EURO NCAP FRONTAL IMPACT WORKING GROUP REPORT

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ABSTRACT

The European New Car Assessment programme (Euro NCAP) has been evaluating frontal impact protection since 1997. The current moderate off-set test procedure is based on that used in UN Regulation 94 (R94) but with the addition of child dummies in the rear and more stringent assessment criteria for the occupants.

Until advanced driver assistance systems become more widespread in the market, front and side impacts will continue to dominate the proportion of killed and seriously injured occupants on our roads. However, there is a clear need for a more advanced test to be adopted for the following reasons: Accident analyses have highlighted the need for improvements in the way vehicles are assessed in partial overlap frontal impacts, particularly in terms of structural engagement or 'compatibility'. In addition, the accident related injury pattern has changed over the years and, in addition to the current test configuration, the Hybrid III dummy no longer reflects the current injury situation in crashes nowadays.

In 2015 Euro NCAP announced that the current offset deformable barrier frontal impact test procedure and Hybrid III dummy would both be replaced by 2020 and a frontal impact working group was set-up to address this. The aim was to evaluate the existing research by FIMCAR, ADAC and other organisations into the 'moving barrier to vehicle' test and to develop new testing and assessment procedures that include the Thor-M mid-sized male ATD. In partnership with the European Enhanced Vehicle safety Committee (EEVC), Euro NCAP examined the extent to which the Thor-M ATD is suitable for use in both Regulatory and consumer testing programmes.

This paper details the group's work to date in reviewing real world accident data and existing research on partial overlap frontal impacts. Significant factors highlighted by the accident analyses, including speed, mass and impact overlap, were used to guide the development of a frontal impact test procedure consisting of a moving barrier to car fitted with a progressively deformable honeycomb barrier face. Research into the definition of the Thor-M ATD, in terms of its build level, injury responses and certification procedures, is also included along with proposed assessment criteria. The final phase of work will be a full scale test programme to evaluate the testing and assessment protocols before implementation into the official assessment in 2020.

BACKGROUND

The 64km/h offset deformable barrier test (ODB) has been used by Euro NCAP in all of its vehicle ratings since 1997 when the first phase of results was launched. The test is based on that used in Regulation 94 but with a higher impact speed, child dummies in the rear, and more stringent assessment criteria for the front occupants. The test has remained largely unchanged in 20 years but vehicle structures and restraints systems improved significantly since the introduction. This has led to a substantial reduction of killed persons in frontal impact scenarios.

Since the start, Euro NCAP has strove to be a catalyst for vehicle safety by empowering vehicle safety engineers and delivering comparative and objective information to the public. This means that the rating system has been continuously reviewed and updated to reflect real-world priorities and available safety technology.

In 2015 Euro NCAP published their latest roadmap and, alongside many other updates, it was agreed that the current frontal ODB impact test procedure and Hybrid III dummy should both be replaced considering the advancements made and current frontal impact accident data.

A frontal impact working group (FIWG) was set-up to improve the methods that are used to assess the occupant protection offered by vehicles in moderate overlap frontal crashes. It was decided that the current fixed offset deformable barrier impact test will be replaced by a mobile barrier test with a progressive deforming element (MPDB) in the year 2020. The basic parameters for such a test have been previously researched in the European FIMCAR and VC Compat projects [1,2], by NHTSA [3] and recently applied and refined by ADAC [4] in a series of vehicle tests. In addition to revised testing parameters, the use of the advanced anthropomorphic test device THOR was considered to offer additional benefits in improved humanlike response and injury assessment capability.

ACCIDENT ANALYSIS

The work of the group began with accident analysis to quantify the frequency and severity of frontal impacts involving passenger cars according to overlap angle of impact and impact velocity in Europe. As Europe lacks a single harmonised database for accident studies, three separate databases were used in the analysis: the German in depth accident data (GIDAS), the French accident data (LAB) and the (Swedish) Volvo Car traffic accident database (VCTAD). This accident research is not available in the public domain, but it is summarised in this paper.

