

Michael Roeth  
Executive Director  
6041 Stellhorn Road #15935  
Fort Wayne, IN 46885

December 2, 2013

Josh Switkes  
CEO and Founder  
Peloton Technology Inc.  
3553-3 Haven Avenue  
Menlo Park, CA 94025

Dear Josh:

Thank you for allowing us to support the recently completed SAE J1321 fuel economy test that we conducted jointly with CR England. The North American Council for Freight Efficiency is working to fulfill our mission to help double the efficiency of North American goods movement and this project allowed us to help Peloton with their development and promotion of your freight efficiency technology.

The following is our report on the test as an independent third party organization witnessing and validating the processes used to ensure an unbiased test of the platooning technology. The very capable, combined team of engineers and technicians from CR England, Peloton and NACFE conducted the tests during the week of November 18<sup>th</sup>, 2013.

Please contact me at [mike.roeth@nacfe.org](mailto:mike.roeth@nacfe.org) or 260.750.0106 to discuss any details of the report or to answer any questions. Thanks for engaging us and we look forward to supporting additional projects such as this one in the future.

Sincerely,



Michael Roeth, Executive Director  
[mike.roeth@nacfe.org](mailto:mike.roeth@nacfe.org)  
[www.nacfe.org](http://www.nacfe.org)

cc: Michael Stapley, CR England Test Lead Engineer  
Allen Nielsen, CR England Director of Fuel

## **Summary**

The North American Council for Freight Efficiency (NACFE) was engaged to plan, oversee and validate a test of the Peloton Technology platooning system. NACFE, specifically Mike Roeth, their Executive Director, engaged CR England, a primarily for-hire fleet to help test the technology. Over the past four years, CR England has tested many new technologies using the Society of Automotive Engineers (SAE) J1321 test protocol that is commonly used in the industry for such purposes. The responsibility of the NACFE was to confirm that the test was run to the prescribed protocol and that the results are accurate for the fuel performance of the technology. The following report discusses the scope of the test, the test protocol, how the team executed the protocol and the results achieved from the testing. The test was conducted per the identified protocol and the results are shown in this report.

## **Peloton Technology Inc. Platooning System**

Peloton Technology is developing a system that uses radar based collision mitigation equipment and truck to truck communication to augment the skill of professional drivers, in order to provide platooning of two tractor trailers for improved safety. The truck to truck communication enables the rear truck to react in a few hundredths of a second, dramatically faster than a human driver. The driver of each truck remains in control and steers the vehicle. Video systems increase driver awareness and assist with lane-keeping and driver-alertness. On-board systems, GPS/telematics and fleet network operations tools optimize the routing and pairing of trucks, limit platooning to appropriate weather and road conditions, and enhance safety. An added benefit of the platooning is the decreased fuel consumption of both vehicles due to aerodynamic drag reduction.

In this test, a first version of the Peloton system was evaluated. This version follows at a 36 feet gap between the vehicles. Peloton reports internally tested versions that allow closer following distance and thus even greater fuel savings, and Peloton looks forward to evaluating these with the industry as soon as they are fully developed.

## **Test Protocol**

CR England is a large for-hire company, which operates the largest refrigerated fleet in North America. They are headquartered in Salt Lake City, Utah and operate about 5,000 tractors and 7,000 trailers. CR England studies, evaluates and implements fuel savings technologies and practices to lower their fuel expense and has developed a robust test procedure based on the SAE J1321 test protocol.

Since 2009, CR England has been testing trucks per SAE test procedures. The current test method is described here.

- Six segments of approximately 40 miles each are tested along Interstate 80 west of Salt Lake City. An approximate one hour warm up is completed, which includes travel from the terminal to the start of the first segment. Segments are shown in Figure 1 below and identified as A to B, B to C, C to B, B to C, C to B and B to A.
- The tests are conducted on the highway with the typical congestion of other vehicles and the six segments are normally completed in one full day of testing.
- A control truck and separate truck with the technology are tested per the SAE protocol using small test fuel tanks built specifically for the test.
- Stationary emissions regenerations are conducted prior to testing as well as all equipment is inspecting including tires checked for appropriate tire pressure.
- Tanks are weighed prior to the start and at the end of each test using portable scales and the weight before and after each test segment noted.
- Fuel is added to each test fuel tank using a hand pump from the normal fuel tank on the truck.
- Weather, traffic, equipment issues and any other similar information is noted and presented to the test engineer along with the accompanying data.
- Once all test segments are completed the test engineer uses the SAE J1321 test protocol to determine if there were three valid tests and completes the analysis.
- A test report is finalized and documented internally at CR England and shared with the appropriate test participants.



