

**Thatcham Accredited Parts Validation**  
**Crash Tests –**  
**The Question of Safety**



## 1. Introduction.

In order to support the claim that Thatcham Accredited Parts do not compromise the occupant protection levels offered by modern vehicles it was decided to compare the crash performance a new car with two others fitted with replacement parts. Since the current Euro NCAP 64 Km/h frontal crash is widely regarded as the most severe safety test currently undertaken it was selected to compare the performance of a “good” scoring vehicle with two identical used vehicles, one fitted with Thatcham Accredited Parts, the other with the VM’s own after market panels.

The vehicle chosen was a Ford Focus (mk1) since it had achieved a good 4 star Euro NCAP rating and a full set of accredited after market parts were available. Two used 2004 Ford Focus’ were purchased with identical specification -1.6l petrol 5 door with manual gearbox. The vehicles were selected to be similar as possible to the Euro NCAP reference vehicle but were to RHD specification – a test condition usually more severe than that of a LHD vehicle due to the engine configuration. The tests undertaken mimicked the Euro NCAP frontal standard – 64 Km/h (40 mph) into a deformable aluminium barrier.

To maintain impartiality the two after market parts vehicles were impacted at the MIRA crash test laboratory at Nuneaton in the UK and the results compared with the original Euro NCAP reference vehicle.

## 2. The Vehicles.

In September 2006 a pair of Ford Focus’ were purchased, one through Reg Vardy (Reading) and the other from Gowrings of Newbury. The vehicles were selected to best mimic the specification and test mass of the Euro NCAP reference test, being both 1.6 litre petrol, 5 door with manual transmission. First registered in January 2005, Vin WFOAXXWPDA4L89990 had 14000 recorded miles. This vehicle was retro fitted with Thatcham

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Accredited parts and given the test designation OW4145. The second vehicle was first registered in October 2003, Vin WFOAXXGCDA3E15576, and had 6800 recorded miles. This vehicle was retro fitted with Ford replacement parts and given the designation OW4146.

On delivery both vehicles were extensively checked to ensure suitability for testing and to ensure that their previous lives had not resulted in wear or damage that would, in some way, compromise the final test results. Both vehicles were found to be HPI clear, had not been written off and had no visual signs of previous crash damage or repair.

### 3. Pre-Test Preparation

Each vehicle had its OEM factory cosmetic parts removed, these consisted of:

- Bonnet (Hood)
- LH and RH Front Wings (Fenders)
- Grille
- Front Panel
- Bumper Cover

Both vehicles were subsequently rebuilt with either Thatcham accredited parts or Ford OEM aftermarket parts. Each vehicle was rebuilt to OEM standards and was visually identical. Each supplanted component was painted in a contrasting colour to make identification easier along with the rest of the vehicle which was painted in a standardised overall blue. The steering geometry was checked on both vehicles and both weighed. Due to variation in specification and wheel types a small amount of ballast was introduced to ensure that both vehicles were tested to an identical mass of 1384 kg (including test devices).



*Figure 4 Thatcham accredited Pre test*



*Figure 5 OE Pre test*

### 3. The Test.

Since the most stringent regulatory frontal crash test (ECE R94) is run at only 56 Km/h (35 mph) it was decided to undertake these Thatcham Accredited Parts Crash Tests to the more stringent Euro NCAP consumer test procedure. The Euro NCAP frontal impact test is conducted at 64kmh (40mph) representing 29% more energy than the legal requirement, offset to 40% of the vehicles width on the drivers side, see figure 1 below. The impact is run into a standardised EEVC aluminium honeycomb barrier representing the structure of a similar vehicle. The test is typically conducted on the highest volume selling derivative in the European market.

