**L.N. 146 of 2002**

# PRODUCT SAFETY ACT (ACT NO. V OF 2001)

## Common Provisions for Pressure Vessels and Inspection Methods Regulations, 2002

IN exercise of the powers conferred by articles 38 to 40 of the Product Safety Act, 2001, the Minister for Economic Services, on the advice of the Malta Standards Authority, has made the following regulations:-

Citation and commencement.

**1.1.** The title of these regulations is the Common Provisions for Pressure Vessels and Inspection Methods Regulations, 2002.

1.2. These regulations shall become operative on the 1st July, 2002:

Provided that the requirements to provide information to the European Commission referred to in regulation 13.4 of these regulations shall come into force on such date as the Minister responsible for Consumer Affairs, after consultation with the Malta Standards Authority, may prescribe.

Scope.

**2.1.** The following are excluded from the scope of these regulations:

2.1.1. Vessels specially designed for nuclear use, failure of which can cause an emission of radioactivity,

2.1.2. Vessels specifically intended for installation on, or for the propulsion of ships and aircraft,

2.1.3. Pipelines and pipeworks.

Definitions.

**3.1.** For the purposes of these regulations, the following definitions shall apply:

3.1.1. "The Directive" means Council Directive 76/767/EEC[1] on the approximation of the laws of the Member States relating to common provisions for pressure vessels and methods of inspecting them.

3.1.2. "Pressure vessel" means any fixed or movable vessel or receptacle in which an effective pressure of more than 0.5 bar on a fluid (gas, steam or liquid) may obtain or develop.

3.1.3. "EEC-type pressure vessel" means any vessel designed and manufactured in such a way that it satisfies the requirements of Schedules V, VI and VII to these regulations, relating to its particular category.

3.1.4. "EEC-type cylinder" shall mean any cylinder designed and manufactured in such a way that it satisfies the requirements of these regulations.

3.1.5. "OJ" means the Official Journal of the European Communities.

3.1.6. "Manufacturer" means the person who is primarily responsible for the design and construction of the pressure vessel so that it complies with the requirements of these regulations;

3.1.7. "Local authorised representative" means any person (or organisation) established in Malta who has been appointed by the manufacturer to act on his behalf in carrying out certain tasks required by these regulations;

3.1.8. "Importer" means any person who places pressure vessels from a foreign country on to the Maltese market so that he supplies such pressure vessels on the first occasion that it is supplied in Malta;

3.1.9. "Person who supplies pressure vessels" means wholesalers, distributors, retailers etc.

3.1.10. "Supply" includes offering to supply, agreeing to supply, exposing for supply and possessing for supply, and cognate expressions shall be construed accordingly;

3.1.11. "Responsible person" in relation to pressure vessels means:

3.1.11.1. the manufacturer thereof;

[1] OJ No. L 262, 27-09-76, p. 153.

3.1.11.2. the manufacturer's local authorised representative; or

3.1.11.3. where the manufacturer is not established in Malta and he has not appointed a local authorised representative, the person who places the pressure vessels on the local market.

3.1.12. "Placing on the market" means importation, wholesale, retail, sale and distribution free of charge.

**4.1.** The provisions of these regulations are applicable to all imported pressure vessels as well as to those manufactured for the local market. Applicability.

4.1.1. No person may construct, import, place on the market or put into service any pressure vessel which does not comply with the provisions of these regulations.

**5.1.** Schedules V, VI and VII to these regulations implementing Directives 84/525/EEC[2], 84/526/EEC[3] and 84/527/EEC[4], shall lay down the design and construction requirements and inspection, testing and, where necessary, operating methods for the categories of pressure vessels to which they relate and, where appropriate, for ancillary equipment. General requirements.

5.1.1. They shall specify, for each category of pressure vessels, whether the vessels are subject to EEC pattern approval and EEC verification or to either or neither of these procedures.

5.1.2. They may lay down:

5.1.2.1. any conditions or time limits to which EEC pattern approval may be subject and any marks to be affixed to pressure vessels in such cases,

5.1.2.2. the identification markings for each pressure vessel,

5.1.2.3. the conditions which different models of an approved vessel must satisfy in order to receive the same pattern approval.

5.1.3. Member States shall attach the same value to EEC pattern approval and EEC verification as to any equivalent national procedures.

5.1.4. The tasks of the administration issuing the EEC pattern approval certificate and of the inspection body carrying out the

[2] OJ No. L 300, 19-11-84, p. 1.
[3] OJ No. L 300, 19-11-84, p. 20.
[4] OJ No. L 300, 19-11-84, p. 48.

verification of the vessel shall be confined to examinations carried out in accordance with the requirements of Schedules V, VI and VII to these regulations and to the operations assigned to them by these regulations.

Free movement.

**6.1.** The marketing and placing into service of an EEC-type pressure vessel which complies with the requirements of these regulations and of Schedules V, VI and VII hereto relating to it, may not, on grounds relating to the construction or inspection of a vessel within the meaning of these regulations and of Schedules V, VI and VII relating to it, be refused, prohibited or restricted.

EEC pattern approval.

**7.1.** Where it is provided for in Schedules V, VI and VII to these regulations, EEC pattern approval shall be preliminary to:

7.1.1. EEC verification where this is required,

7.1.2. marketing and placing into service where EEC verification is not required.

7.2. At the request of the manufacturer or his authorised representative, the EEC pattern approval shall be granted to any type of pressure vessel which satisfies the requirements of Schedules V, VI and VII to these regulations relating to that particular category of pressure vessel.

7.3 EEC pattern approval shall be granted, refused or withdrawn in accordance with the provisions of regulation 7 of these regulations and sections 1, 2 and 4 of Annex I of the Directive, which is set out in Schedule I hereto.

7.4. If the results of the examination provided for in section 2 of Annex I of the Directive, which is set out in Schedule I hereto, are satisfactory, the Member State which carried out the examination shall make out an EEC pattern approval certificate which shall be forwarded to the applicant concerned.

7.4.1. Where this approval relates to a vessel which is subject to EEC verification, the manufacturer must affix to it the approval mark referred to in 3.1 of Annex I of the Directive, which is set out in Schedule I hereto, before verification takes place.

7.5. The requirements relating to the certificate and approval mark are set out in sections 3 and 5 of Annex I of the Directive, which is set out in Schedule I hereto.

7.6. Where EEC pattern approval is not required for a category of pressure vessels which satisfies the requirements of Schedules V, VI and VII to these regulations, but an application has been made for EEC verification, the manufacturer shall, on his own responsibility, before verification takes place, affix to pressure vessels in this category the special mark described in 3.2 of Annex I of the Directive, which is set out in Schedule I hereto.

Withdrawal of EEC pattern approval.

**8.1.** An EEC pattern approval must be withdrawn if any conditions laid down in Schedules V, VI and VII hereto, pursuant to regulation 5.1 of these regulations are not fulfilled.

8.2. If it is found, after EEC pattern approval has been granted, that pressure vessels of the type for which approval has been granted fail to conform to the pattern:

8.2.1. the approval may be maintained where the differences established are minimal, or have no fundamental effect on the design of the vessel or on manufacturing methods and in no way present a safety hazard;

8.2.2. the approval must be withdrawn if the changes constitute a safety hazard;

8.2.3. the manufacturer shall be requested to make the appropriate manufacturing changes as soon as possible if it considers that the batch produced no longer corresponds to the approved pattern. The approval must be withdrawn if the manufacturer fails to comply with this request.

EEC verification.

**9.1.** EEC verification shall serve to establish whether a pressure vessel conforms with the requirements of Schedules V, VI and VII to these regulations relating to it; it shall be attested by the EEC verification mark.

9.2. When a pressure vessel is presented for EEC verification, the inspection body shall check whether:

9.2.1. the pressure vessel belongs to a category subject to EEC pattern approval and, if so, whether it corresponds to the approved pattern and bears the EEC pattern approval mark;

9.2.2. the pressure vessel belongs to a category exempt from EEC pattern approval and, if so, whether it meets the requirements laid down in Schedules V, VI and VII hereto;

9.2.3. the pressure vessel satisfies the requirements of Schedules V, VI and VII to these regulations as regards the performance of the tests and the correct affixing of the statutory marks and inscriptions.

9.3. The manufacturer may not refuse the inspection body access to the place of manufacture where such access is essential if the body is to carry out properly the tasks entrusted to it.

9.4. After carrying out EEC verification of a pressure vessel under the conditions laid down in regulation 9.2 of these regulations and in the manner provided for in Annex II of the Directive, which is set out in Schedule II hereto, the inspection body shall affix the EEC partial or final verification marks to the vessel in accordance with the arrangements laid down in section 3 of that Schedule.

