BRITISH STANDARD

BS EN
13790-2:2003

Agricultural machinery — Sprayers — Inspection of sprayers in use —

Part 2: Air-assisted sprayers for bush and tree crops

The European Standard EN 13790-2:2003 has the status of a British Standard

ICS 65.060.40

BSI
British Standards

National foreword

This British Standard is the official English language version of EN 13790-2:2003.

The UK participation in its preparation was entrusted to Technical Committee AGE/15, Equipment for crop protection and application of liquid fertilizer, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 4 June 2003

Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 16, an inside back cover and a back cover.

The BSI copyright date displayed in this document indicates when the document was last issued.

Amendments issued since publication

Amd. No.	Date	Comments

ISBN 0 580 41985 1

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 13790-2

May 2003

ICS 65.060.40

English version

Agricultural machinery - Sprayers - Inspection of sprayers in use - Part 2: Air-assisted sprayers for bush and tree crops

Matériel agricole - Pulvérisateurs - Contrôle des pulvérisateurs en service - Partie 2: Pulvérisateurs à jet porté pour arbustes et arboriculture

Landmaschinen - Pflanzenschutzgeräte - Prüfung von in Gebrauch befindlichen Pflanzenschutzgeräten - Teil 2: Spritz- und Sprühgeräte für Raumkulturen

This European Standard was approved by CEN on 25 March 2003.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

Ref. No. EN 13790-2:2003 E

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Foreword

This document (EN 13790-2:2003) has been prepared by Technical Committee CEN/TC 144 “Tractors and machinery for agriculture and forestry”, the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2003, and conflicting national standards shall be withdrawn at the latest by November 2003.

This standard consists of the following parts, under the general title *Agricultural machinery — Sprayers - Inspection of sprayers in use:*

— *Part 1: Field crop sprayers*

— *Part 2: Air-assisted sprayers for bush and tree crops*

Annexes A and B are informative.

During recent years, several countries have developed systems for inspection of air-assisted sprayers for bush and tree crops in use. Developments in this direction have been stimulated by public concern about risks, and the aim of reducing the use of crop protection products.

However, there are three main arguments for the inspection:

— test operator safety (minimum requirements are given concerning operator safety in the use of work equipment at work directive 95/63/CE, amending directive 89/655/CEE, and can be complimented by national regulations);

— less potential risk of environmental contamination by crop protection products;

— good control of the pest with the minimum possible input of crop protection product.

As the third argument above indicated, tests of sprayer function are of great importance for the efficiency of the treatment which consequently can also be very profitable for the user of the sprayer.

In order to use crop protection products in agricultural production in Europe safely, it is necessary to define the requirements and test methods for sprayers in use. This is a relevant step after having standardized the requirements for new equipment, in respect of safety hazards (see EN 907) and potential risks of environmental contamination (see EN 12761 Parts 1 to 3).

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

Standardising the requirements and methods for inspection of sprayers in use, takes into consideration not only the original performance of the spraying equipment, but also its use, care and maintenance. This is the logical link between new equipment of good quality and well educated and concerned users.

The inspection of sprayers in use can be done on a voluntary or mandatory basis. In both cases further official or legal specifications are necessary, e.g. on the execution management of the inspection, which organizations are authorized to carry out the inspection, time intervals between inspections etc. As the specifications of this European Standard are based on EN 907 and EN 12761, it may be the case that sprayers in use which were produced before EN 907 and EN 12761 came into force do not fulfil all the specifications given in this European Standard.

1 Scope

This European Standard specifies the requirements and methods of their verification for the inspection of air-assisted sprayers for bush and tree crops in use. It relates mainly to the condition of the sprayer in respect of safety hazards for the test operator, the potential risk of environmental contamination and opportunities to achieve good application.

