COMMISSION OF THE EUROPEAN COMMUNITIES

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PROPOSAL FOR A COUNCIL DIRECTIVE

on the approximation of the laws of the Member States relating to welded unalloyed steel gas cylinders

(submitted to the Council by the Commission)

EXPLANATORY MEMORANDUM

I. Introduction

On 5 January 1973 the Commission forwarded to the Council the proposal for a general Directive concerning approximation of the laws of the Member States relating to the common provisions for pressure vessels and the methods for inspecting them, together with the first particular Directive on unwelded steel gas cylinders.

The Commission has prepared this draft Directive on welded unalloyed steel gas cylinders as a part of the harmonization of the various classes of mass-produced pressure vessels and with a view to eliminating the many barriers that there are to freedom of movement owing to the diversity of the laws and regulations governing design and inspection which are in force in the various Member States of the Community.

This proposed Directive closely conforms with the lay-out of the proposed Directive on unwelded gas cylinders but its formulation takes with account of the technical and safety aspects associated with the type of gas cylinder concerned.

Its aim is to permit the free movement of unfilled cylinders between the Member States. In view of the relative insignificance of the trade in filled cylinders, including those filled with liquified butane and propane gases, no provision for their free movement has been made in this proposed Directive.

Again in compliance with the necessity of leaving the manufacturer with some degree of freedom - so as not to hamper technical advancement - in his choice of equipment and staff for producing cylinders affording a level of safety which is acceptable to all Member States, this proposed Directive merely specifies a number of properties as regards the materials used for and the workmanship of the cylinders, the welds in particular.

Very considerably attention, on the other hand, has been devoted to specifying the tests and inspecting operations to be carried on prototype cylinders in order to obtain EEC approval and on mass-produced cylinders at the time of verification.

With this aim in view it has been necessary to state precisely the tasks that are to be performed by the inspection authorities; each inspection authority's individual assessment has been circumscribed as far as possible.

In view of the fact that welded gas cylinders are produced in very large series, a balance has to be struck between the necessity of carrying out appropriate type-testings and the necessity of avoiding the risk of causing severe stresses in the production cycle.

This is the angle from which the procedures for carrying out the tests provided for during the type-testing of the cylinders have been specified.

It is clear that any relaxing of the tests during the type-testing, particularly in order to take account of the essential requirements of manufacture or storage, must not in any way diminish the measures that are necessary to ensure that satisfactory degree of safety is obtained. This obligation is, however, fulfilled by the fact that the inspecting authority may supervise the measures taken by the manufacturer in order to comply with the requirements of the Directive.

The harmonization solution adopted for this proposed Directive is, as with its predecessor, what is termed an "optional solution"; i.e., once the Community provisions have come into force, they permit the free movement between all the Member States; the old national regulations, however, holding good within each Member State.

This solution has the advantage of enabling the national laws to be more readily and quickly adapted to the requirement of the Directive. At the same time it allows a manufacturer interested in the national market the choice between national regulations and Community regulations and, assuming he decides on manufacturing in accordance with the latter, he will have the necessary time to adapt to them.

It may be hoped that this harmonization involving an acceptable level of safety which is comparable with that in the national regulations, while not substantially increasing the requirements to be met and the tests to be satisfied, will fairly shortly become automatically and through the free choice of the manufacturer -particularly for reasons of simplicity in production and storage - the sole set of regulations employed.

2. Notes on the proposal for a Directive concerning welded unalloyed steel gas cylinders.

General note

Article 1 specifies the scope of this proposal for a Directive. The limits set for both the cylinder hydraulic test pressure and its capacity are dictated by the practical aspects of everyday use.

Article 2 lays down the conditions for a cylinder to come to be accepted as an EEC type.

Article 3 lays down that freedom of movement shall be guaranteed in respect of every cylinder bearing the EEC symbol of approval and mark, signifying that it is wholly in compliance with the provisions of the General Directive and the Directive on welded gas cylinders.

Article 4 specifies the various procedures for inspections regarding the level of danger which a cylinder, depending on its pressure and capacity, might present in the event of an accident, always, of course, with due regard to the provisions of this Directive and of the General Directive.

Articles 5 and 6 concern final provisions which are contained in other Directives that have already had Council approval.

Notes on the Annexes

Annex 1 is concerned mainly with guidelines for making a prototype cylinder, such as the grade of steel to be used, minimum wall thickness, shape of the cylinder bottom, etc. (subsections 2.1., 2.2. and 2.3.).

Another part (subsection 2.4.) is devoted to cylinder construction criteria, and in particular to welding conditions and techniques and the inspection of welding quality.

A description of the tests that are to be performed on completed cylinders, by manufacturer, Member State or again the inspection authority, is given in section 3.

The three types of tests that are described are :

- mechanical tests (tensile and bend tests);
- bursting test under hydraulic pressure;
- hydraulic test.

Whereas the purpose of tests of the first type is to check the quality of the parent material (the steel) and the filler material (the weld), the particular purpose of the other two is to check the integrity of the completed cylinder.

The EEC approval procedure devolving upon the Member State is specified in section 4 of the Annex. It consists of a number of checks on drawings, calculations and any other essential documentation and on prototype cylinders (destructive tests).

Section 5 is the one in which are laid down the conditions for obtaining EEC inspection and the tests and inspections which are to be carried out by either the inspection authority or the manufacturer.

Section 6 prescribes the requirements for the marking of the cylinders and the symbols that need to be stamped thereon to enable each cylinder to be identified.

Annexes II and III set forth the pro-forma EEC Approval Certificate and EEC inspection Certificate respectively.