9.5. Annex II, section 3 of the Directive, which is set out in Schedule II hereto, contains the requirements as to the form and characteristic of the EEC verification marks.

9.6. If Schedules V, VI and VII to these regulations so provide, the inspection body shall issue a certificate indicating the inspections carried out and their results.

9.7. When Schedules V, VI and VII to these regulations relating to a category of pressure vessels do not provide for EEC verification, the manufacturer shall, on his own responsibility, after verifying that each pressure vessel satisfies the requirements of Schedules V, VI and VII to these regulations and, if appropriate, conforms to the approved pattern, affix:

9.7.1. either the special mark described in 5.3 of Annex I of the Directive, which is set out in Schedule I hereto, where EEC pattern approval is necessary;

9.7.2. or the special mark described in 5.4 of Annex I of the Directive, which is set out in Schedule I hereto, where there is exemption from EEC pattern approval.

Provisions common to EEC pattern approval and EEC verification.

**10.1.** The marks prescribed by these regulations relating to an appliance and its ancillary equipment must be visibly, legibly and indelibly affixed on each vessel and on such ancillary equipment.

10.2. All the necessary measures shall be taken to prohibit the use on pressure vessels of marks or inscriptions liable to be confused with the EEC marks.

Derogating clause.

**11.1.** The design of a pressure vessel and the methods used in its manufacture need not comply with all of the provisions of Schedules V, VI and VII to these regulations, without the vessel ceasing to be covered by regulation 6.1 of these regulations, provided that the alterations made are such as to ensure an equivalent degree of safety.

11.2. Schedules V, VI and VII to these regulations shall specify clearly the provisions from which such derogation is possible or the provisions from which there can be no derogation.

Adaptation of the regulations to technical progress.

**12.1.** The amendments necessary to keep:

– Annexes I and II to the Directive, which are set out in Schedules I and II hereto, and

– those provisions of Schedules V, VI and VII to these regulations which are specifically indicated in each of them,

in line with technical progress shall be made in accordance with the procedure laid down in Article 20 of the Directive.

Withdrawal and prohibition from market.

**13.1.** Where there are good grounds for believing that one or more pressure vessels constitute a safety hazard, although satisfying the requirements of these regulations and of Schedules V, VI and VII to these regulations, the Director of Consumer Affairs may temporarily prohibit the marketing of the vessel or vessels or make them subject to special conditions.

13.2. All appropriate measures shall be taken to encourage the local authorities responsible for implementing these regulations to cooperate with each other and provide each other with information in order to assist the functioning of these regulations.

13.3. If the Director of Consumer Affairs notes, on the basis of a substantive justification, that a pressure vessel to which these regulations apply, although complying with the requirements of these regulations, represents a hazard to safety or health, the sale of the pressure vessel in Malta may be provisionally prohibited or subjected to special conditions.

13.3.1. Such a decision shall be notified as soon as possible to the party concerned, who shall at the same time be informed of the legal remedies available to him under the laws in force in Malta and of the time limits to which such remedies are subject.

13.3.2. The Director of Consumer Affairs shall immediately inform the Consumer and Industrial Goods Directorate[5] of the Malta Standards Authority, stating the grounds for its decision.

13.4. The Consumer and Industrial Goods Directorate of the Malta Standards Authority shall immediately inform the Commission and the other Member States of any measures taken in pursuance of regulation 13.3.2 of these regulations.

Special provisions.

**14.1.** Regulation 14.1 shall apply to vessels falling within the scope of these regulations pursuant to regulations 2.1 and 3.1.2 of these regulations, where these are not covered by Schedules V, VI and VII to these regulations.

14.2. In this case, the following rules shall apply:

14.2.1. The Director of Consumer Affairs shall regard pressure vessels which have been inspected and tested by an inspection body chosen in accordance with the procedure laid down in Annex IV of the Directive, which is set out in Schedule IV hereto, as conforming to the national laws, administrative provisions and regulations relating to design;

14.2.2. the tests and inspections must be carried out in accordance with the procedure described in Annex IV of the Directive, which is set out in Schedule IV hereto and using the methods in force in the Member State of destination or recognised as being equivalent by its administrative authorities.

14.3. The tests and inspections referred to in regulation 14.2 of these regulations, shall be all those which it is possible to carry out in the place where the vessels are manufactured.

14.4. The Member States shall attach the same value to reports and certificates issued by the inspection body in the country of origin of the pressure vessel as to the corresponding national documents.

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[5] L.N. 213 of 2000 – Malta Standards Authority (Establishment of Directorates) Order, 2000, published in the Government Gazette No. 17,002 of 20th October, 2000.

# Schedule I[1]

## Based on Annex I of the Directive

### EEC PATTERN APPROVAL

1. APPLICATION FOR EEC PATTERN APPROVAL

1.1. The application and the correspondence relating to it shall be drawn up in an official language of the State to which the application is made in accordance with the laws of that State. The Member State has the right to require that the annexed documents should also be drawn up in that same official language.

1.2. The application shall contain the following information:

- name and address of the manufacturer or firm, of his or its authorized representative or of the applicant, and the place or places of manufacture of the vessels,
- category of the vessel,
- intended use or prohibited uses,
- technical characteristics,
- trade name, if any, or type.

1.3. The application shall be accompanied by two copies of the documents required and in particular:

1.3.1. A description including:

- the materials specifications, the methods of construction and the strength calculations for the vessel,
- any safety devices fitted,
- the places where the approval and verification marks specified in these regulations are to be affixed, as well as the other marks specified in the Schedules V, VI and VII to these regulations.

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[1] See the Appendix to Schedules I and II.

1.3.2. The general plans and, where appropriate, detailed drawings of important design features.

1.3.3. Any other information provided for in Schedules V, VI and VII to these regulations.

1.3.4. A statement certifying that no other application for EEC pattern approval has been submitted for the same pattern of vessel.

## 2. EXAMINATION FOR EEC PATTERN APPROVAL

2.1. The examination for EEC pattern approval shall be carried out on the basis of the plans and, where appropriate, on sample vessels.

The examination shall entail:

(a) Checking of the design calculations, method of manufacture, workmanship and materials;

(b) Where appropriate, checking of the safety devices and measuring equipment and the methods of installation.

## 3. EEC PATTERN APPROVAL CERTIFICATE AND MARK

3.1. The certificate referred to in regulations 7.4 and 7.5 of these regulations shall contain the conclusions of the examination of the pattern and shall indicate any conditions to which, under regulation 5.1 of these regulations, approval may be subject. It shall be accompanied by the descriptions and drawings necessary to identify the pattern and, where appropriate, to explain how it functions. The EEC approval mark provided for in regulations 7.4 and 7.5 of these regulations shall be a stylised letter $\varepsilon$ containing:

- in the upper part, the serial number of Schedules V, VI or VII hereto, allocated according to the chronological order of adoption, and the capital letter(s) identifying the State which has granted EEC pattern approval (B for Belgium, D for the Federal Republic of Germany, DK for Denmark, EL for Greece, F for France, I for Italy, IRL for Ireland, L for Luxembourg, NL for the Netherlands, UK for United Kingdom) and the year of EEC pattern approval; the number of Schedules V, VI or VII hereto, to which the EEC pattern approval refers will be allocated by the Council when it is adopted,
- in the lower part, the EEC pattern approval number.

An example of this mark is shown in section 5.1 of this Schedule.

3.2. The mark referred to in regulation 7.6 of these regulations, represented by the stylised

letter $\varepsilon$ reversed symmetrically about a vertical axis, contains in the upper part the same reference number of the category not subject to EEC pattern approval if so provided in Schedules V, VI or VII hereto.

An example of this mark is shown in point 5.2 of this Schedule.

3.3. The mark mentioned in regulation 9.7.1 of these regulations is the same as the EEC approval mark surrounded by a hexagon.

An example of this mark is shown in point 5.3 of this Schedule.

3.4. The mark mentioned in regulation 9.7.2 of these regulations is the mark of exemption from EEC pattern approval surrounded by a hexagon.

An example of this mark is shown in point 5.4 of this Schedule.

## 4. PUBLICATION OF EEC PATTERN APPROVAL

4.1. At the same time as the party concerned is notified, copies of the EEC pattern approval certificate shall be sent by the Member State to the Commission and to the other Member States, which may also obtain copies of the definitive technical file on the vessel and of the reports on the examinations and tests it has undergone.