NOTE Minimum requirements are given concerning operator safety in the use of work equipment at work directive 95/63/CE, amending directive 89/655/CEE, and can be complimented by national regulations.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 837-1, *Pressure gauges – Part 1: Bourdon tube pressure gauges – Dimensions, metrology, requirements and testing.*

ISO 5682-2:1997, *Equipment for crop protection – Spraying equipment – Part 2: Test methods for hydraulic sprayers.*

3 Inspection

The compliance with the requirements defined in the following clauses shall be checked by inspection, function tests and measurements.

NOTE Some of the tests specified in this standard involve processes which could lead to a hazardous situation. Any person performing tests in accordance with this standard should be appropriately trained in the type of work to be carried out. All national regulatory conditions and health and safety requirements should be followed.

4 Requirements and method of verification

4.1 Power transmission parts and blower

4.1.1 The power take-off drive shaft guard and the guard of the power input connection (PIC) shall be fitted and in good condition:

— the different parts of the shaft, the universal joints and locking systems shall not show any mark of excessive wear and shall operate correctly;

— the function of the guard shall be obvious and the guard shall not show any wear marks, holes, deformations or tears;

— the restraining device that prevents the rotation of the power take-off drive shaft guard shall be present and shall work reliably.

The protective devices and any moving or rotating power transmission parts shall not be affected in their function.

Method of verification: inspection and function test.

4.1.2 A device for supporting the PTO drive shaft when not in use shall be present and in good condition. The chain or device used for restraining the PTO shaft guard shall not be acceptable for this purpose.

The guard of the power input connection (PIC) shall be fitted and in good condition.

4.1.3 The blower (fan, casing, air deflectors) shall be present, in good condition and mounted in a functional manner:

— all parts shall be free of mechanical deformation, wear and tear, corrosion and vibrations;

— the guard to prevent access to the fan shall be present.

Method of verification: inspection and function test.

4.2 Pump

4.2.1 The pump capacity shall be suited to the needs of the equipment.

a) The pump capacity shall be at least 90 % of its original nominal flow, given by the manufacturer of the sprayer

Method of verification: measurement according to 5.2.1.a); or

b) the pump shall have sufficient flow rate capacity in order to be able to spray at maximum working pressure as recommended by the sprayer or the nozzle manufacturer during test with the largest nozzles mounted on the sprayer while maintaining a visible agitation as specified in 4.3.

Method of verification: measurement according to 5.2.1.b).

4.2.2 There shall be no visible pulsations caused by the pump.

Method of verification: inspection and function test.

4.2.3 When there is a pressure safety valve on the pressure side of the pump, this valve shall work reliably.

Method of verification: inspection and function test

4.2.4 There shall be no leakages (e.g. dripping) from the pump.

Method of verification: inspection.

4.3 Agitation

A clearly visible recirculation shall be achieved when spraying at the nominal p.t.o. speed, with the tank filled to the half of its nominal capacity.

Method of verification: inspection.

4.4 Spray liquid tank

4.4.1 There shall be no leakages from the tank or from the filling hole when the cover is closed.

Method of verification: inspection.

4.4.2 There shall be a strainer in good condition in the filling hole.

Method of verification: inspection.

4.4.3 There shall be a grating in the chemical introduction container, if provided.

Method of verification: inspection.

4.4.4 Pressure compensation (to avoid over- or underpressure in the tank) shall be ensured.

Method of verification: inspection.

4.4.5 There shall be a clearly readable liquid level indicator on the tank which is visible from the driver's position and/or from where the tank is filled.

Method of verification: inspection.

4.4.6 It shall be possible to collect the emptied spray liquid simply, without tools, reliably and without spillage (for example using a tap).

Method of verification: function test.

4.4.7 If there is a non-return device on the water filling device of the tank, this device shall work reliably.

Method of verification: inspection and function test.

4.4.8 The chemical introduction container, if provided, shall work reliably.

Method of verification: function test.

4.4.9 The cleaning device for crop protection product containers, if provided, shall work reliably.

Method of verification: function test.

4.5 Measuring systems, controls and regulation systems

4.5.1 All devices for measuring, switching on and off and adjusting pressure and/or flow rate shall work reliably and there shall be no leakages.

Method of verification: inspection and function test.

