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COUNCIL DIRECTIVE

of 26 May 1986

on rear-mounted roll-over protection structures of narrow-track wheeled agricultural and forestry tractors

(86/298/EEC)

(OJ L 186, 8.7.1986, p. 26)

Amended by:

		Official Journal		
		No	page	date
►M1	Council Directive 89/682/EEC of 21 December 1989	L 398	29	30.12.1989
►M2	Commission Directive 2000/19/EC of 13 April 2000	L 94	31	14.4.2000
►M3	Commission Directive 2005/67/EC of 18 October 2005	L 273	17	19.10.2005
►M4	Council Directive 2006/96/EC of 20 November 2006	L 363	81	20.12.2006
►M5	Commission Directive 2010/22/EU of 15 March 2010	L 91	1	10.4.2010

Amended by:

►A1	Act of Accession of Austria, Sweden and Finland	C 241	21	29.8.1994
	(adapted by Council Decision 95/1/EC, Euratom, ECSC)	L 1	1	1.1.1995
►A2	Act concerning the conditions of accession of the Czech Republic, the Republic of Estonia, the Republic of Cyprus, the Republic of Latvia, the Republic of Lithuania, the Republic of Hungary, the Republic of Malta, the Republic of Poland, the Republic of Slovenia and the Slovak Republic and the adjustments to the Treaties on which the European Union is founded	L 236	33	23.9.2003

Corrected by:

►C1 Corrigendum, OJ L 173, 5.7.1988, p. 20 (86/298/EEC)

►C2 Corrigendum, OJ L 145, 9.6.2005, p. 42 (89/682/EEC)

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COUNCIL DIRECTIVE

of 26 May 1986

on rear-mounted roll-over protection structures of narrow-track wheeled agricultural and forestry tractors

(86/298/EEC)

THE COUNCIL OF THE EUROPEAN COMMUNITIES,

Having regard to the Treaty establishing the European Economic Community, and in particular Article 100 thereof,

Having regard to the proposal from the Commission ([1]),

Having regard to the opinion of the European Parliament ([2]),

Having regard to the opinion of the Economic and Social Committee ([3]),

Whereas Council Directive 74/150/EEC of 4 March 1974 on the approximation of the laws of the Member States relating to the type-approval of wheeled agricultural or forestry tractors ([4]), as last amended by the Act of Accession of Spain and Portugal, lays down that the necessary provisions for the implementation of the EEC type-approval procedure in respect of individual tractor parts or characteristics should be specified in special directives; whereas the provisions relating to roll-over protection structures and their attachments to tractors were laid down by Directives 77/536/EEC ([5]) and 79/622/EEC ([6]), as last amended by the Act of Accession of Spain and Portugal; whereas these two Directives cover respectively dynamic and static testing procedures — either of which may be employed by manufacturers for the present — and relate to standard tractors, that is, tractors having a maximum ground clearance of 1 000 mm and a fixed or adjustable track width of one of the driving axles of not less than 1 150 mm and weighing between 1,5 and 4,5 tonnes in the case of tractors covered by the 'dynamic testing' Directive and not less than 800 kilograms in the case of tractors covered by the 'static testing' Directive;

Whereas the tractors covered by this Directive have a maximum ground clearance of 600 mm, a minimum track width of both axles of less than 1 150 mm and a mass greater than 600 kilograms; whereas the roll-over protection structures of these tractors, which are used for specific activities, can be made subject to specific requirement or requirements other than those of Directive 77/536/EEC and 79/622/EEC;

Whereas the technical requirements with which such 'narrow-track' tractors must comply pursuant to national laws relate *inter alia* to roll-over protection structures and to their attachment to the tractor; whereas those requirements differ from one Member State to another; whereas it is therefore necessary that all Member States adopt the same requirements either in addition to or in place of their existing rules in order, in particular, to allow the EEC type-approval procedure which was the subject of Directive 74/150/EEC to be introduced in respect of each type of tractor;

Whereas this Directive covers roll-over protection structures of the rear-mounted rollbar, frame or cab type having a zone of clearance whose upper limit is 900 mm above the seat reference point in order to provide

([1]) OJ No C 123, 9. 5. 1983, p. 1.
([2]) OJ No C 307, 14. 11. 1983, p. 103.
([3]) OJ No C 286, 24. 10. 1983, p. 2.
([4]) OJ No L 84, 28. 3. 1974, p. 10.
([5]) OJ No L 220, 29. 8. 1977, p. 1.
([6]) OJ No L 179, 17. 7. 1979, p. 1.

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a sufficiently large area or unobstructed space for the protection of the driver; whereas another special Directive will be adopted in respect of roll-over protection structures having two pillars mounted in front of the driver;

Whereas a harmonized component type-approval procedure for roll-over protection structures and their attachment to the tractor makes it possible for each Member State to check compliance with the common construction and testing requirements and to inform the other Member States of its findings by sending them copies of the component type-approval certificate completed for each type of roll-over protection structure and its attachment to the tractor; whereas the placing of an EEC component type-approval mark on all structures manufactured in conformity with the approved type obviates any need for technical checks on those structures in the other Member States; whereas common requirements concerning other elements and characteristics of the roll-over protection structure, in particular, devices to prevent continuous roll-over if the tractor overturns, and protection of occupants, will be laid down at a later date;

Whereas the harmonized requirements are intended principally to ensure safety on the road and at work throughout the Community; whereas, for this reason, it is necessary to introduce the obligation for tractors covered by this Directive to be fitted with roll-over protection structures;

Whereas the approximation of the national laws relating to these tractors entails reciprocal recognition by Member States of the checks carried out by each of them on the basis of the common requirements,

HAS ADOPTED THIS DIRECTIVE:

Article 1

This Directive shall apply to tractors as defined in Article 1 of Directive 74/150/EEC having the following characteristics:

— ground clearance of not more than 600 mm measured beneath the lowest points of the front or rear axles, allowing for the differential,

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— fixed or adjustable minimum track width of less than 1 150 mm for the axles fitted with the widest tyres; since the axle fitted with the widest tyres is assumed to be adjusted to a maximum track width of 1 150 mm, the other axle must be capable of being adjusted in such a way that the outer edges of the narrowest tyres do not project beyond the outer edges of the tyres on the axle with the widest tyres. Where both axles are equipped with wheels and tyres of the same size, the fixed or adjustable track width of both axles must be less than 1 150 mm,

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— mass greater than 600 kilograms and corresponding to the unladen weight of the tractor as defined in section 2.4 of Annex I to Directive 74/150/EEC, including the roll-over protection structure fitted in compliance with this Directive and tyres of the largest size recommended by the manufacturer.

Article 2

1. Each Member State shall grant EEC component type-approval for any type of roll-over protection structure and its tractor attachment which satisfies the construction and testing requirements laid down in Annexes I to IV.

2. A Member State which has granted EEC component type-approval shall take the measures required to verify, in so far as is necessary and

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if need be in cooperation with the competent authorities in the other Member States, that production models conform to the approved type. Such verification shall be limited to spot checks.

Article 3

Member States shall, for each type of roll-over protection structure and its tractor attachment which they approve pursuant to Article 2, issue to the manufacturer of the tractor or of the roll-over protection structure, or to his authorized representative, an EEC component type-approval mark conforming to the model shown in Annex VI.

Member States shall take all appropriate measures to prevent the use of marks liable to create confusion between roll-over protection structures which have been component type-approved pursuant to Article 2 and other devices.

Article 4

1. No Member State may prohibit the placing on the market of roll-over protection structures or their attachment to the tractors for which they are intended on grounds relating to their construction if they bear the EEC component type-approval mark.

2. Nevertheless, a Member State may prohibit the placing on the market of roll-over protection structures bearing the EEC component type-approval mark which consistently fail to conform to the approved type.

That State shall forthwith inform the other Member States and the Commission of the measures taken, specifying the reasons for its decision.

Article 5

The competent authorities of each Member State shall, within one month, send to the competent authorities of the ►C1 other Member States ◄ a copy of the component type-approval certificates, an example of which is given in Annex VII, completed for each type of roll-over protection structure which they approve or refuse to approve.

Article 6

1. If the Member State which has granted EEC component type-approval finds that a number of roll-over protection structures and their tractor attachments bearing the same EEC component type-approval mark do not conform to the type which it has approved, it shall take the necessary measures to ensure that production models conform to the approved type. The competent authorities of that State shall advise those of the other Member States of the measures taken which may, if necessary, where there is serious and repeated failure to conform, extend to withdrawal of EEC component type-approval. The said authorities shall take the same measures if they are informed by the competent authorities of another Member State of such failure to conform.

2. The competent authorities of the Member States shall within one month inform each other of any withdrawal of EEC component type-approval and of the reasons for any such measure.

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Article 7

Any decision taken pursuant to the provisions adopted in implementation of this Directive to refuse or withdraw component type-approval for roll-over protection structures and their tractor attachments, or to prohibit their placing on the market or their use, shall set out in detail the reasons on which it is based. Such decisions shall be notified to the party concerned, who shall at the same time be informed of the remedies available to him under the laws in force in the Member States and of the time limits allowed for the exercise of such remedies.

Article 8

No Member State may refuse to grant EEC type-approval or national type-approval in respect of a tractor on grounds relating to roll-over protection structures or their tractor attachment if these bear the EEC component type-approval mark and if the requirements laid down in Annex VIII have been satisfied.

Article 9

No Member State may refuse or prohibit the sale, registration, entry into service or use of any tractor on grounds relating to the roll-over protection structure and its tractor attachment if these bear the EEC component type-approval mark and if the requirements laid down in Annex VIII have been met.

Article 10

This Directive shall not affect the right of Member States to specify — in due compliance with the Treaty — the requirements they deem necessary to ensure that workers are protected when using the tractors in question, provided this does not mean that the protection structures are modified in a way unspecified in this Directive.

Article 11

1. In connection with EEC type-approval, any tractor to which Article 1 refers must be fitted with a roll-over protection structure.

2. Where the protection structure is not one having two pillars mounted in front of the driver's seat, the structure referred to in paragraph 1 must comply with the requirements laid down in Annexes I to IV to this Directive or to Directives 77/536/EEC or 79/622/EEC.

Article 12

Any amendments necessary in order to adapt the requirements of the Annexes to this Directive so as to take account of technical progress shall be adopted in accordance with the procedure laid down in Article 13 of Directive 74/150/EEC.

Article 13

Within 18 months of the notification of this Directive, the Council, acting on a proposal from the Commission, on the basis of the provisions of the Treaty, shall adopt a Directive supplementing this

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Directive by means of provisions introducing the additional impact tests in the dynamic test procedure.

Article 14

1. Member States shall bring into force the provisions necessary in order to comply with this Directive within 24 months of its notification ([1]). They shall forthwith inform the Commission thereof.

2. Member States shall ensure that the texts of the main provisions of national law which they adopt in the field covered by this Directive are communicated to the Commission.

Article 15

This Directive is addressed to the Member States.

([1]) This Directive was notified to the Member States on 2 June 1986.

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ANNEX I

CONDITIONS FOR EEC COMPONENT TYPE-APPROVAL

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1. The definitions and requirements of point 1 of Code 7 ([1]) of OECD Decision C(2008) 128 of October 2008, with the exception of point 1.1 (Agricultural and forestry tractors), shall apply, reading as follows:

‘1. **Definitions**

1.1 [not applicable]

1.2 *Rolling Over Protective Structure (ROPS)*

Roll-over protective structure (safety cab or frame), hereinafter called “protective structure”, means the structure on a tractor the essential purpose of which is to avoid or limit risks to the driver resulting from roll-over of the tractor during normal use.