3. Consultation with circles concerned

With a view to the preparation of the present proposal for a directive, a very detailed examination of the different national regulations will first be carried out. Conclusions drawn from the work of the principal standardisation and controlling bodies will be utilised to a great extent. Already, at the preparatory stage of the work, on the spot contacts are made frequently with consumer associations, controlling bodies, as well as professional circles. This procedure enables the Commission's services to prepare a homogenious draft directive which forms the subject matter for detailed discussions at the principal meetings of the Commission's working group of experts, to which consumer associations, controlling and standardisation bodies and the European association of Manufacturers are invited.

4. Consultation of the European Parliament and the Economic and Social Committee

Pursuant to Article 100(2) of the Treaty, the opinions of these two bodies are required. Implementation of the proposal provisions would, in the case of certain Member States, necessitate amendments to their legislation.

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LIST OF THE PRINCIPAL LEGISLATIONS IN FORCE IN THE MEMBER STATES RELATING TO WELDED STEEL GAS CYLINDERS

BELGIUM: General Regulation for work protection (R.G.P.T.): Kingdom Orders of 11th February 1946 and 27th September 1947 (Articles 349 to 363).

FEDERAL REPUBLIC OF GERMANY:

Regulation for mobile containers and for compressed gas filling equipment (Druckgasverordnung) of 20th June 1968

DENMARK: a) Order for mobile containers designed for holding compressed gas, liquified or dissolved, N° 338 of 11th December 1935 and the following amendments:

N° 75 of the 19th March 1959,
N° 73 of the 21st March 1961,
N° 345 of the 27th September 1963;

b) Instruction N° M3/61 relating to the manufacture of welded containers;

c) Instruction N° 17/1972 relating to labelling and periodical tests.

FRANCE: a) Amended legislation of 28th October 1943

b) Amendment Order of 18th January 1943

c) Amendment Order of 23rd July 1943

d) Order of 26th October 1966.

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ITALY: a) R.D.L. (Royal Order-in-Council) N° 1331 of 9th July 1926 (Establishment of the National Association for the Control of combustion)

b) R.D. (Royal Decree) N° 824 of 12th May 1927 (Approval of legislation for the enforcement of Royal Order-in-Council N° 1331 of 9th July 1926)

c) D.M. (Ministerial Order) of 20th August 1933

d) R.D. N° 2421 of 11th December 1933

e) D.M. of 1st August 1935

f) D.M. of 27th October 1969.

IRELAND: Common Law and particularly the "Rylands v Fletcher" Statute.

LUXEMBOURG: Grand Duchy Order of 24th October 1938.

UNITED KINGDOM:

Gas Cylinder Conveyance Legislation, 1931, as amended in 1947 and 1959, and certain Exemption Orders.

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PROPOSAL FOR A COUNCIL DIRECTIVE ON THE APPROXIMATION OF THE LAWS OF THE MEMBER STATES RELATING TO WELDED UNALLOYED STEEL GAS CYLINDERS

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;

Having Regard to the Opinion of the European Parliament;

Having Regard to the Opinion of the Economic and Social Committee;

Whereas in the Member States the construction and controls of gas cylinders are subject to mandatory provisions varying from one Member State to another, and consequently hinder trade in such vessels; that it is therefore necessary to undertake the approximation of these provisions;

Whereas the Council Directive of ....., on the approximation of the laws of the Member States relating to common provisions on pressure vessels and to the methods used for verifying these apparatus, lays down in particular the procedures of EEC approval and inspection for these vessels; whereas according to this directive, it is advisable to lay down the technical requirements to be complied with by EEC-type welded unalloyed steel gas cylinders with a capacity of 0.2 to 150 litres in order to be put into circulation, marketed and used without restraint after having undergone inspection and bearing accordingly the marks and the symbols.

HAS ADOPTED THIS DIRECTIVE

Article 1

This Directive applies to the unalloyed steel stress-resistant shells of welded gas cylinders, i.e., formed from several pieces likely to be refilled several times, with a capacity ranging from 0.2 to 150 litres inclusive designed to contain compressed, liquified or dissolved gases except liquified gases at very low temperatures and acetylene. The design pressure for these cylinders shall not exceed 60 bars.

These welded gas cylinders are hereinafter called "cylinders".

Article 2

The cylinders which conform to the requirements set out in Annex to this Directive are EEC-type cylinders.

Article 3

No Member State may, for reasons connected with construction or verification, prohibit or restrain the placing on the market and putting into appropriate service of EEC-type cylinders bearing the EEC approval symbol and the EEC inspection mark, subject to the conditions provided for in Article 4.

Article 4

An EEC-type cylinder shall be subject to :

a) EEC approval :

1. if its capacity is not more than 1 litre, irrespective of the hydraulic test pressure;
2. if its capacity is more than 1 litre but not more than 5 litres and provided the hydraulic test pressure is 15 bars or less.

b) EEC approval and EEC inspection :

1. if its capacity is more than 1 litre but not more than 5 litres and provided the hydraulic test pressure is more than 15 bars;
2. if its capacity is more than 5 litres irrespective of the hydraulic test pressure.

Article 5

1. Member States shall put into force the laws regulations and administrative provisions necessary to comply with this Directive within eighteen months of its notification and shall forthwith inform the Commission thereof.

2. Member States shall ensure that the texts of the provisions of national law adopted by them in the field governed by this Directive are communicated to the Commission.

Article 6

This Directive is addressed to the Member States.