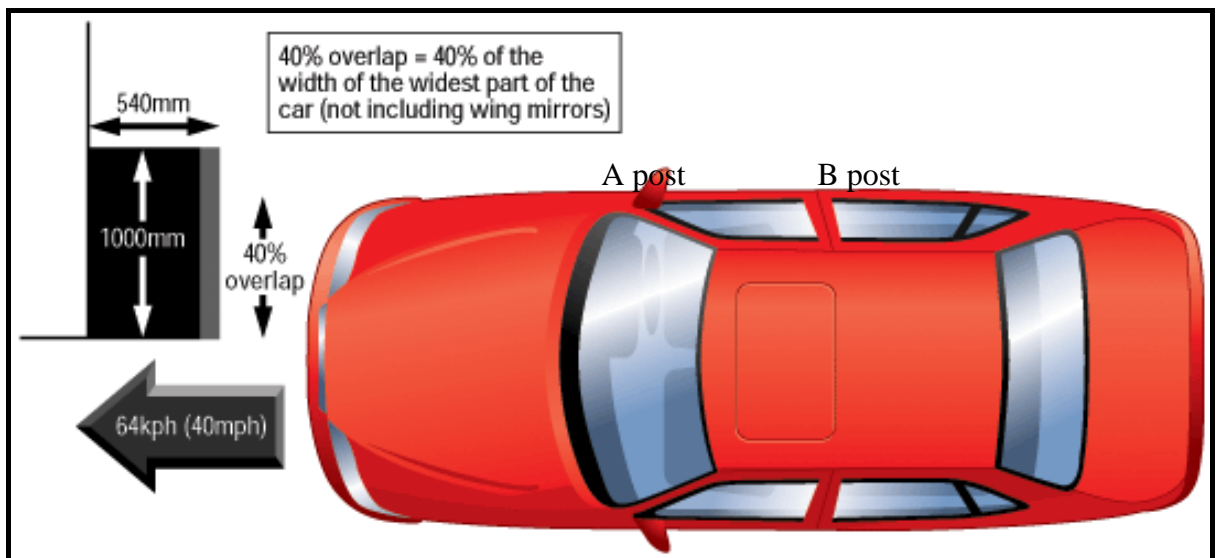


Figure 1.

The vehicle is equipped with instrumentation to measure the forces that the vehicle and occupants are subjected to. Accelerometers attached to the B post measure in X, Y, and Z directions (forward, backward, left right, and up, down) and on the airbag electronic control unit (ECU) in the X direction.

In order to replicate human occupants and measure the forces endured in the crash two Hybrid 3 ATD's (anthropomorphic test devices) occupy the

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front seats. (Figure 2 ). These crash test dummies are as biofidelic as technology currently allows and can accurately record forces and accelerations typical of a magnitude that has been shown to be injurious. The head is made of aluminium and covered in rubber 'flesh'. Inside, three accelerometers are set at right angles, each providing data on the forces and accelerations to which the brain would be subjected in a crash. The neck (figure 3) features measuring devices to detect the bending, shearing and tension forces on the neck as the head is thrown forwards and backwards during the impact. Neither arm carries any instrumentation. The Hybrid 3's steel ribs are fitted with equipment that records deflection of the rib cage in the frontal impact since injuries can occur where forces exerted on the chest, such as from the seat belt are in excess of biomechanical limits. Load cells in the femur and legs provide data in frontal impacts on likely leg, hip and pelvis fractures. A 'knee slider' is used to measure forces transmitted through the dummy's knees, particularly if they strike the lower fascia. Lower Leg Instruments fitted inside the dummies' legs measure bending, shear, compression and tension, allowing injury risks to the tibia (shin-bone) and fibula (connecting knee to ankle) to be assessed. Assessment of feet and ankles injury risk in the frontal impact is made by measuring distortion and rearward movement of the driver's footwell area.

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*Figure 2*



*Figure 3*

In order to absorb the energy of the crash a vehicle manufacturer must design the vehicle in such a way to allow the distortion and bending of the structure. However this distortion must not encroach into the occupant compartment or the survival space of the passengers may be compromised. In order to measure this distortion a number of static measurements are taken with a CMM device (Coordinate Measuring Machine) that allows an assessment to be made of structural distortion and intrusion pre and post crash.

A number of points are selected on the vehicle structure and within the occupant compartment to measure intrusion and are recorded pre and post test without the ATD's. The movement of the steering column is also

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assessed to control airbag deployment stability and prevent excessive force being transmitted to the drivers head and chest. This is again measured pre and post crash.

Prior to the test the vehicles seats are set to a pre determined point defined by the use of an SAE H-Point manikin and the steering column and seatbelt height adjuster all pre set and measured. Once the seat is in placed in the standardised position the ATD's are installed and the associated sensors connected to a computer controlled Data Acquisition Unit – a ruggedised instrument that holds the data from the crash until it can be transferred to an external computer post crash for processing.