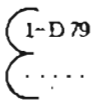
4.2. Withdrawal of EEC pattern approval shall be published in accordance with the procedure laid down in point 4.1 of this Schedule.

4.3. Any Member State refusing EEC pattern approval shall inform the other Member States and the Commission of such refusal.

## 5. MARKS RELATING TO EEC PATTERN APPROVAL

5.1. Mark of EEC pattern approval (see point 3.1 of this Schedule)

Example :

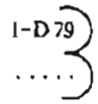



EEC pattern approval granted by the Federal Republic of Germany in 1979, pursuant to Schedule V to these regulations.

EEC pattern approval number.

5.2. Mark of exemption from EEC pattern approval (see point 3.2 of this Schedule)

Example :

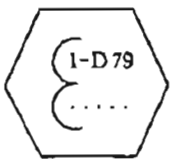



Vessel constructed in Germany in 1979 and not subject to EEC pattern approval pursuant to Schedule V to these regulations.

Reference number of the category not subject to EEC pattern approval if so provided in Schedules V, VI or VII hereto.

5.3. Mark of EEC pattern approval and exemption from EEC verification (see point 3.3 of this Schedule)

Example :

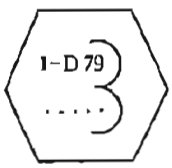



EEC pattern approval issued by the Federal Republic of Germany in 1979, pursuant to Schedule V to these regulations.

EEC pattern approval number.

5.4. Mark of exemption from EEC pattern approval and from EEC verification (see point 3.4 of this Schedule)

Example :




Vessel constructed in Germany in 1979 and not subject to EEC pattern approval pursuant

to Schedule V to these regulations.

Reference number of the category not subject to EEC pattern approval if so provided in Schedules V, VI or VII hereto.

5.5 Schedules V, VI and VII to these regulations may specify the placing and dimensions of the marks relating to EEC pattern approval.

Unless otherwise indicated in Schedules V, VI and VII hereto, the letters and numbers in each mark must be at least 5mm high.

# Schedule II[2]

## Based on Annex II of the Directive

### EEC VERIFICATION

1. GENERAL

1.1. EEC verification may be carried out in one or more stages.

1.2. Subject to the requirements of Schedules V, VI and VII to these regulations :

1.2.1. EEC verification shall be carried out in one stage only on vessels which constitute a whole on leaving the factory, that is to say vessels which, theoretically, can be transferred to their place of installation without first having to be dismantled;

1.2.2. The verification of vessels not dispatched in one piece shall be carried out in two or more stages;

1.2.3. Verification must in particular ensure that the vessel conforms to the approved pattern or, in the case of vessels exempt from EEC pattern approval, to the requirements laid down by the Schedules V, VI or VII hereto.

2. NATURE OF EEC VERIFICATION

2.1. Subject to the requirements of Schedules V, VI and VII hereto the verification shall entail :

- examination of the characteristics of the materials,
- checking of the design calculations, method of manufacture, workmanship and materials used,
- an internal examination consisting of a check on the internal parts and the welding,
- a pressure test,
- inspection of any safety devices and measuring equipment fitted,

[2] See the Appendix to Schedules I and II.

- an external examination of the various parts of the vessel,

- a performance test where this is prescribed in Schedules V, VI and VII to these regulations.

## 3. EEC VERIFICATION MARKS

### 3.1. Description of EEC verification marks

3.1.1. Subject to the requirements of Schedules V, VI and VII to these regulations, EEC verification marks which are affixed in accordance with point 3.3 of this Schedule shall be as follows:

3.1.1.1. The EEC final verification mark shall be composed of two stamps :

3.1.1.1.1. The first consisting of a letter 'e' containing :

- in the upper half, the capital letter(s) identifying the State in which the verification is carried out (B for Belgium, D for the Federal Republic of Germany, DK for Denmark, EL for Greece, F for France. I for Italy, IRL for Ireland, L for Luxembourg, NL for the Netherlands and UK for the United Kingdom) together, where necessary with one or two numbers identifying a territorial subdivision.
- in the lower half, the mark of the inspection body affixed by the verifying agent, together with the mark of the verifying agent of appropriate;

3.1.1.1.2. The second stamp consisting of the date of verification in a hexagon described with the accuracy required by Schedules V, VI and VII to these regulations.

3.1.1.2. The EEC partial verification mark shall consist solely of the first stamp[3].

### 3.2. Shape and dimensions of marks

3.2.1. An example of the stamps described in points 3.1.1.1.1 and 3.1.1.1.2 of this Schedule is illustrated in figures 1 and 2 below.
Schedules V, VI and VII hereto may specify the placing and dimensions of the EEC

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[5] *Explanatory note on the EEC final verification mark and EEC partial verification mark*
If a vessel cannot be assembled at its place of manufacture, or if transporting it is likely to affect its characteristics, EEC verification shall be carried out as follows:

- verification of the vessel at its place of manufacture by an inspection body of the country of origin which, providing the vessel conforms to EEC requirements shall affix the 'e' stamp described in 3.1.1.1.1 and known as the EEC partial verification mark, final verification of the vessel at its place of installation by an inspection body of the country of destination which, providing the vessel conforms to EEC requirements, shall affix the stamp described in 3.1.1.1.2 which, together with the EEC partial verification mark, forms the EEC final verification mark.

verification marks.
Unless otherwise indicated in Schedules V, VI and VII to these regulations, the letters and numbers of each mark must be at least 5 mm high.

3.2.2. The inspection bodies of the Member States shall mutually exchange copies of the drawings of the EEC verification marks.

**3.3. Affixing the marks**

3.3.1. The EEC final verification mark shall be affixed in the required position on the vessel when the latter has been finally verified and is recognized as conforming to EEC requirements.

3.3.2. Where verification is carried out in more than one stage, the EEC partial verification mark shall be affixed at the place of manufacture on the vessel or part of a vessel which is recognized as conforming to EEC requirements at that stage of the inspection procedure, and in the place specifically provided for the stamping place or in any other place specified in Schedules V, VI and VII to these regulations.