A N N E X I

1. SYMBOLS AND TERMS, USED IN THIS APPENDIX

1.1. The symbols used in this appendix have the following meanings :

P_h = hydraulic test relative pressure (design pressure) in bars;

P_r = cylinder bursting relative pressure measured in the bursting test, in bars;

P_{rt} = calculated minimum theoretical rupture relative pressure, in bars;

R_e = minimum value of the yield stress (R_{eh} or R_p 0.2) guaranteed by the cylinder manufacturer, in N/mm2;

R_m = minimum value of the tensile strength guaranteed by the cylinder manufacturer, in N/mm2;

R_t = actual tensile strength, in N/mm2;

a = minimum thickness of the cylindrical shell wall, in mm;

D = nominal outside diameter of the cylinder, in mm;

R = inside radius of courvature of convex base;

r = inside radius of junction of convex base;

H = outside height of dished ends;

h = height of cylindrical part of dished ends;

L = length of cylinder stress-resistant shell;

A = elongation value (%) of parent metal;

V_o = initial volume of the cylinder at the start of the bursting pressure test;

V = final volume of the cylinder on bursting.

1.2. Yield Stress

The term "yield stress" means the upper yield stress (R_{eh}).

For steels that do not exhibit a defined elastic limit, however, the value to be used is the conventional yield stress R_p 0.2 i.e., the value of the stress (σ) which gives rise to a non-proportional elongation equal to 0.2 % of the gauge length of the test-piece.

1.3. Normalization

The term "normalization" relates to the heat treatment to which a completed cylinder is subjected, during which the cylinder is heated to a uniform temperature higher than the steel's highest critical point (A_{c3}) and then cooled in still air.

1.4. Stress relieving

The term "stress relieving" relates to the heat treatment to which a completed cylinder is subjected, during which the cylinder is heated to a temperature below the steel's lowest critical point (A_{c1}) in order to reduce the residual stresses.

2. TECHNICAL REQUIREMENTS

2.1. Materials

2.1.1. The material used for the manufacture of the cylinder stress-resistant shells shall be steel as specified by EURONORM 120-72.

2.1.2. All components of the cylinder body and the parts welded thereto shall be made of mutually compatible materials.

2.1.3. The filler materials shall be compatible with the steel so as to form welds with properties equivalent to those specified for the parent metal.

2.1.4. The cylinder manufacturer shall obtain and provide cast analysis certificates in respect of the steels supplied for the manufacture of the cylinder stress-resistant shells.

2.1.5. The inspection authority shall have the opportunity of making independent analyses. These analyses shall be carried out either on specimens taken from the materials as supplied to the cylinder manufacturer or on the finished cylinders.

2.1.6. The manufacturer shall make available to the inspection authority the results of metallurgical and mechanical tests and analyses carried out on welds and shall also describe it of the welding methods and processes adopted which can be regarded as representative of the weldments made during production.

2.2. Heat treatment

When heat treatment has been applied, the manufacturer shall state the type of treatment employed (normalization or stress-relieving), the temperature and duration thereof and the quenching technique used.

2.3. Calculation of the parts under pressure

2.3.1. The wall thickness at any point on the stress-resistant shell shall not be less than that calculated by the formula :

$$a = \frac{P_h \cdot D}{\frac{20\ R_e}{1.3} + P_h}$$

The value of R_e shown in the formula shall in no case be greater than $0.75\ R_m$.

2.3.2. The minimum wall thickness shall in no case be less than :

- 1.5 mm for cylinders with a capacity of less than 6.5 litres;
- 1.9 mm for cylinders with a capacity equal to or more than 6.5 litres but less than 30 litres and whenever the ratio $L/D < 2$;
- whichever of 1.9 mm or $0.136\sqrt{D}$ is the higher for cylinders with a capacity equal to or more than 6.5 litres but less than 30 litres, when the ratio $L/D \geq 2$, and for cylinders with a capacity of 30 litres or more.

2.3.3. The dimensions of the dished ends of cylinders shall fulfil the following conditions :

if torispherical : $R \leqslant D$ $r \geqslant 0.10\ D$ $h \geqslant 4a$ $H \geqslant 0.25D$

if ellipsoidal : $H \geqslant 0.25\ D$ $h \geqslant 4\ a$

2.3.4. The cylinder body, valve excluded, may be up of two or three parts. The ends shall be in one piece and convex.

2.4. Construction and workmanship

2.4.1. General requirements

2.4.1.1. The manufacturing facilities and techniques and the inspection methods used in production shall be such as to ensure that cylinders conforming to the provisions of this Directive are produced.

2.4.1.2. Drawings shall contain all important particulars, such as dimensions, materials, openings and the locations of markings and symbols.

2.4.1.3. The manufacturer shall ensure through proper supervision over the manufacture that wall thicknesses are at least equal to the dimensions shown on the drawing.

2.4.1.4. The surfaces of the plates of the cylindrical body and pressed parts shall be clean and free from serious defects.

2.4.2. Welding conditions

2.4.2.1. The manufacturer shall have at his disposal staff specializing in welding operations and supervision and in non-destructive testing.

2.4.2.2. The manufacturer shall be an expert in the techniques used in the fabrication and welding processes. He shall notify the Member State of any amendment or major extension to his manufacturing programme.

2.4.3. Welding specifications

2.4.3.1. There shall be no butt welds in the stress-resistant shell in any area where a change in profile occurs.

2.4.3.2. There shall be no superimposition of an angle weld over a butt weld and there shall be a space of at least 10 mm between them.

2.4.3.3. The parts that make up the stress-resistant shell (ends, rings and orifice bases) shall be welded in accordance with Figs 1, 2 and 3 of this Annex, viz. :

- Longitudinal weld (Fig. 1);

- Circumferential weld (Fig. 2);
- Valve sleeve weld (fig. 3).

The maximum permissible malalignment of the joint faces shall be one fifth of the thickness (1/5a).

2.4.4. Welding of fittings

2.4.4.1. The steel footrings, handles and protective collars shall be assembled by angle welding, the contact surfaces with the stress-resistant shell being provided by the cross-section of the item to be assembled.

The welding shall be along the entire length of the seam but not necessarily on both sides.

2.4.4.2. Such identification plates as are required, shall be welded to the stress-resistant shell over their entire peripheries. In order to allow air to be expelled during heat treatment, each identification plate shall be provided with a hole through it which is suitably plugged once the heat treatment is complete.