It should be noted that the sampling and data collection strategy applied for these databases is generally different in each case. As inclusion filters applied to each database can have a significant impact on the outcome, it was agreed by the group to agree on the following filters for the analysis:

- Accidents from 2000 onwards.
- Vehicles of model year 1998 onwards.
- Frontal impacts (no multiple impacts).
- Direction of force from 10 o'clock to 2 o'clock (longitudinal engagement).
- Delta V or EES of 15km/h.
- Collision partner – cars.
- Belted occupants in any seating position and all ages.

After application of the filters, the remaining cases were analysed and are summarised in Table 1.

	GIDAS	Volvo Cars Traffic Accident Database	LAB (weighted data)
Accidents	2000+ Germany Injured accidents	2002+ Sweden High repair costs	2000+ France Injured+ accidents
Vehicles	Cars MY 1998+ or Reg. 2000+	Volvo cars MY 1998+	Cars MY 1998+
Impacts	Frontal (no multiple) Longitudinal beam engaged DoF 10 to 2 o'clock $\Delta V \geq 15$ km/h or EES ≥ 15 km/h	Frontal (no multiple) No 1/3 central impact DoF 10 to 2 o'clock EES ≥ 15 km/h	Frontal (no multiple) Longitudinal beam engaged DoF 10 to 2 o'clock $\Delta V \geq 15$ km/h or EES ≥ 15 km/h
Collisions	Opponent: cars, all impacts and angles		
Occupants	Belted or in CRS, all seat positions, all ages, injury severity ≥ NISS2+		
Sample Number	447	168	633
MAIS 2+ Number	139 (31% of NISS2+)	42 (25% of NISS2+)	317 (50% of NISS2+)
MAIS 3+ Number	28 (6% of NISS2+)	9 (5% of NISS2+)	133 (21% of NISS2+)

Table 1: Summary of cases analysed

All databases used in the analysis showed a similar picture with only slight deviations due to restrictions of the data collection, as presented below.

A) Impact angle and overlap

For MAIS 2+ injuries:

- Main direction of force, 12 o'clock, impacts cover 61% (GIDAS) and 73% (LAB) of injured belted occupants.

- The main overlap found is 100% in GIDAS (55%) and maximum of 2/3rd in LAB data (45%)
- The combined result of overlap and direction of force gives the following result, 12 o´clock and 2/3rd: 18% (GIDAS and 32%(LAB), while 11+1 o´clock and 2/3 are showing 12%(GIDAS) and 13%(LAB) of frontal impact scenarios.

For MAIS 3+ injuries:

- Main direction of force 12 o'clock covers 63% (GIDAS) and 74% (LAB) of injured belted occupants.
- The main overlap is 100% in GIDAS (61%) and a maximum of 2/3rd in LAB (47%).
- The combined result of overlap and direction of force give the following data, 12 o´clock and 2/3rd: 14% (GIDAS and 37%(LAB), while 11+1 o´clock and 2/3 are showing 11%(GIDAS) and 11%(LAB) of frontal impact scenarios.

The result of this accident data suggests that Euro NCAP should continue to test at a configuration of 12 o´clock impact, and a maximum overlap of 2/3rd of the vehicle front. In order to enable a potential compatibility rating of the whole vehicle front structure, the overlap was finally chosen to 50% of the impacted vehicle.

B) Impact speed

Applying impact angle and overlap, a further analysis of the accident data was carried out to determine impact speed. The data shows a median EES of 56km/h for MAIS 2+ and 60km/h for MAIS 3+ injuries (LAB) while the impact speed in GIDAS was slightly less. With the experience of earlier tests carried out in this configuration, compared to a car to car impact, the impact speed was set to 50km/h for both trolley and vehicle. Consideration was given to the having a stationary vehicle impacted by a trolley travelling at 100km/h. This configuration was not deemed practicable due to concerns with the deformation of the barrier face being raised.

