

## Test Summary

# Autobahn Simulation Testing with AlloyGator OE Rim Protectors

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Test Date(s) 01/12/15 - 08/12/15

### Test Objectives

To evaluate the security and integrity of the fitted AlloyGator OE wheel rim protectors, and any other effects observed. The tests were run as follows;

1. 1 x half Autobahn simulation cycle without AlloyGator OE rim protectors to check for any wheel balancing issues etc.
2. 3 x full Autobahn simulation cycles with AlloyGator OE rim protectors fitted to all four wheels.

### Specimen Description

The same test vehicle and wheel tyre combinations were used as described in Report issue 1210410#1a (Handling Tests on AlloyGator OE Alloy Wheel Rim Protectors) to the same conditions, with the exception of having no passenger in the vehicle. The test tyres and rim protectors were mounted onto the alloy wheels by the customer and delivered to HORIBA MIRA for the test.

Two combinations of tyre, wheel and AlloyGator fitment were evaluated as follows:

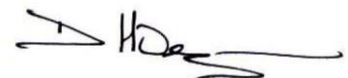
1. Standard wheels and tyres, no AlloyGator OE rim protectors fitted
2. Standard wheels and tyres, AlloyGator OE rim protectors fitted to all four wheels

Prepared By:



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Approved By:



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Date: 16<sup>th</sup> December 2015

Test Equipment

A Racelogic VBOX Sport data logger with GPS speed measurement was used for validation of the vehicle speeds on the Autobahn simulations. Example GPS speed data is shown in Appendix 1.

Tyre pressures were checked and set to the vehicle’s recommended pressure of 2.2 bar (32psi) prior to the start of each cycle. Wheel bolts were checked and torqued to 110Nm prior to the start of each cycle.

All AlloyGator OE rim protectors were paint-pen marked at 3 equally spaced radial locations across the rim, gator and tyre to observe any relative movement during the testing. This set-up is shown in Figure 1 below.



Figure 1 - Wheel/Tyre Set-ups with AlloyGator Rim Protectors

## Test Description

The tests were conducted to the HORIBA MIRA Autobahn simulation cycle around the Number 1 circuit. This cycle consists of high speed driving, with some transient sections. The vehicle is driven up to the maximum achievable speed for the 'Vmax' sections, and limited to 100mph on the 33° banked corners. A breakdown of the test cycle is given in Appendix 2.

## Test Numbers

The following tests were performed:

### Test 1 (day 1)

- Half cycle (Laps 1-16) without AlloyGator OE rim protectors fitted to any of the wheels.

### Test 2 (day 2)

- Full cycle (33 laps, ~92 miles) with AlloyGator OE rim protectors fitted to all four wheels.

### Test 3 (days 3-4\*)

- Full cycle (33 laps, ~92 miles) with AlloyGator OE rim protectors fitted to all four wheels.
- \*Laps 1-15 were completed on day 3 and laps 16-33 were completed on day 4, as described in the next section (Test Results).

### Test 4 (day 4)

- \*Laps 16-33 of test 3.
- Full cycle (33 laps, ~92 miles) with AlloyGator OE rim protectors fitted to all four wheels.

Maximum speed achieved was ~198km/h as recorded by the VBox data logger, which corresponded with an indicated 125mph on the vehicle instrumentation.

## Test Results

### Test 1 (day 1)

Half cycle without rim protectors was completed without any issues. No wheel balancing/ vibration issues were present, and no loss of tyre pressure occurred.

### Test 2 (day 2)

First full Autobahn simulation cycle with rim protectors fitted was completed successfully. There was no loss of tyre pressures and no movement of the rim protectors observed. Some intermittent excessive vibration occurred at high speed (>100mph) towards the end of the test, but not thought to be related to the fitting of the rim protectors. Wheel balancing was checked and re-done as necessary but made no difference to the vibration felt at high speed.