2.4.5. Welding techniques and methods

2.4.5.1. Butt welding shall be carried out by an automatic technique.

2.4.5.2. All traces of oil, grease and rust shall be eliminated from the welding edges before welding.

2.4.5.3. Complete penetration of the weld seam shall be obtained over the entire thickness and length of the joints.

2.4.5.4. The techniques and methods used shall be such that the welds are seen to be smooth and regular and free from incisions, craters, deviations or undercuts.

With regard to butt welds, any barrelling shall not be greater in height than one quarter of the width, except for the overlay at the end of the seam, where a reinforcement, which shall be entirely devoid of craters, is permissible.

Angle welds shall be seen to be regular and smooth and devoid of craters at the extremities. The joint made between welded pieces shall be progressive and free from incisions and undercuts.

2.4.5.5. Before the ends are squeezed, a visual examination of the longitudinal weld shall be carried out on both of its faces in order to ensure that the weld shows a continuous penetration without any deviation of the weld seam.

2.4.5.6. All the pressurized parts of the cylinder shall be inspected internally at each stage in manufacture and inspected externally after the final assembly, the purpose of these inspections being to ascertain that the cylinder is free from any surface or welding defect liable to endanger safety.

2.4.6. Cylindricity

The out-of-roundness of the cylindrical part shall be limited to such a value that the difference between the maximum and minimum outside diameter in the same cross-section is not more than 1 % of the average of those diameters.

2.4.7. Fittings

2.4.7.1. The cylinder-carrying handles or rings shall be fabricated and welded to the cylinder body in such a way as not to cause dangerous concentrations of stresses or form traps for water.

2.4.7.2. The footring must be sufficiently strong and made of metal compatible with that of the cylinder and give the cylinder sufficient stability. The top edge of the footring must fit the stress-resistant shell perpendicularly and be welded to it in such a way as to prevent the formation of water traps. The footring must contain ventilation holes.

2.4.7.3. Any other material, however, may be used for the manufacture of the footrings and cylinder-carrying handles or rings, provided that their strength is assured and that all risk of the cylinder end corroding is removed.

2.4.8. Protection of the cock or valve

The cylinder cock or valve shall be effectively protected, either through the way in which it is designed or through the design of the cylinder itself (e.g., with a protective collar), or by means of a protective cap or cover secured by a safe device.

3. TESTS

3.1. Mechanical tests

3.1.1. General requirements

3.1.1.1. The mechanical tests, where not covered by the requirements contained in this Annex, shall be carried out in accordance with the EURONORMS Nos :

a) 2 - 57 and 11 - 55 for the tensile test, where $a \geq 3$ mm and $a < 3$ mm respectively;

b) 6 - 55 and 12 - 55 for the bend test, where $a \geq 3$ mm and $a < 3$ mm respectively.

3.1.1.2. All the mechanical tests for checking the properties of the parent metal and filler material used for the stress-resistant shells of the gas cylinders shall be carried out on test pieces taken from the finished cylinders.

3.1.2. Types of test and evaluation of test results

3.1.2.1. Each sample cylinder shall be subjected to the following tests :

A) For cylinders containing only circumferential welds (two pieces), on test pieces taken from the places shown in Fig. 4 of this Annex :

1 tensile test : parent metal in the longitudinal direction (a);

1 tensile test : perpendicular to the circumferential weld (b);

1 bend test : top of circumferential weld (c);

1 bend test : bottom of circumferential weld (d).

B) For cylinders with longitudinal and circumferential welds (three pieces), on test pieces taken from the places shown in Fig. 5 of this Annex :

1 tensile test : parent metal of the cylindrical part (a);

1 tensile test : parent metal from bottom (b);

1 tensile test : perpendicular to the longitudinal weld (c);

1 tensile test : perpendicular to the circumferential weld (d);

1 bend test : top of longitudinal weld (e);

1 bend test : bottom of longitudinal weld (f);

1 bend test : top of circumferential weld (g);

1 bend test : bottom of circumferential weld (h).

3.1.2.1.1. Test pieces which are not sufficiently flat must be flattened by cold pressing.

3.1.2.1.2. In all test pieces containing a weld, the weld is machined until it is flush with the surface of the plate.

3.1.2.1.3. Any cut across the weld in a test piece must be sound and compact throughout.

3.1.2.2. Tensile test

3.1.2.2.1. The procedure for carrying out the tensile test shall be as given in the appropriate EURONORM in compliance with subsection 3.1.1.1.

The two faces of the test piece which are respectively the inside and outside walls of the cylinder shall not be machined.

3.1.2.2.2. The elongation of the parent metal (in percent) shall not be less than :

$$A = \frac{1000 - R_t}{c}$$

The values of coefficient c are respectively 25 and 20 for wall thicknesses of less than 3 mm and 3 mm or above.

In no case must the elongation in percent be less than that given in the following table :

	$R_t \leq 500$ N/mm^2	$R_t > 500$ N/mm^2
3 mm $\leq a \leq$ 5 mm	27	19
$a <$ 3 mm	22	15

3.1.2.2.3. The "perpendicular to the weld" tensile test shall be carried out on a test piece having a thinned cross-section 25 mm in width and 15 mm in length measured from either edge of the weld, as shown in Fig. 6 of this Annex. Beyond this central part the width of the test specimen must increase progressively.

3.1.2.2.4. The observed values of the elastic limit and the tensile strength should be at least equal to those guaranteed for the parent metal irrespective of where the rupture is produced in the cross-section of the central part of the test piece.

3.1.2.3. Bend test

3.1.2.3.1. The procedure for carrying out the bend test shall be as given in the appropriate EURONORM in compliance with sub-section 3.1.1.1.