Figure 1: Test segments west of Salt Lake City, UT

### **CR England Peloton Test the week of November 18**

In mid-October 2013, Peloton Technology engaged the NACFE and CR England to assist them with a fuel efficiency test of their platooning technology. Many meetings were held to plan the testing that culminated in a fuel efficiency test the week of November 18<sup>th</sup> in Salt Lake City per the protocol described above.

### Test Equipment

- Two identically specified 2011 model year Peterbilt 386s with ISX15L diesel engines and Eaton 10 speed manual transmissions, with Peloton platooning technology added. Test fuel tanks for these trucks were built by Peloton.
- Freightliner Cascadia for control truck purposes, using CR England test fuel tanks.
- CR England weighted, fuel efficiency test trailers with side skirts.
- CR England trailer for control truck loaded with pallets.

This test was somewhat unique to CR England in that to determine the fuel efficiency gains of the Peloton Technology, two sets of fuel efficiency tests would be conducted simultaneously. This would require two test trucks, Peterbilts provided by Peloton and a control truck made available by CR England. The two test trailers, pulled by the Peterbilts, were the normal CR England test trailers, fully loaded as they are generally for this testing. The trailer for the control truck was also supplied by CR England and was loaded with pallets to provide its load. As the control truck's purpose is for comparison to both test trucks, its absolute fuel efficiency and load is rather unimportant. Pictures of the trucks and testing details in process are included in Appendix A.

Peloton built a test fuel tank for each tractor prior to driving the tractors to Salt Lake City per design recommendations provided by CR England. The control truck used a test fuel tank provided by CR England. One, the same, portable scale was used to weigh all test fuel tanks before and after each test segment.

Monday, November 18

Equipment was organized at the CR England terminal after new tires were supplied by Michelin and mounted to the Peloton Peterbilt test trucks. A test planning meeting was conducted and preparations made for the testing to be conducted the next two days. It was determined that the test would be run at 64 miles per hour and when the platooning technology was engaged, the following difference would be 36 feet. Peloton and CR England test engineers and technicians as well as Mike Roeth from NACFE were present for the testing.

Tuesday, November 19

Two days of testing were conducted on Tuesday and Wednesday. All six test segments were completed on Day 1 with 30 seconds of separation between all three vehicles; the control truck, Peloton Peterbilt C1 and Peloton Peterbilt B1. This is approximately ½ mile between each tractor trailer. As stated before, this was a baseline test of the two Peloton Peterbilt Trucks. Tests were conducted per the previously mentioned procedures and fuel tank weights and exact distances documented on the test data sheets.

Wednesday, November 20

On November 20, the Peloton Platooning system was turned on and the two Peloton Peterbilts followed 36 feet apart 30 seconds behind the control truck. The on or off condition of the platooning technology was noted via Peloton data collection equipment in each tractor.

### **NACFE Approach to Validation**

During the weeks leading up to the tests, NACFE reviewed the CR England test protocol procedures and oversaw the preparation for the testing conducted by both CR England and Peloton Technology. Mike Roeth attended the testing in Salt Lake City and verified that the procedures used matched the planned methods. Finally, this report is submitted by NACFE to document the results.

### **Test Results**

As stated above, tank weights were recorded after each segment. This was completed by both CR England test technicians and Peloton engineers simultaneously. Mike Roeth witnessed this data collection. Data documentation sheets were submitted to Michael Stapley, CR England Test Lead Engineer. Analysis was completed and the test data formalized in the test report shown in Figure 2. Mike Roeth confirmed its accuracy to the test data collection and a test analysis meeting was held on Friday, November 22<sup>nd</sup>, between CR England, Peloton Technology and NACFE.

