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Concept- 6yo PDI

User Manual

Detailed Specification

Detailed Certification Procedure



Version 1.0

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1. Introduction

The Pedestrian-Detection-Impactor (PDI) is used to test the pedestrian sensor systems of a car and their responses upon a frontal impact with a 6YO pedestrian child dummy (6yo TNO-2 dummy) at a relative impact speed of 20 - 55 km/h.

For impact speeds between 20 km /h and 40 km/h, the physical properties of the PDI have been designed to exert similar force vs. time characteristics and energy (deformation energy) vs. time characteristics on a vehicle frontend structure, as obtained upon impact with a 6YO pedestrian dummy (Fig.1.1).

The design of the PDI allows for easy component assembly, user-friendly handling during the tests and a durability to withstand tests with impact speeds of up to 55 km/h, either by driving the vehicle against the free-standing impactor (full-scale-tests) or by using a propulsion system, similar to those used for a regular pedestrian legform impactor.

Even if directly passed over by the car, no major damage is to be expected to the main carbon pipe of the PDI (see Fig.1.2).

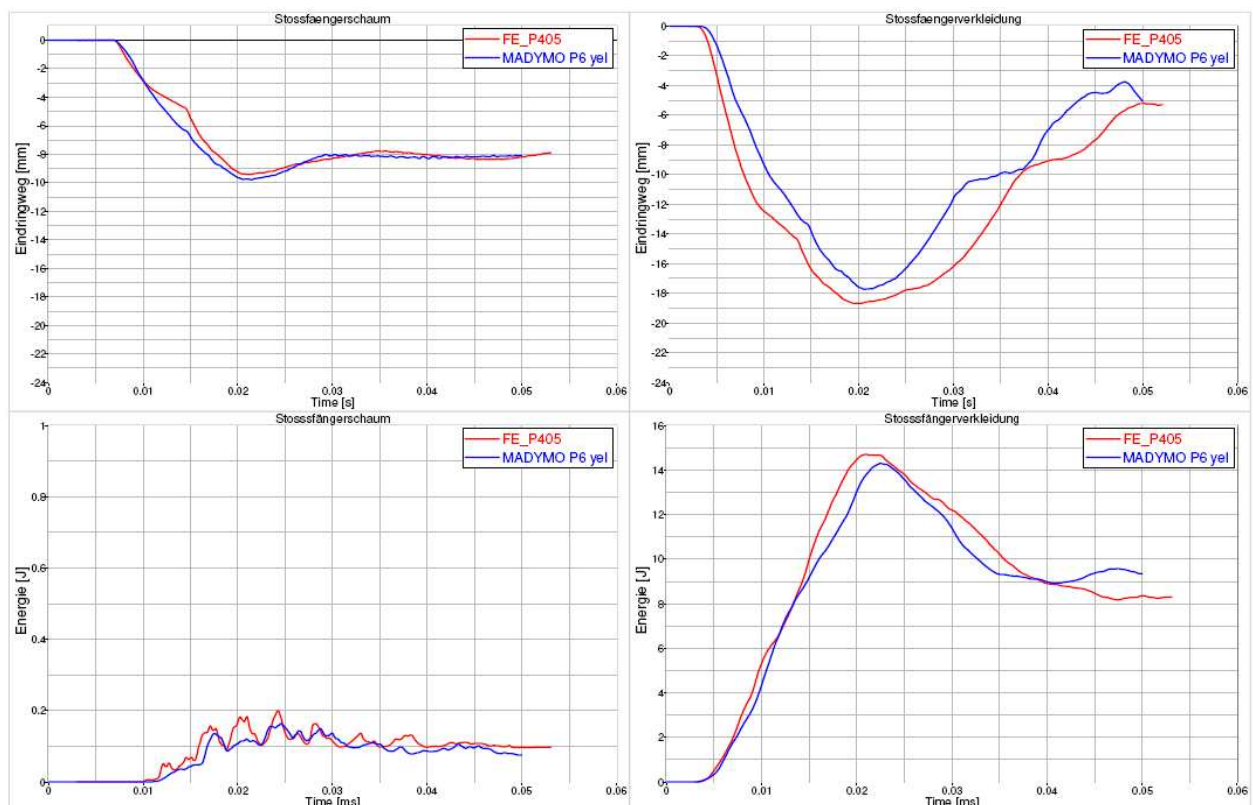
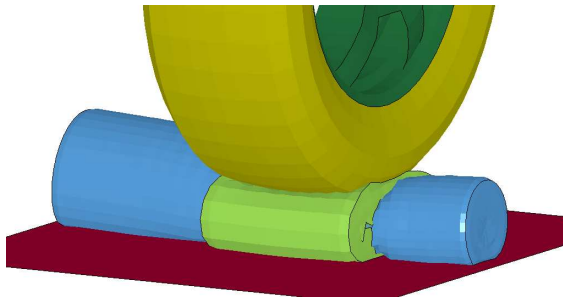