3.1.2.3.2. The test piece shall remain uncracked when bent inwards around a former untill the interior edges are at a distance apart not greater than the diameter of the former.

3.1.2.3.3. The ratio (n) between the diameter of the former and the thickness of the test piece shall conform to the values given in the following table :

Actual tensile strength R_t (N/mm^2)	Value of n
up to 440 inclusive	2
above 440 to 520 inclusive	3
above 520	4

3.2. Bursting test under hydraulic pressure

3.2.1. Test conditions

3.2.1.1. The bursting test under hydraulic pressure shall be carried out in two successive stages by means of an apparatus such that the pressure in the cylinder increases regularly until the cylinder bursts and that the curve of the pressure variation with time is recorded.

3.2.1.2. During the Stage 1, the rate of pressure increase until the point at which plastic deformation begins shall be about 1 bar/s.

As from that pressure value (Stage 2), the rate of pumping shall be increased to twice what it was in Stage 1 and kept at a steady value until the cylinder bursts.

3.2.2. Performance of test

The bursting test under hydraulic pressure shall afford :

a) an examination of the pressure/time curve telling the pressure at which plastic deformation of the cylinder commences, the bursting pressure and the deformation of the cylinder during the test;

b) a measurement of the volume of water used between the time when the pressure starts to rise and the time of bursting, giving the volumetric expansion of the cylinder;

c) an examination of the fracture and the shape of its edges.

3.2.3. Test acceptance conditions

3.2.3.1. The pressure observed at the initiation of the plastic deformation shall be not less than four-thirds of the hydraulic test pressure.

3.2.3.1. The measured bursting pressure (P_r) shall be greater than the calculated minimum theoretical bursting pressure (P_{rt}).

This theoretical pressure shall be calculated from the minimum effective thickness "a" and the guaranteed minimum tensile strength (R_m) used for the cylinder calculation, according to the formula :

$$P_{rt} = \frac{20\ a\ R_m}{D - a}$$

The measured bursting pressure (P_r) shall not be less than nine-fourths of the test pressure (P_h).

3.2.3.3. The specific change in volume of the cylinder $\frac{(V - V_o)}{V_c}$ at the time of bursting shall not be less than 20 %.

3.2.3.4. The bursting test shall not cause any fragmentation of the cylinder.

3.2.3.5. The main fracture shall not be of the brittle type, i.e., the edges of the fracture shall not be radial but shall be sloped in relation to a diametrical plane and shall display a striction throughout their thickness.

3.2.3.6. The fracture shall not reveal a characterized defect in the metal.

3.2.3.7. In the case of a three-piece cylinder the burst shall not originate in one of the ends, a longitudinal weld or a circumferential weld (unless the burst is perpendicular thereto). The last requirement also applies to two-piece cylinder.

3.3. Hydraulic test

3.3.1. The hydraulic test pressure shall equal the design pressure (P_h).

3.3.2. The water pressure in the cylinder shall increase regularly until the test pressure is reached.

3.3.3. The cylinder shall remain under the test pressure for a sufficient length of time to demonstrate that the pressure shows no tendency to fall and that leaktightness has been achieved.

3.3.4. Any cylinder which does not satifsy these test requirements shall be rejected.

4. EEC APPROVAL

4.1. The applicant for approval shall submit the documentation necessary for the inspection prescribed below, together with three prototype cylinders which are entirely representative of future output and any additional information required by the Member State.

4.2. In the course of the EEC approval process, the Member State shall :

- verify that the calculations set out in section 2.3. are correct;
- verify that the provisions set out in sections 2.1., 2.2. and 2.4. have been fulfilled;
- perform on the cylinders submitted as prototype :
  a) the test set forth in section 3.1. on one cylinder,
  b) the test set forth in section 3.2. on another cylinder.
- issue in the EEC approval certificate conforming to the model provided for in Annex II to this Directive.

5. EEC INSPECTION

5.1. For the purpose of the EEC inspection the cylinder manufacturer shall make available to the inspection authority :

5.1.1. the EEC approval certificate;

5.1.2. the cast analysis certificates in respect of the steels supplied for the construction of the stress-resistant shells of the cylinders;

5.1.3. the means of identifying the cast of steel used for each cylinder;

5.1.4. the documents relating to the heat treatment provided in section 2.2.;

5.1.5. the results of non-destructive tests carried out during production and the welding methods used to ensure good reproducibility of cylinders during manufacture;

5.1.6. a list of the cylinders, stating the numbers and markings as required in section 6.

5.2. EEC inspection procedure

5.2.1. The inspection authority shall :

- ascertain that an approval certificate has been obtained and that the cylinders conform thereto;
- check the documents giving data concerning the materials and the manufacturing processes, in particular those specified in section 2.1.6.;
- ascertain whether the technical requirements set out in section 2 have been met, and in particular verify by means of an external visual examination of each cylinder and an internal sampling examination of between 5 and 10% of the cylinders in each batch whether the construction as well as the inspections carried out by the manufacturer are satisfactory;
- be present at the tests prescribed in sections 3.1. and 3.2. and check their progress;
- spot-check whether the information supplied by the manufacturer in the list specified in subsection 5.1.6. is correct. Between 5 and 10% of the cylinders in each batch shall be subjected to this check;
- issue the EEC inspection certificate conforming to the model set out in Annex III to this Directive.

5.2.2. For the purpose of carrying out the two types of tests specified in sections 3.1. and 3.2. a random sample shall be taken from each batch of cylinders of identical shape, all having been made from the same materials (steel plates identical as to properties and supplier and the same filler material) and produced on a continuous basis using the same welding techniques and inspections as well as an identical heat treatment, the number of cylinders comprised in the sample being as shown in the following table :

	No. of cylinders sampled	No. of cylinders subjected to :	
		Mechanical tests	Bursting test
Batch of 402 cylinders or part batch thereof	2	1	1
Batch of 1,206 (3 x 402) cylinders	6	2	4
Batch of 2,412 (6 x 402) cylinders	12	3	9

Depending on the batch, the cylinders sampled shall be subjected to the tests specified in section 3.1. (mechanical tests) and to the test specified in section 3.2. (bursting test) in accordance with the breakdown in the table above.