The roll-over protective structure is characterized by the provision of space for a clearance zone large enough to protect the driver when seated either inside the envelope of the structure or within a space bounded by a series of straight lines from the outer edges of the structure to any part of the tractor that might come into contact with flat ground and that is capable of supporting the tractor in that position if the tractor overturns.

1.3 *Track*

1.3.1 Preliminary definition: median plane of the wheel

The median plane of the wheel is equidistant from the two planes containing the periphery of the rims at their outer edges.

1.3.2 Definition of track

The vertical plane through the wheel axis intersects its median plane along a straight line which meets the supporting surface at one point. If A and B are the two points thus defined for the wheels on the same axle of the tractor, then the track width is the distance between points A and B. The track may be thus defined for both front and rear wheels. Where there are twin wheels, the track is the distance between two planes each being the median plane of the pairs of wheels.

1.3.3 Additional definition: median plane of the tractor

Take the extreme positions of points A and B for the tractor rear axle, which gives the maximum possible value for the track. The vertical plane at right angles to the line AB at its centre point is the median plane of the tractor.

1.4 *Wheelbase*

The distance between the vertical planes passing through the two lines AB as defined above, one for the front wheels and one for the rear-wheels.

1.5 *Determination of seat index point; Seat adjustment for test*

1.5.1 Seat index point (SIP) ([2])

The seat index point shall be determined in accordance with ISO 5353:1995

1.5.2 Seat location and adjustment for test

1.5.2.1 where the inclination of the backrest and seat pan is adjustable, these must be adjusted so that the seat index point is in its rear uppermost position;

([1]) OECD standard code for the official testing of rear-mounted roll-over protective structures on narrow-track wheeled agricultural and forestry tractors.

([2]) For extension tests to test reports that originally used seat reference point (SRP), the required measurements shall be made with reference to SRP instead of SIP and the use of SRP shall be clearly indicated (see Annex 1).

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1.5.2.2 where the seat is equipped with suspension, the latter must be blocked at mid-travel, unless this is contrary to the instructions clearly laid down by the seat manufacturer;

1.5.2.3 where the position of the seat is adjustable only lengthwise and vertically, the longitudinal axis passing through the seat index point shall be parallel with the vertical longitudinal plane of the tractor passing through the centre of the steering wheel and not more than 100 mm from that plane.

1.6 *Clearance zone*

1.6.1 Reference plane

The clearance zone is illustrated in Figures 7.1 and 7.2. The zone is defined in relation to the reference plane and the seat index point (SIP). The reference plane is a vertical plane, generally longitudinal to the tractor and passing through the seat index point and the centre of the steering wheel. Normally the reference plane coincides with the longitudinal median plane of the tractor. This reference plane shall be assumed to move horizontally with the seat and steering wheel during loading but to remain perpendicular to the tractor or the floor of the roll-over protective structure. The clearance zone shall be defined on the basis of sub clauses 1.6.2 and 1.6.3.

1.6.2 Determination of the clearance zone for tractors with a non-reversible seat

The clearance zone for tractors with a non-reversible seat is defined in 1.6.2.1 to 1.6.2.13 below and is bounded by the following planes, the tractor being on a horizontal surface, the seat, where adjustable, adjusted to its rear uppermost position ([1]), and the steering wheel, where adjustable, adjusted to the mid-position for seated driving:

1.6.2.1. a horizontal plane A_1 B_1 B_2 A_2, (810 + a_v) mm above the seat index point (SIP) with line B_1B_2 located (a_h–10) mm behind the SIP;

1.6.2.2. an inclined plane H_1 H_2 G_2 G_1, perpendicular to the reference plane, including both a point 150 mm behind line B_1B_2 and the rearmost point of the seat backrest;

1.6.2.3. a cylindrical surface A_1 A_2 H_2 H_1 perpendicular to the reference plane, having a radius of 120 mm, tangential to the planes defined in 1.6.2.1 and 1.6.2.2 above;

1.6.2.4. a cylindrical surface B_1 C_1 C_2 B_2, perpendicular to the reference plane, having a radius of 900 mm extending forward for 400 mm and tangential to the plane defined in 1.6.2.1 above along line B_1B_2;

1.6.2.5. an inclined plane C_1 D_1 D_2 C_2, perpendicular to the reference plane, joining the surface defined in 1.6.2.4 above and passing 40 mm from the forward external edge of the steering wheel. In the case of a high steering wheel position, this plane extends forward from line B_1B_2 tangentially to the surface defined in 1.6.2.4 above;

1.6.2.6. a vertical plane D_1 K_1 E_1 E_2 K_2 D_2 perpendicular to the reference plane 40 mm forward of the external edge of the steering wheel;

1.6.2.7. a horizontal plane E_1 F_1 P_1 N_1 N_2 P_2 F_2 E_2 passing through a point (90–a_v) mm below the seat index point (SIP);

1.6.2.8. a surface G_1 L_1 M_1 N_1 N_2 M_2 L_2 G_2, if necessary curved from the bottom limit of the plane defined in 1.6.2.2 above to the horizontal plane defined in 1.6.2.7 above, perpendicular to the reference plane, and in contact with the seat backrest throughout its length;

([1]) Users are reminded that the seat index point is determined according to ISO 5353 and is a fixed point with respect to the tractor that does not move as the seat is adjusted away from the mid-position. For purposes of determining the clearance zone, the seat shall be placed in the rear and uppermost position.'

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1.6.2.9. two vertical planes K_1 I_1 F_1 E_1 and K_2 I_2 F_2 E_2 parallel to the reference plane, 250 mm either side of the reference plane, and bounded at the top 300 mm above the plane defined in 1.6.2.7 above;

1.6.2.10. two inclined and parallel planes A_1 B_1 C_1 D_1 K_1 I_1 L_1 G_1 H_1 and A_2 B_2 C_2 D_2 K_2 I_2 L_2 G_2 H_2 starting from the upper edge of the planes defined in 1.6.2.9 above and joining the horizontal plane defined in 1.6.2.1 above at least 100 mm from the reference plane on the side where the loading is applied;

1.6.2.11. two portions of vertical planes Q_1 P_1 N_1 M_1 and Q_2 P_2 N_2 M_2 parallel to the reference plane, 200 mm either side of the reference plane, and bounded towards the top 300 mm above the horizontal plane defined in 1.6.2.7 above;

1.6.2.12. two portions of I_1 Q_1 P_1 F_1 and I_2 Q_2 P_2 F_2 of a vertical plane, perpendicular to the reference plane and passing (210–a_h) mm in front of the SIP;

1.6.2.13. two portions I_1 Q_1 M_1 L_1 and I_2 Q_2 M_2 L_2 of the horizontal plane passing 300 mm above the plane defined in 1.6.2.7 above.

1.6.3 Determination of the clearance zone for tractors with a reversible driver's position

For tractors with a reversible driver's position (reversible seat and steering wheel), the zone of clearance is the envelope of the two clearance zones defined by the two different positions of the steering wheel and the seat.

1.6.4 Optional seats

1.6.4.1 In case of tractors that could be fitted with optional seats, the envelope comprising the seat index points of all options offered shall be used during the tests. The protective structure shall not enter the larger clearance zone which takes account of these different seat index points.

1.6.4.2 In the case where a new seat option is offered after the test has been performed, a determination shall be made to see whether the clearance zone around the new SIP falls within the envelope previously established. If it does not, a new test must be performed.

1.7 *Permissible measurement tolerances*

Linear dimension:	± 3 mm
except for	
— tyre deflection:	± 1 mm
— structure deflection during horizontal loadings:	± 1 mm
— height of fall of the pendulum block:	± 1 mm
Masses:	± 1 %
Forces:	± 2 %
Angles:	± 2°

1.8 *Symbols*

a_h	(mm)	Half of the horizontal seat adjustment
a_v	(mm)	Half of the vertical seat adjustment
B	(mm)	Minimum overall width of the tractor
B_6	(mm)	Maximum outer width of the protective structure
D	(mm)	Deflection of the structure at the point of impact (dynamic tests) or at the point of, and in line with, the load application (static tests)
D′	(mm)	Deflection of the structure for the calculated energy required

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E_a	(J)	Strain energy absorbed at point when load is removed. Area contained within F-D curve
E_i	(J)	Strain energy absorbed. Area under F-D curve
E'_i	(J)	Strain energy absorbed after additional loading following a crack or tear
E''_i	(J)	Strain energy absorbed in overload test in the event of the load having been removed before starting this overload test. Area under F-D curve
E_{il}	(J)	Energy input to be absorbed during longitudinal loading
E_{is}	(J)	Energy input to be absorbed during side loading
F	(N)	Static load force
F′	(N)	Loading force for calculated energy required, corresponding to E'_i
F-D		Force/deflection diagram
F_{max}	(N)	Maximum static load force occurring during loading, with the exception of the overload
F_v	(N)	Vertical crushing force
H	(mm)	Falling height of the pendulum block (dynamic tests)
H′	(mm)	Falling height of the pendulum block for additional test (dynamic tests)
I	(kgm^2)	Tractor reference moment of inertia about the centre line of the rear wheels, whatever the mass of these rear wheels may be
L	(mm)	Tractor reference wheelbase
M	(mm)	Tractor reference mass during strength tests, as defined in section 3.1.1.4. of Annex II

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2. GENERAL REQUIREMENTS

2.1. Every protection structure and its attachment to a tractor must be so designed and constructed as to fulfil the essential purpose laid down in Item 1.1 above.

2.2. This condition is considered to be fulfilled when the requirements of Annexes II and III are complied with.

3. APPLICATION FOR EEC COMPONENT TYPE-APPROVAL

3.1. The application for EEC component type-approval with regard to the strength of a protection structure and the strength of its attachment to a tractor shall be submitted by the tractor manufacturer or by the manufacturer of the protecion structure or by their authorized representatives.

3.2. The application for EEC component type-approval shall be accompanied by the undermentioned documents in triplicate and by the following particulars:

— general arrangement drawing either to a scale marked on the drawing or giving the main dimensions of the protection structure. This drawing must, in particular, show details of the mounting components,

— photographs from side and rear showing mounting details,

— brief description of the protection structure including type of construction, details of mounting on the tractor and, where necessary, details of cladding, means of access and escape, details of interior padding and features to prevent continuous rolling and details of heating and ventilation,

— details of materials used in structural parts including attaching brackets and fixing bolts (see Annex V).

3.3. A tractor representative of the tractor type for which the protection structure to be approved is intended shall be submitted to the technical service responsible for conducting the component type-approval tests. This tractor shall be fitted with the protection structure.

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3.4. The holder of EEC component type-approval may request its extension to other tractor types. The competent authority which has granted the original EEC component type-approval shall grant the extension if the approved protection structure and the type(s) of tractor for which the extension is requested comply with the following conditions:

— the mass of the unballasted tractor, as defined in Item 1.4 of Annex II, does not exceed by more than 5 % the reference mass used in the tests,

— the wheelbase or the moment of inertia in relation to the rear-wheel axle is not more than the reference wheelbase or moment of inertia,

— the method of attachment and the points of attachment to the tractor are identical,

— any components, such as mudguards and bonnet which may provide support for the protection structure have indentical strength and are identically situated with respect to the protection structure,

— the critical dimensions and the position of the seat and steering wheel relative to the protection structure, and the position relative to the protection structure of the points deemed rigid and takeninto account for the purpose of verifying that the zone of clearance is protected, are such that the zone of clearance continues to be protected by the structure after the latter has undergone the deformation resulting from the various tests.