4.5.2 All devices for adjusting pressure shall maintain a constant working pressure with a tolerance of ± 10 % at constant rotational speed and reach the same working pressure after the equipment has been switched off and on again.

Method of verification: inspection and function test.

4.5.3 The controls necessary for spraying shall be mounted in such a way that they can be easily reached and operated during the application and information provided for example on displays that can be read respectively.

Switching on and off of all nozzles shall be possible simultaneously.

NOTE Turning of the head and the upper body is acceptable.

Method of verification: inspection.

4.5.4 Application to one side only shall be possible by switching off the other side.

Method of verification: inspection.

4.5.5 The scale of the pressure gauge shall be clearly readable and suitable for the working pressure range used.

Method of verification: inspection.

4.5.6 The scale shall be marked:

— at least every 0,2 bar for working pressures less than 5 bar;

— at least every 1,0 bar for working pressures between 5 bar and 20 bar;

— at least every 2,0 bar for working pressures more than 20 bar.

Method of verification: inspection.

4.5.7 For analogue pressure gauges the minimum diameter of the pressure gauge cases shall be 63 mm.

Method of verification: measurement.

4.5.8 The accuracy of the pressure gauge shall be ± 0,2 bar for working pressures between 1 bar (included) and 2 bar (included).

From a pressure of 2 bar, the pressure gauge shall measure with an accuracy of ± 10 % of the real value.

The pointer on the pressure gauge shall remain stable in order to permit reading-off of the working pressure.

Method of verification: according to 5.2.2.

4.5.9 Other measuring devices, especially flow meters (used for controlling the volume/hectare rate), shall measure within a maximum error of 5 % of the real data.

Method of verification: according to 5.2.3.

4.6 Pipes and hoses

4.6.1 There shall be no leakages from pipes or hoses when tested up to the maximum obtainable pressure for the system.

Method of verification: inspection and function test.

4.6.2 Hoses shall be positioned in such a way that there are no sharp bends and no abrasion which makes the woven fabric visible.

Method of verification: inspection.

4.6.3 Hoses in working positions shall not be suspended in the range of the spray.

Method of verification: inspection.

4.7 Filtering

4.7.1 There shall be at least one filter on the pressure side of the pump and in case of positive displacement pumps also one filter on the suction side.

NOTE Nozzle filters are not considered as pressure side filters.

The filter(s) shall be in good condition and the mesh size shall correspond to the nozzles fitted according to the instructions of the nozzle manufacturers.

Method of verification: inspection and function test.

4.7.2 If an isolating device is provided, it shall be possible, with the tank filled to its nominal volume, to clean filters without any spray liquid leaking out except for that which may be present in the filter casing and the suction lines.

Method of verification: inspection.

4.7.3 Filter inserts shall be changeable.

Method of verification: inspection.

4.8 Nozzles

4.8.1 The nozzle equipment shall be suitable for appropriate application of the plant protection products.

Method of verification: inspection.

4.8.2 The nozzle equipment (e.g. nozzle types, sizes) shall be symmetrical on the left and right hand sides, except where they are intended for a special function (e.g. spraying on one side, fitting of nozzles to compensate the blow dissymmetry, etc).

Method of verification: inspection.

4.8.3 After being switched off, the nozzles shall not drip. 5 s after the spray jet has collapsed there shall be no dripping.

Method of verification: inspection.

4.8.4 It shall be possible to switch off each nozzle separately. In the case of multi-head nozzles, this requirement applies to each multi-head nozzle.

Method of verification: inspection and function test.

4.8.5 It shall be possible to adjust the position of the nozzles in a symmetric and reproducible manner.

Method of verification: inspection and function test.

4.9 Distribution

4.9.1 Uniformity of spray jet

Each nozzle shall form a uniform spray jet (e.g. uniform shape, homogeneous spray).

Method of verification: inspection and function test with switched off blower in the case of hydraulic nozzles and switched on blower in the case of other nozzles (for example pneumatic nozzles).