### Test 3 (day 3)

Laps 1-15 of the second full Autobahn simulation with rim protectors fitted. The test was stopped initially at lap 11 due to continued intermittent vibration at high speed, of concern to the driver's safety. Vehicle was inspected again to find no issues with the rim protectors coming loose, or any issues with the wheels and tyres. The vehicle's wheels were then switched front to rear, and the vehicle was driven up to lap 15 by an additional driver for a second opinion of the vibration issue. The vibration was experienced once more yet deemed acceptable for this type of vehicle. The decision was made to continue testing as normal, with extra vigilance on the following day.

### Test 4 (day 4)

Laps 16-33 of the second full Autobahn simulation with rim protectors fitted. There was no loss of tyre pressures, and no movement of the rim protectors was observed.

The third full Autobahn simulation with rim protectors fitted was completed successfully. There was no loss of tyre pressures, and no movement of the rim protectors was observed.

Intermittent vibration at high speed was again observed in the latter cycles. Following discussions with the customer, a most likely diagnosis was given by the vehicle owner's Engineer – this was deemed to be as a result of excessive camber and castor for track use, when compared with the road vehicle specification.

### Conclusions

No radial movement or outward displacement was observed between the AlloyGator OE rim protectors, wheel rims and tyres in any of the tests. Although tyre pressures increased slightly in each test (to a maximum of 38psi), this is normal for this type of drive cycle, caused by the increase in tyre temperature. To validate that there was no loss of tyre pressure after each test cycle, the vehicle was given an appropriate ambient soak period before re-checking the tyre pressures against the original specification of 32psi.

As there was no displacement of the AlloyGator OE rim protectors, and no loss of tyre pressures, the security and integrity of the fitted AlloyGator OE rim protectors was validated for all of the Autobahn simulation cycles.

### Recommendations

HORIBA MIRA recommends that AlloyGator should inspect all rims, tyres and rim protectors to check for any damage that could have been caused by or to the AlloyGator rim protectors.

Appendix 1

Example section of recorded Autobahn simulation data showing the maximum speeds of 198km/h.