4. MARKINGS

4.1. Every protection structure conforming to the approved type shall bear the following markings:

4.1.1. The trade mark or name.

4.1.2. A component type-approval mark conforming to the model in Annex VI.

4.1.3. Serial number of the protection structure.

4.1.4. Make and type(s) of tractor(s) for which the protection structure is intended.

4.2. All these particulars must appear on a small plate.

4.3. These markings must be visible, legible and indelible.

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ANNEX II

Technical requirements

The technical requirements for the EC type-approval of rear-mounted roll-over protection structures of narrow-track wheeled agricultural or forestry tractors shall be those set out in point 3 of Code 7 of the OECD Decision C(2008) 128 of October 2008, with the exception of points 3.1.4 (Test report), 3.3.1 (Administrative extensions), 3.4 (Labeling) and 3.6 (Seat belt anchorage performance), reading as follows:

‘3. RULES AND DIRECTIONS

3.1 **Conditions for testing the strength of protective structures and of their attachment to tractors**

3.1.1 *General requirements*

3.1.1.1 Test purposes

Tests made using special rigs are intended to simulate such loads as are imposed on a protective structure, when the tractor overturns. These tests enable observations to be made on the strength of the protective structure and any brackets attaching it to the tractor and any parts of the tractor which transmit the test load.

3.1.1.2 Test methods

Tests may be performed in accordance with the dynamic procedure or the static procedure. The two methods are deemed equivalent.

3.1.1.3 General rules governing preparation for tests

3.1.1.3.1 The protective structure must conform to the series production specifications. It shall be attached in accordance with the manufacturer’s recommended method to one of the tractors for which it is designed.

Note: A complete tractor is not required for the static strength test; however, the protective structure and parts of the tractor to which it is attached represent an operating installation, hereinafter referred to as “the assembly”.

3.1.1.3.2 For both the static test and the dynamic test the tractor as assembled (or the assembly) must be fitted with all series production components which may affect the strength of the protective structure or which may be necessary for the strength test.

Components which may create a hazard in the clearance zone must also be fitted on the tractor (or the assembly) so that they may be examined to see whether the requirements of the Acceptance Conditions in 3.1.3 have been fulfilled. All components of the tractor or the protective structure including weather protective must be supplied or described on drawings.

3.1.1.3.3 For the strength tests, all panels and detachable non-structural components must be removed so that they may not contribute to the strengthening of the protective structure.

3.1.1.3.4 The track width must be adjusted so that the protective structure will, as far as possible, not be supported by the tyres during the strength tests. If these tests are conducted in accordance with the static procedure, the wheels may be removed.

3.1.1.4 Tractor reference mass during strength tests

The reference mass M, used in the formulae to calculate the height of the fall of the pendulum block, the loading energies and the crushing forces, must be at least the mass of the tractor, excluding optional accessories but including coolant, oils, fuel, tools plus the protective structure. Not included are optional front or rear weights, tyre ballast, mounted implements, mounted equipment or any specialised components.

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3.1.2 *Tests*

3.1.2.1 Sequence of tests

The sequence of tests, without prejudice to the additional tests mentioned in sections 3.2.1.1.6, 3.2.1.1.7, 3.2.2.1.6 and 3.2.2.1.7, is as follows:

1. impact (dynamic test) or loading (static test) at the rear of the structure (see 3.2.1.1.1 and 3.2.2.1.1);
2. rear crushing test (dynamic or static test) (see 3.2.1.1.4 and 3.2.2.1.4);
3. impact (dynamic test) or loading (static test) at the front of the structure (see 3.2.1.1.2 and 3.2.2.1.2);
4. impact (dynamic test) or loading (static test) at the side of the structure (see 3.2.1.1.3 and 3.2.2.1.3);
5. crushing at the front of the structure (dynamic or static test) (see 3.2.1.1.5 and 3.2.2.1.5).

3.1.2.2 General requirements

3.1.2.2.1 If, during the test, any part of the tractor restraining equipment breaks or moves, the test shall be restarted.

3.1.2.2.2 No repairs or adjustments of the tractor or protective structure may be carried out during the tests.

3.1.2.2.3 The tractor gear box shall be in neutral and the brakes off during the tests.

3.1.2.2.4 If the tractor is fitted with a suspension system between the tractor body and the wheels, it shall be blocked during the tests.

3.1.2.2.5 The side chosen for application of the first impact (dynamic test) or the first load (static test) on the rear of the structure shall be that which, in the opinion of the testing authorities, will result in the application of the series of impacts or loads under the most unfavourable conditions for the structure. The lateral impact or load and the rear impact or load shall be applied on both sides of the longitudinal median plane of the protective structure. The front impact or load shall be applied on the same side of the longitudinal median plane of the protective structure as the lateral impact or load.

3.1.3 *Acceptance conditions*

3.1.3.1 A protective structure is regarded as having satisfied the strength requirements if it fulfils the following conditions:

3.1.3.1.1 after each test in the dynamic test procedure, it shall be free from tears or cracks, as defined in 3.2.1.2.1. If during the dynamic test, significant tears or cracks appear, an additional impact test or crushing test as defined in 3.2.1.1.6 or 3.2.1.1.7 must be performed immediately after the test which caused these tears or cracks to appear;

3.1.3.1.2 during static test, at the point when the energy required is attained in each horizontal load test prescribed or in the overload test the force must be greater than 0,8 F;

3.1.3.1.3 if during a static test, cracks or tears appear as a result of the application of the crushing force, an additional crushing test as defined in 3.2.2.1.7 must be performed immediately after the crushing test which caused these cracks or tears to appear;

3.1.3.1.4 during the tests other than the overload test, no part of the protective structure must enter the clearance zone as defined in 1.6 of Annex I;

3.1.3.1.5 during the tests other than the overload test, all parts of the clearance zone shall be secured by the structure, in accordance with 3.2.1.2.2 and 3.2.2.2.2;

3.1.3.1.6 during the tests the protective structure must not impose any constraints on the seat structure;

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3.1.3.1.7 the elastic deflection, measured in accordance with 3.2.1.2.3 and 3.2.2.2.3 shall be less than 250 mm.

3.1.3.2 There shall be no accessories presenting a hazard for the driver. There shall be no projecting part or accessory which is liable to injure the driver should the tractor overturn, or any accessory or part which is liable to trap him – for example by the leg or the foot – as a result of the deflections of the structure.

3.1.4 [not applicable]

3.1.5 *Apparatus and equipment for dynamic tests*

3.1.5.1 Pendulum block

3.1.5.1.1 A block acting as a pendulum must be suspended by two chains or wire ropes from pivot points not less than 6 m above the ground. Means must be provided for adjusting independently the suspended height of the block and the angle between the block and the supporting chains or wire ropes.

3.1.5.1.2 The mass of the pendulum block must be 2 000 ± 20 kg excluding the mass of the chains or wire ropes which themselves must not exceed 100 kg. The length of the sides of the impact face must be 680 ± 20 mm (see Figure 7.3). The block must be filled in such a way that the position of its centre of gravity is constant and coincides with the geometrical centre of the parallelepiped.

3.1.5.1.3 The parallelepiped must be connected to the system which pulls it backwards by an instantaneous release mechanism which is so designed and located as to enable the pendulum block to be released without causing the parallelepiped to oscillate about its horizontal axis perpendicular to the pendulum's plane of oscillation.

3.1.5.2 Pendulum supports

The pendulum pivot points must be rigidly fixed so that their displacement in any direction does not exceed 1 per cent of the height of fall.

3.1.5.3 Lashings

3.1.5.3.1 Anchoring rails with the requisite track width and covering the necessary area for lashing the tractor in all the cases illustrated (see Figures 7.4, 7.5 and 7.6) must be rigidly attached to a non-yielding base beneath the pendulum.

3.1.5.3.2 The tractor shall be lashed to the rails by means of wire rope with round strand, fibre core, construction 6 × 19 in accordance with ISO 2408:2004 and a nominal diameter of 13 mm. The metal strands must have an ultimate tensile strength of 1 770 MPa.

3.1.5.3.3 The central pivot of an articulated tractor shall be supported and lashed down as appropriate for all tests. For the lateral impact test, the pivot shall also be propped from the side opposite the impact. The front and rear wheels need not be in line if this facilitates the attachment of the wire ropes in the appropriate manner.

3.1.5.4 Wheel prop and beam

3.1.5.4.1 A softwood beam of 150 mm square shall be used as a prop for the wheels during the impact tests (see Figures 7.4, 7.5 and 7.6).

3.1.5.4.2 During the lateral impact tests, a softwood beam shall be clamped to the floor to brace the rim of the wheel opposite the side of impact (see Figure 7.6).

3.1.5.5 Props and lashings for articulated tractors

3.1.5.5.1 Additional props and lashings must be used for articulated tractors. Their purpose is to ensure that the section of the tractor on which the protective structure is fitted is as rigid as that of a non-articulated tractor.

3.1.5.5.2 Additional specific details are given in section 3.2.1.1 for the impact and crushing tests.

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3.1.5.6 Tyre pressures and deflections

3.1.5.6.1 The tractor tyres shall not be liquid-ballasted and shall be inflated to the pressures prescribed by the tractor manufacturer for field work.

3.1.5.6.2 The lashings shall be tensioned in each particular case such that the tyres undergo a deflection equal to 12 per cent of the tyre wall height (distance between the ground and the lowest point of the rim) before tensioning.

3.1.5.7 Crushing rig

A rig as shown in Figure 7.7 shall be capable of exerting a downward force on a protective structure through a rigid beam approximately 250 mm wide connected to the load-applying mechanism by means of universal joints. Suitable axle stands shall be provided so that the tractor tyres do not bear the crushing force.

3.1.5.8 Measuring apparatus

The following measuring apparatus is needed:

3.1.5.8.1 device for measuring the elastic deflection (the difference between the maximum momentary deflection and the permanent deflection, see Figure 7.8).

3.1.5.8.2 device for checking that the protective structure has not entered the clearance zone and that the latter has remained within the structure's protective during the test (see section 3.2.2.2.2).

3.1.6 *Apparatus and equipment for static tests*

3.1.6.1 Static testing rig

3.1.6.1.1 The static testing rig must be designed in such a way as to permit thrusts or loads to be applied to the protective structure.

3.1.6.1.2 Provision must be made so that the load can be uniformly distributed normal to the direction of loading and along a flange having a length of one of the exact multiples of 50 between 250 and 700 mm. The stiff beam shall have a vertical face dimension of 150 mm. The edges of the beam in contact with the protective structure shall be curved with a maximum radius of 50 mm.

3.1.6.1.3 The pad shall be capable of being adjusted to any angle in relation to the load direction, in order to be able to follow the angular variations of the structure's load-bearing surface as the structure deflects.

3.1.6.1.4 Direction of the force (deviation from horizontal and vertical):

— at start of test, under zero load: ± 2°,

— during test, under load: 10° above and 20° below the horizontal. These variations must be kept to a minimum.

3.1.6.1.5 The deflection rate shall be sufficiently slow, less than 5 mm/s so that the load may at all moments be considered as static.

3.1.6.2 Apparatus for measuring the energy absorbed by the structure

3.1.6.2.1 The force versus deflection curve shall be plotted in order to determine the energy absorbed by the structure. There is no need to measure the force and deflection at the point where the load is applied to the structure; however, force and deflection shall be measured simultaneously and co-linearly.