C) Mass of impacted vehicles

The MPDB test procedure should reflect the real world accident scenarios in Europe. Due to this fact, the vehicle mass of the current vehicle fleet in Europe was taken into account. While accident data of LAB showing a mass ratio from 0,5 to 1,5 and median masses around1200kg, the compact class, which is sold most in Europe has a vehicle mass in average of 1,4t. Hence, a preliminary trolley mass of 1400kg has been chosen.

D) Affected body regions

A further analysis of the LAB data found that for drivers, the abdomen, thorax and lower legs were the main body regions suffering MAIS3+ injuries. For front seat adult passengers, abdomen and thorax injuries stand out.
A separate study was undertaken by ADAC, using their accident data base to have a closer look into lower leg MAIS 2+ injuries. This study suggested that the main lower leg injuries are soft tissue injuries, 23% femur or tibia/fibula fractures and 20% ankle joint injuries. The actual Hybrid III lower legs could cover the ankle and tibia/fibula injuries, however soft tissue injuries could not be detected, neither by the THOR-LX legs, nor by the Hybrid III-legs. Hence, the decision was taken to continue the use of the Hybrid III-legs in a first stage.

TEST SPECIFICATION AND REVIEW OF THE MOBILE PROGRESSIVE DEFORMABLE BARRIER TEST

All results of the accident analyses provided the baseline for the following test configuration.

- A 12 o´clock frontal impact
- with 50% overlap of the bullet car.
- The mobile barrier has an impact mass of 1400kg.
- Both vehicle and barrier have an approaching speed of 50km/h.

With regards to the latter point, the group reviewed the possibility to carry out a stationary versus moving car similar to the US NCAP proposal. However, due to more realistic approach and for better consumer understanding, the decision was taken to have both vehicles travelling at a speed of 50km/h. A diagram of the basic MPDB test set-up is provided in Figure 1.

Currently Euro NCAP uses the EEVC deformable barrier in the 64km/h ODB impact test. With the decision move towards a 180-degree impact without any oblique impact angle, a compatibility rating based on barrier face deformation would be possible as otherwise the aluminium honeycomb will not be able to produce stable footprints. The existing EEVC barrier is not suited for such assessment however.

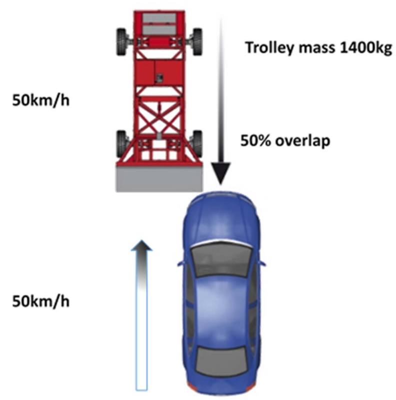


Figure 1: Impact condition of the MPDB test

A great deal of research already exists in the development of progressive deformable barrier. Many organisations, from governments to vehicle manufacturers and suppliers, have carried out frontal impact research over the last 15 years and discussed potential new barrier solutions. In particular, the European 7th Framework project Frontal Impact and Compatibility Assessment Research (FIMCAR) provides a summary of numerous research projects into the use of metrics and procedures that can be used to measure vehicle compatibility [1].

This research has formed the basis of discussions in the Euro NCAP FIWG. Two barrier faces were considered by the group: the MPDB XT as submitted to GRSP [5] and the MPDB XT-ADAC version, a reduced height variant.

The group evaluated the results of full scale moving barrier tests with the XT barrier and it was noted that it allows loading to be applied in an area equivalent to the upper facia level of small cars. This loading was observed in full scale tests of a Ford Fiesta and a Peugeot 308, as well as in comparable MPDB test with the Ford Fiesta and different sizes of PDB XT barriers performed at ADAC. With this in mind, ADAC developed a revised version of the barrier that reduced in height from 700mm to 567mm. Full scale testing and numerical simulations were performed comparing these two barriers and showed that the barriers and vehicle performed similarly both in terms of the self and partner protection. The group agreed that loading should be applied in a more restricted area than that permitted by the PDB XT to improve the consistency of the measurement.