#### 4. The Crash Test

The vehicles are placed at the end of a 100m runway and attached to a winching device that pulls the car forward at the pre-determined speed until in contact with the barrier. The tests are filmed on 8 high speed video cameras placed around the vehicle recording at 1000 fps. This is subsequently downloaded post impact to analyse the kinematics of the occupant and vehicle during the crash but can also be used to cross check impact speed. Special attention is paid to ensure the horizontal alignment of the vehicle with respect to the barrier (offset) is within the permitted tolerance range.

#### 5. Test Results.

The results are shown in table 1 below, For reference this table also contains the results of Euro NCAP's original 1999 Ford Focus test carried out at The Transport Research Laboratory (TRL). These results shown list the two Thatcham test vehicles against the Euro NCAP Focus (33HF). AP denotes the Thatcham Accredited Parts vehicle and OE denotes the vehicle fitted with Ford branded parts.

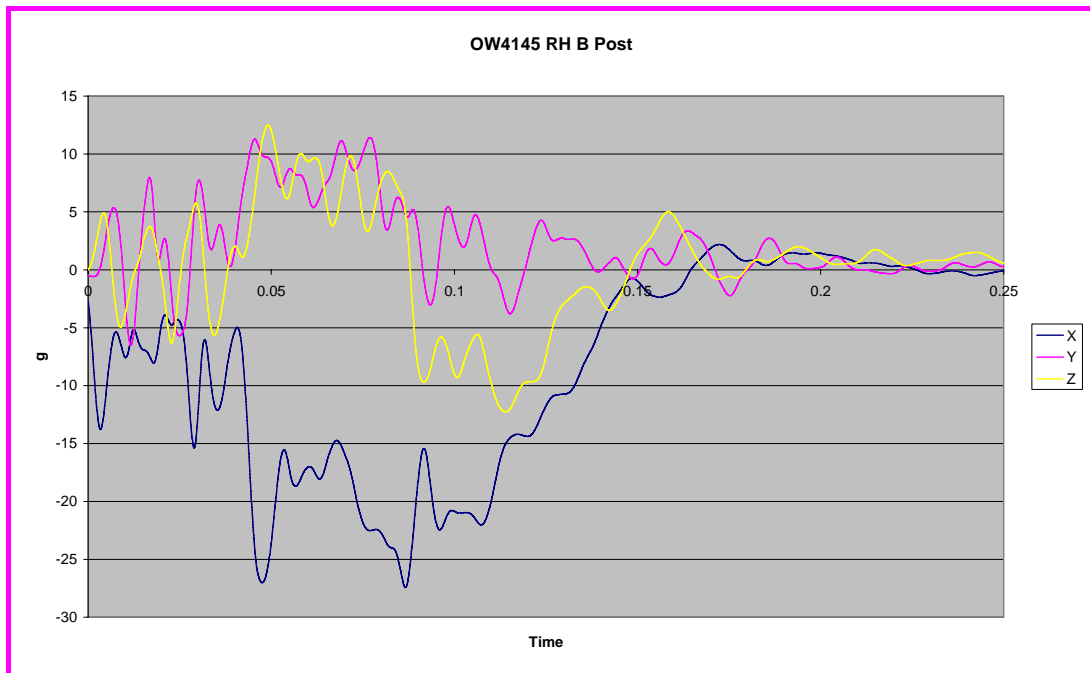
The table lists the key variables that are measured during the test and are referenced to the limit value – these either being legislative with ECE R94 or are Euro NCAP's own criteria. Any exceeded values outside of the specification are indicated in red.

Comparison Table				
	33HF	OW4145	OW4173	Limits
Test derivative	NCAP	AP	OE	-
Model Year	1998	2004	2003	-
Speed (64 km/h)	64.1	64.1	64.3	+/-1 km/h
Time of maximum intrusion (ms)	-	128	123	-
Offset (mm)	5	18	7	+/- 20
Mass (KG)	1378	1384	1384	-
Hand Of Drive	LHD	RHD	RHD	-
Dummy				
HIC (36)	500	248	296	1000
Head 3ms Exceedence (g)	53	44	41.1	88
Neck Peak Extension (Nm)	14.4	30	33	57
Chest Def (mm)	29.87	31.13	29.8	50
Viscus Criterion (VC)	0.14	0.11	0.13	1
Femur (kN) (WC)	0.81	1.8	2.05	9
Upper Tibia Index (WC)	0.34	0.35	0.52	1.3
Lower Tibia Index (WC)	1.02	0.63	0.54	1.3
Intrusion (mm)				
Steering Column	24	16	13.5	100
Pedal Back (Brake)	139	154	112.2	100*
Pedal Up (Brake)	43	6.3	6.7	80*
A Post Back (Struck side)	38	28.5	33.9	100*
Notes: * NCAP capping limit, not a legal requirement.				