In the case of three-piece cylinders, the cylinders taken as samples from each batch shall undergo a prior radiographic test on each weld joint comprising 100 mm of the longitudinal weld and 50 mm (25 mm on each side of the joint) of the circumferential weld (Fig. 8 in this Annex) in order to check compliance with the conditions specified in subsections 2.4.5.3. and 2.4.5.4.

If one of the tests fails even partially to give satisfaction, the same number of cylinders shall be taken at random from the same batch and subjected to the type of test which was failed.

If any of these further cylinders fails to give satisfaction, all the cylinders in that batch shall be unconditionally rejected.

5.2.3. The selection of specimens and all the tests shall be carried out in the presence of a representative of the inspection authority.

5.2.4. All the cylinders in the batch shall be subjected to a hydraulic test as specified in section 3.3. in the presence of and under the supervision of a representative of the inspection authority.

5.3. Exemption from the EEC inspection

For any cylinders covered by Article 4(a) of this Directive and in conformity with the provisions set out in Article 15(a) of the Council Directive of ..... on the approximation of the laws of the Member States relating to the common provisions for pressure vessels and to the methods of inspection and testing of such vessels, all the test and inspection operations prescribed in section 5.2. shall be carried out by the manufacturer on his responsibility.

The manufacturer shall provide the inspection authority with all the documents and the test and inspection reports.

The presence of a representative of the inspection authority referred to in sections 5.2.3. and 5.2.4. of this Annex shall not be required.

6. MARKING

6.1. When all the prescribed checks have been carried out by the inspection authority, and provided that the results are satisfactory, the inspection authority shall issue a certificate stating the checks which have been carried out.

6.2. The markings shall be grouped together and none may be stamped on the stress-resistant shell of a cylinder.

6.3. Any identification plate required shall be affixed to the top head and have a minimum thickness of 3 mm.

6.4. Each cylinder shall be stamped with the symbol (E) specified in section 5.3. of Annex I to the Council Directive of ..... on the approximation of the laws of the Member States relating to the common provisions for pressure vessels and to the methods for the inspecting and testing of such vessels for cylinders covered by Article 4(a) of this Directive and the symbol of the EEC type approval "E " specified in section 5.1. of Annex I followed by the EEC type-test symbol "e" specified in section 3.1.1.1.(a) of Annex II of the Directive quoted above for cylinders covered by Article 4(b) of this Directive.

These symbols shall be followed by the following markings :

6.5. Markings based on the construction

6.5.1. Relating to the metal

A number indicating the value of R_e in N/mm^2 on which the calculation was based.

The symbol N (cylinder in a normalized condition), or
the symbol S (cylinder in a stress-relieved condition).

6.5.2. Relating to the hydraulic test

The value of the test pressure in bars marked in large digits at the centre and above it the date of the initial hydraulic test (month and year).

6.5.3. Relating to the cylinder type

Below the figures to the test pressure, the weight of the cylinder (less its cock or valve) in kg, and the minimum capacity of the cylinder in litres guaranteed by the manufacturer.

The weight and the capacity shall be expressed to three significant figures, the third figure being arrived at by "rounding down" for the capacity and "rounding up" for the wieght.

6.5.4. Relating to the origin

The manufacturer's mark and the serial number.

6.5.5. Example :

04/72

E ⇐ 250 N 60 .... 6.851

70.4/40.5

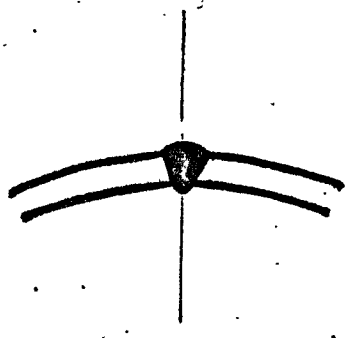


FIGURE 1 :

Longitudinal weld.

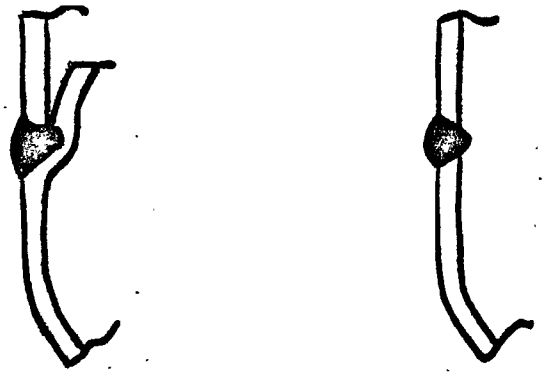


FIGURE 2 :

Circumferential weld.

