IWG-DPPS/1/06

IWG-DPPS Comments

Dynamic Testing

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Background

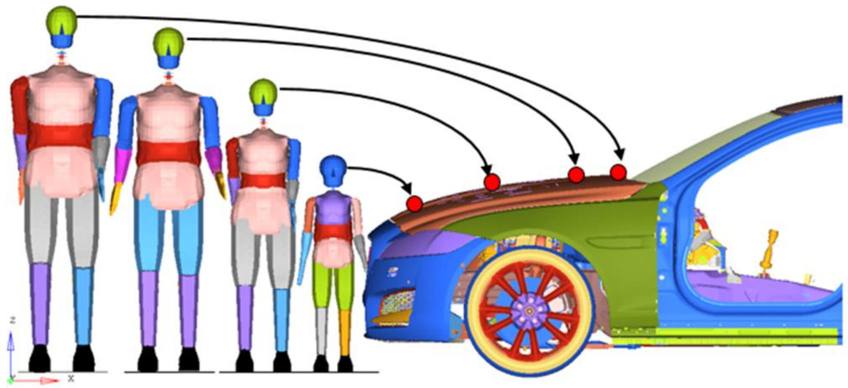
- For deployable systems that do not have a permanently deployed position or TRT>HIT, dynamic testing is required ensuring synchronisation of the head form launch device and system deployment to achieve correct head impact time
- For deployable systems that do not have a permanently deployed position mark-up for both type approval and Euro NCAP is conducted with the bonnet in an undeployed position

Dynamic Testing

- To enable dynamic tests to be completed head impact time, sensing time and total time from rig start to head impact are required inputs

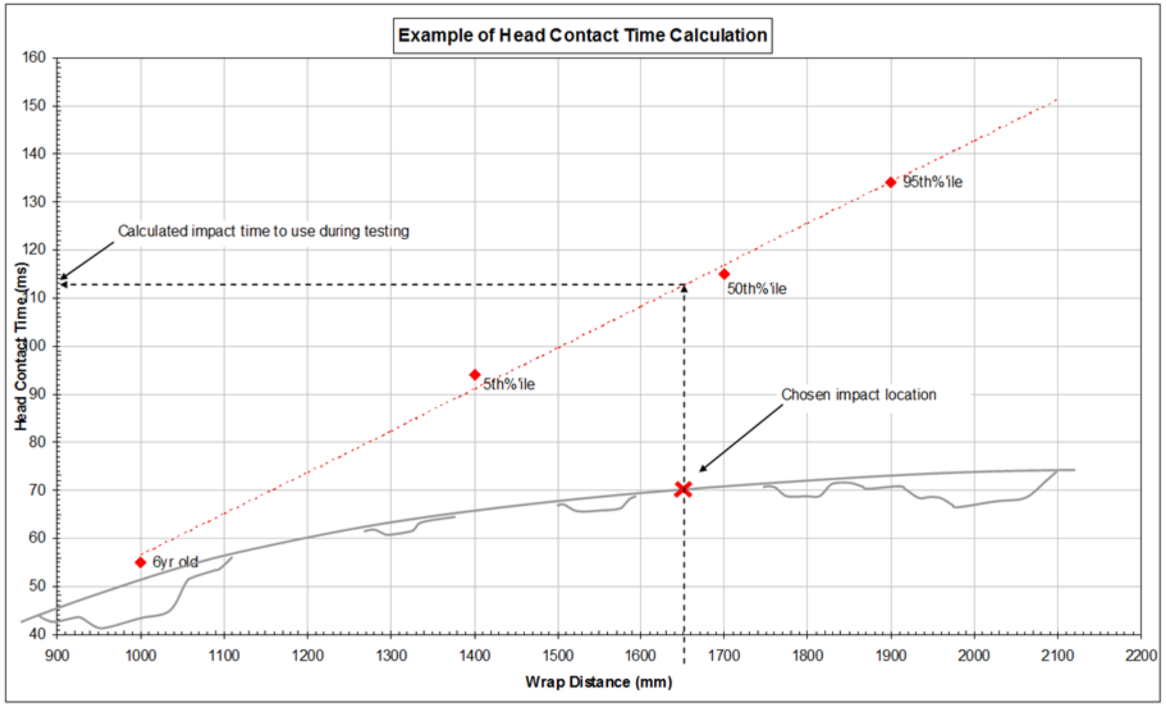
Head Impact Time (HIT)