4.9.2 Nozzle output

The output of each nozzle with the same marking shall not deviate more than 15 % from the nominal output or 10 % from the mean output of all nozzles within the same identification.

For symmetrical spraying, the difference between the left and right hand sides mean output shall be a maximum of 10 %.

Method of verification: measurement according to 5.2.4.

4.9.3 Pressure difference

The pressure difference at each section inlet shall be a maximum of 15 %.

Method of verification: measurement according to 5.2.5.

4.9.4 Optional patternator measurement

NOTE In order to provide the owner/operator with further information in addition to 4.9.1 to 4.9.3, the spray distribution may be measured by using a vertical patternator test bench according to 4.10.1 of EN 13790-1:2003.

4.10 Blower

4.10.1 The blower shall rotate at the speed specified by the manufacturer.

Method of verification: function test.

4.10.2 If the blower can be switched off separately from other driven parts of the machine, the clutch shall work reliably.

Method of verification: function test.

4.10.3 Adjustable air guide plates on the blower and on an additional blower casing shall function properly.

Method of verification: inspection and function test.

4.10.4 Parts of equipment shall not be sprayed, with the exception that this is necessary for the functioning of the blower and does not cause dripping.

Method of verification: inspection and function test.

5 Test methods

5.1 Preparation of sprayer

The test shall not start if requirements of 4.1.1 are not verified.

Before the inspection takes place, the sprayer shall be carefully cleaned. Attention shall be paid to rinsing and internal cleaning of the sprayer including filters and filters inserts, and external cleaning of those parts of the sprayer that are most exposed to the crop protection product when spraying.

Visible and other known faults should preferably be remedied before the inspection. A preparatory "rough inspection" should be done at the site of the ordinary inspection, in order to avoid wasting time making measurements on sprayers with very obvious serious faults.

The owner/operator of the sprayer should preferably be present at the inspection.

5.2 Test facilities and methods

5.2.1 Pump capacity measurement

a) The error of the flowmeter shall not exceed 2 % of the measured value when the capacity of the pump is ≥ 100 l or 2 l/min when the capacity of the pump is < 100 l. The flow shall be measured at free outlet and at one pressure between 8 bar and 10 bar, or if lower at the highest permitted working pressure for the pump.

b) On sprayers not fitted with a test adapter or for pumps for which the maximum working pressure is not known (see 4.2.1) a calibration pressure gauge shall be placed at an end nozzle and the maximum working pressure recommended by the sprayer or the nozzle manufacturer during test shall be established.

5.2.2 Verification of the sprayers pressure gauges

5.2.2.1 Specifications of pressure indicators used for verification

Analogue pressure gauges used for testing shall have a minimum diameter of 100 mm. Other minimum requirements on pressure gauges used for testing are given in Table 1.

Table 1 — Characteristics of pressure gauges used for testing (in accordance with EN 837-1)

Pressure range Δp bar	**Scale unit max.** bar	**Accuracy** bar	**Class required**	**Scale end value** bar
$0 < \Delta p \leq 6$	0,1	0,1	1,6 1,0 0,6	6 10 16
$6 < \Delta p \leq 16$	0,2	0,25	1,6 1,0	16 25
$\Delta p > 16$	1,0	1,0	2,5 1,6 1,0	40 60 100

The pressure gauge shall be checked at least once a year.

5.2.2.2 Verification method of the sprayer pressure gauge

The sprayers pressure gauge shall be tested on the sprayer or on a test bench. Measurements shall be done with increasing and decreasing pressures respectively.

5.2.3 Flow meters for controlling the volume-hectare rate

The error of the measuring instruments in the test equipment shall not exceed 1,5 % of the measured value.

5.2.4 Measurement of the nozzle output

The nozzle output shall be measured at a reference pressure given by the nozzle manufacturer and according to clause 8 of ISO 5682-2:1997 or any other relevant method.

5.2.5 Measurement of pressure differences

A standard pressure gauge shall be located at the section inlet. At least two reference pressures at the pressure gauge of the sprayer shall be established. The values indicated by the pressure gauge of the sprayer shall be compared with the value measured by the standard pressure gauge.