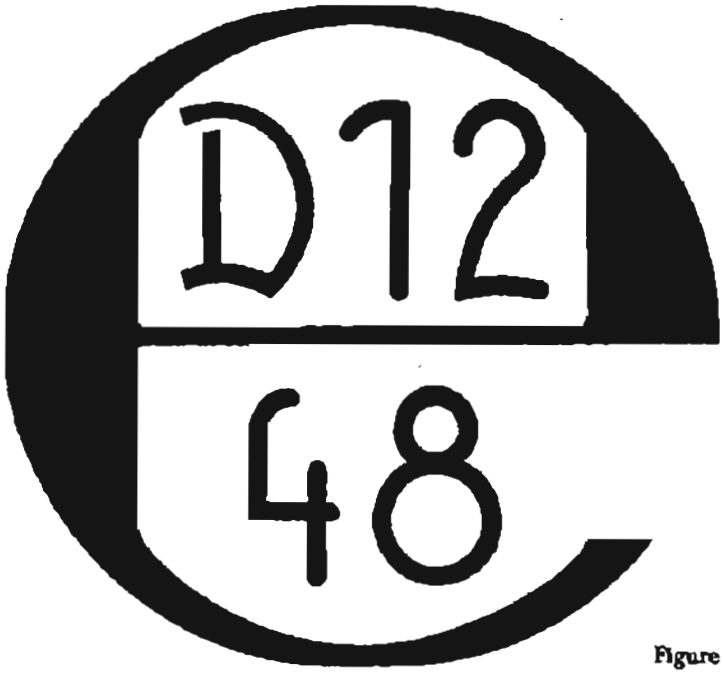



Figure 1

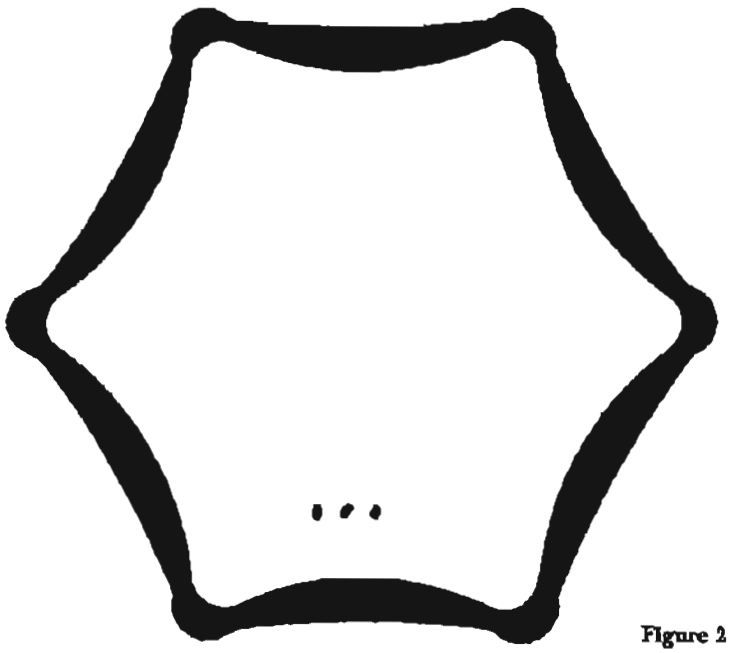
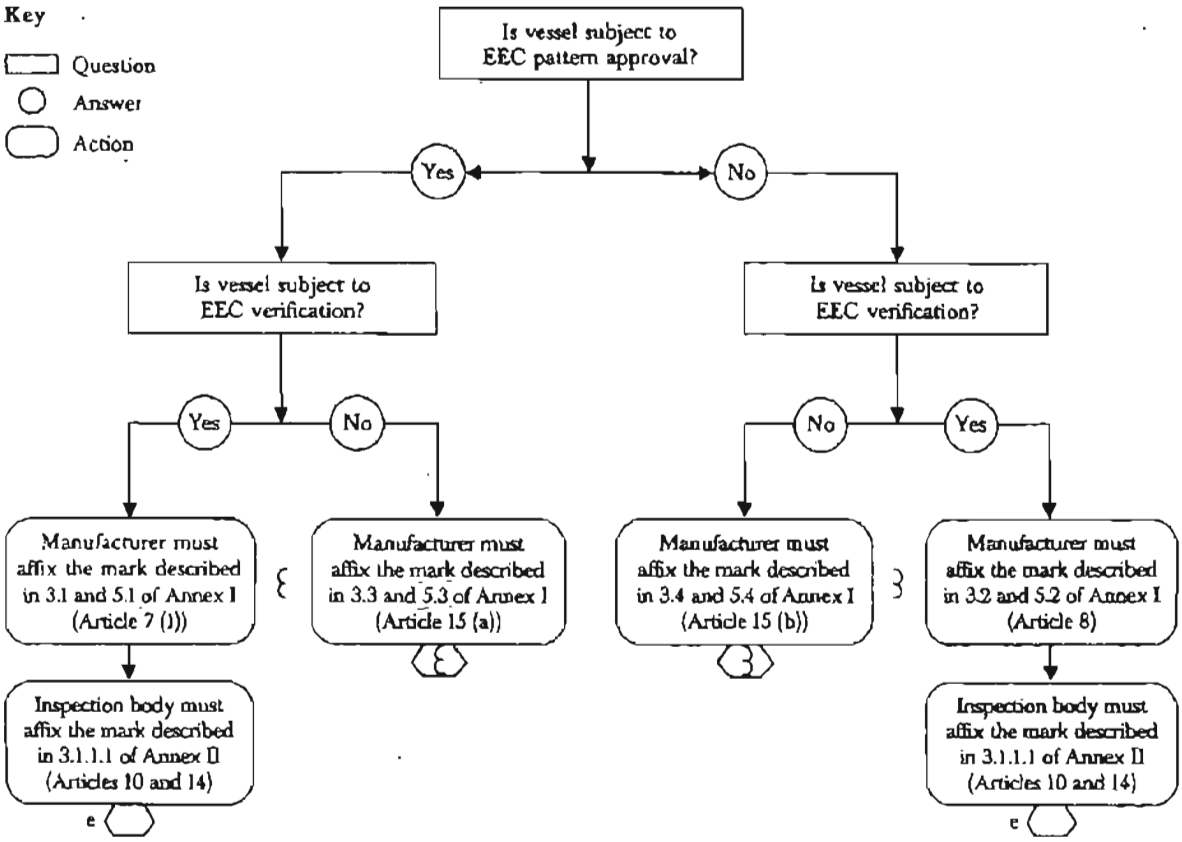


Figure 2

*Appendix to Schedules I and II*

**Table illustrating the various possible combinations for EEC pattern approval or EEC verification**



# Schedule III

## Based on Annex III of the Directive

### EEC VERIFICATION

**Minimum criteria to be taken into account by Member States when appointing inspection bodies to carry out EEC verification**

1. The inspection body, its director and the staff responsible for carrying out the verification tests may not be the designer, manufacturer, supplier, installer of vessels or installations which they inspect, nor the authorized representative of any of those parties. They may not become directly involved in the design, construction, marketing, representation or maintenance of the vessels or installations, nor represent the parties engaged in these activities. This does not preclude the possibility of exchanges of technical information between the manufacturer and the inspection body.

2. The inspection body and its staff must carry out the verification tests with the highest degree of professional integrity and technical competence and must be free from all pressures and inducements, particularly financial, which might influence their judgement or the results of the inspection, especially from persons or groups of persons with an interest in the results of verifications.

3. The inspection body must have at its disposal the necessary staff and possess the necessary means for it to perform properly the administrative and technical tasks connected with verifications; it must also have access to the equipment required for special verifications.

4. The staff responsible for inspection must have :

   - sound technical and professional training,

   - satisfactory knowledge of the requirements of the tests they carry out and adequate experience of such tests,

   - the ability to draw up the certificates, records and reports required to authenticate the performance of the tests.

5. The impartiality of inspection staff must be guaranteed. Their remuneration must not depend on the number of tests carried out, nor on the results of such tests.

6. The inspection body must take out a third party insurance policy unless civil liability is assumed by the State in accordance with national law, or the Member State itself is directly

responsible for the tests.

The staff of the inspection body shall be bound to observe professional secrecy with regard to all information gained in carrying out its tasks (except *vis-à-vis* the competent administrative authorities of the State in which its activities are carried out) under these regulations and the Schedules V, VI and VII hereto, or any provision of national law giving effect to them.

# Schedule IV

## Based on Annex IV of the Directive

### DEFINITIONS

Country of origin : Member State where the pressure vessel was manufactured.

Recipient country : Member State into which a pressure vessel is to be imported, or in which it is to be marked and/or placed into service.

Administration of origin : The competent administrative authorities of the country of origin.

Recipient administration : The competent administrative authorities of the recipient country.

### PROCEDURE

Where a manufacturer wishes to export a pressure vessel, or more than one pressure vessel of a single type, he or his representative shall forward an application, directly or through the importer in the recipient country, to the recipient administration, citing regulation 14 of these regulations and asking for the verification tests to be carried out in accordance with the methods laid down in the recipient country by an inspection body other than those of the recipient country.

In his application, the manufacturer or his representative shall indicate which inspection body he has chosen. The choice must be made from the list sent in by the country of origin under Article 13 of the Directive. However, by way of exception to this procedure, in the case of vessels designed for a complex installation manufactured in accordance with the information and specifications provided by the customer or a consultancy bureau appointed by him, an inspection body in the Member State of origin shall be chosen by the customer, whether or not included on the list referred to in Article 13 of the Directive, provided the recipient administration agrees to the choice.

The recipient administration shall inform the administration of origin of the decisions it had taken on the matter.

The name of the customer or importer, if known, must be shown in the application.

The application shall be accompanied by a file containing drawings and calculations relating to the vessel or pattern, specifications of the materials, information on the manufacturing processes involved, and details of the verification methods during manufacture, together with any other information which the manufacturer or his representative consider may help the

recipient administration's decision as to whether a pressure vessel of the same pattern, conforming to the plans, satisfies the statutory requirements for pressure vessels in the recipient country.

The documents shall be forwarded in quadruplicate in the language or languages of the recipient country or in another language acceptable to that country.

2.

2.1. The recipient administration shall acknowledge receipt of the file as soon as it is received.

2.2.

2.2.1. If the recipient administration considers that the file received contains all the information required under section 1 of this Schedule, it shall have three months from the date of receipt of the file to conduct a substantive examination of the documents in the file.

2.2.2. If the recipient administration considers that the file received does not contain all the information required under section 1 of this Schedule, it shall have one month from the date of receipt of the file to inform the applicant of the further details which should be supplied. On receipt of the file duly completed, the procedure in point 2.2.1 of this Schedule shall be followed.

2.3.

2.3.1. If it is apparent from a substantive examination of the file that the vessel, or the vessels of a single type have been produced or are intended to be produced in accordance with the relevant documents, and satisfy the statutory requirements for pressure vessels in the recipient country or may be accepted if a derogation from these requirements is granted, the recipient administrations shall notify the applicant accordingly within the period laid down in point 2.2.1 of this Schedule.