3.1.6.2.2 The point of origin of deflection measurements shall be selected so as to take account only of the energy absorbed by the structure and/or by the deflection of certain parts of the tractor. The energy absorbed by the deflection and/or the slipping of the anchoring must be ignored.

3.1.6.3 Means of anchoring the tractor to the ground

3.1.6.3.1 Anchoring rails with the requisite track width and covering the necessary area for anchoring the tractor in all the cases illustrated must be rigidly attached to a non-yielding base near the testing rig.

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3.1.6.3.2 The tractor must be anchored to the rails by any suitable means (plates, wedges, wire ropes, jacks, etc.) so that it cannot move during the tests. This requirement shall be checked during the test, by means of the usual devices for measuring length.

If the tractor moves, the entire test shall be repeated, unless the system for measuring the deflections taken into account for plotting the force versus deflection curve is connected to the tractor.

3.1.6.4 Crushing rig

A rig as shown in Figure 7.7 shall be capable of exerting a downward force on a protective structure through a rigid beam approximately 250 mm wide, connected to the load-applying mechanism by means of universal joints. Suitable axle stands must be provided so that the tractor tyres do not bear the crushing force.

3.1.6.5 Other measuring apparatus

The following measure devices are also needed:

3.1.6.5.1 device for measuring the elastic deflection (the difference between the maximum momentary deflection and the permanent deflection, see Figure 7.8).

3.1.6.5.2 device for checking that the protective structure has not entered the clearance zone and that the latter has remained within the structure's protective during the test (section 3.3.2.2.2).

3.2 **Test procedures**

3.2.1 *Dynamic tests*

3.2.1.1 Impact and crushing tests

3.2.1.1.1 *Impact at the rear*

3.2.1.1.1.1 The tractor shall be so placed in relation to the pendulum block that the block will strike the protective structure when the impact face of the block and the supporting chains or wire ropes are at an angle with the vertical plane A equal to M/100 with a 20° maximum, unless, during deflection, the protective structure at the point of contact forms a greater angle to the vertical. In this case the impact face of the block shall be adjusted by means of an additional support so that it is parallel to the protective structure at the point of impact at the moment of maximum deflection, the supporting chains or wire ropes remaining at the angle defined above.

The suspended height of the block shall be adjusted and necessary steps taken so as to prevent the block from turning about the point of impact.

The point of impact is that part of the protective structure likely to hit the ground first in a rearward overturning accident, normally the upper edge. The position of the centre of gravity of the block is 1/6 of the width of the top of the protective structure inwards from a vertical plan parallel to the median plane of the tractor touching the outside extremity of the top of the protective structure.

If the structure is curved or protruding at this point, wedges enabling the impact to be applied thereon must be added, without thereby reinforcing the structure.

3.2.1.1.1.2 The tractor must be lashed to the ground by means of four wire ropes, one at each end of both axles, arranged as indicated in Figure 7.4. The spacing between the front and rear lashing points must be such that the wire ropes make an angle of less than 30° with the ground. The rear lashings must in addition be so arranged that the point of convergence of the two wire ropes is located in the vertical plane in which the centre of gravity of the pendulum block travels.

The wire ropes must be tensioned so that the tyres undergo the deflections given in 3.1.5.6.2. With the wire ropes tensioned, the wedging beam shall be placed in front of and tight against the rear wheels and then fixed to the ground.

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3.2.1.1.1.3 If the tractor is of the articulated type, the point of articulation shall, in addition, be supported by a wooden block at least 100 mm square and firmly lashed to the ground.

3.2.1.1.1.4 The pendulum block shall be pulled back so that the height of its centre of gravity above that at the point of impact is given by one of the following two formulae:

$$H = 2{,}165 \times 10^{-8}\ M\ L^2$$

or

$$H = 5{,}73 \times 10^{-2}\ I$$

The pendulum block is then released and strikes the protective structure.

3.2.1.1.1.5 For tractors with a reversible driver's position (reversible seat and steering wheel), the height shall be whichever is greater of either of the above or either of the following:

$$H = 25 + 0{,}07\ M$$

for tractor with a reference mass of less than 2 000 kg;

$$H = 125 + 0{,}02\ M$$

for tractor with a reference mass of more than 2 000 kg.

3.2.1.1.2 *Impact at the front*

3.2.1.1.2.1 The tractor shall be so placed in relation to the pendulum block that the block will strike the protective structure when the impact face of the block and the supporting chains or wire ropes are at an angle with the vertical plane A equal to M/100 with a 20° maximum, unless, during deflection, the protective structure at the point of contact forms a greater angle to the vertical. In this case the impact face of the block shall be adjusted by means of an additional support so that it is parallel to the protective structure at the point of impact at the moment of maximum deflection, the supporting chains or wire ropes remaining at the angle defined above.

The suspended height of the pendulum block shall be adjusted and the necessary steps taken so as to prevent the block from turning about the point of impact.

The point of impact is that part of the protective structure likely to hit the ground first if the tractor overturned sideways while travelling forward, normally the upper edge. The position of the centre of gravity of the block is 1/6 of the width of the top of the protective structure inwards from a vertical plane parallel to the median plane of the tractor touching the outside extremity of the top of the protective structure.

If the structure is curved or protruding at this point, wedges enabling the impact to be applied thereon must be added, without thereby reinforcing the structure.

3.2.1.1.2.2 The tractor must be lashed to the ground by means of four wire ropes, one at each end of both axles, arranged as indicated in Figure 7.5. The spacing between the front and rear lashing points must be such that the wire ropes make an angle of less than 30° with the ground. The rear lashings must in addition be so arranged that the point of convergence of the two wire ropes is located in the vertical plane in which the centre of gravity of the pendulum block travels.

The wire ropes must be tensioned so that the tyres undergo the deflections given in 3.1.5.6.2. With the wire ropes tensioned, the wedging beam shall be placed behind and tight against the rear wheels and then fixed to the ground.

3.2.1.1.2.3 If the tractor is of the articulated type, the point of articulation shall, in addition, be supported by a wooden block at least 100 mm square and firmly lashed to the ground.

3.2.1.1.2.4 The pendulum block shall be pulled back so that the height of its centre of gravity above that at the point of impact is given by one of the following two formulae, to be chosen according to the reference mass of the assembly subjected to the tests:

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$$H = 25 + 0{,}07\ M$$

for tractor with a reference mass of less than 2 000 kg;

$$H = 125 + 0{,}02\ M$$

for tractor with a reference mass of more than 2 000 kg.

The pendulum block is then released and strikes the protective structure.

3.2.1.1.2.5 In case of tractors with a reversible driver's position (reversible seat and steering wheel):

— if the protective structure is a rear two-post rollbar, the above formula shall apply,

— for other types of protective structure, the height shall be whichever is greater from the formula applied above and that selected below:

$$H = 2{,}165 \times 10^{-8}\ ML^2$$

or

$$H = 5{,}73 \times 10^{-2}\ I$$

The pendulum block is then released and strikes the protective structure.

3.2.1.1.3 *Impact from the side*

3.2.1.1.3.1 The tractor shall be so placed in relation to the pendulum block that the block will strike the protective structure when the impact face of the block and the supporting chains or wire ropes are vertical unless, during deflection, the protective structure at the point of contact forms an angle of less than 20° to the vertical. In this case the impact face of the block shall be adjusted by means of an additional support so that it is parallel to the protective structure at the point of impact at the moment of maximum deflection, the supporting chains or wire ropes remaining vertical on impact.

3.2.1.1.3.2 The suspended height of the pendulum block shall be adjusted and necessary steps taken so as to prevent the block from turning about the point of impact.

3.2.1.1.3.3 The point of impact shall be that part of the protective structure likely to hit the ground first in a sideways overturning accident, normally the upper edge. Unless it is certain that another part of this edge would hit ground first, the point of impact shall be in the plane at right angles to the median plane and passing 60 mm in front of the seat index point, the seat being set at the mid-position of longitudinal adjustment.

3.2.1.1.3.4 For tractors with a reversible driver's position (reversible seat and steering wheel), the point of impact shall be in the plane at right angles to the median plane and passing at the midpoint of the segment joining the two seat index points defined by joining the two different positions of the seat. For protective structures having a two-post system, the impact shall be located on one of the two posts.

3.2.1.1.3.5 The tractor wheels on the side which is to receive the impact must be lashed to the ground by means of wire ropes passing over the corresponding ends of the front and rear axles. The wire ropes must be tensioned to produce the tyre deflection values given in 3.1.5.6.2.

With the wire ropes tensioned, the wedging beam shall be placed on the ground, pushed tight against the tyres on the side opposite that which is to receive the impact and then fixed to the ground. It may be necessary to use two beams or wedges if the outer sides of the front and rear tyres are not in the same vertical plane. The prop shall then be placed as indicated in Figure 7.6 against the rim of the most heavily loaded wheel opposite to the point of impact, pushed firmly against the rim and then fixed at its base. The length of the prop shall be such that it makes an angle of 30 ± 3° with the ground when in position against the rim. In addition, its thickness shall, if possible, be between 20 and 25 times less than its length and

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between 2 and 3 times less than its width. The props shall be shaped at both ends as shown in the details on Figure 7.6.

3.2.1.1.3.6 If the tractor is of the articulated type, the point of articulation shall in addition be supported by a wooden block at least 100 mm square and laterally supported by a device similar to the prop pushed against the rear wheel as in 3.2.1.1.3.2. The point of articulation shall then be lashed firmly to the ground.

3.2.1.1.3.7 The pendulum block shall be pulled back so that the height of its centre of gravity above that at the point of impact is given by one of the following two formulae, to be chosen according to the reference mass of the assembly subjected to the tests:

$$H = 25 + 0{,}20\ M$$

for tractors with a reference mass of less than 2 000 kg;

$$H = 125 + 0{,}15\ M$$

for tractors with a reference mass of more than 2 000 kg.

3.2.1.1.3.8 In case of tractors with a reversible driver's position (reversible seat and steering wheel):

— if the protective structure is a rear two-post rollbar, the selected height shall be whichever is greater from the formulae applicable above and below:

$$H = (25 + 0{,}20\ M)\ (B_6 + B) / 2B$$

for tractor with a reference mass of less than 2 000 kg;

$$H = (125 + 0{,}15\ M)\ (B_6 + B) / 2B$$

for tractor with a reference mass of more than 2 000 kg.

— for other types of protective structures, the selected height shall be whichever is greater from the formulae applicable above and below:

$$H = 25 + 0{,}20\ M$$

for tractor with a reference mass less than 2 000 kg;

$$H = 125 + 0{,}15\ M$$

for tractor with a reference mass of more than 2 000 kg.

The pendulum block is then released and strikes the protective structure.

3.2.1.1.4 *Crushing at the rear*

The beam shall be positioned over the rear uppermost structural member(s) and the resultant of crushing forces shall be located in the tractor's median plane A force F_v shall be applied where:

$F_v = 20\ M$

The force F_v shall be maintained for five seconds after the cessation of any visually detectable movement of the protective structure.

Where the rear part of the protective structure roof will not sustain the full crushing force, the force shall be applied until the roof is deflected to coincide with the plane joining the upper part of the protective structure with that part of the rear of the tractor capable of supporting the tractor when overturned.

The force shall then be removed, and the crushing beam repositioned over that part of the protective structure which would support the tractor when completely overturned. The crushing force F_v shall then be applied again.