5.2.6 Other facilities

Tachometer (P.T.0), measuring tape (nozzle spacing and height), stop watch (flow rate, distribution), measuring cylinder (with measuring range 2 l, scale division 20 ml, error 20 ml) or flow meter (nozzle output) and air pressure gauge (pressure pulsation damper).

6 Summary of the inspection

A summary of the inspection is given in annex A.

7 Test report

A test report shall be given to the user directly following the inspection at the inspection site. This report shall mention the malfunctions of the sprayer and inform the user of the repairs required to be made on his equipment. The test report shall also include the results of the measurements.

An example of a test report is given in annex B.

Annex A
(informative)

Summary of the inspection

Clause	Requirement	Inspection/ Function test	Measure-ment	Note
4.1	Power transmission parts and blower	X		
4.2	Pump			
4.2.1	- Capacity		X	
4.2.2	- Pulsations	X		On pressure gauge
4.2.3	- Pressure safety valve, if applicable	X		
4.2.4	- Leakages	X		
4.3	Agitation	X		Half filled tank
4.4	Spray liquid tank			
4.4.1	- Leakages	X		
4.4.2	- Strainer	X		In the filling hole
4.4.3	- Grating, if applicable	X		In the container
4.4.4	- Pressure compensation	X		
4.4.5	- Level indicator	X		
4.4.6	- Emptying	X		Reliable
4.4.7	- Non-return device	X		
4.4.8	- Chemical introduction container, if applicable	X		
4.4.9	- Can cleaning device, if applicable	X		Reliable
4.5	Measuring systems, controls and regulation systems			
4.5.1	- Reliability/leakages	X		Reliable
4.5.2	- Constant working pressure		X	
4.5.3	- Operation of controls	X		
4.5.4	- Application to one side only	X		
4.5.5, 4.5.8	- Pressure gauge	X	X	
4.5.9	- Other measuring devices		X	
4.6	Pipes and hoses			
4.6.1	- Leakages	X		Maximum obtainable
4.6.2	- Bending/Abrasion	X		pressure for the system
4.6.3	- Out of spray	X		
4.7	Filtering			
4.7.1	- Filters presence	X		
4.7.2	- Cleaning, if applicable	X		
4.7.3	- Filters inserts changeability	X		
4.8	Nozzles			
4.8.1	- Suitability	X		
4.8.2	- Symmetry	X		
4.8.3	- Dripping	X		
4.8.4	- Switching off	X		
4.8.5	- Adjustment	X		
4.9	Distribution			
4.9.1	- Uniformity of spray jet	X		
4.9.2	- Nozzle output/sector output		X	
4.9.3	- Pressure difference		X	
4.10	Blower			
4.10.1	- Rotational speed	X		
4.10.2	- Switching off	X		
4.10.3	- Guide plates	X		
4.10.4	- Dripping	X		

NOTE Inspection = looking at the machine to see it is all there;
Function test = a check on the normal operation of the machine/component to see that it performs as specified;
Measurement = determining a value by using some form of device or instrument.

Annex B
(informative)

Test report

Test station:	**Test report** **for the inspection of air-assisted sprayers for bush and tree crops according to EN 13790-2**
Owner's identity:	
Owner's address:	Manufacturer ..... Type ..... Serial-No ..... Year of construction ..... ☐ Mounted ☐ trailed ☐ self-propelled sprayer Owned by ☐ farmer ☐ contractor ☐ machine ring

Remarks:						
Result of the inspection			Signature			
☐ no defect	☐ minor defect	☐ critical defects	Label	☐ yes	☐ no	Date .....