If the vessel, or the vessels of a single-type, covered by the application are not subject to regulations in the recipient country, the recipient administration may require that the regulations governing pressure vessels in the country of origin are complied with.

2.3.2. If it is apparent form a substantive examination of the file that the vessel, or the vessels of a single type, have been produced or are intended to be produced in accordance with the relevant documents, but do not satisfy the statutory requirements for pressure vessels in the recipient country and may not be granted a derogation from these requirements, the recipient administration shall notify the applicant accordingly within the period laid down in point 2.2.1 of this Schedule, and shall indicate which provisions have not been complied with and which provisions must be complied with if the vessel, or the vessels of a single type are to be accepted. It shall also inform the applicant of the manufacturing requirements and the checks, tests and verifications required by the regulations on pressure vessels which are in force in the recipient country.

If the applicant is prepared to amend the design, manufacturing process and/or verification methods relating to the vessel, or the vessels of a single type, so as to satisfy the required conditions, he shall amend his file accordingly. On receipt of the amended file, the procedure outlined in point 2.2.1 of this Schedule shall be followed, but the period for examination shall be reduced to two months.

2.3.3. The criteria used by the recipient administration for granting or refusing the derogations referred to in points 2.3.1 and 2.3.2 of this Schedule shall be the same as those currently applied for manufacturers established in the recipient country.

2.4. The fees, taxes or other charges for the examination of the file shall be those laid down by the rules applying in the recipient administration.

3. The inspection body chosen in accordance with section 1 of this Schedule shall carry out the operations required of it by the recipient administration.

4. After carrying out the checks, tests and verifications required by the recipient administration, and establishing that the results are satisfactory, the inspection body shall issue to the manufacturer or his representative, and to the recipient administration, the reports on these checks, tests and verifications, and certificates confirming that the checking, testing and verification methods used and the results obtained comply with the requirements of the recipient country.
If the results of the checks are not satisfactory, the inspection body shall inform the applicant and the recipient administration.

These documents must be drawn up in the language of the recipient country or in another language acceptable to it.

5. The fees, taxes or charges for carrying out these checks and tests shall be in accordance with the rules of the inspection body.

6. The recipient administration must ensure that all plans and documents forwarded to it remain confidential.

# Schedule V

## Based on Directive 84/525/EEC[3]

### Scope

This Schedule shall apply to the steel pressure resistant shells of seamless cylinders, i.e. formed from a single piece, capable of being refilled and transported, with a capacity of between 0.5 and 150 litres inclusive and designed to contain compressed, liquefied or dissolved gases.

These gas cylinders are hereinafter referred to as 'cylinders'.

This Schedule shall not apply to cylinders made of austenitic steel or to cylinders to which metal is added when the base is being sealed.

This Schedule shall apply irrespective of the number of outlets the cylinder has (one or two).

### EEC verification and pattern aproval

All EEC-type cylinders shall be subject to EEC pattern approval.

All EEC-type cylinders shall be subject to EEC verification with the exception of cylinders with a hydraulic test pressure of 120 bars or less and with a capacity of not more than one litre.

### Adaptation to technical progress

Any amendments necessary to adapt sections 2.1.3, 2.1.4, 2.3, 3.1.1.1, 3.4, 3.5, 3.6, 3.7, 4, 5 and 6 of this Annex and other Annexes to this Schedule to technical progress shall be adopted in accordance with the procedure laid down in Article 20 of the Directive.

The procedure laid down in Article 17 of the Directive may apply to section 2.2 of Annex I to this Schedule.

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[3] OJ No. L 300, 19-11-84, p. 1.

# *ANNEX I*

## 1. DEFINITIONS OF, AND SYMBOLS FOR, THE TERMS USED IN THIS SCHEDULE

### 1.1. YIELD STRESS

For the purpose of this Schedule, the yield stress values used in the calculation of the parts subjected to pressure shall be as follows:

- when a steel does not display a lower and an upper yield point, the minimum value of the conventional yield point $R_{p0.2}$ is to be taken;

- when a steel displays a lower and an upper yield point, the value to be taken is:

  - $R_{eL}$,

  - $R_{eH} \times 0.92$, or

  - $R_{p0.2}$.

### 1.2. BURSTING PRESSURE

For the purpose of this Schedule, 'bursting pressure' means the pressure at plastic instability, i.e. the maximum pressure obtained during a pressure bursting test.

### 1.3. SYMBOLS

The symbols used in this Schedule have the following meanings:

$P_h$ = hydraulic test pressure, in bars;

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

$P_m$ = calculated minimum theoretical bursting pressure, in bars;

$R_e$ = value of the field stress taken into account in accordance with point 1.1 of this Annex for the purpose of determining the value of R used in calculating the parts subjected to pressure, in $N/mm^2$;

$R_{eL}$ = minimum value of the lower yield point, guaranteed by the cylinder manufacturer, in $N/mm^2$;

$R_{eH}$ = minimum value of the upper yield point, guaranteed by the cylinder manufacturer, in $N/mm^2$;

$R_{p\,0.2}$ = conventional yield point 0.2%, guaranteed by the manufacturer, in $N/mm^2$

The conventional yield point is the value of the stress which gives rises to a non-proportional elongation equal to 0.2% of the original gauge length.

$R_m$ = minimum value of the tensile strength guaranteed by the cylinder manufacturer, in $N/mm^2$;

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

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

d = mandrel diameter for bend tests, in mm;

$R_{mt}$ = actual tensile strength, in $N/mm^2$.

1.4. NORMALIZATION

The term 'normalization' is used in this Schedule as defined in paragraph 68 of EURONORM 52-83.

Normalization may be followed by tempering at a uniform temperature below the lowest transformation point (Ac1) of the steel.

1.5. QUENCHING AND TEMPERING

The term 'quenching and tempering' relates to the heat treatment to which a completed cylinder is subjected, during which the cylinder is heated to a uniform temperature above the upper transformation point (Ac3) of the steel. The cylinder is then cooled at a rate not exceeding 80% of that obtained by cooling in water at 20 °C and subsequently tempered at a uniform temperature below the lowest transformation point (Ac1) of the steel.

The heat treatment must be such that it does not cause cracks in the cylinder. The cylinders must not be quenched in water without additives.

## 2. TECHNICAL REQUIRMENTS

### 2.1. STEELS USED

2.1.1. A steel shall be defined according to its method of manufacture, its chemical composition and the heat treatment to which the finished cylinder is subjected, and its mechanical characteristics. The manufacturer shall give the corresponding information, taking account of the requirements listed below. Any change in such information shall be deemed to correspond to a change in the type of steel for the purposes of EEC pattern approval.

(a) *Method of manufacture*

The method of manufacture shall be defined by reference to the process used (for example open-hearth furnace, oxygen converter, electric furnace) and the killing method used.

(b) *Chemical composition*

The chemical composition must show at least:

- the maximum sulphur and phosphorous content in all cases,
- the carbon, manganese and silicon content in all cases,
- the nickel, chromium, molybdenum and vanadium content when such substances are deliberately introduced as alloying elements.

The carbon, manganese, silicon and, where appropriate, nickel, chromium, molybdenum and vanadium content must be given with tolerances such that the differences between the maximum and minimum values for each cast do not exceed:

- carbon:
  - 0.06% when the maximum content is less than 0.30%,
  - 0.07% when the maximum content is 0.03% or more;
- manganese and silicon:

- 0.30%;

- chromium:

  - 0.30% when the maximum content is less than 1.5%,

  - 0.50% when the maximum content is 1.5% or more;

- nickel:

  - 0.40%;

- molybdenum:

  - 0.15%;

- vanadium:

  - 0.10%.

(c) *Heat treatment*

The heat treatment shall be defined in terms of the temperature, the length of the time held at the temperature and the nature of the cooling fluid used for each stage of the treatment (normalization, whether or not followed by tempering, or quenching and tempering).

The austenitization temperature before quenching or normalization must be fixed with a margin of 35° C either way.

The same applies to the tempering temperature.

2.1.2. Conditions to be fulfilled

The steel used must be killed steel and resistant to ageing. The whole of the finished cylinder must be subjected to heat treatment which may either normalization, whether or not followed by tempering, or quenching followed by tempering. The sulphur and phosphorus contents obtained for the cast sample should each be not more than 0.035% and must not in total exceed 0.06%. The sulphur and phosphorous contents obtained for the product must each be not more than 0.04% and must not in total exceed 0.07%.