3.2.1.1.5 *Crushing at the front*

The beam shall be positioned across the front uppermost structural member(s) and the resultant of crushing forces shall be located in the tractor's median plane. A force F_v shall be applied where:

$$F_v = 20\ M$$

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The force F_v shall be maintained for five seconds after the cessation of any visually detectable movement of the protective structure.

Where the front part of the protective structure roof will not sustain the full crushing force, the force shall be applied until the roof is deflected to coincide with the plane joining the upper part of the protective structure with that part of the front of the tractor capable of supporting the tractor when overturned.

The force shall then be removed, and the crushing beam repositioned over that part of the protective structure which would support the tractor when completely overturned. The crushing force F_v shall then be applied again.

3.2.1.1.6 *Additional impact tests*

If cracks or tears which cannot be considered negligible appear during an impact test, a second, similar test, but with a height of fall of:

$$H' = (H \times 10^{-1})\ (12 + 4a)\ (1 + 2a)^{-1}$$

shall be performed immediately after the impact tests causing these tears or cracks to appear, "a" being the ratio of the permanent deformation (D_p) to the elastic deformation (D_e):

$$a = D_p / D_e$$

as measured at the point of impact. The additional permanent deformation due to the second impact shall not exceed 30 per cent of the permanent deformation due to the first impact.

In order to be able to carry out the additional test, it is necessary to measure the elastic deformation during all the impact tests.

3.2.1.1.7 *Additional crushing tests*

If during a crushing test, significant cracks or tears appear, a second, similar, crushing test, but with a force equal to 1,2 F_v shall be performed immediately after the crushing tests which caused these tears or cracks to appear.

3.2.1.2 Measurements to be made

3.2.1.2.1 *Fractures and cracks*

After each test all structural members, joints and fastening systems shall be visually examined for fractures or cracks, any small cracks in unimportant parts being ignored.

Any tears caused by the edges of the pendulum weight are to be ignored.

3.2.1.2.2 *Entry into the clearance zone*

During each test the protective structure shall be examined to see whether any part it has entered a clearance zone round the driving seat as defined in 1.6.

Furthermore, the clearance zone shall not be outside the protection of the protective structure. For this purpose, it shall be considered to be outside the protection of the structure if any part of it would come in contact with flat ground if the tractor overturned towards the direction from which the test load is applied. For estimating this, the front and rear tyres and track width setting shall be the smallest standard fitting specified by the manufacturer.

3.2.1.2.3 *Elastic deflection (under side impact)*

The elastic deflection shall be measured (810 + a_v) mm above the seat index point, in the vertical plane in which the load is applied. For this measurement, any apparatus similar to that illustrated in Figure 7.8 may be used.

3.2.1.2.4 *Permanent deflection*

After the final crushing test, the permanent deflection of the protective structure shall be recorded. For this purpose, before the start of the test, the position of the main roll-over protective structure members in relation to the seat index point shall be used.

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3.2.2 *Static tests*

3.2.2.1 Loading and crushing tests

3.2.2.1.1 *Loading at the rear*

3.2.2.1.1.1 The load shall be applied horizontally, in a vertical plane parallel to the tractor's median plane.

The load application point shall be that part of the roll-over protective structure likely to hit the ground first in a rearward overturning accident, normally the upper edge. The vertical plane in which the load is applied shall be located at a distance of one third of the external width of the upper part of the structure from the median plane.

If the structure is curved or protruding at this point, wedges enabling the load to be applied thereon shall be added, without thereby reinforcing the structure.

3.2.2.1.1.2 The assembly shall be lashed to the ground as described in 3.1.6.3.

3.2.2.1.1.3 The energy absorbed by the protective structure during the test shall be at least:

$$E_{il} = 2{,}165 \times 10^{-7}\ M\ L^2$$

or

$$E_{il} = 0{,}574 \times I$$

3.2.2.1.1.4 For tractors with a reversible driver's position (reversible seat and steering wheel), the energy shall be whichever is the higher of the formula selected above or the followisng:

$$E_{il} = 500 + 0{,}5\ M$$

3.2.2.1.2 *Loading at the front*

3.2.2.1.2.1 The load shall be applied horizontally in a vertical plane parallel to the tractor's median plane. The point of application shall be that part of the protective structure likely to hit the ground first if the tractor overturns sideways while travelling forward, i.e. normally the upper edge. The point of application of the load shall be 1/6 of the width of the top of the protective structure inwards from a vertical plane parallel to the median plane of the tractor touching the outside extremity of the top of the protective structure.

If the structure is curved or protruding at this point, wedges enabling the load to be applied thereon shall be added, without thereby reinforcing the structure.

3.2.2.1.2.2 The assembly shall be lashed to the ground as described in 3.1.6.3.

3.2.2.1.2.3 The energy absorbed by the protective structure during the test shall be at least:

$$E_{il} = 500 + 0{,}5\ M$$

3.2.2.1.2.4 In case of tractors with a reversible driver's position (reversible seat and steering wheel):

— if the protective structure is a rear two-post rollbar the preceding formula shall also apply,

— for other types of protective structures, the energy shall be whichever is the higher of the above or either of the following as selected:

$$E_{il} = 2{,}165 \times 10^{-7}\ ML^2$$

or

$$E_{il} = 0{,}574\ I$$

3.2.2.1.3 *Loading from the side*

3.2.2.1.3.1 The side loading shall be applied horizontally, in a vertical plane perpendicular to the tractor's median plane passing 60 mm in front of the seat index point, the seat being at the mid-position of the longitudinal adjustment. The load application point shall be that part

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of the roll-over protective structure likely to hit the ground first in a sideways overturning accident, normally the upper edge.

3.2.2.1.3.2 The assembly shall be lashed to the ground as described in 3.1.6.3.

3.2.2.1.3.3 The energy absorbed by the protective structure during the test shall be at least:

$$E_{is} = 1{,}75\ M$$

3.2.2.1.3.4 For tractors with a reversible driver's position (reversible seat and steering wheel), the load application point shall be in the plane at right angles to the median plane and passing at the midpoint of the segment joining the two seat index points defined by joining the two different positions of the seat. For protective structures having a two-post system, the load shall be located on one of the two posts.

3.2.2.1.3.5 In case of tractors with a reversible driver's position (reversible seat and steering wheel) where the protective structure is a rear two-post rollbar, the energy shall be whichever is higher of the following:

$$E_{is} = 1{,}75\ M$$

or

$$E_{is} = 1{,}75\ M\ (B_6 + B)/2B$$

3.2.2.1.4 *Crushing at the rear*

All provisions are identical to those given in 3.2.1.1.4.

3.2.2.1.5 *Crushing at the front*

All provisions are identical to those given in 3.2.1.1.5.

3.2.2.1.6 *Additional overload test (Figures 7.9 to 7.11)*

An overload test shall be carried out in all cases where the force decreases by more than 3 per cent during the last 5 per cent of the deflection reached when the energy required is absorbed by the structure (see Figure 7.10).

The overload test involves the gradual increase of the horizontal load by increments of 5 per cent of the initial energy requirement up to a maximum of 20 per cent of energy added (see Figure 7.11).

The overload test is satisfactory if, after each increase by 5, 10, or 15 per cent in the energy required, the force decreases by less than 3 per cent for a 5 per cent increment and remains greater than 0,8 F_{max}.

The overload test is satisfactory if, after the structure has absorbed 20 per cent of the added energy, the force exceeds 0,8 F_{max}.

Additional cracks or tears and/or entry into or lack of protective of the clearance zone due to elastic deflection are permitted during the overload test. However, after the removal of the load, the structure shall not enter the clearance zone, which shall be completely protected.

3.2.2.1.7 *Additional crushing tests*

If cracks or tears which cannot be considered as negligible appear during a crushing test, a second, similar crushing, but with a force of 1,2 F_v shall be applied immediately after the crushing test which caused the cracks or tears to appear.

3.2.2.2 Measurements to be made

3.2.2.2.1 *Fractures and cracks*

After each test all structural members, joints and attachment systems shall be visually examined for fractures or cracks, any small cracks in unimportant parts being ignored.

3.2.2.2.2 *Entry into the clearance zone*

During each test the protective structure shall be examined to see whether any part of it has entered a clearance zone as defined in 1.6 of Annex I.

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In addition, an examination shall be made to determine whether any part of the clearance zone is outside the protection of the structure. For this purpose it is considered to be outside the protection of the roll-over protective structure if any part of it would have come in contact with the ground plane if the tractor had overturned in the direction from which the impact came. For this purpose the front and rear tyres and track setting are assumed to be the smallest specified by the manufacturer.

3.2.2.2.3 *Elastic deflection under side loading*

The elastic deflection shall be measured $(810 + a_v)$ mm above the seat index point, in the vertical plane in which the load is applied. For this measurement, any apparatus similar to that illustrated in Figure 7.8 may be used.

3.2.2.2.4 *Permanent deflection*

After the final crushing test, the permanent deflection of the protective structure shall be recorded. For this purpose, before the start of the test, the position of the main roll-over protective structure members in relation to the seat index point shall be used.

Extension to other tractor models

3.3.1 [not applicable]

3.3.2 *Technical extension*

When technical modifications occur on the tractor, the protective structure or the method of attachment of the protective structure to the tractor, the testing station that has carried out the original test can issue a "technical extension report" in the following cases:

3.3.2.1 Extension of the structural test results to other models of tractors

The impact and crushing tests need not be carried out on each model of tractor, provided that the protective structure and tractor comply with the conditions referred to hereunder 3.3.2.1.1 to 3.3.2.1.5.

3.3.2.1.1 The structure shall be identical to the one tested.

3.3.2.1.2 The required energy shall not exceed the energy calculated for the original test by more than 5 per cent.

3.3.2.1.3 The method of attachment and the tractor components to which the attachment is made shall be identical.

3.3.2.1.4 Any components such as mudguards and bonnet that may provide support for the protective structure shall be identical.

3.3.2.1.5 The position and critical dimensions of the seat in the protective structure and the relative position of the protective structure on the tractor shall be such that the clearance zone would have remained within the protection of the deflected structure throughout all tests (this shall be checked by using the same reference of clearance zone as in the original test report, respectively Seat Reference Point [SRP] or Seat Index Point [SIP]).

3.3.2.2 Extension of the structural test results to modified models of the protective structure

This procedure has to be followed when the provisions of paragraph 3.3.2.1 are not fulfilled, it may not be used when the method of attachment of the protective structure to the tractor does not remain of the same principle (e.g. rubber supports replaced by a suspension device):

3.3.2.2.1 Modifications having no impact on the results of the initial test (e.g. weld attachment of the mounting plate of an accessory in a non-critical location on the structure), addition of seats with different SIP location in the protective structure (subject to checking that the new clearance zone(s) remain(s) within the protection of the deflected structure throughout all tests).

3.3.2.2.2 Modifications having a possible impact on the results of the original test without calling into question the acceptability of the protective structure (e.g. modification of a structural component, modification

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of the method of attachment of the protective structure to the tractor). A validation test can be carried out and the test results will be drafted in the extension report.

The following limits for this type extension are fixed:

3.3.2.2.2.1 no more than 5 extensions may be accepted without a validation test;

3.3.2.2.2.2 the results of the validation test will be accepted for extension if all the acceptance conditions of the Code are fulfilled and:

if the deflection measured after each impact test does not deviate from the deflection measured after each impact test in the original test report by more than ± 7 % (in case of a dynamic test);

if the force measured when the required energy level has been reached in the various horizontal load tests does not deviate from the force measured when the required energy has been reached in the original test by more than ± 7 % and the deflection measured ([1]) when the required energy level has been reached in the various horizontal load tests does not deviate from the deflection measured when the required energy has been reached in the original test by more than ± 7 % (in case of a static test).

