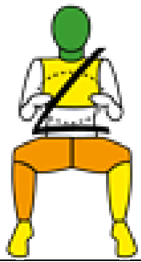
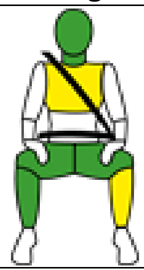
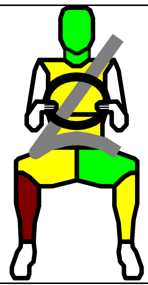
Offset Deformable Barrier – Frontal Impact

Dummy Score

	Driver	Passenger
2003 Test at TRL		
Score (worst)	11	
2018 Test at Thatcham		
Score (worst)	12.289	

Modifier	Score	Reason
Head airbag contact – Bottoming out (Head)	-1	After analysing the data further (p6), around the 122 ms point in the Head X shows evidence of the head bottoming out the airbag and contacting the steering wheel rim. This can be confirmed with offboard footage.
Bodyshell Integrity (Chest)	-1	Euro NCAP require two widely space, parallel stable load paths that are capable of transmitting further load in a controlled manner if the severity of the crash were to increase slightly. From the severe A pillar and Sill buckling, it can be said with high certainty that the structure of the vehicle would NOT be able to sustain any increased loading.
Footwell Rupture (Lower legs)	-1	The large split in the floor and large amounts of deformation in the floor clearly indicate a footwell rupture. This increases the chance of objects outside may enter passenger compartment and cause additional risk to the occupant.
Variable Contact (Lower legs)	-1	This modifier is applied when the femur loading is above 3.8kN, which was exceeded on the right femur of the driver to 4.59kN.
Concentrated Loading (Lower legs)	-1	Loading on the knee was seen to not be well distributed, causing localised loading on the knee.
Final Frontal Score	**7.289**	

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Bumper Beams and Front Chassis Leg

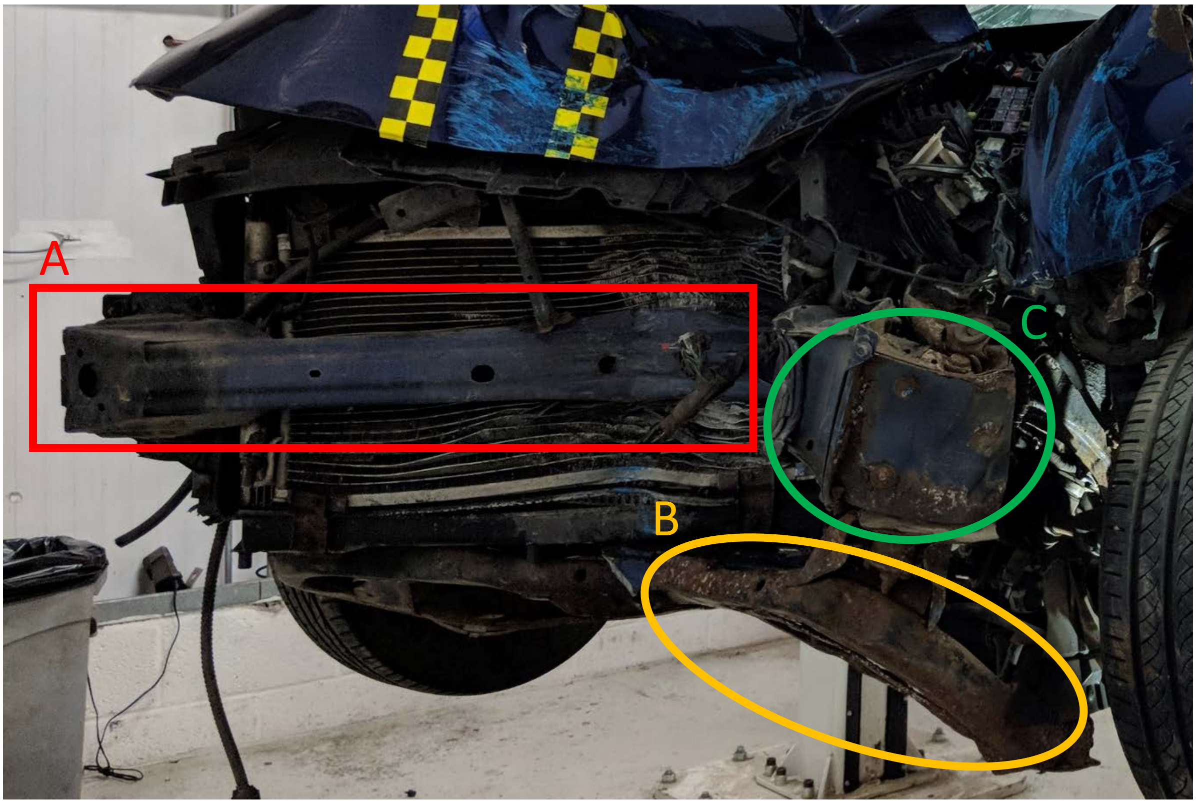

Figure 1 ODB front upper bumper beam(A), front lower bumper beam(B) and the chassis leg(C).

Figure 1 shows the front bumper beam mounted to the chassis leg, with the separate lower bumper beam below it. Figure 2 and 3 highlight the large amount of the on the chassis leg, both on joins and through the top face of the chassis leg.

Figure 3 Front Chassis Leg Side View

Figure 2 Front Chassis Leg Top View

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From Figure 2 and 3 the extent of the rust is very severe; however, it does not appear to have greatly affected the structure of the lower chassis leg. The welds on the left image have not failed despite being surrounded in rust. The top of the chassis leg can be seen from the Figure 4, and once again the rusted areas do not appear to have cause any structural weakness in the material. This level of deformation of the front chassis leg is to be expected from the ODB impact, but without any original 2003 test images it is impossible to say with certainty if this vehicle reacted differently.

