EURO NCAP

#FORSAFERCARS

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Vulnerable Road User Impactors Specification and Certification

Crash Protection

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PREFACE

During the test preparation, vehicle manufacturers are encouraged to liaise with the laboratory and to check that they are satisfied with the way cars are set up for testing. Where a manufacturer feels that a particular item should be altered, they should ask the laboratory staff to make any necessary changes. Manufacturers are forbidden from making changes to any parameter that will influence the test, such as dummy positioning, vehicle setting, laboratory environment etc.

It is the responsibility of the test laboratory to ensure that any requested changes satisfy the requirements of Euro NCAP. Where a disagreement exists between the laboratory and manufacturer, the Euro NCAP secretariat should be informed immediately to pass final judgment. Where the laboratory staff suspect that a manufacturer has interfered with any of the setup, the manufacturer's representative should be warned that they are not allowed to do so themselves. They should also be informed that if another incident occurs, they will be asked to leave the test site.

Where there is a recurrence of the problem, the manufacturer's representative will be told to leave the test site and the Secretary General should be immediately informed. Any such incident may be reported by the Secretary General to the manufacturer and the person concerned may not be allowed to attend further Euro NCAP tests.

DISCLAIMER: Euro NCAP has taken all reasonable care to ensure that the information published in this protocol is accurate and reflects the technical decisions taken by the organisation. In the unlikely event that this protocol contains a typographical error or any other inaccuracy, Euro NCAP reserves the right to make corrections and determine the assessment and subsequent result of the affected requirement(s).

CONTENTS

1 APLI - LEGFORM

1.1 General

The aPLI shall conform to the specification in ISO/TS 20458:2023.

1.2 Certification

The dynamic certification procedures are based on the FlexPLI inverse certification test and are detailed in the aPLI user manual. See UN regulation No. 127, revision 2. Available at https://unece.org/transport/vehicle-regulations-wp29/standards/addenda-1958-agreement-regulations-121-140.

The legform shall be re-certified after a maximum of 20 impacts and at least once every 12 months.

The legform shall be re-certified according to the procedures prescribed in ISO TS 20458.

If the legform exceeds any of its Channel Amplitude Classes (CAC) then it shall be re-certified.

1.2.1 aPLI dynamic certification corridors

The dynamic certification corridors for the aPLI were drafted according to the method established at UNECE level for the FlexPLI.

Zander, O: Refinement of Corridors for FlexPLI Dynamic Assembly Certification Tests. Document TF-RUCC-4-04. Available at https://wiki.unece.org/display/trans/TF-RUCC+4th+session

Zander, O: Dynamic Certification Corridors for aPLI according to UNECE Method. Euro NCAP Document PED-2102-02

Two types of linear dynamic certification tests are performed with each impactor, the knee test (type I) and the femur test (type II). The impactor readings of the femur and the tibia strain gauges as well as the knee potentiometers shall meet the following certification corridors.

For the knee test (type I):

		Femur 3	Femur 2	Femur 1	Tibia 1	Tibia 2	Tibia 3	Tibia 4	ACL	PCL	MCL
Certification Corridors	upper	134	178	208	334	272	193	116	4	8	16
Knee Test	lower	101	133	162	291	238	160	92	3	6	12

For the femur test (type II):

		Femur 3	Femur 2	Femur 1	Tibia 1	Tibia 2	Tibia 3	Tibia 4	ACL	PCL	MCL
Certification Corridors	upper	190	238	293	251	228	164	83	4	10	24
Femur Test	lower	147	189	233	206	182	132	63	3	8	20

1.3 Instrumentation

Location	Measurement	CFC (Hz)	CAC
Upper mass	Acceleration	180	500g
Femur Bending	Femur upper - 3 Femur middle - 2 Femur lower - 1	180	600Nm
Knee Elongation	Medial collateral ligament Anterior cruciate ligament Posterior cruciate ligament	180	40mm
Tibia Bending	Tibia upper - 1 Tibia upper middle - 2 Tibia lower middle - 3 Tibia lower - 4	180	400Nm

2 UPPER LEGFORM

2.1 General

The upper legform used shall conform to that specified in UN Regulation No. 127 Revision 2, Annex 4.

