing several different types of side guards in the field on 16 vehicles, data from studies and our own field observations have led to this ordinance.

This ordinance will implement safety protections allowing drivers of large trucks to see in the areas in front of them where children and cyclists are invisible to the driver, and also to be able to see the sides better, reducing the risk of incidents involving cyclists, making Boston a safer place for all road users.

I urge your Honorable Body to act favorably on the proposed amendment.

Sincerely,

Martin J. Walsh
Mayor of Boston

SEP 10 2014
CITY OF BOSTON

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COMMITTEE



**CITY OF BOSTON
IN CITY COUNCIL**

Be it ordained by the City Council of Boston, as follows that the City of Boston Code be amended by adding the following ordinance:

SECTION 1. City of Boston Code, Ordinances, Chapter IV is hereby amended by inserting after Section 4-7 the following new section:--

4-8 AN ORDINANCE REQUIRING CITY VENDORS TO SAFEGUARD UNPROTECTED ROAD USERS.

4-8.1 Purpose.

Vehicles covered by this ordinance shall be so constructed and/or equipped as to offer effective protection to unprotected road users against the risk of falling under the sides of the vehicle and being caught under the wheels.

4-8.2 Definitions.

The words defined in this ordinance shall have the meanings set forth below whenever they appear in this section unless the context in which they are used clearly requires a different meaning, or a different definition is prescribed for a particular paragraph or provision.

- (i) *Approval of a vehicle* means the approval of a complete vehicle type with regard to its lateral protection.
- (ii) *City* means the City of Boston.
- (iii) *Department(s)* shall mean those City of Boston Departments, Authorities, Agencies, Commissions and any other instrumentality acting on behalf of another ("Awarding Authorities") under the supervision of the Mayor or persons appointed by him/her.
- (iv) *Contract* means the contract between a Vendor and a Department resulting from a request for proposals or an invitation for bids issued by the City to do any work or to make any purchase.
- (v) *Gross weight* means the sum of the weights transmitted to the road surface by all the wheels of the vehicle.
- (vi) *Large vehicle* means a motor vehicle with a gross weight exceeding 10,000 lbs; or a trailer with an unladen mass exceeding 10,000 lbs; or a semi-trailer with a gross weight exceeding 26,000 lbs.
- (vii) *Lateral protective device* means an apparatus installed on large vehicles between the front and rear wheels to help prevent injuries to unprotected road users, particularly from falling underneath the vehicle.
- (viii) *Mayor* shall mean the Mayor or persons designated by him/her.
- (ix) *Otherwise qualified* means any Vendor that meets all other criteria for the award of a Contract.



- (x) *Unladen mass* means the weight of the vehicle in running order, unoccupied and unloaded, but complete with fuel, coolant, lubricant, tools, and spare wheel, if supplied by the vehicle manufacturer as standard equipment.
- (xi) *Unprotected road users* mean pedestrians, cyclists, or motorcyclists using the road in such a way that they are liable to fall under the sides of the vehicle and to be caught under the wheels.
- (xii) *Vendor* means any firm, vendor, contractor, or supplier of goods and/or services to the City of Boston, and any of its subcontractors.

4-8.3 Requirements for Large Vehicles.

When any officer or board in charge of a Department or other awarding agency of the City issues requests for proposals or invitations for bids to do any work or make any purchase, said officer or board shall contract with a responsible and eligible Vendor that has also installed, or that demonstrates that it will install, side under-ride guards, convex mirrors, and appropriate warning signage on all large vehicles it uses or will use within the City of Boston in connection with the Contract in preference of otherwise qualified Vendors.

4-8.4 Policy Implementation.

Every Large vehicle or a conventional cab configuration in which more than half of the engine length is forward of the foremost point of the windshield base and the steering wheel hub is in the forward quarter of the vehicle length used by a Vendor in connection with a Contract shall be equipped with convex mirrors, cross-over mirrors, decals, and side under-ride guards affixed to the sides of such vehicles in a manner consistent this section and with rules and regulations further promulgated by the Boston Transportation Department, the Boston Police Department, and the Inspectional Service Department.