3.3.2.2.2.3 more than one protective structure modifications may be included in a single extension report if they represent different options of the same protective structure, but only one validation test can be accepted in a single extension report. The options not tested shall be described in a specific section of the extension report.

3.3.2.2.3 Increase of the reference mass declared by the manufacturer for a protective structure already tested. If the manufacturer wants to keep the same approval number it is possible to issue an extension report after having carried out a validation test (the limits of ± 7 % specified in 3.3.2.2.2.2 are not applicable in such a case).

3.4 [not applicable]

3.5 **Cold weather performance of protective structures**

3.5.1 If the protective structure is claimed to have properties resistant to cold weather embrittlement, the manufacturer shall give details that shall be included in the report.

3.5.2 The following requirements and procedures are intended to provide strength and resistance to brittle fracture at reduced temperatures. It is suggested that the following minimum material requirements shall be met in judging the protective structure's suitability at reduced operating temperatures in those countries requiring this additional operating protection.

3.5.2.1 Bolts and Nuts used to attach the protective structure to the tractor and used to connect structural parts of the protective structure shall exhibit suitable controlled reduced temperature toughness properties.

3.5.2.2 All welding electrodes used in the fabrication of structural members and mounts shall be compatible with the protective structure material as given in 3.5.2.3 below.

3.5.2.3 Steel materials for structural members of the protective structure shall be of controlled toughness material exhibiting minimum Charpy V-Notch impact energy requirements as shown in Table 7.1. Steel grade and quality shall be specified in accordance with ISO 630:1995.

Steel with an as-rolled thickness less than 2,5 mm and with a carbon content less than 0,2 per cent is considered to meet this requirement.

Structural members of the protective structure made from materials other than steel shall have equivalent low temperature impact resistance.

([1]) Permanent + elastic deflection measured at the point when the required energy level is obtained.'

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3.5.2.4 When testing the Charpy V-Notch impact energy requirements, the specimen size shall be no less than the largest of the sizes stated in Table 7.1 that the material will permit.

3.5.2.5 The Charpy V-Notch tests shall be made in accordance with the procedure in ASTM A 370-1979, except for specimen sizes that shall be in accordance with the dimensions given in Table 7.1.

Table 7.1

Minimum Charpy V-notch impact energies

Specimen size	Energy at	Energy at
	–30 °C	–20 °C
mm	J	J (b)
10 × 10 (a)	11	27,5
10 × 9	10	25
10 × 8	9,5	24
10 × 7,5 (a)	9,5	24
10 × 7	9	22,5
10 × 6,7	8,5	21
10 × 6	8	20
10 × 5 (a)	7,5	19
10 × 4	7	17,5
10 × 3,5	6	15
10 × 3	6	15
10 × 2,5 (a)	5,5	14

(a) Indicates preferred size. Specimen size shall be no less than largest preferred size that the material permits.

(b) The energy requirement at – 20 °C is 2,5 times the value specified for – 30 °C. Other factors affect impact energy strength, i.e. direction of rolling, yield strength, grain orientation and welding. These factors shall be considered when selecting and using steel.

3.5.2.6 Alternatives to this procedure are the use of killed or semi-killed steel for which an adequate specification shall be provided. Steel grade and quality shall be specified in accordance with ISO 630:1995, Amd 1:2003.

3.5.2.7 Specimens are to be longitudinal and taken from flat stock, tubular or structural sections before forming or welding for use in the protective structure. Specimens from tubular or structural sections are to be taken from the middle of the side of greatest dimension and shall not include welds.

3.6 [not applicable]

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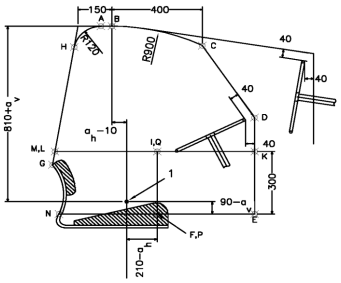
Figure 7.1

Clearance zone

Figure 7.1.a

Side view

Section in reference plan



Dimensions in mm

Figure 7.1.b

Rear view

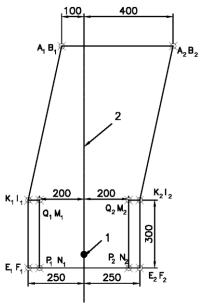
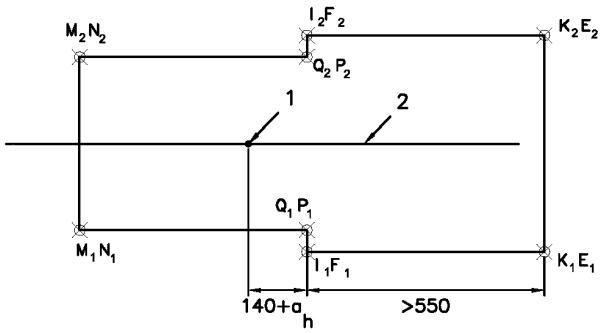


Figure 7.1.c

Seen from above

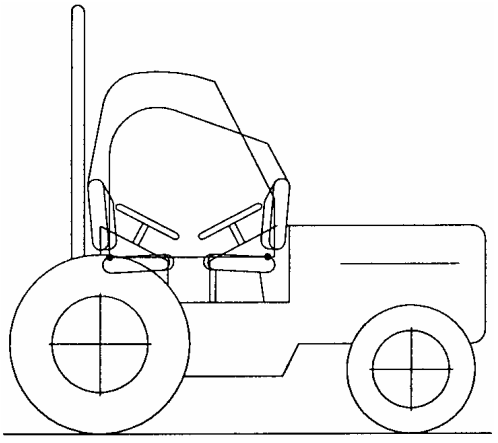


1 — Seat index point

2 — Reference plane

Figure 7.2.a

Clearance zone for tractors with reversible seat position: two-post rollbar



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Figure 7.2.b

Clearance zone for tractors with reversible seat position: other types of ROPS

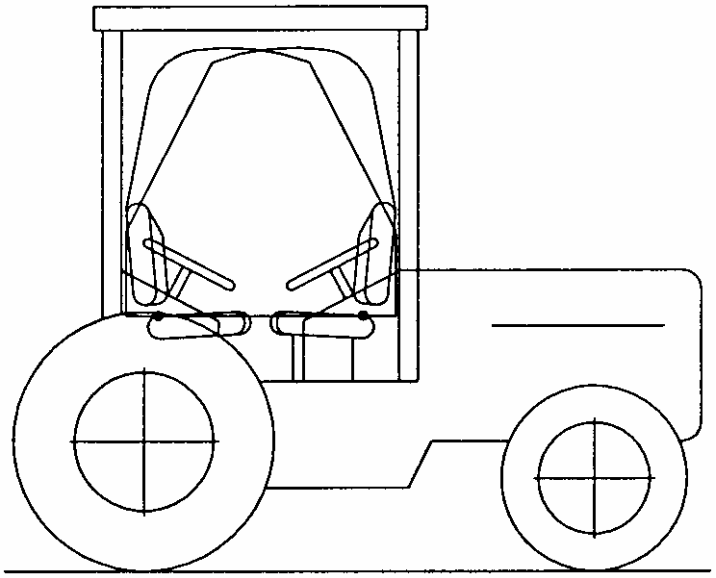
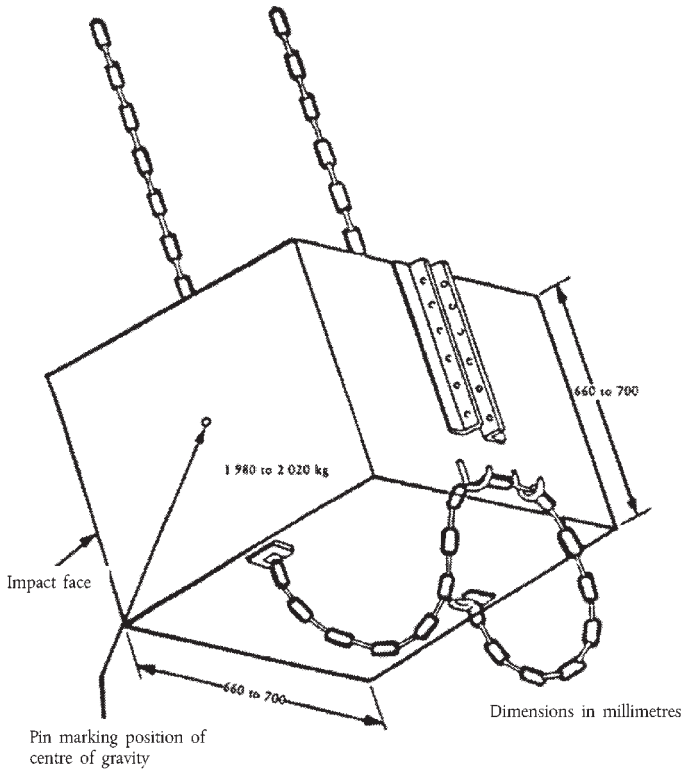


Figure 7.3

Pendulum block and its suspending chains or wire ropes



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Figure 7.4

Example of tractor lashing (rear impact)

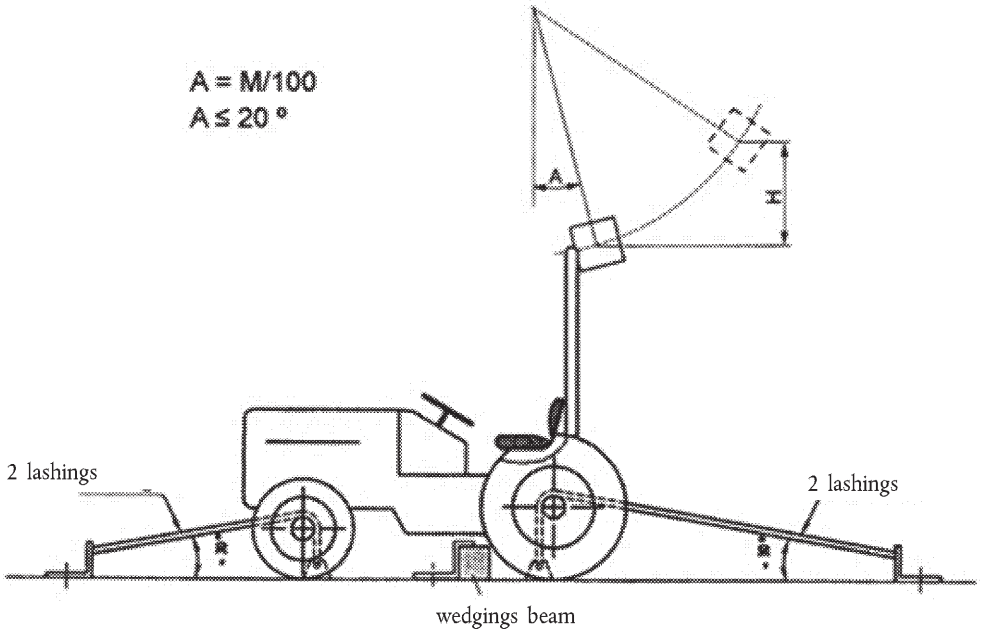
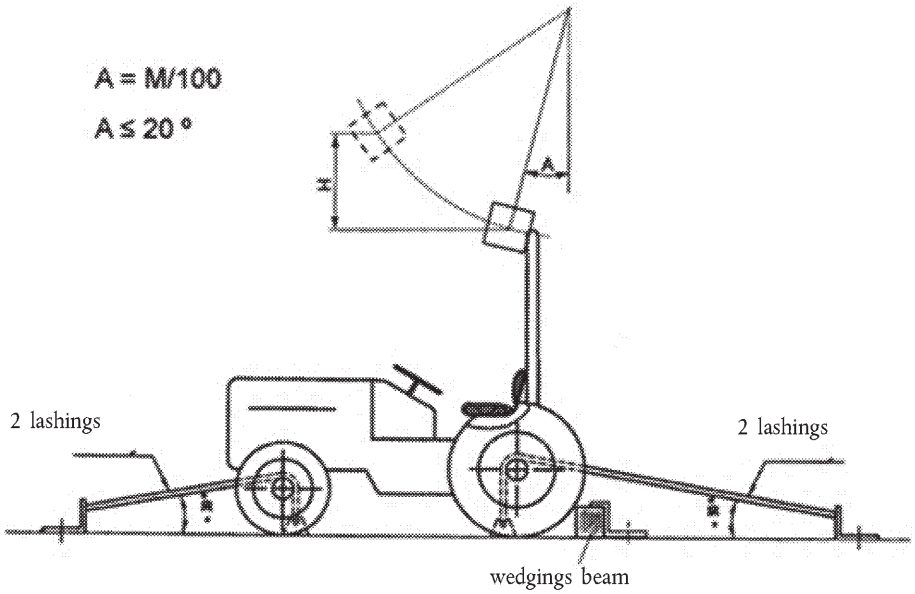