22-Nov-13

**Lead Peloton Peterbilt Truck C1 vs Cascadia Control Truck Summary**

Wendover							
Baseline Test, 11/19/2013				Peloton Technology on Lead Peterbilt Truck C1, 11/20/12			
Valid Runs	Consumed Fuel LBS		T/C Ratio	Valid Runs	Consumed Fuel LBS		Run % Savings
	Test Truck C1	Control Truck			Test Truck C1	Control Truck	
	43.36	37.20	1.166		41.79	37.86	4.68%
	42.86	36.91	1.161		33.37	30.28	4.83%
	41.36	36.05	1.147		36.02	32.35	3.85%
Baseline Average T/C Ratio			Average Valid Test Runs T/C Ratio				
1.158			1.106				
Baseline T/C Ratio of Variation			Valid Test Runs T/C Ratio of Variation				
0.825%			0.555%				
Fuel Saved, %							
4.456%							

**Tail Peloton Peterbilt Truck B1 vs Cascadia Control Truck Summary**

Wendover							
Baseline Test, 11/19/2013				Peloton Technology on Tail Peterbilt Truck B1, 11/20/12			
Valid Runs	Consumed Fuel LBS		T/C Ratio	Valid Runs	Consumed Fuel LBS		Run % Savings
	Test Truck B1	Control Truck			Test Truck B1	Control Truck	
	43.74	37.20	1.176		39.58	37.86	10.82%
	43.29	36.91	1.173		34.80	32.86	9.66%
	42.11	36.05	1.168		34.31	32.35	9.53%
Baseline Average T/C Ratio			Average Valid Test Runs T/C Ratio				
1.172			1.055				
Baseline T/C Ratio of Variation			Valid Test Runs T/C Ratio of Variation				
0.825%			0.790%				
Fuel Saved, %							
10.001%							

Figure 2: Platooning Test Results

The lead Peloton truck was C1 and showed an average fuel saved of 4.5% during the three validated test segments. B1, the following truck saved 10.0%. Again, this data is the result of a 36 feet following distance at 64 miles per hour. The minimum platooning system percent on during the 3 tests was 99%, as noted by the Peloton data collection equipment.

## Conclusion

In conclusion, the North American Council for Freight Efficiency has validated that the team conducted this test per the protocol and that the results are accurate given the test procedure used. No other analysis or comments are made with respect to the platooning technology by the NACFE.

Thank you for involving the NACFE on this project and we look forward to assisting this team on any future needs.

A handwritten signature in black ink, appearing to read "M. Roeth".

Michael Roeth, Executive Director, NACFE

Appendix includes pictures of the testing conducted near Salt Lake City, November 18 – 21.

Appendix A



Chase van



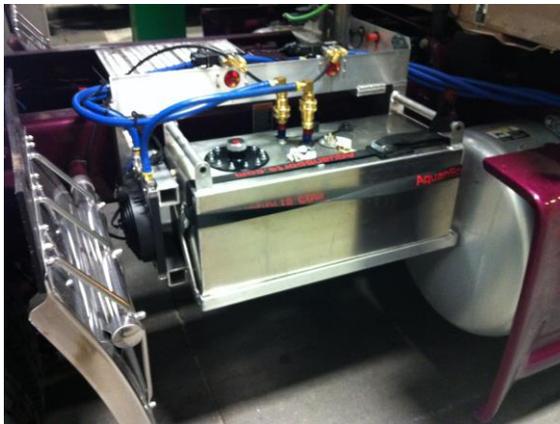
Team meeting prior to a test segment



New tires installed



Checking tire pressure prior to test



Test fuel tank installed on C1



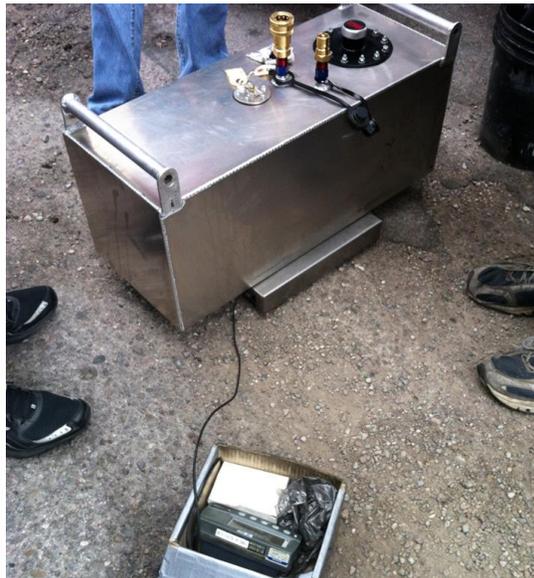
Control and test trucks entering interstate.



All three tractors at Wendover, UT



Recording data



Weighing tanks



Refueling test fuel tank at end of segment



Control truck



Peloton platooning trucks