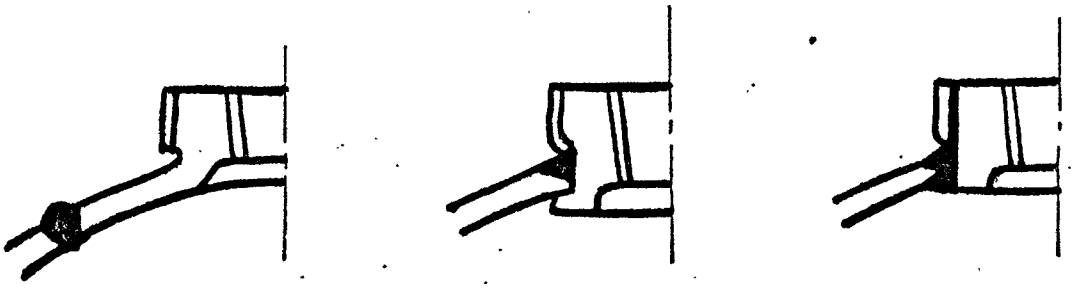
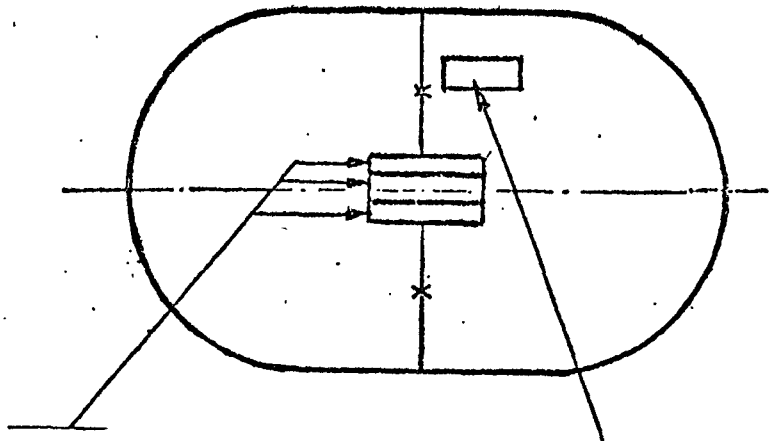


FIGURE 3 :

Valve sleeve weld.

30



(b) tensile test piece
(c) bend test piece
(top of weld)
(d) bend test piece
(bottom of weld)

(a) tensile test piece

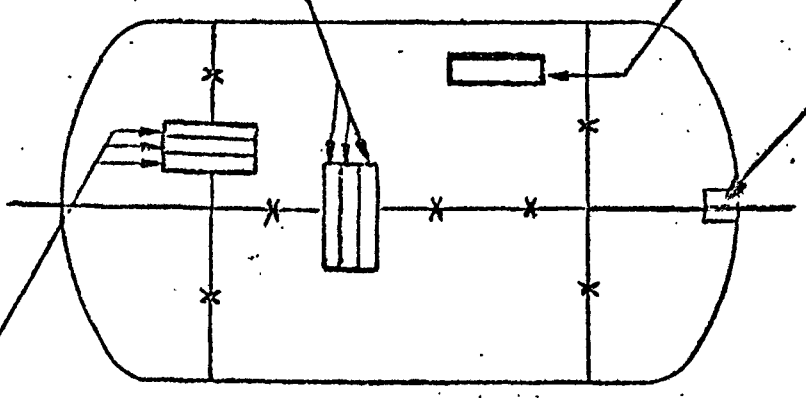
FIGURE 4 :

Test pieces taken from two-piece cylinders

(c) tensile test piece
(e) bend test piece
(top of weld)
(f) bend test piece
(bottom of weld)

(a) tensile test piece

(b) tensile test piece



(d) tensile test piece
(g) bend test piece
(top of weld)
(h) bend test piece
(bottom of weld)

FIGURE 5 :

Test pieces taken from three-piece cylinders

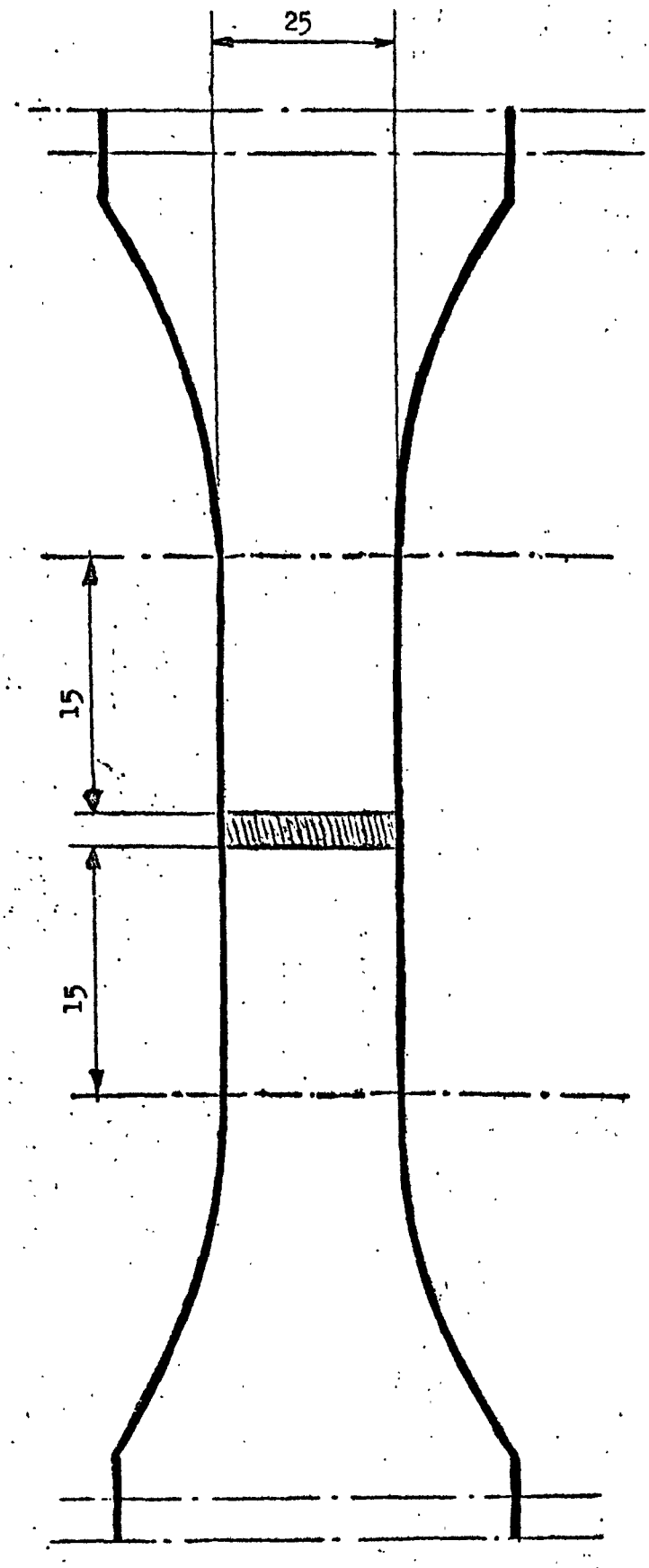


FIGURE : 6

The "perpendicular to the weld" tensile test piece
(Subsection 3.1.2.2.3.)