Figure 7.5

Example of tractor lashing (front impact)



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Figure 7.6

Example of tractor lashing (side impact)

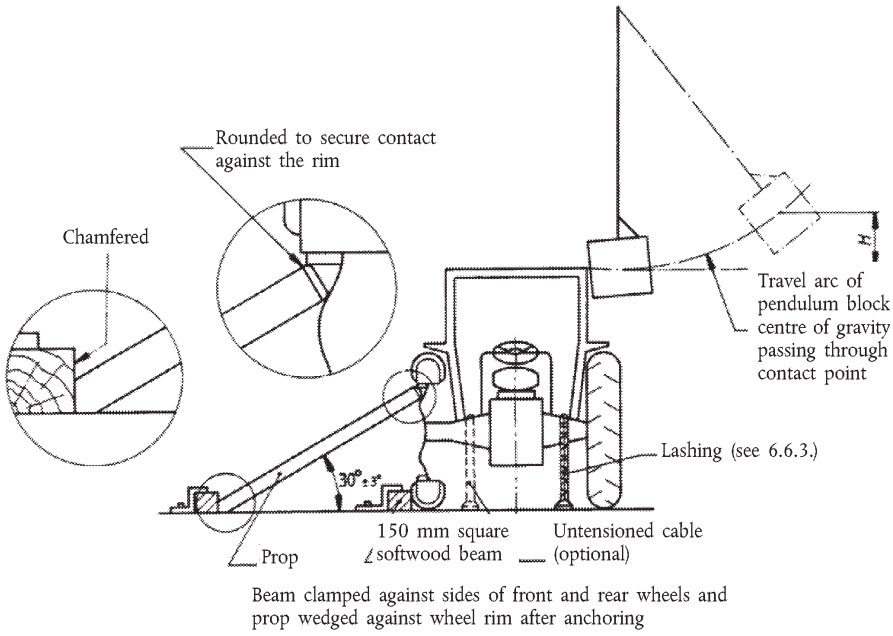
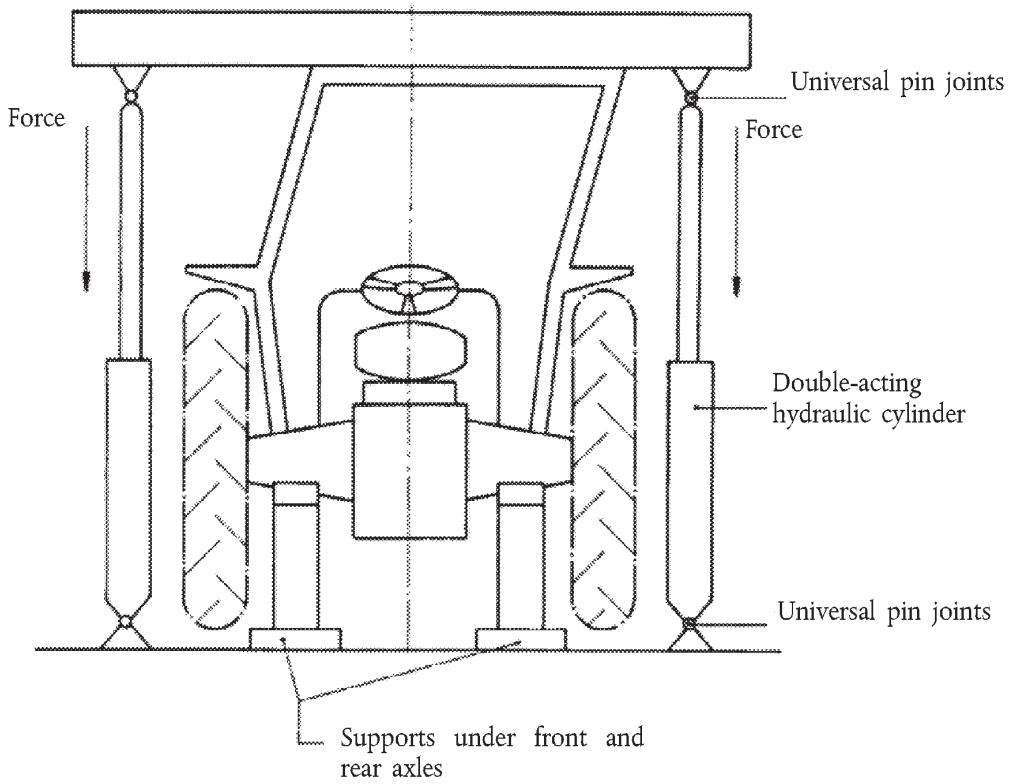


Figure 7.7

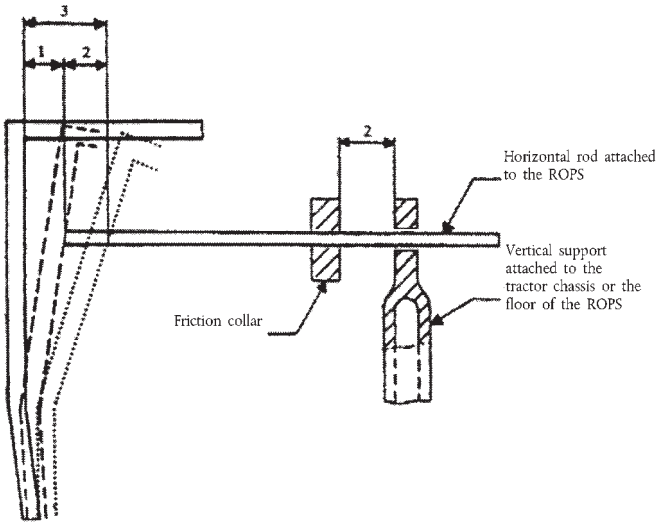
Example of crushing rig of the tractor



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Figure 7.8

Example of apparatus for measuring elastic deflection



1 — Permanent deflection

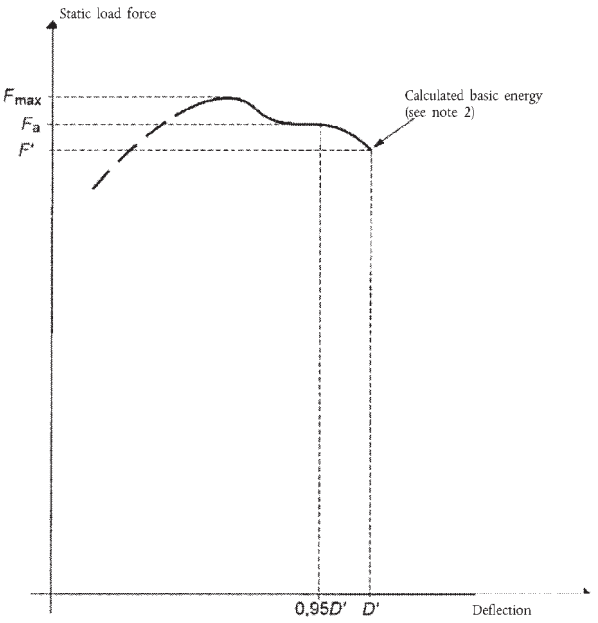
2 — Elastic deflection

3 — Total deflection (permanent plus elastic)

Figure 7.9

Force/deflection curve

Overload test not necessary



Notes:

1. Locate F_a in relation to 0,95 D′

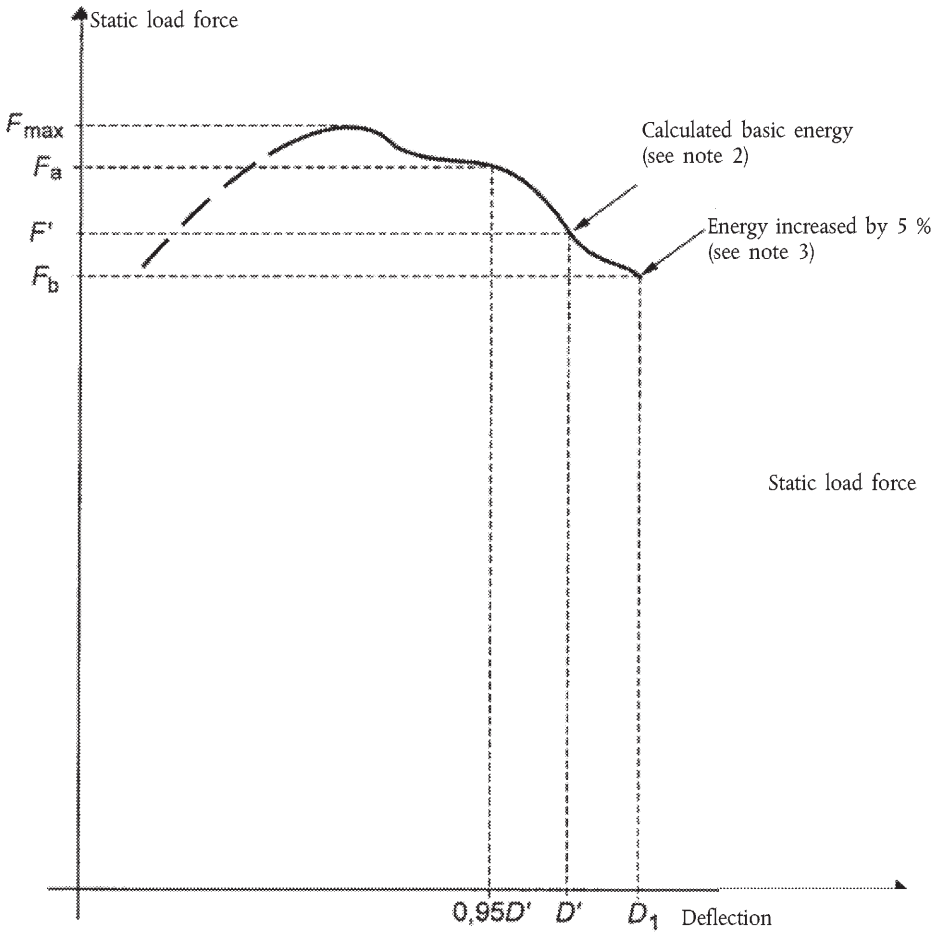
2. Overload test not necessary as $F_a \leq 1{,}03\ F'$