2.2 Certification

The certification procedures are detailed in Regulation UN Regulation No. 127 Revision 2 Annex 6, Chapter 2.

The foam sheet from which the pieces of foam shall be taken shall be certified before the test programme. The foam shall be 25mm thick ConforTM foam type CF-45 or equivalent.

The upper legform shall be re-certified after a maximum of 20 impacts and at least once every 12 months.

If the upper legform exceeds any of its Channel Amplitude Classes (CAC) then it shall be re-certified.

2.3 Instrumentation

Location	Measurement	CFC (Hz)	CAC
Upper femur	Force	180	10kN
Lower femur	Force	180	10kN
Centre of femur	Bending moment	180	1000Nm
50mm above centre of femur	Bending moment	180	1000Nm
50mm below centre of femur	Bending moment	180	1000Nm

3 HEADFORMS

3.1 General

The small adult/child and adult headforms shall conform to that specified in UN Regulation No. 127 Revision 2, Annex 4.

3.2 Certification

The certification procedures are detailed in Regulation UN Regulation No. 127 Revision 2, Annex 6, Chapter 3.

The headforms, consisting of headskins, aluminium sphere and instrumentation, shall be certified after a maximum of 20 impacts and at least once every 12 months.

If the headforms exceed the Channel Amplitude Class (CAC) in any direction then all components shall be re-certified.

3.3 Instrumentation

Location	Measurement	CFC (Hz)	CAC
Centre of gravity of headform	Fore/Aft acceleration - relative to the direction of motion of the headform	1000	500g
Centre of gravity of headform	Vertical acceleration	1000	500g
Centre of gravity of headform	Lateral acceleration	1000	500g

3.3.1 Headform accelerometers

Damped accelerometers will be used for all adult child/small adult headform tests including tests to areas other than the windscreen. Accelerometers shall have a damping ratio between 0.2 and 0.71 and that the Data Acquisition minimum measurement range should be set at three times the maximum expected amplitude. Countermeasures shall be taken to limit noise as follows:

- Apply the maximum allowable excitation voltage
- Apply ground wire to the back plate and make sure to remove anodising layer locally and test ground wire electric conductivity.
    - Do not attach the ground wire close to the accelerometer!
- Avoid secondary impact from cables on the bonnet either by
    - Elastically suspended cable away from the bonnet
    - Cushioning of the bonnet in the cable contact area.

Accelerometers with the required damping characteristics
Endevco 7264H
Kyowa ASE-A-500 SA7
TE Connectivity 64X-2000-360
TE Connectivity EGAS-S398C

APPENDIX A APLI CORRIDOR

1. Corridor development method

The method for the determination of the type I and type II dynamic certification corridors is described in TF-RUCC-4-04. The below steps were analogously followed.

1.1. Definition of reproducibility corridors

1.1.1. Determination of individual coefficients of variation (CV) for all segments of the three master legs
1.1.2. Determination of segments for drafting the reproducibility corridors (CV < 5%)
1.1.3. Calculation of pooled means of all segments with CV < 5%
1.1.4. Calculation of reproducibility corridors (pooled mean +/-10%)

1.2. Definition of certification corridors

1.2.1. Determination of reproducible test results
1.2.2. Determination of individual maxima and minima of all reproducible segments
1.2.3. Determination of corridor limits, considering a scatter in testing of +/- 5%

Sections 1.1and 1.2 were followed for both, test type I and test type II.

Inverse test data from the three master legs (SN01, SN02 and SN03) was generated in three master labs. Altogether, a set of 21 type I inverse tests and 21 type II inverse tests was considered for the definition of the inverse certification corridors. After filtering according to the procedure marked out in chapter 2.1, the following results could be used for the final corridors:

Type I: 21 (MCL: 18)

Type II: 21 (Femur-3: 18, ACL: 15)