**Pedestrian Headform Test Procedure for Vehicles Equipped with Active Devices for Pedestrian Protection**

1. **Application**

1.1. For vehicles equipped with active devices for pedestrian protection such as an active bonnet (hereafter called “Protection Device”), the test conditions for system activation tests and headform tests shall be determined in accordance with this test procedure.

1.2. A manufacturer shall provide the agency with detailed information with regard to the activation of the Protection System during headform tests to be used to identify if the Protection System is fully activated, partially activated or not activated upon head impact.

1.3. The agency shall determine the activation state of the Protection System in headform tests by referring to the information provided by the manufacturer, this test procedure and discussion with the manufacturer.

2. **Detection Test for the Hardest-to-Detect Pedestrian**

2.1. Test Tool Representing the Hardest-to-Detect Pedestrian

2.1.1. Detection tests shall utilize a test tool representing a hardest-to-detect pedestrian (hereafter called “HTD”). PDI2 or other tools may be used as a test tool representing HTD.

2.1.2. In case a tool other than PDI2 is used to represent HTD, the validity of the use of the tool shall be shown by means of the methods as specified in paragraphs 2.1.2.1. through 2.1.2.5.

2.1.2.1. Numerical or physical models representing 6YO, F05, M50 and M95 shall be used to identify HTD.

2.1.2.2. The pedestrian models shall be positioned with a mid-gait cycle facing laterally to the direction of travel of a vehicle.

2.1.2.3. The data showing the biofidelity of the pedestrian models used to identify HTD shall be submitted to the agency. In case that the pedestrian models specified in Euro NCAP TB013, data submission may be exempted.

2.1.2.4. For each of the pedestrian model, HTD shall be identified in the vertical longitudinal plane at both the vehicle centerline and the outer-most grid point for which the Protection System may or may not be activated and the activation influences the test result.

2.1.2.5. The pedestrian providing the longest sensing time of the Protection System (hereafter called “ST”) in all combinations of the pedestrian model and the impact location shall be defined as HTD. For the identified HTD, an appropriate test tool to be used for system activation tests representing properties of the pedestrian for HTD shall
be identified, and the equivalence of its properties to those of HTD shall be demonstrated.

2.2. Test conditions

2.2.1. The system activation tests shall be conducted using a test tool representing HTD at two impact locations specified in paragraph 2.1.2.4. by the manufacturer or the test laboratory. The agency shall confirm that the tests were conducted appropriately.

3. Headform Test Conditions

3.1. HIT-WAD diagram

3.1.1. The manufacturer shall provide the agency with crash simulation results conducted using an appropriate position of the Protection System and a travel speed of the vehicle (the manufacturer and the agency shall discuss and confirm the results by taking the track records from Euro NCAP into consideration). All of the pedestrian models representing 6YO, AF05, AM50 and AM95 shall be used unless the head does not contact the area of activation of the Protection System. The posture of the pedestrian models shall comply with paragraph 2.1.2.2. and the impact location shall be at the centerline of the vehicle.

3.1.2. The relationship between the head impact time (HIT) and the wrap around distance (WAD) shall be plotted using the results of the crash simulations to determine a regression line as shown in Figure 1.

![Figure 1. Relationship between WAD and HIT](image)

3.2. Calculation of Total Response Time

3.2.1. The Total Response Time (TRT) shall be determined by the maximum value of the two impact locations when the test specified in paragraph 2 is conducted at the test speed equivalent to that used to develop the HIT-WAD diagram.

3.2.2. TRT shall be calculated from either the direct measurement or the sum of the Sensing Time (ST) and Deployment Time (DT).

3.3. Determination of Headform Test Conditions

3.3.1. The Protection Device shall be set in the inactive position for the grid points where activation of the Protection Device does not influence the test results. The same also applies to the grid points that do not correspond to the area covered by the system activation tests specified in paragraph 2.2.1.

3.3.2. The position of the Protection Device for the grid points where activation of the Protection Device influences
the test results shall be determined by the procedure specified in paragraphs 3.3.2.1. through 3.3.2.3. using the maximum values of TRT and ST, and the HIT-WAD diagram presented in Figure 1.

3.3.2.1. All of the grid points not forward of WAD where TRT equals HIT shall be subjected to static tests specified in paragraph 6.1.

3.3.2.2. All of the grid points forward of WAD where TRT equals HIT, and not forward of WAD where HIT equals the maximum value of ST, shall be subject to dynamic tests specified in paragraph 6.2.

3.3.2.3. All of the grid points forward of WAD where HIT equals the maximum value of ST shall be tested at the inactive position of the Protection Device.

3.3.3. If the Protection Device, such as airbags, cannot maintain its activated position, dynamic tests specified in paragraph 6.2. shall apply to all test points.

4. Detection Test at Lowest Speed of Activation of Protection Device

4.1. Test Procedure

4.1.1. The manufacturer shall provide the agency with the lowest speed of activation of the Protection Device (hereafter called as “Low Speed”).

4.1.2. The test tool and the test points for the pedestrian detection tests shall comply with paragraph 2. at the test speed specified in paragraph 4.1.1.

4.2. The manufacturer shall prove that the Protection Device is activated in the tests specified in paragraph 4.1.

5. Headform Test at Low Speed

5.1. The headform tests at Low Speed specified in paragraph 4.1.1. shall be conducted for the grid points for which the test results are influenced by the activation of the Protection Device, except the grid points specified in paragraphs a. through d. In case that the vehicle is equipped with a Protection Device with a movable bonnet (active bonnet) only, the grid points specified in paragraphs 2.4.1.2. through 2.4.1.4. of Euro NCAP Pedestrian Testing Protocol (Version 8.2) may be regarded as the grid points for which the test results are influenced by the activation of the Protection Device.

a. Default grid points

b. Grid points with equivalent structures to those of the vehicle without the Protection Device

c. Grid points with equivalent protection performance at Low Speed with the Protection Device inactivated to that of the vehicle without the Protection Device

d. Grid points proved to be unable to contact with the head of a pedestrian at Low Speed with the Protection Device inactivated.

5.2. Test Procedure

5.2.1. The manufacturer shall provide the agency with the color codes at Low Speed.

- $\text{HIC}_{15} \leq 1000$: Yellow
- $1000 < \text{HIC}_{15} \leq 1350$: Orange

5.2.2. The headform tests at Low Speed may be conducted up to three tests. The test points shall be randomly chosen by the agency.

5.3. Requirements

5.3.1. HIC shall be no more than 1350 at Low Speed for the grid points within the test area with the headform test performance rated Green, Yellow or Orange.

5.3.2. HIC shall be no more than 1000 at Low Speed for no less than two thirds of the grid points within the test area.
5.3.3. All the headform tests shall be conducted with the Protection Device inactivated if the test results do not comply with the requirements specified in paragraphs 5.3.2. and 5.3.3.

6. Headform Test Procedure

6.1. Static Test

6.1.1. Tests shall be conducted with the fully activated position of the Protection Device. Other test Procedures shall be identical to those of the vehicles without Protection Devices.

6.2. Dynamic Test

6.2.1. The HIT-WAD diagram specified in paragraph 3.1. shall be developed from the results of impact simulations at 40 km/h with the inactivated position of the Protection System.

6.2.2. The headform shall be shot out by synchronizing with the activation of the Protection Device to represent head impact.

6.2.3. The tolerance of headform impact location shall be ±10mm in dynamic tests. The deviation from the grid point is not measured in case that the Protection Device in the activated position does not allow accurate measurement of the headform impact location.