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Figure 7.10

Force/deflection curve

Overload test necessary



Notes:

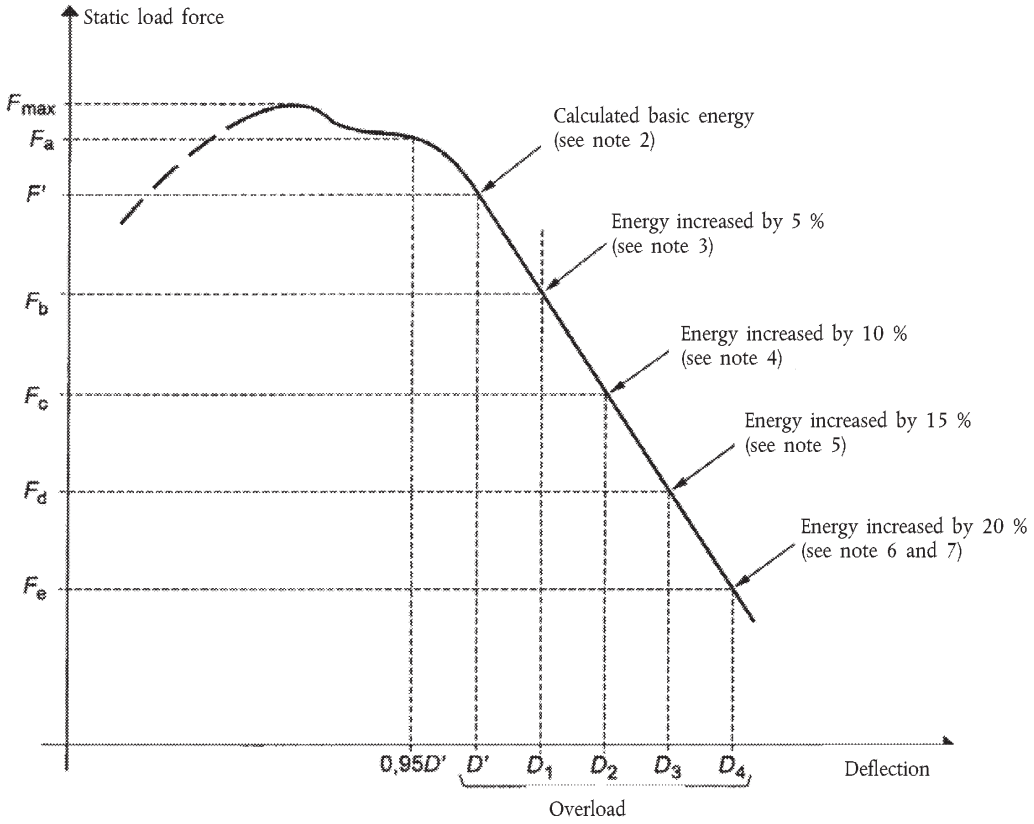
1. Locate F_a in relation to 0,95 D′
2. Overload test necessary as F_a 1,03 F′
3. Overload test performance satisfactory as F_b 0,97F′ and F_b 0,8F_{max}.

▼M5

Figure 7.11

Force/deflection curve

Overload test to be continued



Notes:

1. Locate F_a in relation to 0,95 D′
2. Overload test necessary as F_a 1,03 F′
3. F_b 0,97 F′ therefore further overload necessary
4. F_c 0,97 F_b therefore further overload necessary
5. F_d 0,97 F_c therefore further overload necessary
6. Overload test performance satisfactory, if F_e 0,8 F_{max}
7. Failure at any stage when load drops below 0,8 F_{max}.

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ANNEX VI

MARKS

The EEC component type-approval mark shall consist of:

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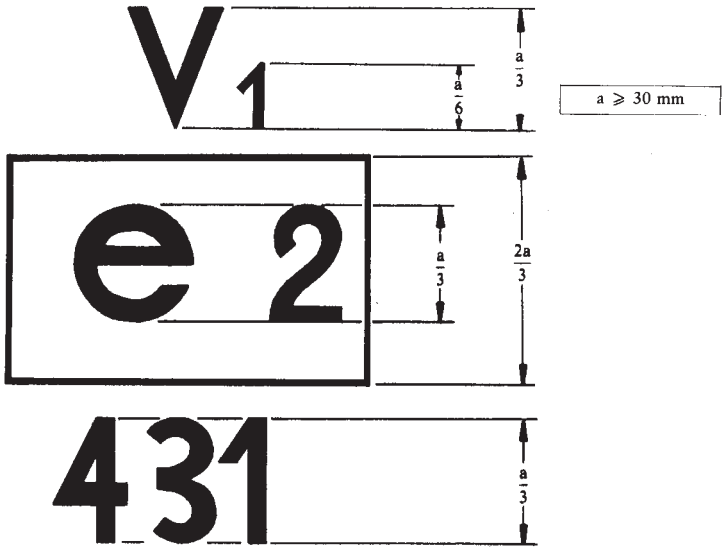
— a rectangle surrounding the lower case letter 'e' followed by the distinguishing number of the Member State which has granted the component type-approval:

1 for Germany, 2 for France, 3 for Italy, 4 for the Netherlands, 5 for Sweden, 6 for Belgium, ►A2 7 for Hungary, 8 for the Czech Republic ◄ 9 for Spain, 11 for the United Kingdom, 12 for Austria, 13 for Luxembourg, 17 for Finland, 18 for Denmark, ►A2 20 for Poland, ◄ 21 for Portugal, 23 for Greece, 24 for Ireland, ►A2 26 for Slovenia, 27 for Slovakia, 29 for Estonia, 32 for Latvia, 36 for Lithuania, CY for Cyprus, MT for Malta, ◄ ►M4 34 for Bulgaria, 19 for Romania, ◄

▼B

— the EEC component type-approval number which corresponds to the number of the EEC component type-approval certificate issued with regard to the strength of the type of protection structure and its attachment to the tractor placed under and in the vicinity of the rectangle,

— the letters V or SV, depending on whether a dynamic (V) or static (SV) test was conducted, followed by the number 1, indicating that this is a protection structure within the meaning of this Directive.



Example of EEC component type-approval mark

The protection structure bearing the EEC component type-approval mark shown above is a structure of the rear-mounted rollbar, frame or cab type which has been subjected to a dynamic test, is intended for a narrow-track tractor (V1) and for which EEC component type-approval was granted in France (e2) under the number 431.

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ANNEX VII

MODEL EEC COMPONENT TYPE-APPROVAL CERTIFICATE

Name of competent authority

Notification concerning the granting, refusal, withdrawal or extension of EEC component type-approval with regard to the strength of a protection structure (rear-mounted rollbar, frame or cab) and to the strength of its attachment to the tractor

EEC component type-approval No: .....

.....extension (1)

1. Trade name or mark and type of protection structure: .....

.....

2. Name and address of manufacturer of protection structure: .....

.....

3. If applicable, name and address of authorized representative of manufacturer of protection structure: .....

.....

4. Trade mark or name, type and commercial description of tractor for which protection structure is intended: .....

.....

5. Extension of EEC component type-approval for tractors of the following type(s) and, where appropriate, commercial descriptions: .....

.....

.....

5.1. The mass of the unballasted tractor, as defined in 1.4 of Annex II, exceeds/does not exceed (2) the reference mass used for the test by more than 5 %.

5.2. The method of attachment and points of attachment are/are not (2) identical.

5.3. All the components likely to serve as supports for the protection structure are/are not (2) identical.

6. Submitted for EEC component type-approval on: .....

7. Test station: .....

8. Date and number of the report of the test station: .....

9. Date of granting/refusal/withdrawal of EEC component type-approval (2): .....

10. Date of granting/refusal/withdrawal of the extension of EEC component type-approval (2): .....

11. Place: .....

12. Date: .....

13. The following documents, bearing the component type-approval number shown above, are annexed to this certificate (e.g. report of the test station). These documents must be sent to the competent authorities of the other Member States if they so request .....

14. Remarks, if any: .....

15. Signature: .....

(1) If applicable, state whether this is the first, etc. extension of the original EEC component type-approval.
(2) Delete where inapplicable.

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ANNEX VIII

CONDITIONS FOR EEC TYPE-APPROVAL

1. The application for EEC type-approval of a tractor with regard to the strength of a protection structure and the strength of its attachment to the tractor shall be submitted by the tractor manufacturer or by his authorized representative.

2. A tractor representative of the tractor type to be approved, on which a protection structure and its attachment, duly approved, are mounted, shall be submitted to the technical services responsible for conducting the type-approval tests.

3. The technical service responsible for conducting the type-approval tests shall check whether the approved type of protection structure is intended to be mounted on the type of tractor for which the type-approval is requested. In particular, it shall ascertain whether the attachment of the component type-approval was granted.

4. The holder of the EEC type-approval may ask for its extension to other types of protection structures.

5. The competent authorities shall grant such extension on the following conditions:

5.1. The new type of protection structure and its tractor attachment must have received EEC component type-approval.

5.2. The new type of protection structure must be designed to be mounted on the type of tractor for which the extension of the EEC type-approval is requested.

5.3. The attachment of the protection structure to the tractor must correspond to that which was tested when EEC component type-approval was granted.

6. A certificate, of which a model is shown in Annex IX, shall be annexed to the EEC type-approval certificate for each type-approval or type-approval extension which has been granted or refused.

7. If the application for EEC type-approval for a type of tractor is introduced at the same time as the request for EEC component type-approval for a type of protection structure intended to be mounted on the type of tractor for which type-approval is requested, the checks laid down in 2 and 3 are not applicable.

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ANNEX IX

MODEL

Name of competent authority

ANNEX TO THE EEC TYPE-APPROVAL CERTIFICATE FOR A TRACTOR TYPE WITH REGARD TO THE STRENGTH OF PROTECTION STRUCTURES (REAR-MOUNTED ROLLBAR, FRAME OR CAB) AND THE STRENGTH OF THEIR ATTACHMENT TO THE TRACTOR

(Articles 4 (2) and 10 of Council Directive 74/150/EEC of 4 March 1974 on the approximation of the laws of the Member States relating to the type-approval of wheeled agricultural or forestry tractors)

EEC type-approval No: .....

.....extension (1)

1. Trade name or mark of tractor: .....
2. Tractor type and commercial description: .....
3. Name and address of tractor manufacturer: .....
   .....
4. If applicable, name and address of manufacturer's authorized representative: .....
   .....
5. Trade name or mark and type of protection structure: .....
   .....
6. Extension of EEC-approval for the following type(s) of protection structure: .....
   .....
7. Tractor submitted for EEC type-approval on: .....
8. Technical service responsible for EEC type-approval conformity control: .....
   .....
9. Date of report issued by that service: .....
10. Number of report issued by that service: .....
11. EEC type-approval with regard to the strength of the protection structures and the strength of their attachment to the tractor has been granted/refused (2).
12. The extension of EEC type-approval with regard to the strength of the protection structures and the strength of their attachment to the tractor has been granted/refused (2).
13. Place: .....
14. Date: .....
15. Signature: .....

(1) If applicable, state whether this is the first, etc. extension of the original EEC type-approval.
(2) Delete where inapplicable.