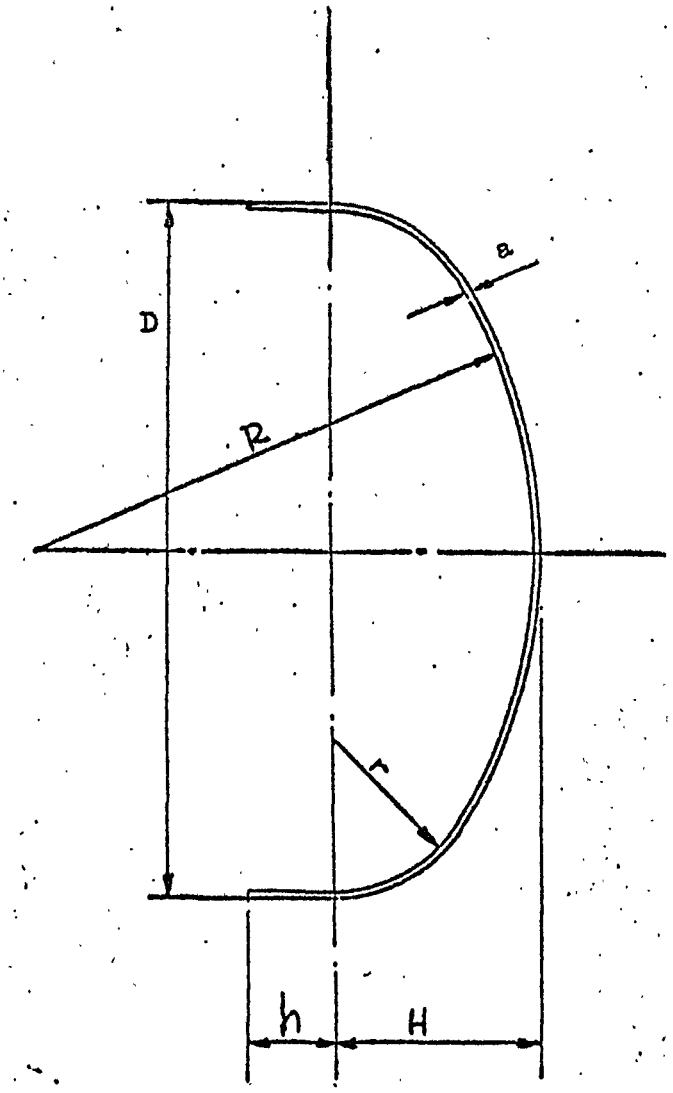


Fig. 7 Cylinder end.

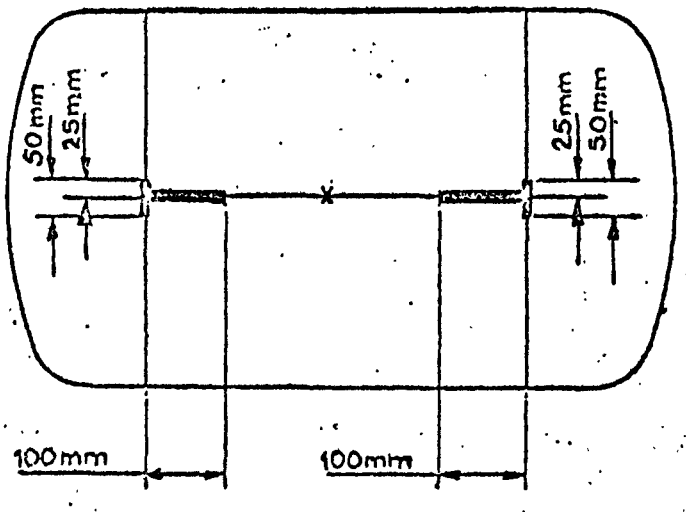


Fig. 8 Dimensions of weld joints undergoing radiography.

A N N E X II

EEC APPROVAL CERTIFICATE

Inspecting Authority :

Application of Council Directive No. ..... of .....

Date :

EEC Approval Code No. .....

Designation of cylinders :

Capacity : .....

Manufacturer's name and address :

The undersigned hereby declares that he has checked that the verifications, tests and inspections specified in section 4.2. of Annex I to Council Directive No. ..... of ..... have been successfully performed.

Cylinders of the accepted model) are /) are not subject to EEC inspection

General observations : the drawing which was the subject of approval is annexed hereto.

Signed and certified this ..... day of ..... at .....

.....
(Signature and capacity)

A N N E X III

EEC INSPECTION CERTIFICATE

Inspecting Authority

Date :

Designation of cylinders :

Application of Council Directive No..... of .....

EEC Approval Code No.....

EEC Type-testing Code No .....

Capacity : .....

Manufacturing batch No.....

Manufacturer's name and address :

The undersigned hereby declares that he has checked that the verifications, tests and inspections specified in section 5.2. of Annex I to Council Directive No. ..... of ..... have been successfully performed.

Special observations :

General observations :

Signed and certified this ..... day of ..... at .....

.....
(Signature and capacity)