2.1.3. A steel within the meaning of point 2.1.1 of this Annex may not be seamless cylinders. Each Member State shall supply any other Member State on request with a list of the material used on its territory for the manufacture of the cylinders covered by this Schedule.

2.1.4. There must be an opportunity of making independent analyses, in particular for the purposes of checking that the sulphur and phosphorous contents corresponds to the requirements of point 2.1.2 of this Annex. These analyses must be carried out on either specimens taken from the semi-finished product as supplied to the cylinder manufacturer by the steel maker or the finished cylinders.

When it is decided to take a specimen from a cylinder, it is permissible for the specimen to be taken from one of the cylinders previously for the mechanical tests specified in point 3.1 or for the pressure bursting test specified in point 3.2 of this Annex.

2.2. CALCULATIONS FOR THE PRESSURE PARTS

2.2.1. The minimum wall thickness shall be at least equal to the greatest value given by the following:

- $a = \frac{P_h \cdot D}{\frac{20R}{4/3} + P_h}$ mm

where R is the smaller of the following two values:

(1) $R_e$;

(2) $0.75 \cdot R_m$, for normalized or normalized and tempered cylinders,

$0.85 \cdot R_m$ for quenched and tempered cylinders.

- $a = \frac{D}{250} + 1$ mm

- a = 1.5 mm

2.2.2. If a convex end is obtained by forging from tube, the wall thickness measured at the center of the shaped end shall be at least 1.5a.

2.2.3. The thickness of the concave base of cylinders must not be less than 2a within the diameter on which the cylinder stands.

2.2.4. In order to ensure satisfactory stress distribution, the thickness of the cylinder walls must increase progressively in the transition between the cylindrical wall and the base.

2.3. CONSTRUCTION AND WORKMANSHIP

2.3.1. The thickness of each cylinder shall be checked and the condition of its internal and external surfaces inspected by the manufacturer in order to verify that:

- the wall thickness is at no point less than specified on the drawing,

- the internal and external surfaces of the cylinder are free from defects which would adversely affect the operating safety of the cylinder.

2.3.2. The cut-of-roundness of the cylindrical shell must be limited to such a value that the difference between the maximum and minimum outside diameters in the same cross-section is not more than 1.5% of the average of those diameters.

The maximum deviation of the cylindrical part of the shell from a straight line shall not exceed 3 mm per metre length.

2.3.3. Cylinder footrings, where provided, must be sufficiently strong and be manufactured from a material which, with regard to corrosion, is compatible with the type of steel of which the cylinder is made. The shape of the footring must give the cylinder an adequate degree of stability. Footrings must not allow water to accumulate or permit ingress of water between the ring and the cylinder.

## 3. TESTS

3.1. MECHANICAL TESTS

3.1.1. General requirements

3.1.1.1. Except where otherwise specified by this Schedule, the mechanical tests shall be carried out in accordance with the following EURONORMS:

EURONORM 2-80: tensile test for steel;

EURONORM 3-79: Brinell hardness test;

EURONORM 6-55: bend test for steel;

EURONORM 11-80: tensile test for steel sheet and strip less than 3 mm thick;

EURONORM 12-55: bend test for steel sheet and strip less than 3 mm thick;

EURONORM 45-63: impact test on a notched test-piece resting on two supports.

3.1.1.2. All mechanical tests for checking the quality of the material used in cylinders shall be carried out test pieces taken from the finished cylinders.

3.1.2. Types of test and test criteria

Every test criteria must undergo one tensile in a longitudinal direction, four bend tests in a circumferential direction and, if the wall thickness makes it possible to take test-pieces at least 5 mm wide, three impact tests. The impact test-pieces shall be taken in transverse direction; however, if the thickness and/or diameter of the cylinder prevents a test specimen of at least 5 mm wide from being taken in a transverse direction, the impact test-pieces shall be taken in a longitudinal direction.

3.1.2.1. *Tensile test*

3.1.2.1.1. The test-piece shall be in accordance with the provisions:

- of chapter 4 of EURONORM 2-80, where it is 3 mm thick or more,

- of chapter 4 of EURONORM 11-80, where it is less than 3 mm thick. In this case, the gauge width and length of the test-piece shall be 12.5 and 50 mm respectively, irrespective of the thickness of the test-piece.

3.1.2.1.2. The two faces of the test-piece corresponding to the internal and external walls of the cylinder must not be machined.

3.1.2.1.3. The elongation, expressed as a percentage, must not be less than:

$$\frac{25 \cdot 10^3}{2R_{m1}}$$

Moreover, the elongation must in no case be less than:

- 14%, where the test is carried out in accordance with EURONORM 2-80

- 11%, where the test is carried out in accordance with EURONORM 11-80.

3.1.2.1.4. The value for tensile must not be less than $R_m$.

The yield stress to be determined during the tensile test shall be that used in accordance with point 1.1 of this Annex for the cylinder calculation. The upper yield point must be determined from the load/elongation diagram or by any equally precise method.

The value obtained for the yield stress must not be less than $R_{cH}$, $R_{cL}$, or $R_{p\,0.2}$, as the case may be.

3.1.2.2. *Bend test*

3.1.2.2.1. The bend test shall be carried out on test-pieces obtained by cutting a ring 25 mm wide into two parts of equal length, each of which may be machined only on the edges. The two faces of each test-piece which correspond to the internal and external walls of the cylinder may not be machined.

3.1.2.2.2. The bend test must be carried out using a mandrel of diameter d and two cylinders separated by a distance of d + 3a.

During the test inside face of the ring must remain against the mandrel.

3.1.2.2.3. The test-piece must not crack when bent inwards round a mandrel until the inside edges are no farther apart then the diameter of a mandrel (see diagram in Annex III of this Schedule)

3.1.2.2.4. The ratio (n) between the diameter of the mandrel and the thickness of the test-piece must not exceed the values given in the following table:

| Actual tensile strength $R_{mt}$ in N/mm$^2$ | Value of n |
|---|---|
| Up to 440 inclusive | 2 |
| Above 440 to 520 inclusive | 3 |
| Above 520 to 600 inclusive | 4 |
| Above 600 to 700 inclusive | 5 |
| Above 700 to 800 inclusive | 6 |
| Above 800 to 900 inclusive | 7 |
| Above 900 | 8 |

3.1.2.3. *Impact test*

3.1.2.3.1. The impact test shall be carried out on test-pieces of the EURONORM 45-63 type.

All impact strength measurements shall be carried out at –20 °C.

The notch shall be perpendicular to the faces of the cylinder wall.

The test-pieces used for the impact test may be straightened and must be machined on the six faces, but only to the extent necessary to achieve flat surfaces.

3.1.2.3.2. The average impact strength value obtained from three tests in a longitudinal or transverse direction and each of the individual values obtained from the test may not be less than the corresponding value, expressed in J/cm$^2$, indicated in the following table:

| | Steels for which $R_m$ is not more than 650 N/mm$^2$ | | Steels for which $R_m$ in greater than 650 N/mm$^2$ | |
|---|---|---|---|---|
| | longitudinal | transverse | longitudinal | transverse |
| Average of the three test-pieces | 33 | 17 | 50 | 25 |
| Each individual value | 26 | 13 | 40 | 20 |

3.2. HYDRAULIC PRESSURE BURSTING TEST

3.2.1. Test conditions

Cylinders subjected to this must bear the markings as specified in section 6 of this Schedule.

3.2.1.1. The hydraulic pressure bursting test must be carried out in two successive stages, using a test-rig which allows pressure in the cylinder to be increased at an even rate until the cylinder bursts and curve of pressure variations against time to be recorded. The test must be carried out at room temperature.

3.2.1.2. During the first stage, the increase in pressure shall be constant up to the level at which plastic deformation starts. This rate must not exceed 5 bars/sec.

From the start of plastic deformation (second phase), delivery from the pump must not be more than twice as much as it was in the first phase and must be maintained constant until the cylinder bursts.

3.2.2. Interpretation of test

3.2.2.1. The interpretation of the pressure bursting test shall involve:

- examination of the pressure/time curve to determine the bursting pressure,
- examination of the tear and of the shape of its edges,
- verification, in the case of cylinders with a concave base, that the base of the cylinder has not been reversed.

3.2.2.2. The measured bursting pressure ($P_r$) shall be greater than the value given by:

$$P_n = \frac{20aR_m}{D-a}$$

3.2.2.3. The bursting test must not cause fragmentation of the cylinder.

3.2.2.4. The main tear must not be the brittle type, i.e. the edges of the fracture must not be radial but be sloping in relation to a diametral plane and must display a contraction.

