**Technical Report Documentation Page**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **1. Report No.**  DOT HS XXX XXX | **2. Government Accession No.** | | **3. Recipient’s Catalog No.** | |
| **4. Title and Subtitle**  Cost, Weight and Lead Time Analysis of Advanced Laminated Glazing for Motorcoach Bus | | | **5. Report Date**  August 21, 2019 | |
| **6. Performing Organization Code** | |
| **7. Author**  Ricardo Inc. | | | **8. Performing Organization Report No.** | |
| **9. Performing Organization Name and Address**  **Detroit Technical Center**  **Van Buren Twp., MI**  **48111 USA** | | | **10. Work Unit No. (TRAIS)** | |
| **11. Contract or Grant No.**  DTNH2216D00037  Task Order: 693JJ918F000168 | |
| **12. Sponsoring Agency Name and Address**  National Highway Traffic Safety Administration  Evaluation Division; National Center for Statistics and Analysis  1200 New Jersey Avenue SE.  Washington, DC 20590 | | | **13. Type of Report and Period Covered**  NHTSA Technical Report | |
| **14. Sponsoring Agency Code**  NSA-310 | |
| **15. Supplementary Notes** | | | | |
| **16. Abstract**  Ricardo has found that changes to motorcoach side window glazing to prevent occupant ejection in a rollover crash have a broad range of costs depending on what type of glazing the manufacturer is presently using. Changes required to meet FMVSS No. 217a were determined for the three motorcoach manufacturers by NHTSA as reported in “Motorcoach Side Glazing Retention Research,” published in November 2013. As a result of this research, NHTSA has found that motorcoach side windows must use laminated glazing for the inner pane in order to withstand impact after having the glass pre-broken before testing. It is also important to note that the changes made to the window latches by NHTSA were not intended to be ready for production by the bus manufacturers but rather were attempts to keep the windows from unlatching when impacted as specified by FMVSS No. 217a. The three manufacturers with the highest sales volumes in the US are MCI, Prevost and Van Hool.  MCI had the lowest cost for modification since it already uses laminated glazing in its side windows. MCI buses had changes to the side window latches that amounted to an incremental manufacturing cost of $5.04 and an end user price increase of $6.47. The latching changes were the addition of steel washers to the top of the striker posts and a thicker, heavier latch plate. These changes prevented the detent lever from sliding over the striker post upon impact to keep the window closed. The modified latching hardware weighed 0.76 kg more than the production hardware for a bus with 8 emergency exit windows.  Prevost buses use tempered glass panes for their double-paned windows and therefore would need to change to laminated glazing of the inner pane to meet the requirements of FMVSS No. 217a. The incremental cost for laminated glazing in 8 emergency exit windows was determined to be $124.08. The modified latch posts and locator tabs were made of steel which made the latching heavier but less costly than the production parts which were aluminum and plastic, respectively. However, a satisfactory solution for the latch bar failures was not found. Overall, the changes made to the Prevost bus windows as recorded by NHTSA incurred an incremental manufacturing cost of $118.77 but weighed 0.13 kg less than the 8 production windows due to a lighter laminated inner pane. The end user price increase for Prevost buses was $154.42.  Van Hool buses also use tempered glass panes in their double-paned windows and would also require a change to advanced laminated glazing. Like the Prevost buses, the laminated glazing cost was $124.18 for 8 side windows. The changes to the latching hardware in the NHTSA research report were more extensive than for Prevost window latching and involved making a thicker, stronger spring clip; a longer, thicker and stronger slider; and adding aluminum angle bars over the sliders to the window frame. The incremental latching costs totaled $44.11 for the Van Hool windows. Overall, the changes to the Van Hool bus side windows would incur an incremental cost penalty of $168.19 and weigh 5.28 kg more. The end user price increase for Van Hool coaches was $217.15. | | | | |
| **17. Key Words**  Laminated, Glazing, Advanced, motorcoach, bus, aluminum and plastic | | **18. Distribution Statement**  This report is free of charge from the NHTSA Web site at [www.nhtsa.dot.gov](http://www.nhtsa.dot.gov) | | |
| **19. Security Classif. (Of this report)**  Unclassified | **20. Security Classif. (Of this page)**  Unclassified | | **21. No. of Pages**  38 | **22. Price** |

**Form DOT F 1700.7** (8-72)