Fig. 1.1: Simulation results of a PDI-impact on a car frontend at 20km/h, compared to the results of a FE-MADYMO-coupled simulation with a 6YO-pedestrian dummy.

a)



b)

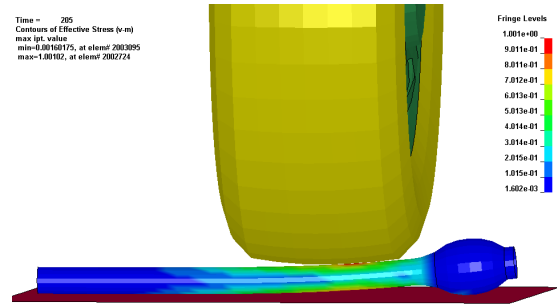


Fig. 1.2: Simulations of static load tests: Application of a 1000 kg load via a tyre (a) with impactor-foam-cladding and (b) without foam.

2. Instrumentation

During full-scale test procedures, the PDI acts as a purely passive impactor, without any sensor-equipment. Whereas for tests with a propulsion system, it can be equipped with a triaxial accelerometer, situated within the central carbon tube, close to the impactor's centre of gravity (see Fig. 4.2).

3. Testing with the PDI

3.1 Full-scale test

The PDI is delivered with a cylindrical foam base (height = 70mm), which serves as a platform when the impactor has to be positioned in a free-standing, upright position before the test. This way, the centre of gravity of the impactor is automatically positioned at the correct height, relative to the ground.

The free-standing impactor shall be hit by the driving car within the specified velocity range.

It should be noted, that the PDI has been developed to represent the 6YO-dummy behaviour at temperatures close to room temperature. Nevertheless, all hitherto performed full-scale tests show, that for testing purposes, the physical properties of the impactor as a whole, exhibit only insignificant variations between -30°C and +70°C, thus allowing for uncomplicated outdoor-testing, regardless of the weather.

Still, the exact correspondence between the behaviour of the real impactor and its simulation-representations (FE-models of impactor or 6YO-dummy) can only be guaranteed for room temperature.



Fig. 3.1: PDI-sled-test at 20 km/h using a standardised vehicle frontend.

3.2 Test with a propulsion system

The testing procedures can alternatively be performed by using a propulsion system similar to those, used for pedestrian legform impactors.

In this case, the impactor can be equipped with a triaxial accelerometer if no other means for measurement of the impact velocity are available.