A fracture shall be acceptable only if it meets the following conditions:

1. In the case of cylinders the thickness 'a' of which does not exceed 7.5 mm:

   (a) the greater part of the fracture must be unmistakably longitudinal;

   (b) the fracture must be without multiple branches;

   (c) the fracture must not have a circumferential development of more than 90° on either side of its main part;

   (d) the fracture must not extend into those parts of the cylinder which are more than 1.5 times thicker than the maximum thickness measured halfway up the cylinder;

   (e) in the case of cylinders with convex bases, the fracture must not reach the center of the cylinder base.

   However, it is permissible for condition (d) not to be met:

   (a) in the case of a conical head or convex base where the fracture does not extend into parts of the cylinder having a diameter less than 0.75 times the nominal external diameter of the cylinder;

   (b) in the case of a concave base, where the distance between the furthermost point of the fracture and the base-plane of the cylinder exceeds 5 times the thickness 'a';

2. In the case of cylinders the thickness 'a' of which exceeds 7.5 mm, the greater part of the fracture must be unmistakably longitudinal.

3.2.2.5. The tear shall not reveal any obvious defect in the metal.

3.3. PRESSURE CYCLING TEST

3.3.1. Cylinders subjected to this test must bear the markings specified in section 6 of this Annex.

3.3.2. The pressure cycling test shall be carried out on two cylinders which are guaranteed by the manufacturer to be reasonably representative of the minimum values specified in the design using a non-corrosive fluid.

3.3.3. This set shall be cyclical. The maximum cyclic pressure shall be equal either to pressure $P_h$ or two-thirds thereof.

The lower cyclic pressure must not exceed 10% of the upper cyclic pressure.

The minimum number of cycles and the maximum test frequently are shown in the following table:

| Maximum applied pressure | $P_h$ | $\frac{2}{3} P_h$ |
|---|---|---|
| Minimum number of cycles | 12 000 | 80 000 |
| Maximum frequency in cycles per minute | 5 | 12 |

The temperature measured on the outer wall of the cylinder must not exceed 50 °C during the test.

The test shall be considered satisfactory if the cylinder attains the required number of cycles without developing a leak.

3.4. HYDRAULIC TEST

3.4.1. The water pressure in the cylinder must increase at an even rate until the pressure $P_h$ is reached.

3.4.2. The cylinder must remain under the pressure $P_h$ long enough to make it possible to establish that the pressure shows no tendency to fall and that there are no leaks.

3.4.3. After the test cylinder must show no permanent deformation.

3.4.4. Any tested cylinder which does nor fulfill the test requirements shall be rejected.

3.5. CHECK ON THE CONSISTENCY OF A CYLINDER

This test involves checking that any two points on the metal of the external surface of the cylinder do not differ in hardness by more than

25 HB. The check must be carried out on two transverse sections of the cylinder near the head and the base, at four evenly points.

3.6. CHECK ON THE CONSISTENCY OF A BATCH

This test, which is carried out by the manufacturer, involves checking by means of a hardness test or some other appropriate means that no error has been made in the choice of the original material (sheet metal, billet, tubing) or in carrying out the heat treatment. However, in the case of normalization but non-tempered cylinders, the test need not be carried out on each cylinder.

3.7. CHECK ON BASES

A meridian section shall be made in the base of the cylinder and one of the surfaces thus obtained polished for examination under a magnification of between 5 and 10.

The cylinder must be regarded as defective if the pressure of fissures is detected. It is also to be regarded as defective if the dimensions of any pores or inclusions present reach values considered to pose a threat to safety.

## 4. EEC PATTERN APPROVAL

The EEC pattern approval referred to in this Schedule may also be issued for families of cylinders.

'Family of cylinders' means cylinders from the same factory which differ only in their length, but within the following limits:

- the minimum length must not be less than 3 times the diameter of the cylinder;

- the maximum length must not be more than 1.5 times the length of the tested cylinder.

4.1. The applicant for EEC pattern approval shall, for each family of cylinders, submit the documentation necessary for the checks prescribed below and make available to the Member State a batch of 50 cylinders from which the number of cylinders required for the tests referred to in the same paragraph will be taken, together with any additional information required by the Member State. The applicant must indicate the type and duration of heat treatment and temperatures.

He must obtain and provide cast analysis certificates for steel supplied for cylinder manufacture.

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

4.2.1. verify that:

- the calculations specified in point 2.2 of this Annex are correct,

- the thickness of the wall on two cylinders meets the requirements of point 2.2 of this Annex, the measurements being taken on three transverse sections and over the whole circumference of the longitudinal sections of the base and head,

- the conditions specified in point 2.1 and point 2.3.3 of this Annex are fulfilled,

- the requirements of point 2.3.2 of this Annex are complied with for all cylinders selected by the Member State,

- the internal and external surfaces of the cylinder are free of any defect which may make them unsafe.

4.2.2. carry out the following tests on the cylinder selected:

- the test specified in point 3.1 of this Annex, on two cylinders; however, where the length of the cylinder is 1 500 mm or more, the tensile test in a longitudinal direction and the bend test shall be carried out on test-pieces taken from the upper and lower regions of the shell,

- the test specified in point 3.2 of this Annex, on two cylinders,

- the test specified in point 3.3 of this Annex, on two cylinders,

- the test specified in point 3.5 of this Annex, on one cylinder,

- the test specified in point 3.7 of this Annex, on all sample cylinders.

4.3. If the results of the checks are satisfactory, the Member State shall issue the EEC pattern approval certificate in accordance with the model contained in Annex IV of this Schedule.

## 5. EEC VERIFICATION

5.1. FOR THE PURPOSE OF EEC VERIFICATION, THE CYLINDER MANUFACTURER SHALL:

5.1.1. provide the inspection body with the EEC pattern approval certificate;

5.1.2. provide the inspection body with certificates stating the cast analyses of the steel supplied for the construction of the cylinders;

5.1.3. have a means of identifying the cast of steel from which each cylinder was made;

5.1.4. provide the inspection body with the documents relating to heat treatment, necessary to certify that the cylinders provided by him are either the normalized or the quenched and tempered condition, and state that treatment applied;

5.1.5. provide the inspection body with a list of cylinders, stating the numbers and inscriptions as required in section 6 of this Annex.

5.2. DURING EEC VERIFICATION

5.2.1. The inspection body shall:

- ascertain that the EEC pattern approval certificate has been obtained and that the cylinders conform to it,
- check the documents which give data concerning the materials;
- check whether the technical requirements set out in section 2 of this Annex have been met, and in particular check by an external, and if possible internal, visual examination of the cylinders whether the construction and the checks carried out by the manufacturer in accordance with point 2.3.1 of this Annex are satisfactory; the visual examination shall cover at least 10% of the cylinders submitted,
- carry out tests specified in sections 3.1 and 3.2 of this Annex,
- check whether the information supplied by the manufacturer in the list referred to in point 5.1.5 of this Annex is correct; this shall be done by means of a random check;

- assess the result of the checks on the consistency of the batch carried out by the manufacturer in accordance with point 3.6 of this Annex.

  if the results of the checks are satisfactory, the inspection body shall issue an EEC verification certificate conforming to the model contained in Annex V of this Schedule.

5.2.2. For the two types of test prescribed in points 3.1 and 3.2 of this Annex, two cylinders shall be taken at random form each batch of 202 cylinders or part thereof that have been made from the same cast and have undergone the specified heat treatment in identical circumstance.

One of the cylinders shall be subjected to the tests specified in point 3.1 (mechanical tests) of this Schedule and the other to the test specified in point 3.2 (bursting test) of this Annex. If it is shown that a test has been wrongly carried out or that a measuring error has been made, the test must be repeated.

If one or more tests prove even partially unsatisfactory, the cause must be investigated by the inspection body.

5.2.2.1. If the failure is not due to the heat treatment, the batch shall be rejected.

5.2.2.2. If the failure is due to the heat treatment, the manufacturer may subject all the cylinders in the batch to re-heat treatment.
Following re-heat treatment:

- the manufacturer shall carry out the check provided for in point 3.6 of this Annex,

- the inspection body shall carry out all the tests provided for in the first and second paragraphs of point 5.2.2 of this Annex.

If the cylinders are not subject to re-heat treatment or if the results of the check and tests carried out following re-heat treatment do not satisfy the requirements of these regulations, the batch shall be rejected.

5.2.3. The selection of the specimen and all the tests shall be carried out in the presence and under supervision of a representative of the inspection body.