- Humanoid model is used to establish HIT and equivalent WAD to undeployed bonnet
  - Simulations conducted with a vehicle speed of 40km/h at vehicle centreline with pedestrian statures that contact the deployable system



Dummy	Time to contact (ms)	Wrap Around Distance (WAD) mm
6YO	64.0	965.1
5%tile	85.0	1403.7
50%tile	117.0	1818.5
95%tile	132.0	1979.5

Head Impact Time (HIT)



- Data is plotted on a graph and linear best fit straight line generated (harmonised with Euro NCAP process)
- When a test point is chosen, as the wrap around distance will be known, the equivalent head contact time can be obtained from the graph that will be incorporated into the dynamic test set up

Sensing Time (ST)

- Sensor fire times are determined from 40km/h lower leg testing carried out during internal sensor calibration testing
  - ➢ Vehicle manufacturer declares worst case (longest) sensor time to be used during the dynamic head impact test

Total Time From Rig Start to Head Impact (TT)

- For synchronisation the rig's TT from rig start to head impact onto the undeployed bonnet is required for each impact angle, speed and head type. This is achieved by conducting several runs of each combination of speed and angle for the child and the adult head. Here is an example of the data:

Adult

Test	Angle	Speed	Impact speed	Time trigger	Time launch	Time delatch	Time impact
1			19.896	0	4.4	245.9	307.7
2	50	20	20.357	0	4.25	245.05	306.7
3			19.886	0	3.45	245	306.75
1							
2	50	25	25.553	0	4.15	192.35	245
3			25.503	0	3.45	191.95	244.85
1			35.017	0	3.55	148.2	194.7
2	50	35	35.018	0	4.2	148.3	195
3			35.038	0	4.35	148.7	195.15
1			40.388	0	4.2	129.4	174.35
2	50	40	40.583	0	4.2	128.95	174.05
3			40.421	0	3.75	129.2	174.15
1			20.159	0	3.55	247.35	313.3
2	65	20	19.952	0	4.65	248.15	313.8
3			20.177	0	4.3	247.8	313.4
1			25.261	0	3.3	195.3	252.8
2	65	25	25.406	0	3.2	195.1	252.9
3			24.96	0	3.4	195.5	252.9
1			34.427	0	4.05	150.5	197.8
2	65	35	35.111	0	4.25	149.6	197.3
3			35.277	0	4.2	150.45	197.95
1			39.744	0	4.35	132.7	178.6
2	65	40	39.933	0	4.4	132.35	178.4
3			40.391	0	4.75	132.8	178.75