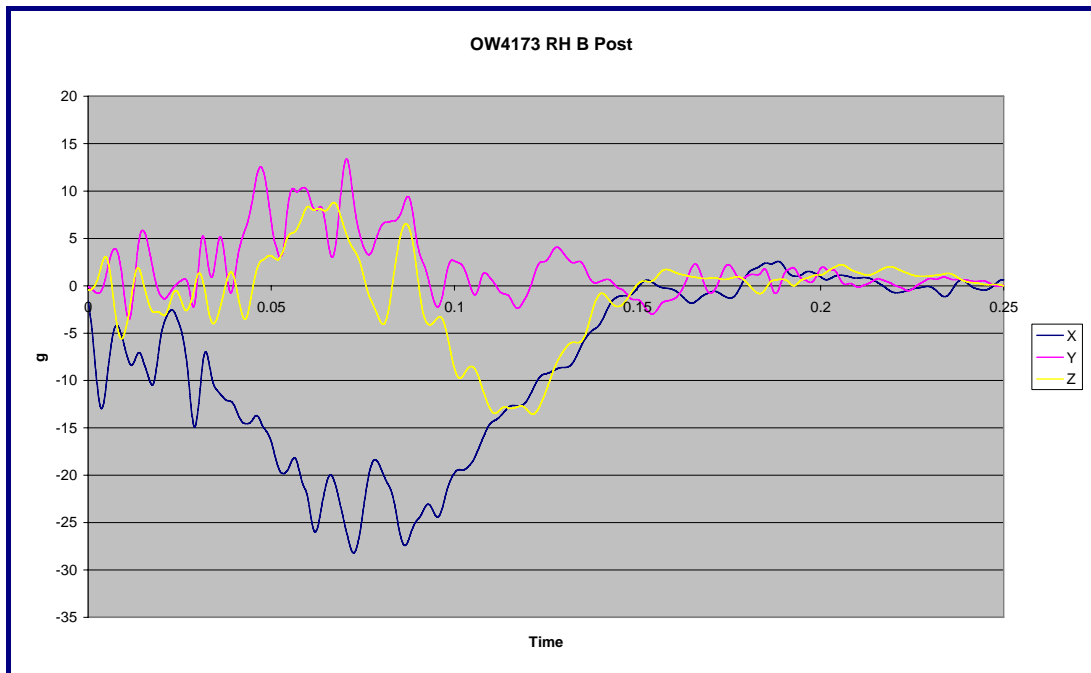
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### 6. Time Histories

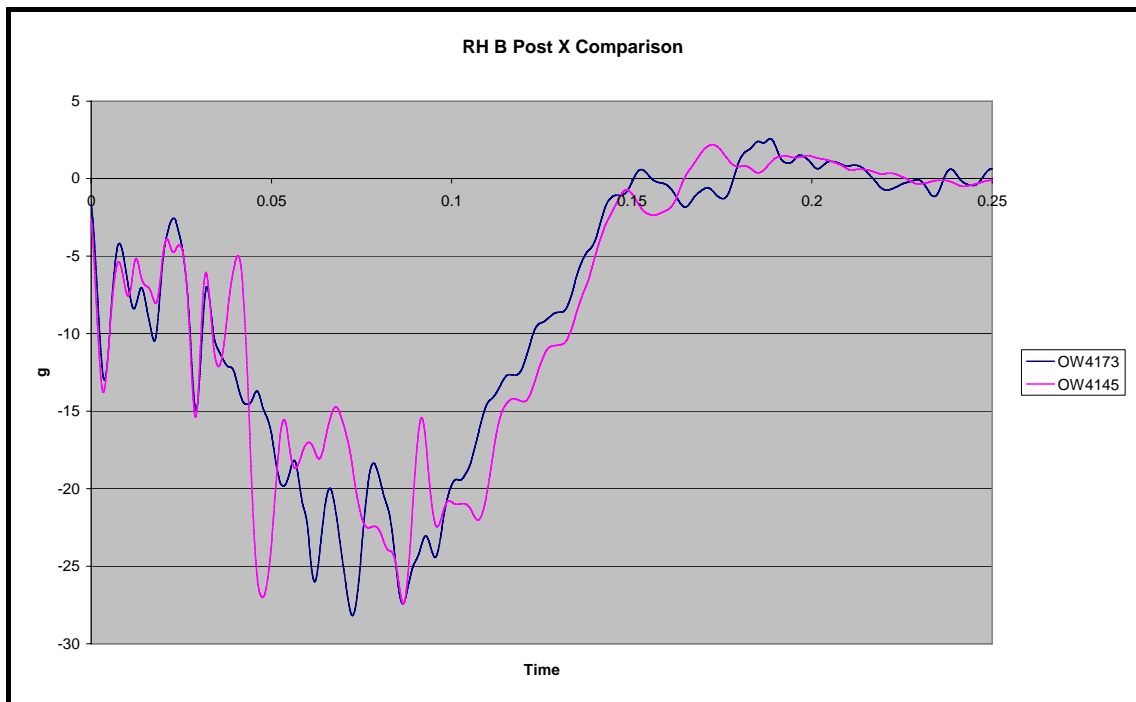
The following graphs show the comparative structural time histories of the two Thatcham test cars taken at the lower B-Pillar and centrally placed airbag module.