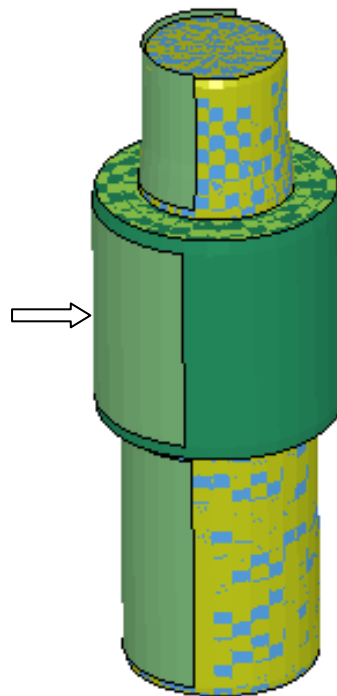


Fig. 3.2: Adapter for the propulsion system (shown here in the FE simulation model as half-shell supports)

3.3 Maintenance

Due to the secondary impact on the ground, especially during full-scale tests, the foam cladding of the impactor is subjected to continuous damage. It is recommended to regularly change especially the softer inner foam (blue), to avoid further damage of the carbon tube or the surroundings. If cracks are visible on the outside of any foam part, a certification test should be performed (see Sec.5.) to further ensure proper functionality.



Fig. 3.3: Typical damage/crack after secondary impact of a high speed (55km/h) test.

4. Detailed Specification

4.1 Parts list

The PDI consist of five components (also described in the Assembly-Manual):



Fig. 4.1: Disassembled parts of the PDI

- 1) Inner foam
- 2) Outer foam
- 3) Carbon tube with lead-core (3a)
- 4) Rubber plate
- 5) Base / Foot

The components should be assembled, following the procedure described in the Assembly-Manual.

4.2 Physical Properties

Impactor-mass (assembled parts): 9.8 ± 0.2 kg

Centre of gravity (height from ground without base-plate): 420 mm

Moment of inertia around the horizontal axis through the CG: $0.305 \text{ kg}\cdot\text{m}^2$

Mass of Carbon-tube + lead-core: 4180 ± 20 g

Foam materials: polyetherurethane foam

Mass of inner foam: 2780 ± 10 g; Density = 0.23 g/cm^3

Mass of outer foam: 3230 ± 15 g; Density = 0.43 g/cm^3

Height of Impactor (without base): 666.0 mm

Outer diameter of lower/inner foam: 190.0 mm

Outer diameter of outer/upper foam: 240.0 mm

Length of carbon-tube: 631.0 mm

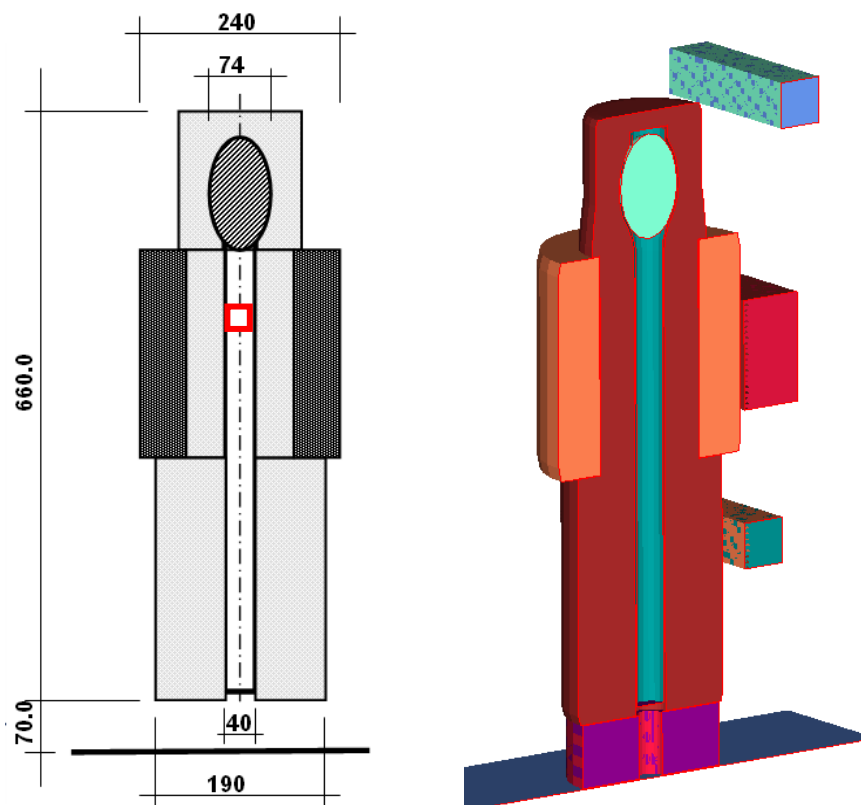


Fig. 4.2: Cross-section of the PDI with the position of the optional, triaxial accelerometer (red square) at a height of 420 mm from the base of the impactor (or 490 mm from ground level respectively).