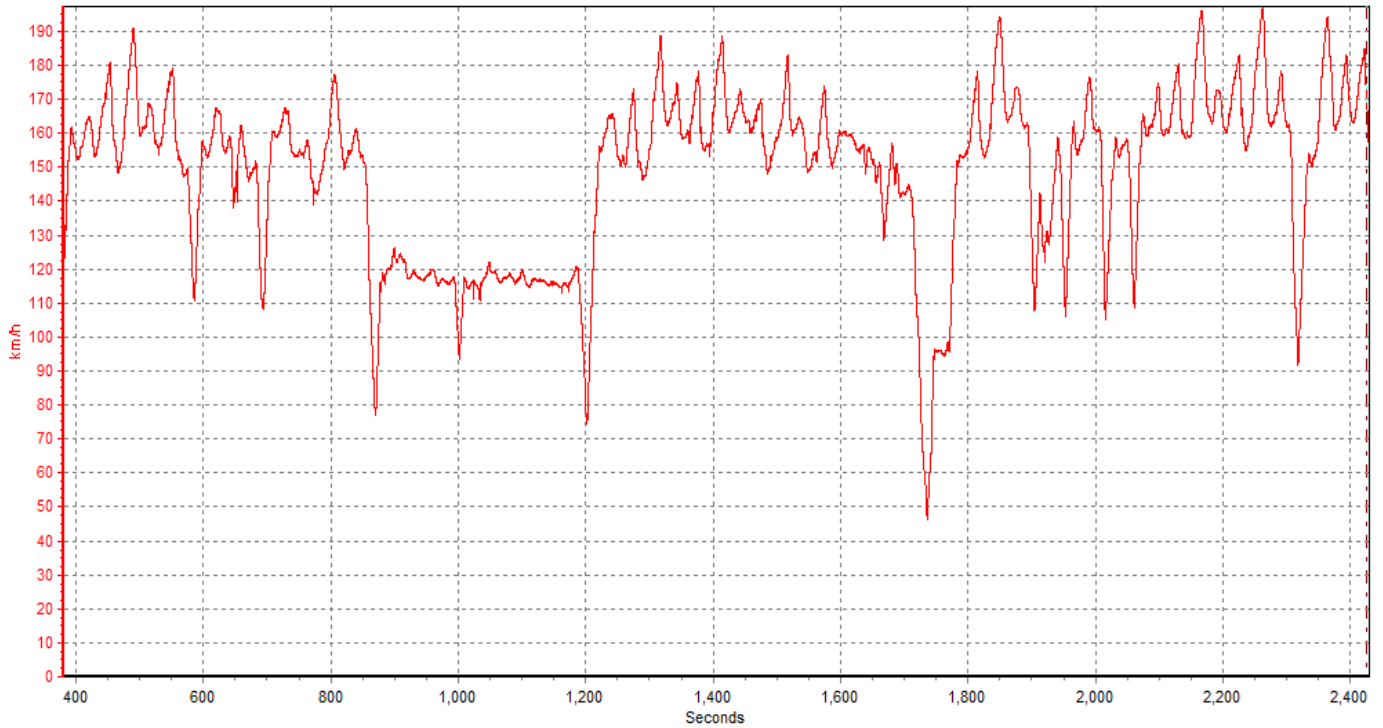


Figure 2 - Example Section of Autobahn Simulation Data

## Appendix 2

### MIRA Autobahn Simulation

(Vmax and bend speed to be set for vehicle type and current weather conditions.)

Start cycle at the entrance to number 1 circuit

#### Laps

- 1 Accelerate to Vmax
- 2 At the start of lap 2 decel to 70 mph then accel back to Vmax  
At the 1 mile post decel to 80 mph then accel to Vmax; At 1 3/4 mile post decel to 70 mph then accel to Vmax
- 3 Lap 3 is Vmax slowing to 110 mph max for the bends
- 4 Lap 4 decel to 70 mph at the start post then accel to Vmax  
At 1 mile post decel to 80 mph then accel to Vmax; At the 1 3/4 mile post decel to 70 mph then accel to Vmax
- 5 Lap 5 Vmax
- 6 Lap 6 Vmax
- 7 Lap 7 Vmax
- 8 Lap 8 Vmax
- 9 Lap 9 Vmax
- 10 Lap 10 Vmax
- 11 At the start post decel to 95 mph then accel to Vmax  
At the 1 mile post decel to 95 mph then accel to Vmax; At the 1 3/4 mile post decel to 95 mph then accel to Vmax
- 12 At the start post decel to 95 mph then accel to Vmax  
At the 1 mile post decel to 95 mph then accel to Vmax; At the 1 3/4 mile post decel to 95 mph then accel to Vmax
- 13 Lap 13 Vmax
- 14 Lap 14 Vmax
- 15 Lap 15 Vmax
- 16 Lap 16 Vmax
- 17 At the start post decel to 70 mph the accel to Vmax  
At the 1 3/4 mile post decel to 80 mph then accel to Vmax
- 18 At the start post decel to 70 mph the accel to Vmax
- 19 At the 1 3/4 mile post decel to 50 mph (braking) then accel to 75 mph
- 20 At the 1 3/4 mile post decel to 60 mph then accel to 75 mph
- 21 Lap at 75 mph
- 22 At the start post decel to 50 mph then accel to Vmax
- 23 Lap 23 Vmax
- 24 Lap 24 Vmax
- 25 At the 2 mile post decel to 100 mph
- 26 At the 1 3/4 mile post decel to 80 mph then accel to 100 mph
- 27 At the start post decel to 30 mph (braking) the accel to 60 mph  
At the 1 mile post accel to Vmax
- 28 At the 1 3/4 mile post decel to 70 then accel to Vmax
- 29 At the start post decel to 70 mph then accel to Vmax  
At the 1 3/4 mile post decel to 70 then accel to Vmax
- 30 At the start post decel to 70 mph the accel to Vmax
- 31 Lap 31 Vmax
- 32 At the 1 3/4 mile post decel to 60 mph then accel to Vmax
- 33 Exit track and stop at fuel station with engine at idle for 5 mins, Or stop at fuel station with engine off for 5 mins  
**One high speed lap is 4.478 km (2.78 miles) long, and one drive cycles is 147.7 km (91.78 miles)**