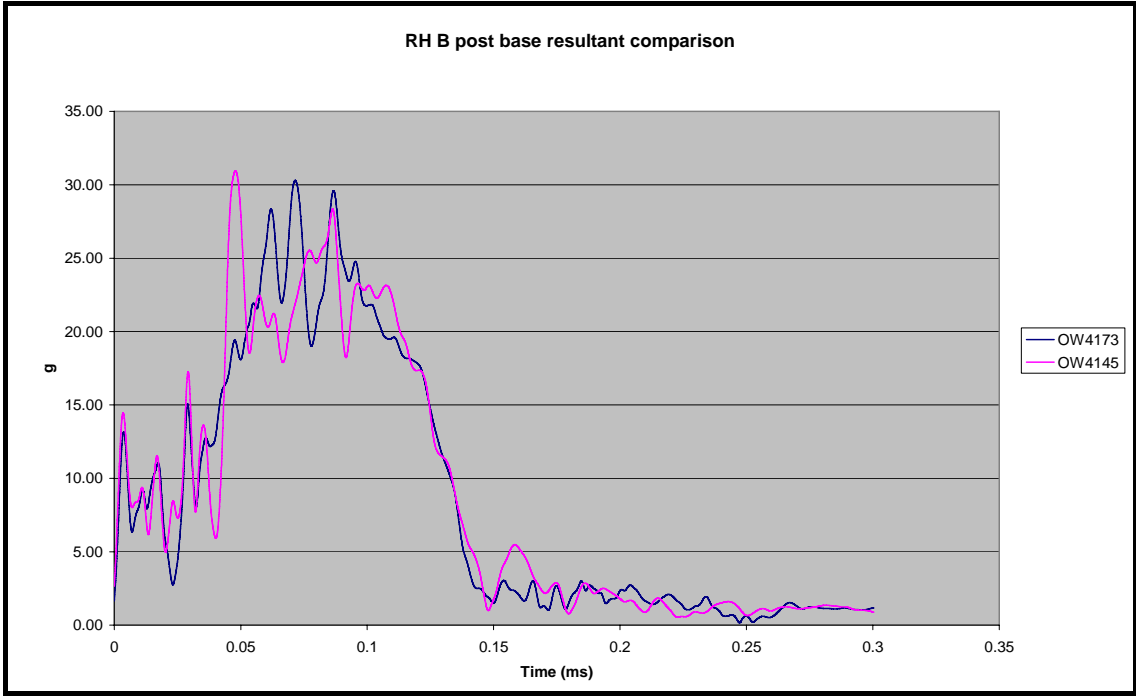
Graph 1. Three axis struck side B post base for TA vehicle. The data has been filtered to CFC 60 to remove excess noise and give a clearer picture of the underlying pulse.