Figure 4 Front Chassis Leg Bottom View

Figure 4 again highlights the extent of the rust, with the thinner parts of the material starting to flake away from the main material. Although this particular part of the chassis leg is not crucial to the crash performance, it does indicate the level of corrosion present in the vehicle.

Lower Chassis Rail

Figure 5 Lower Chassis Rail

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Figure 5 shows where the front chassis leg joins the lower chassis rail. Once again, the extent of the rust is shown, not only on the chassis rail but on the sill as well. The floor underneath the driver compartment has deformed, collapsing downwards along the length of the chassis rail. This has also caused the chassis rail and floor to de-bond in multiple sections along the length of the vehicle (shown in Figure 6).

Figure 6 De-bonding of chassis rail and floor

The point at which the chassis leg meets the lower chassis rail is severely covered by rust, however this section did not fail as shown in Figure 6. The point of failure is the spot welds between the two sections. Once these spot welds failed, the floor section was able to greatly deform into the passenger compartment. It was noted in the original 2003 Euro NCAP Test that the footwell of the vehicle ruptured, and without original test images it is difficult to say what the extent of this deformation was.

Figure 7 shows that further rearwards the chassis rail buckled, but there is no evidence that this is due to excess rust in that particular area. This buckling is also causing additional separation of the floor and chassis rail. This is evidence for the bodyshell integrity modifier, as any additional load in a higher impact would not be transmitted in a controlled manner.

Figure 7 Lower Chassis Rail Buckling

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Sill

The sill on the underside of the vehicle was heavily covered in corrosion, seen in Figure 8. The rust extends down the entire length of the sill, with evidence of flaking and splitting between layers.

Figure 8 Extent of the corrosion on along the sill

The sill if often used by manufacturers as a load path during the ODB impact. Figure 9 shows the area of the sill directly behind the driver side wheel. Once again the level of corrosion is evident, with holes in the metal clearly visible. This is one of the highest loading points of the ODB impact, and so any structural weakness should be visible here. From Figure 9, the sill structure has not entirely collapsed, despite the extensive rust and the high load put through it. The high-speed video suggests that the loads were completed transferred through this section, with no energy absorption taking place. This then caused the deformation further rearwards of the vehicle. It is difficult to determine whether this is part of the original crash structure of the vehicle.

Figure 9 Sill structure behind the driver side wheel

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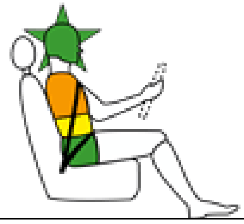
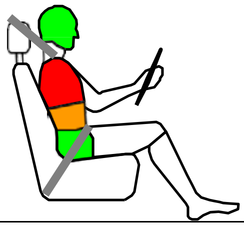
Mobile Deformable Barrier – Side Impact

<u>Dummy Score</u>

	Driver
2003 Test at TRL	
Score	13
2018 Test at Thatcham	
Score	9.520

Modifier	Score	Reason
Back plate modifier	-1.187	The ES2 dummy has a back plate designed to space the ribs off the seat cushion to allow them to move freely. However, during the impact high loads were fed into the dummy via the backplate, bypassing normal instrumentation load paths. Load sensors detected this abnormal loading of the backplate, hence the application of the modifier.
Final Score	**8.520**	

Sill

Figure 10 shows the deformation of the sill after the MDB impact. The footwell can be seen to have buckled a large amount in the impact, which most likely caused the additional compression of the ribs in the dummy. Again it is difficult to say whether the corrosion caused additional collapse of the sill and B-pillar without knowledge of the original 2003 impact.

Figure 11 shows where the sill has not transferred the load in a controlled manner, causing the sill outer layer to spit, and then deform the floor of the passenger compartment. This in turn cause the driver seat mounting to move during the impact. This also most likely aided the higher loads seen on the dummy lower ribs.

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Figure 10 MDB Sill Rust

Figure 11 Floor deformation and Sill outer layer

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Conclusion

Without the original footage and full inspection report it is difficult to say with certainty about the effect of the condition of the vehicle on it's safety performance. However, the results from the dummies and subsequent modifiers do indicate that the vehicles did not perform as well as in the 2003 tests.

The ODB test was relatively comparable to the 2003 tests until the modifiers were applied during the inspection. The head bottoming out the airbag, the body shell integrity and footwell rupture modifiers are the most crucial, as they are the most likely to be affected by a defect in the structure of the vehicle. The variable loading and concentrated loading modifiers were likely to have been applied to the original tests as are they are an innate design feature of the vehicle facia, although a high amount of deformation of the footwell would intensify these issues. The head bottoming out the airbag was almost certainly not seen in the original test, and implies that some structure was not able to transfer loads effect during the impact, causing interaction between the steering wheel and the dummy.

The MDB test scored 0 (zero) points for the dummy chest due to the backplate modifier. This modifier was also likely to be applied in the original tests, but without the report we cannot say exactly how many points were removed. However, the large compression of the ribs does indicate that the sill and footwell of the vehicle deformed in such a way to cause greater loading onto the dummy. It can also be confirmed that there were no issues with the seat mounted airbag from high speed footage.

It is the opinion of the author that the corrosion of the vehicles did negatively affect the safety performance of these tests. However, the extent of this negative affect is not as severe as expected. Without modifiers, the scores between the 2003 and 2018 tests are very comparable, and only after the application of modifiers do the results begin to differ. Without a much deeper analysis of the structure of the crashed vehicles, would you be able to confidently comment upon the affect of the corrosion onto the crash performance of the structure of the vehicle.

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