			Defect				**General remarks on the state of the sprayer**
Subject	**Description**	**Requirement** [a]	no	minor	critical	repaired	
1.Power transmission/blower		Guards	☐	☐	☐	☐	
2. Pump	☐ Piston	Capacity	☐	☐	☐	☐	
	☐ Diaphragm	Pulsations	☐	☐	☐	☐	
	☐	Pressure safety valve [a]	☐	☐	☐	☐	
	.....l/min at ....bar	Leakages	☐	☐	☐	☐	
3. Agitation	☐ mechanic ☐ hydraulic	Recirculation	☐	☐	☐	☐	

			Defect				General remarks on the state of the sprayer
Subject	**Description**	**Requirement** [a]	no	minor	critical	repaired	
4. Spray liquid tank	Volume l	Leakages	☐	☐	☐	☐	
		Strainer	☐	☐	☐	☐	
		Grating (introduction container) [a]	☐	☐	☐	☐	
		Pressure compensation	☐	☐	☐	☐	
		Level indicator	☐	☐	☐	☐	
		Emptying	☐	☐	☐	☐	
		Non-return device	☐	☐	☐	☐	
		Chemical introduction container [a]	☐	☐	☐	☐	
		Can cleaning device[a]	☐	☐	☐	☐	
5.Measuring systems, controls and regulation systems		Function	☐	☐	☐	☐	
		Leakages	☐	☐	☐	☐	
		Constant working pressure	☐	☐	☐	☐	
		Operation of controls	☐	☐	☐	☐	
		Application to one side only	☐	☐	☐	☐	
		Pressure gauge					
		- readability	☐	☐	☐	☐	
		- marking	☐	☐	☐	☐	
		- diameter	☐	☐	☐	☐	
		- accuracy	☐	☐	☐	☐	
		- steadiness of pointer	☐	☐	☐	☐	
		Other measuring devices (error < 5 %)	☐	☐	☐	☐	
6. Pipes and hoses		Leakages	☐	☐	☐	☐	
		Bending/abrasion	☐	☐	☐	☐	
		Out of spray	☐	☐	☐	☐	
7. Filtering		Filters presence	☐	☐	☐	☐	
		Cleaning[a]	☐	☐	☐	☐	
		Filters inserts changeability	☐	☐	☐	☐	

			Defect				General remarks on the state of the sprayer
Subject	**Description**	**Requirement** [a]	no	minor	critical	repaired	
8. Nozzles	Number of nozzles	Suitability	☐	☐	☐	☐	
		Symmetry	☐	☐	☐	☐	
	Type	Dripping	☐	☐	☐	☐	
		Switching off	☐	☐	☐	☐	
		Adjustment	☐	☐	☐	☐	
9. Distribution		Uniformity of spray jet	☐	☐	☐	☐	
		Deviation of nozzle output of each nozzle (≤ 15 % from nominal output, or ≤ 10 % from mean output)	☐	☐	☐	☐	
		Mean output left / right side (≤ 10 %)	☐	☐	☐	☐	
		Pressure difference at section inlet (≤15 %)	☐	☐	☐	☐	
10 Blower		Rotational speed	☐	☐	☐	☐	
		Switching off	☐	☐	☐	☐	
		Guide plates	☐	☐	☐	☐	
		Dripping	☐	☐	☐	☐	

[a] if applicable

Bibliography

[1] EN 907:1997, *Agricultural and forestry machinery – Sprayers and liquid fertilizer distributors – Safety.*

[2] EN 12761-1:2001, *Agricultural and forestry machinery – Sprayers and liquid fertilizer distributors - Environmental protection – Part 1: General.*

[3] EN 12761-2:2001, *Agricultural and forestry machinery – Sprayers and liquid fertilizer distributors – Environmental protection – Part 2: Field crop sprayers.*

[4] EN 12761-3:2001, *Agricultural and forestry machinery – Sprayers and liquid fertilizer distributors - Environmental protection – Part 3: Air-assisted sprayers for bush and tree crops.*

[5] EN 13790-1:2003, *Agricultural machinery – Sprayers – Inspection of sprayers in use – Part 1: Field crop sprayers.*

[6] *Directive 95/63/EC, Minimum safety requirements for the use of work equipment by workers at work (amendment to Directive 89/655/EEC).*

[7] *Directive 89/655/EEC, Minimum safety requirements for the use of work equipment by workers at work.*

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