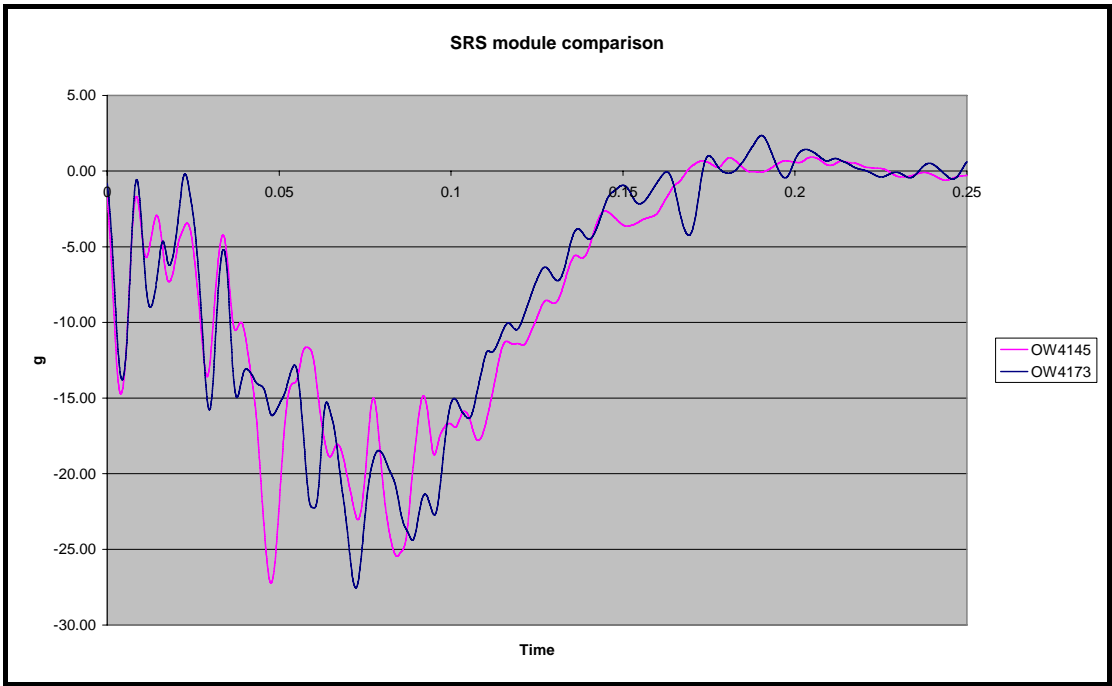
Graph 2. Three axis struck side B post base for OE vehicle. The data has been filtered to CFC 60 to remove excess noise and give a clearer picture of the underlying pulse.



Graph3. X channel from both tests overlaid for easier comparison. The correlation between the two is evident.



Graph4. Resultant accelerations from the B post traces overlaid. Overall there is a good correlation between the two pulses.



Graph 5. Airbag ECU comparison

7. Visual assessment.

The following photographs show the comparative residual structural deformation after the two crash tests. Detail shots illustrate the wheel to sill loading condition and the bonnet windshield intrusion. Note should be made of the identical fold initiation of the two bonnets at the windshield area indicating identical structural performance.

Two pictures taken from the high speed video cameras show the maximum dynamic crush and occupant ride down into the restraint system.

Pictures also illustrate the deformation pattern against the aluminium honeycomb barriers and show the vehicles comparative stiffness and intrusion performance.