DEVELOPMENT OF THE EURO NCAP PDB FACE SPECIFICATION

Although the PDB face is already well documented, there has not been any design/build specification of sufficient detail available that could be used for Euro NCAP testing. It is essential that the barriers used in the official tests are constructed in a way that is repeatable and reproducible, regardless of the barrier supplier. Starting from the existing PDB XT barrier details [5], a Euro NCAP barrier specification has been developed by an ad-hoc group of Euro NCAP representatives and three barrier manufacturers. This specification is detailed in Euro NCAP Technical Bulletin TB022 [6].

The original XT version of the barrier is constructed from four honeycomb blocks [5]. However, as the Euro NCAP version has a reduced height, it was not practicable for the upper block (termed 3 in the GRSP document) to be reduced in height to 100mm. It was decided that the middle block should be simplified into a single honeycomb core. This simplifies the design, improves repeatability and saves production costs.

The construction of the Euro NCAP MPDB is shown in Figure 2. The impactor consists of three layers of honeycomb blocks (A, B and C), the principal dimensions of all blocks are 1000 ± 2.5mm x 568 ± 2.5mm. The three blocks are stacked; the rear block (A) is 90 ± 1.0mm deep, the middle (B) block is 450 ± 1.0mm deep and the front block (C) is 250 ± 1.0mm deep. Blocks A and C have a homogeneous crush strength, whereas block B increases in crush strength with depth. Between the blocks are intermediate plates and the front block is covered by a contact plate 1.5mm thick to limit the likelihood of the barrier tearing apart when impacted. The barrier is then wrapped in a cladding plate and supported at the rear by a backing plate. Rivets have been used to connect the contact and cladding plates.

Qualification of the revised PDB XT barrier

The certification of the original PDB XT barrier was based on static and dynamic tests. The revision of the height and the stiffness of the main block are not allowing that the same certification process for the new PDB element can be used. Therefore a new certification process needs to be defined, where the old procedures could be taken on board, but different corridors and loadings have to be taken into account.

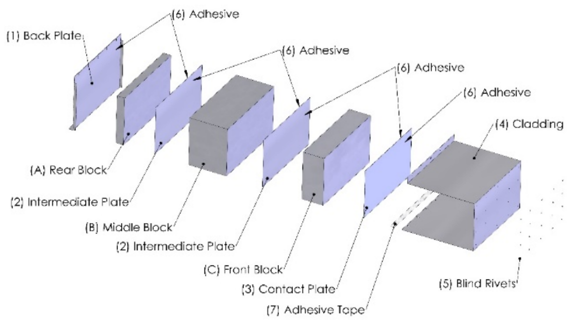


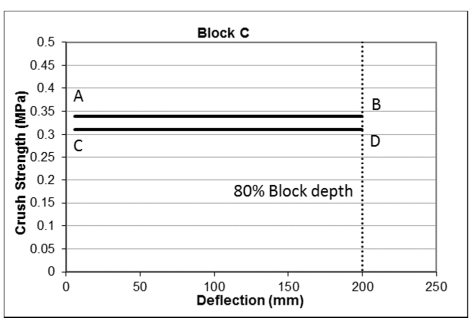
Figure 2: Exploded isometric view of MPDB

Quasi-static testing

The barrier manufacturers have provided data from honeycomb samples for comparison. The different layers of honeycomb will be tested quasi-static individually. The elements will have the following specifications, see Figure 3:

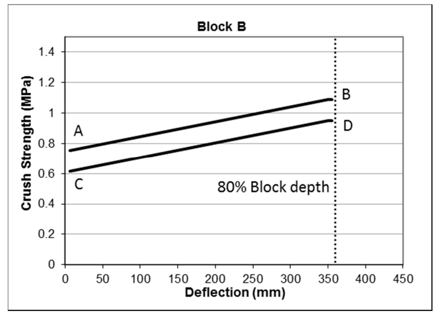
Front honeycomb block "C":

	Displacement	Crush strength
A	6mm	0.34MPa
B	200mm	0.34MPa
C	6mm	0.31MPa
D	200mm	0.31MPa