4-8.5 Technical Specifications for the Equipment of Lateral Protective Devices, Convex Mirrors and Convex Cross-over Mirrors, and Safety Decals

(a) Lateral Protective Devices

Large vehicles must be constructed or equipped in such a way as to offer, throughout their length, effective protection to unprotected road users against the risk of falling under the side of the vehicle and being caught under the wheels. This requirement will be considered satisfied either

1. If the vehicle is equipped with a special lateral protective device (side under-ride guard) in accordance with the requirements of Section 4-8.5b
2. If the vehicle is so designed and/or equipped at the side that, by virtue of their shape and characteristics, its component parts can be incorporated and/or regarded as replacing the lateral protective device. Components whose combined function satisfies the requirements set out in Section 4-8.5b below are considered to form a lateral protective device.

(ii) Technical Specifications

The lateral protective device can use horizontal rails or a continuous flat surface that meets the following dimensional requirements:

1. The lower edge of the lateral protective device shall at no point be more than 21.5 inches above the ground
2. The upper edge of the lateral protective device shall not be more than 14 inches below that part of the structure of the vehicle, cut or contracted by a



vertical plane tangential to the outer surface of the tires, excluding any bulging close to the ground

3. Not more than 12 inches to the rear of the vertical plane perpendicular to the longitudinal plane of the vehicle and tangential to the outer surface of the tire on the wheel immediately forward of the guard
4. The rearward edge of the lateral protective device shall not be more than 12 inches forward of the vertical plane perpendicular to the longitudinal plane of the vehicle and tangential to the outer surface of the tire on the wheel immediately to the rear
5. The lateral protective device shall not increase the overall width of the large vehicle and the main part of its outer surface shall not be more than 5 inches inboard from the outermost plane (maximum width) of the vehicle.
6. Every lateral protective device shall be essentially rigid and securely mounted. They shall not be liable to loosening due to vibration in normal use of the vehicle. The lateral protective device shall be considered suitable if it is capable of withstanding a force of 440 pounds applied perpendicularly to any part of its surface by the center of a ram the face of which is circular and not more than 8.5 inches in diameter, and during such application
7. No part of the side under-ride guard shall be deflected by more than 6 inches; and,
8. No part of the side under-ride guard which is less than 10 inches from its rearmost part shall be deflected by more than 1.25 inches.

(iii) Convex Mirrors

Large vehicles must be equipped with convex mirrors to enable the operator of the large vehicle to see all points on an imaginary horizontal line which:

1. Is three feet above the road;
2. Is one foot directly forward from the midpoint of the front of such large vehicle; and extends the full width of such large vehicle

(iv) Cross-Over Mirrors

Large vehicles must be equipped with convex cross-over mirror on the front of the vehicle to enable the operator of the large vehicle with a conventional cab configuration in which at least more than half of the engine length is forward of the foremost point of the windshield base and the steering wheel hub is in the forward quarter of the vehicle length to allow the driver to see:

1. Any person or object at least three feet tall passing in front of the vehicle.
2. The area from the front bumper to where direct vision is possible.

(v) Safety Decals

Large vehicles must be equipped with a minimum of two (2) safety decals on the rear and sides that warn pedestrians and cyclists of blind spots:

1. Decals should be 'safety yellow' in color
2. Decals should include language or images warning of the blind spot locations on the vehicle.



3. Decals should be placed, when possible, on or near the lateral protection devices.

4-8.6 Compliance and Enforcement.