*Figure 6 Thatcham accredited Post test.*



*Figure 7 OE Post test*



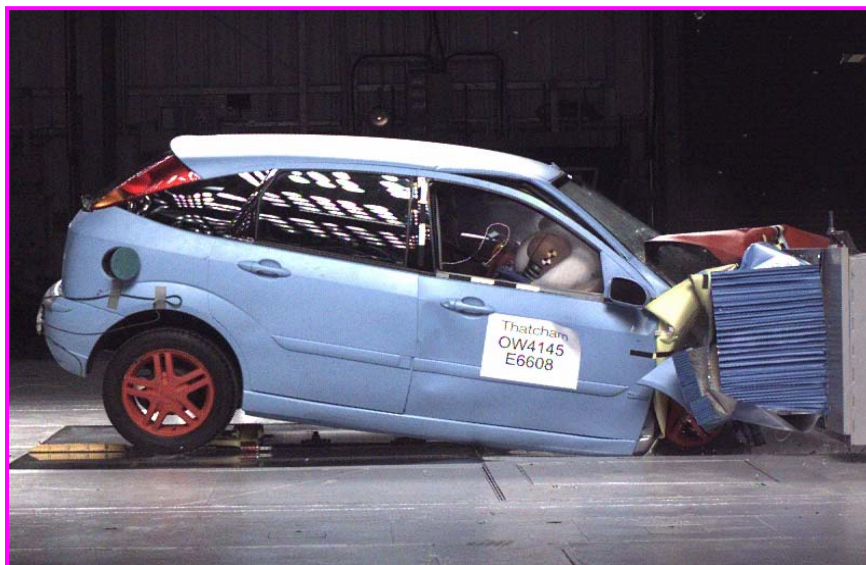
*Figure 8 Thatcham accredited detail*



*Figure 9. OE detail*



*Figure 10. Euro NCAP LHD Reference vehicle at maximum intrusion*



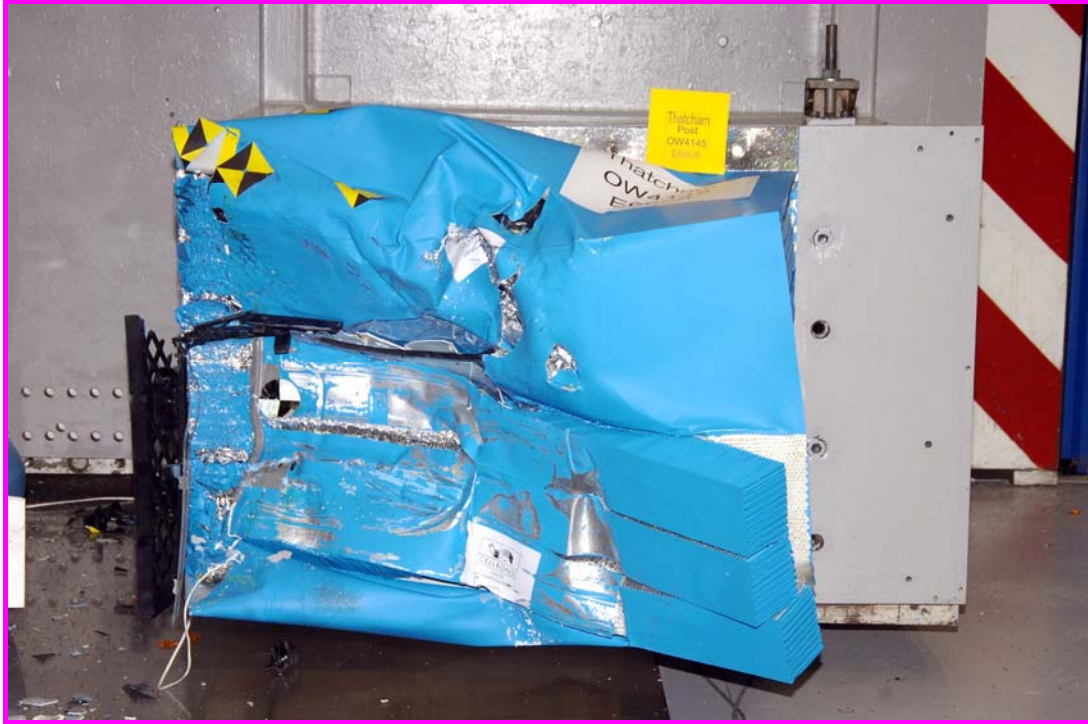
*Figure 11. Thatcham AP vehicle at Maximum intrusion*