Centre/Main progressive honeycomb block "B":

	Displacement	Crush strength
A	6mm	0.76MPa
B	350mm	1.09MPa
C	6mm	0.62MPa
D	350mm	0.95MPa



Rear honeycomb block "A":

	Displacement	Crush strength
A	6mm	1.71MPa
B	72mm	1.71MPa
C	6mm	1.54MPa
D	72mm	1.54MPa

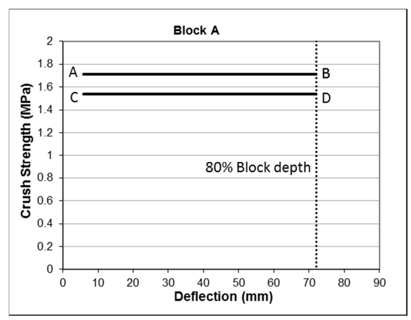


Figure 3: Stiffness of honeycomb material

Dynamic testing

Euro NCAP is still considering the need for dynamic barrier certification tests. Two possibilities are available, a rigid loadcell wall test and/or a tubular impactor test that offers loading that is more representative of a vehicle. A review of both options is currently taking place.

Trolley Specification

Several simulations were carried out by vehicle manufacturers to show the influence of wheel base, track, position of the CoG and positioning of the deformable element. The results of the simulations show an insignificant effect on the vehicle results for different sizes of vehicles. Two existing trolley designs were considered to be used in the test. This is the FMVSS 2014 trolley and the AE-MDB trolley. As the mass of the AE-MDB trolley will be aligned with the MPDB trolley in the near future, the use of the AEMDB trolley is preferred for the MPDB test. The specification of the AE-MDB trolley is the following, wheel base is 3000+/-10mm and track width 1500+/-10mm. A final decision about trolley for the MPDB will be taken after the first round robin validation tests planned in the next phase of the work.

ADOPTION OF ADVANCED ANTHROPOMETRIC TEST DEVICE THOR

The accident analyses highlighted a significant number of MAIS 3+ chest and abdominal injuries and MAIS 2+ lower extremity injuries, despite many advancements made in vehicle safety over the years. In pursuing a further reduction of these injuries in the real-world, many have pointed out that the Hybrid III 50%ile male dummy, used in most testing today, has reached its limit. To make progress, a more biofidelic and restraint sensitive test device would be needed.

To that effect, Euro NCAP has long planned to replace the Hybrid III 50%ile male by the Test device for Human Occupant Restraint (THOR-M) 50%ile male dummy, which has better biofidelity and generally reflects a human person in a better way than the Hybrid III dummy. However, there have been several issues with the durability, repeatability and reproducibility with the first THOR dummies in use, which have put the THOR's dummy readiness in doubt. To address the concerns, Euro NCAP and EEVC have joined forces in the THOR Evaluation for Frontal Impact Regulation (TEFIRE) group.

The TEFIRE group has collected data of THOR users in Europe and elsewhere to gain insight in the R&R of the latest version of THOR-M in daily use. The group found that the dummy's repeatability is considered to be Excellent or Good in most available data, including in sled tests. However, some remaining problems were found regarding reproducibility, particularly for the thorax. It should be noted, however, that a study into the reproducibility of the injury metrics has suggested that the metrics (used for rating) are less variable than the individual measurements.
R&R tests of working group members were also taken into account including sled tests and car to car impact tests. As part of this work, the BAST (German Road Administration) carried out sled tests with different THOR dummies and repeated these sets several times. The test setup included airbag and load limiter function of the seat belt. See Figure 4.