- (a) Non-compliance with the provisions of this section 4-8 by a Vendor shall be grounds for
 1. A fine of \$100 for the first offense on a Contract, escalating to \$150 for the second offense, and \$200 for the third offense.
 2. Termination of the Contract.
- (b) This section 4-8 shall be enforced by the Inspectional Services Department's Weights and Measures Division and the Boston Police Department. The Boston Police Department and The Inspectional Services Department shall determine non-compliance with the provisions of this section 4-8 and any applicable regulations and may make recommendations, if any, to the contracting Department.
- (c) The Inspectional Services Department shall issue, for a Vendor's large vehicles, a compliance certification through a vehicle inspection of convex mirrors, lateral protective devices, and decals prior to the date Vendor begins work on a Contract. A fee to cover the costs associated with inspection will be determined by the Commissioner of the Inspectional Services Department and passed on to the Vendor.
- (d) Vehicle compliance will be certified with a sticker denoting the year of inspection. Inspections must be updated Biennially.
- (e) Vendors may file for a waiver as stipulated in section 4-8.7. Waiver applications must be made in writing at the time of contract bid to the Commissioner of Inspectional Services, the Department requesting services, and the Commissioner of Transportation. Waiver applications filed after contract bids will not be considered.
- (f) Inspectional Services Department shall issue an annual report to be filed with the Mayor and the City Clerk and transmitted by the Clerk to the City Council on the actions undertaken by the Inspectional Services Department on enforcement of this ordinance no later than May 31st of each year. The annual written report shall include, but not be limited to, the following items for the twelve (12) month period prior to the report's due date:
 1. Any financial costs to the City associated with this ordinance
 2. The number of vehicles this ordinance applied to
 3. The number of vehicle exemptions, if any
 4. The total number of inspections performed by inspectors and any subsequent violations of this ordinance

4-8.7 Waiver.

- (a) If a Vendor or Department determines that extenuating circumstances exist which prevent the Vendor from complying with this section 4-8, then such Vendor or



Department may request an exemption from compliance to the City of Boston with its provisions. Waivers are issued at the sole discretion of the City of Boston.

- (b) This ordinance does not apply to
 - (i) A motor vehicle which has a maximum speed not exceeding 15 mph
 - (ii) An agricultural trailer
 - (iii) A fire engine
 - (iv) An emergency medical vehicle
 - (v) A vehicle which is being driven or towed to a place where by previous arrangement a side under-ride guard is to be fitted so that it complies with this section 4-8
 - (vi) Vehicles used solely for the purpose of snow removal.
 - (vii) Street sweeper vehicles
 - (viii) City of Boston Fleet Vehicles purchased before July 1, 2014

4-8.8 Conformity with Existing State and Federal Law.

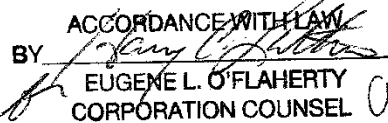
This section shall be implemented in conformity with state and federal law.

4-8.9 Severability.

The provisions of this section are severable and if any provision, or portion thereof, should be held to be unconstitutional or otherwise invalid by any court of competent jurisdiction, such unconstitutionality or invalidity shall not affect the remaining provisions, which shall remain in full force and effect.

4-8.10 Effective Date.

- (a) This section shall take effect one hundred and eighty days after passage and shall apply to all new Contracts awarded and to all renewal terms of existing Contracts executed after that date.
- (b) City of Boston fleet vehicles purchased after July 1, 2014 that are Large Vehicles as defined herein will be required to comply with the provisions of this section.
- (c) The Inspectional Services Department, Boston Police Department, and the Transportation Department shall issue rules and regulations to implement the provisions of this section within ninety days of the date it takes effect.

I HEREBY CERTIFY THAT
THE FOREGOING, IF PASSED IN
THE ABOVE FORM, WILL BE IN
ACCORDANCE WITH LAW
BY 
EUGENE L. O'FLAHERTY
CORPORATION COUNSEL *ENC*



U.S. Department of Transportation
John A. Volpe National Transportation Systems Center
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617-494-2000

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DOT-VNTSC-DCAS-14-01