TT

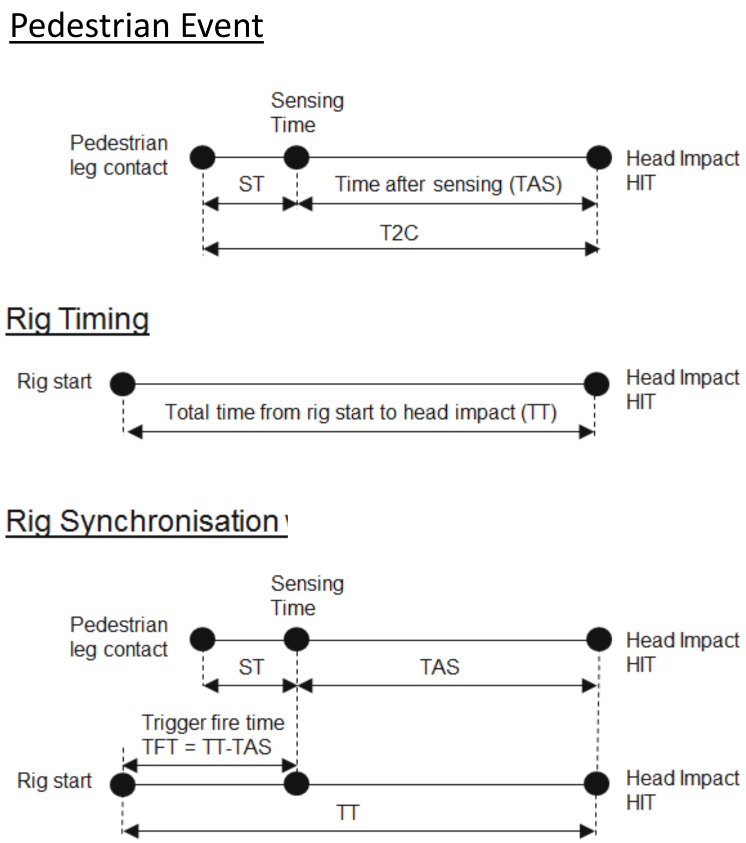
Child

Test	Angle	Speed	Impact speed	Time trigger	Time launch	Time delatch	Time impact
1			20.153	0	4.7	230.95	301.05
2	20	20	20.127	0	5.2	231.45	301.6
3			20.13	0	4	231.1	301
1			24.335	0	3.95	190	254.2
2	20	25	24.371	0	4.2	190.15	254.35
3			24.375	0	3.4	189.85	254.5
1			34.887	0	3.6	135.3	189.75
2	20	35	34.968	0	3.85	135.9	190.25
3			34.824	0	3.8	136.2	190.7
1			39.692	0	4	122.2	173.2
2	20	40	39.67	0	4.05	122.85	173.75
3			39.838	0	3.85	122.6	173.75
1			19.561	0	3.95	240.7	303.05
2	50	20	19.992	0	4.3	240.5	303.3
3			19.819	0	4.45	240.3	302.85
1			24.233	0	4.35	195.25	250.6
2	50	25	23.93	0	4.85	194.8	250.15
3			23.86	0	6.25	197.1	252.65
1			34.866	0	3.85	143.85	190.6
2	50	35	34.837	0	3.6	143.35	190.25
3			34.697	0	3.95	144	190.9
1			39.944	0	3.9	126.65	171.6
2	50	40	39.914	0	3.8	126.6	171.6
3			40.066	0	3.7	126.7	171.9

TT

Rig Synchronisation

- Using the HIT graph for each impact point the time it takes the humanoid's head to hit the undeployed bonnet is calculated. The rig is then synchronised adjusting the trigger firing times to match the required HIT



ST = Sensing Time
TAS = Time after sensing
T2C = Time to contact calculated from CAE
TT = Total time head impact for the pedestrian test rig
TFT = Trigger fire time set in the pedestrian test rig

Example:

Child test 35 km/h at 50 degrees. According to the rig set up the TT = 190 ms
Test point is at WAD = 1000
From HIT graph T2C=32ms
ST = 19 ms
TAS = 13 ms
The trigger firing time set in the pedestrian rig is:
TFT = TT-TAS = 190-13 = 177 ms
The deployment signal will be initiated after 177 ms from launch start of the head

Dynamic Testing - Alignment Challenge

- When conducting dynamic testing the selected test point moves in XZ plane. As a result if the test point is targeted in the undeployed position there is a risk that the +-10mm impact tolerance will not be achieved
- For dynamic testing of deployable bonnets the bonnet is manually raised to its deployed position and the head impactor realigned to impact the selected test point. The bonnet is then returned to undeployed position
- The above method is not 100% reliable and based on previous type approval experience a limited number of repeat tests may be required
- Euro NCAP waiver the +-10mm head impact accuracy in X direction for deployable systems
- Additionally it is not feasible to measure impact accuracy on airbag systems or areas of bonnet with unique profiles eg. concave surface

Proposal: Remove the +-10mm impact tolerance in X direction

Impact Velocity Measurement Using Accelerometer

- Some pedestrian rigs cannot use laser to measure impact velocity and as a result use integration of the head accelerometer
- When using a fully electric test rig inconsistencies have been seen in the measurement of the speed using wired heads by integrating head accelerometer. Potentially this could have been caused by the magnets of the electric motors interfering with the data cables producing excessive noise
- When using wireless heads, the integration of the accelerometer has resulted in consistent speeds

Proposal: Integration of head accelerometer or use of laser are both acceptable methods to measure impact velocity

Total Response Time (TRT) Test Requirement

- Dynamic testing ensures synchronisation of the headform launch device and deployable system deployment to achieve correct head impact time
- When dynamic tests are conducted the total response time of the system becomes irrelevant

Proposal: If dynamic testing is required to be conducted an additional TRT test is not required