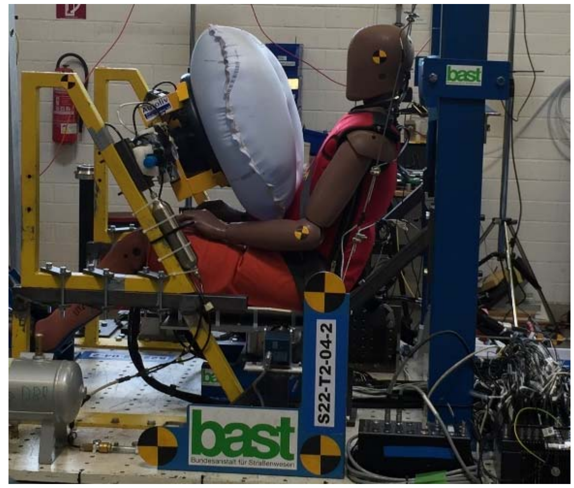


Figure 4: THOR R&R sled testing

Table 2 shows the overall result of the repeatability of two THOR-M dummies and the reproducibility of these two dummies in the BASt sled test series. While the repeatability is excellent or good for all values the reproducibility is good for nearly all the values the lower ribs still show poor reproducibility.

	repeatability BASt	repeatability Humanetics	reproducibility BASt to Humanetics
Rib right upper	6,99%	7,27%	6,98%
Rib left upper	3,71%	5,22%	7,91%
Rib right lower	8,69%	7,23%	15,22%
Rib left lower	1,88%	5,64%	11,70%
Head acceleration in x	2,08%	1,53%	6,23%
Lower Neck in x	4,86%	2,51%	5,61%
Lower Neck in z	5,90%	5,84%	9,30%
Pelvis acceleration in x	4,24%	3,69%	3,89%
Abdomen disp. left	1,60%	1,53%	9,47%
Abdomen disp. right	1,68%	2,08%	7,95%

Table 2: R&R results from sled tests

Three full size vehicle crash tests have been carried out by ADAC to check the repeatability and reproducibility of the THOR dummy in a vehicle surrounding. The results of this test show the good repeatability of the THOR dummy in a vehicle test, as seen in the sled test the lower ribs show the highest deviation. Similar to the results of the sled tests, these full scale tests shows adequate reproducibility. See
Table **3** and Figure 5.

REGION	CRITERION	Test 1	Test 2
HEAD	HIC15	516,57	475,93
	BrIC	*Not measured*	
	Res. Acceleration	70,72g	74,74g
NECK	Tensile Force Fz+	1,44kN	1,22kN
	Compressive Force Fz-	-0,18kN	-0,37kN
	Nij	0,73	0,57
	cNij	0,55	0,45
CHEST	Deflection X		
	Left Upper	-11,23mm	-6,87mm
	Left Lower	-12,35mm	-9,55mm
	Right Upper	-33,34mm	-33,34mm
	Right Lower	-18,29mm	-21,14mm
	Deflection R		
	Left Upper	16,05mm	15,96mm
	Left Lower	23,36mm	21,80mm
	Right Upper	38,32mm	39,04mm
	Right Lower	26,06mm	28,74mm
	Max Rmax	38,32mm	39,04mm
SPINE	T1 Acceleration R		84,91g
	T4 Acceleration R		51,69g
	T12		
	Force R	2,95kN	4,55kN
	Torque R	116,22 Nm	120,84Nm
ABDOMEN	Deflection R L	65,21mm	63,92mm
	Deflection R R	53,79mm	55,06mm
PELVIS	Deceleration R	68,57g	81,45g
	Femur		
	Force Fz- Left	-5,24kN	-6,39kN
	Force Fz- Right	-5,80kN	-7,52kN

Table 3: Dummy results

Figure 5: Car to car impact with THOR dummy

During the impact test series carried out in the TEFIRE R&R program, including severe impact scenarios with vehicle deceleration of about 60g, there were no noticeable durability issues.

Seating & seating procedure

Euro NCAP carried out two seating position workshops to trail the proposed seating procedure by NHTSA. At this stage, Euro NCAP plans to adopt the NHTSA seating procedure for the driver THOR 50%ile male.

So far it is planned to use the THOR dummy just on the driver position. Several tests will be conducted with a second THOR on the front passenger seat to check if there will be a need to have a second dummy included on the front row. The alternative is to have the Hybrid III 50% male on the front passenger seat for the Euro NCAP MPDB test.