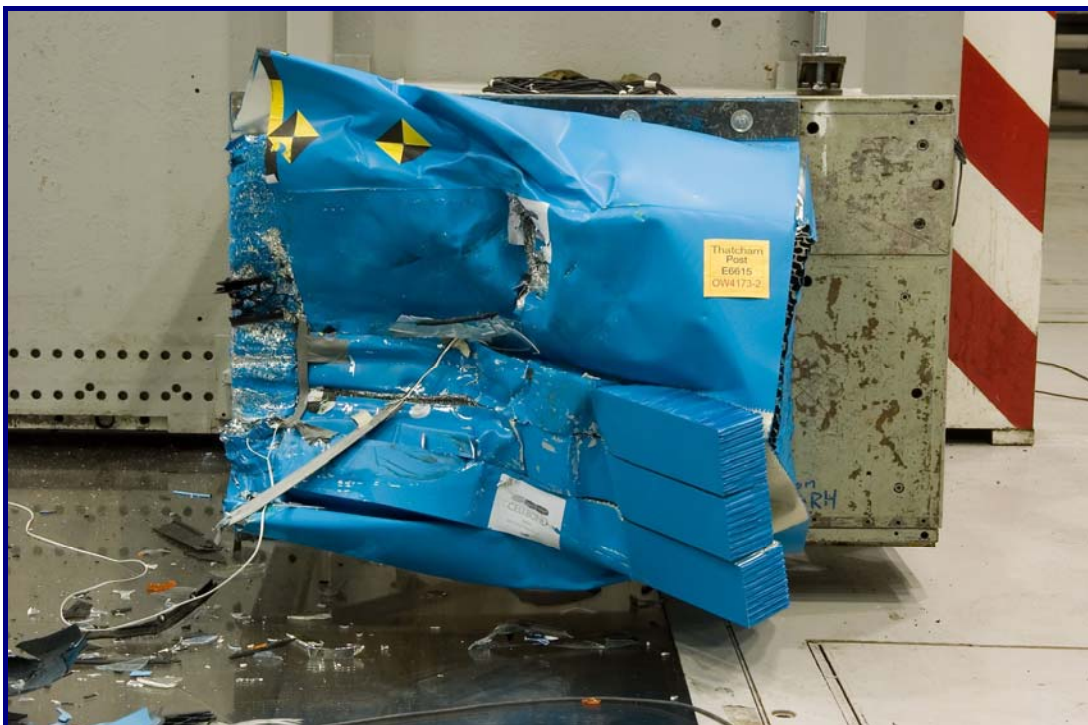
*Figure 11. OE fitted vehicle at maximum intrusion*

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Figures 10 and 11 show both vehicles at maximum intrusion of 128 milliseconds for the Thatcham accredited, and 123 milliseconds for the OE fitted vehicle. Stable airbag contact is observable.



*Figure 12. Deformable element OW4145*



*Figure 13. Deformable element OW4173*

Figures 12 and 13 are post impact photographs of the deformable elements, they show similar patterns of damage.

#### 8. Discussion.

The test results indicate that there was no meaningful structural performance difference between these two Ford Focus'. The age, specification and configuration of the two cars test weights and impact speeds were almost identical. Analysis of the visual material shows both vehicles have a stable structure that engages the barrier at a similar point with crush being initiated at similar points and within milliseconds of each other. The deformation of each vehicle follows a similar pattern with the same OSF wheel loading trait in the sill area and similar crush to the wing and door structure. The bonnet initiation points for both TA and OE are identical, both protecting the occupant from windshield intrusion. The A pillar structure remained stable with a small amount of distortion to the cant rail and door aperture area being visible on both vehicles – a similar distortion level as seen on the original Euro NCAP reference vehicle.

Analysis of the restraint system shows that both vehicles airbags deployed consistently and remained stable with both drivers riding down into the airbags in a controlled manner. Steering column intrusion was similar for both vehicles and ensured to correct deployment of the restraint system.

Both drivers and passengers endured similar force levels during each crash. Head acceleration, neck loads, chest deflection, femur and lower leg loads were all very similar and well within the prescribed limits. The slightly inferior performance to some values observed in OE vehicle could be attributable to the small increase in test speed or overlap variation, but are typical of the inter-test variation. The HIC (head injury criteria) observed on both vehicles was significantly less than seen in the original Euro NCAP reference test, such performance increase being typical of the newer dual stage airbag fitted to this generation of Ford vehicles.

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Analysis of the time histories of both vehicles show very similar loading conditions with no meaningful difference in the vehicles structural performance.

### 9. Conclusions.

Two identical Ford Focus Mk1 vehicles were tested to the most severe frontal crash test currently undertaken. The tests were performed by an independent and respected test laboratory and were undertaken within weeks of each other. Both vehicles were fitted with a replacement set of frontal cosmetic parts, one with Thatcham Accredited, the other with OE branded items. The tests results produced showed performance that was almost indistinguishable from each other and very similar to another identical vehicle tested by Euro NCAP some years earlier. No risk of significant injury was observable in either test and vehicle deformation and intrusion remained controlled and stable throughout.

It can therefore be concluded, that the fitting of Thatcham Accredited parts has made no difference to the overall vehicle performance in a high speed impact, and that the fitting of these parts in no way compromises the protection of the occupants in the event of a crash.



Questions relating to this test can be made to Matthew Avery Crash  
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