5. Detailed Certification procedure

All PDI's will be delivered only after passing a certification procedure, performed with a standardised pendulum, either by using an ECE-R21-pendulum, or alternatively, an ECE-R21 linear impactor.

For the certification test, the impact speed of the pendulum-head is 25.00 ± 0.25 km/h, the pendulum-head mass being 6.8 kg, the pendulum-diameter is 165 mm and the arm length of the pendulum is at least 2.0 m. The impact height is in the middle of the outer foam (red), which is 470mm from the ground level. The tests have to be performed on 3 different positions: every 120° rotated around the z-axis.

The measured deceleration pulse of the pendulum-sphere should be within a ± 4.0 g corridor, referring to the pulse maximum of 45 g (see Fig. 5.1, or the exemplary calibration certificate).

These tests have to be performed after assembling with new foams, after max. 100 tests, or after the appearance of cracks in the foam cladding (see 3.3).

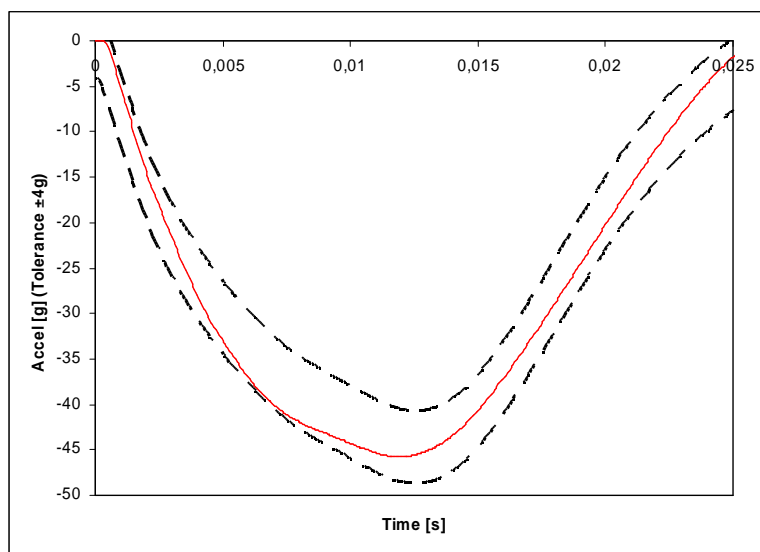


Fig. 5.1: Certification-test result and deceleration-pulse corridor

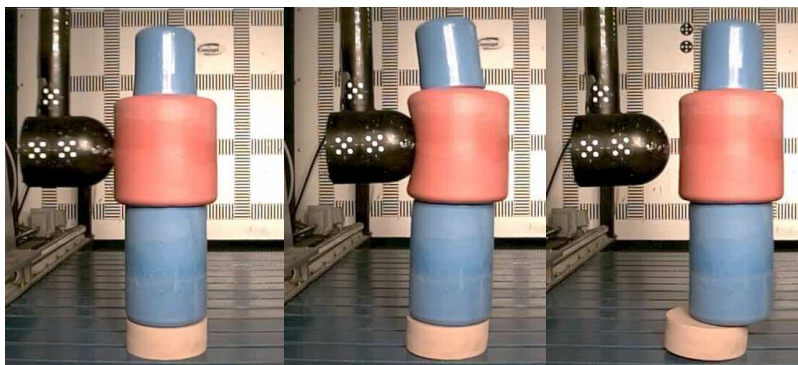


Fig. 5.2: Certification-pendulum-test of the PDI