Dummy hardware configuration

As Euro NCAP and TEFIRE were evaluating THOR-M, further hardware updates have been incorporated at the request of NHTSA, Euro NCAP and other users. For its 2020 implementation year, Euro NCAP has agreed to use the current THOR SBL-A specification as the platform. However, some modifications to standard SBL-A will be needed to use the dummy for the future Euro NCAP MPDB test.

Euro NCAP is aware that the heavy cable umbilical and data acquisition system in the car boot may have an adverse effect on the dummy and vehicle responses and therefore is actively promoting the use of in dummy DAS. Depending on the preferred supplier solution, this requires a modified spine box to place the data acquisition system in the dummy. This new spine will also allow a more repeatable adjustment of the seating position, as it limits the number of settings. See Figure 6.

Figure 6: Modified spine box (Humanetics)

As mentioned previously, Euro NCAP will use the standard Hybrid III 50th male lower legs, while the interface will be the knee joint of the THOR dummy, slider of the THOR knee and fork of the Hybrid III upper Tibia.

To detect submarining of the dummy, a set of ASIS load cells will be installed in the pelvis. These load cells will have a rounded cap to avoid them cutting into the lap belt. An additional attached sternum mass will have a better repeatability in the calibration process. All the above changes will become part of the Euro NCAP “SBL-A for Euro NCAP” specification.

The THOR instrumentation list is detailed in Table 4 on the next page.

DUMMY CALIBRATION

NHTSA has released a set of draft verification procedures for THOR-M based on their own certification needs and dummies.

Euro NCAP is currently setting up a round robin test program, which will include European, Asian and North American calibration labs and dummies in the field. The objective is to recognize issues during calibration, dummy issues and confirm calibration corridors based on a realistic set of dummies. This work will start April 2017 and is scheduled to finish by the end of 2017.

LOAD CELLS / IR-TRACCs

CH	*QTY*	*Instrument*
12	4	IR-TRACC Assy, 3D Thorax
6	2	IR-TRACC Assy, 3D Abdomen
2	2	Skull Spring Load Cell
6	1	Upper Neck Load Cell
4	2	A.S.I.S Load Cell
4	1	Clavicle Load Cell Left
4	1	Clavicle Load Cell Right
5	1	Thoracic Spine Load Cell
3	1	Acetabulum Load Cell Left
3	1	Acetabulum Load Cell Right
12	2	Leg Load Cell (Femur)
10	2	Tibia Load Cell Upper
10	2	Tibia Load Cell Lower

POTENTIOMETERS

CH	*QTY*	*Location*
2	2	Knee (BBKS)

Angular sensors

CH	*QTY*	*Location*
2	1	Head
2	1	Chest
2	1	Pelvis

ACCELEROMETERS

CH	*QTY*	*Location*
3	3	Head
3	3	T1
3	3	T4
3	3	T12
1	1	Mid Sternum
1	1	Upper Abdomen
3	3	Pelvis

Table 4: Dummy instrumentation

ASSESSMENT CRITERIA

Dummy Criteria

Euro NCAP’s assessment of adult occupant protection in the new MDB tests will be based on the same principles as the current ODB test. This means the test result will be based on dummy values, derived from lower and higher performance limits against a set of dummy criteria, and restraint and structural modifiers. At this stage, only tentative dummy criteria and provisional working limits, have been discussed in the group. A decision on a list of final dummy parameters and limits is expected before the end of the year.
3D measurement data of the vehicle and modifiers will be used to define modifiers. The modifiers will include airbag deployment, bottoming out of airbags, knee impact zone, pedal and footwell intrusions, as well as submarining of the dummy or door opening and vehicle body stability.

List of preliminary assessment criteria

- HIC15
- BrIC (monitoring)
- Nij
- C-Nij (monitoring)
- Chest displacement / Rmax
- Chest displacement / PCA (monitoring)

- Abd compression
- Left acetabulum load
- Right acetabulum load
- Left femur force
- Right femur force
- Left knee shear displacement
- Right knee shear displacement
- Left tibia index
- Right tibia index
- Left tibia compression
- Right tibia compression
- Pedal rearwards displacement

Table 5: Injury criteria

Compatibility assessment

The aforementioned European research projects, FIMCAR and VC Compat, as well as consumer protection Institutions, such as ADAC and the FIA, have studied the incompatibility between cars for several years. This research has identified mass differential, stiffness of front structures and geometric alignment as the parameters most influencing vehicle incompatibility.

The PDB XT barrier was developed to replicate a vehicle front structure with a progressive structure. The last sheet, with the highest stiffness, is present to avoid bottoming out of the alloy honeycomb and allows a calculation of the energy absorption of the barrier.

A 180° impact scenario, as it will be used in Euro NCAP from 2020 onwards, will lead to a nearly vertical loading of the barrier, which enables a good calculation of the energy transferred into the barrier and measurement of the footprint in the barrier by scanning the intrusion depth, see Figure 7. The trolley deceleration provides an alternative means to assess the impact energy that is transferred to the trolley.

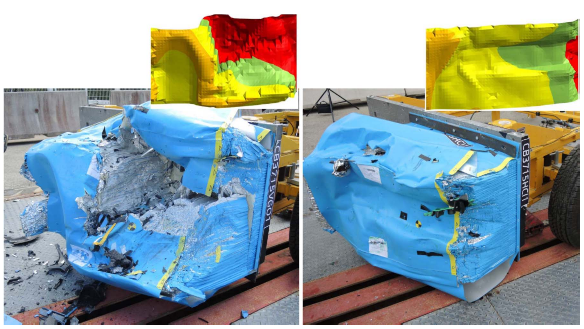


Figure 7: PDB barrier and scan

Euro NCAP is currently reviewing how these measures can used to rate the aggressiveness of the vehicle front-end. The idea of a compatibility rating for Euro NCAP is still under development, but some basic work has been undertaken by ADAC already for some years. ADAC uses a method by which certain area of the PDB element will be digitised before and after impact to calculate the intrusion depth. By using the intrusion depth and energy absorption, the horizontal and vertical spread of intrusion depth can be evaluated. The measurements are transferred into a spreadsheet for analysis, an example of this is shown in Figure 8. Initial results of this method are encouraging and allow for a useful comparison between vehicles.

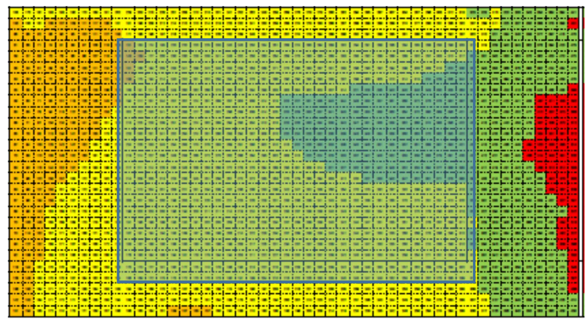


Figure 8: Digitising of intrusion depth.

VERIFICATION OF THE DRAFT PROCEDURE

In 2017, the first validation of the test procedure will be undertaken by the working group. Data will be gathered from different vehicle classes to verify the injury criteria of the THOR dummy, provide additional input for the compatibility rating and allow for a review of the test protocols.

Next year, a final round robin test series will be undertaken with all the labs included in the Euro NCAP program to check the repeatability of the test method across different labs and allow for final adjustments of the testing and assessment protocol. The final protocol release is planned in autumn 2018 for implementation in the year 2020.

CONCLUSIONS

With the introduction of the MPDB test, Euro NCAP is revising its offset frontal impact protocols based on the latest information from accident data and state of the art measurement equipment. The new test setup will replicate vehicle to vehicle crashes in a more realistic way than that of the current 64km/h ODB test. The ATD used in the test should address the most common issues seen in the European accident data bases, which is are thoracic and abdominal injuries. With the development of a compatibility rating, better interaction and alignment of vehicle front crash structures should be promoted to cover a broader range of front impact scenarios.

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Members of the FIWG are:

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