5.2.4. After all the specified test have been carried out, all the cylinders in the batch shall be subjected to the hydraulic test specified in point 3.4 of this Annex in the presence and under supervision of a representative of the inspection body.

5.3. EXEMPTION FROM EEC VERIFICATION

In the case of the cylinders exempted from EEC verification, all the test and inspection operations prescribed in point 5.2 of this Annex shall be out by the manufacturer on his own responsibility.

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

## 6. MARKS AND INSCRIPTIONS

The marks and inscriptions specified in this section shall be stamped visibly, legibly and indelibly on the shoulder of the cylinder.

In the case of cylinders with a capacity of not more than 15 liters the marks and inscriptions may be stamped on either the shoulder or another sufficiently thick part of the cylinder.

A diagram showing examples of the marks and inscriptions is given in Annex II to this Schedule.

6.1. STAMPING OF MARKS

By the way of derogation from the requirements of section 3 of Annex I of the Directive, which is set out in Schedule I to these regulations, the manufacturer shall stamp the EEC approval mark in the following order:

- for the cylinder subject to EEC pattern approval and EEC verification pursuant to this Schedule:

  - the stylized letter Ɛ,

  - the serial number 1 of this Schedule,

  - the capital letter(s) identifying the State which has granted EEC pattern approval and the final two figures of the year in which pattern approval was granted,

- the number of the EEC pattern approval (e.g. Ɛ D 79 45);

- for the cylinders exempted from EEC verification:

  - the stylized letter Ɛ surrounded by a hexagon,

  - the serial number 1 of this Schedule allocated according to the chronological order of adoption,

  - the capital letter(s) identifying the State which has granted EEC pattern approval and the final two figures of the year in which patter approval was granted,

  - the number of the EEC pattern approval (e.g. Ⓔ 1 D 79 54)

By way of derogation from the requirements of section 3 of Annex II of the Directive, which is set out in Schedule III to these regulations, the inspection body shall affix the EEC verification mark in the following order:

- the small letter 'e',

- the capital letter(s) identifying the State in which the verification is carried out, together with, where necessary, one or two numbers identifying a territorial subdivision,

- the mark of the inspection body affixed by the verifying agent, together with the mark of the verifying agent if appropriate,

- a hexagon,

- the date of verification: year, month (e.g. e D × ○ 80/01).

6.2. CONSTRUCTION INSCRIPTIONS

The manufacturer shall stamp the following construction inscriptions:

6.2.1. as regards the steel:

- a number indicating the value indicating the value of R in $N/mm^2$ on which the calculation was based,

- the symbol N (cylinder in the normalized condition or normalized and tempered) or the symbol T (cylinder in the quenched and

tempered condition);

6.2.2. as regards the hydraulic test:

the value of the test pressure in bars followed by the symbol 'bar';

6.2.3. as regards the type of cylinder:

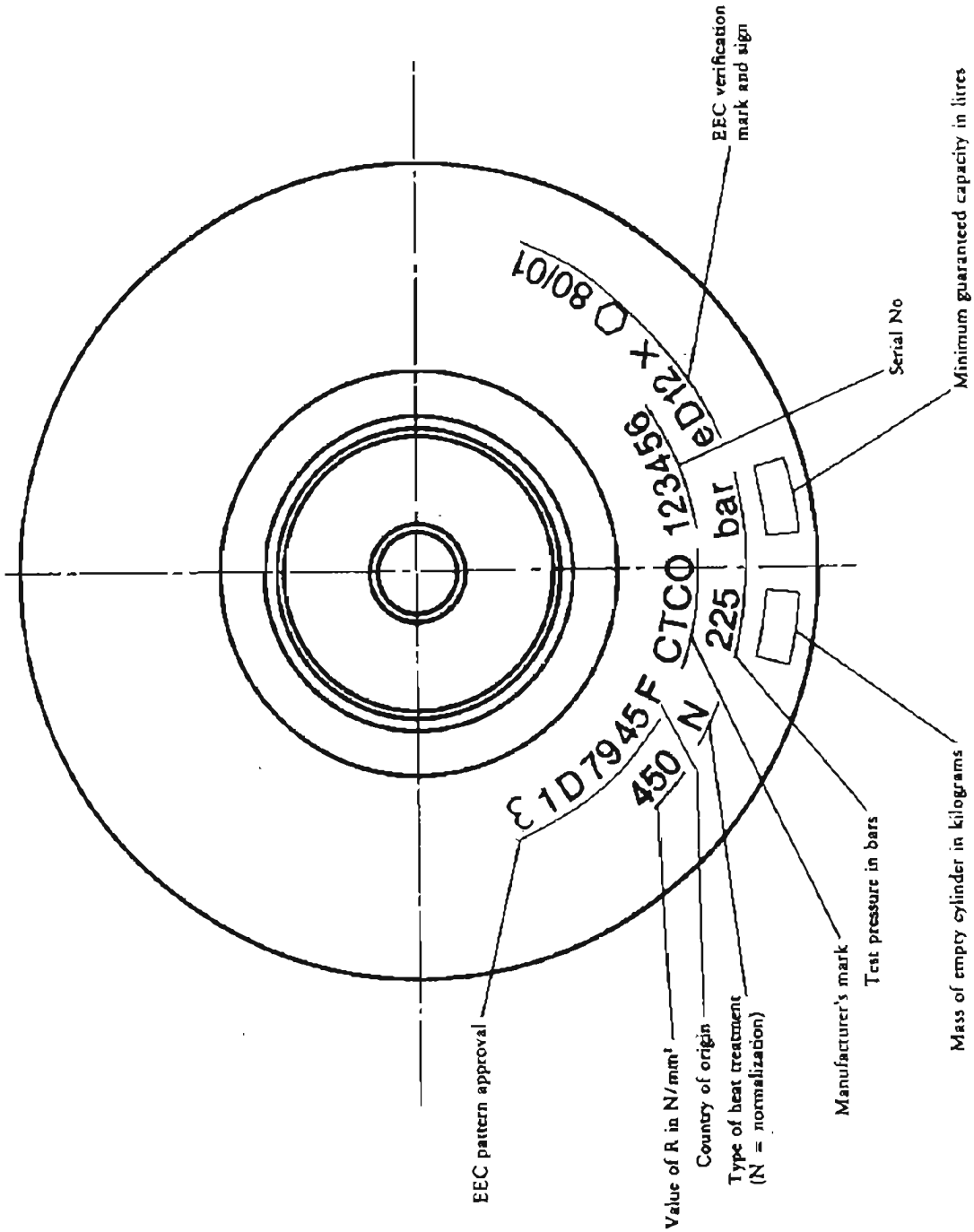
the mass of the cylinder, including all integral parts but excluding valve, in kilograms, and the minimum capacity in litres as guaranteed by the manufacturer of the cylinder;

the figures for mass and capacity must be given to one decimal place. This value is to be rounded down for the capacity and up for the mass;

6.2.4. as regards the origin:

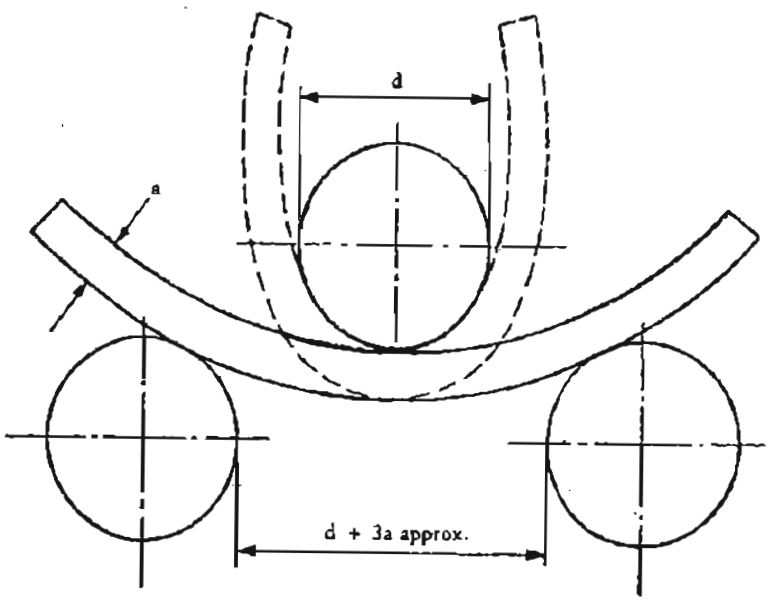
the capital letter(s) indicating the country followed by the manufacturer's mark and the serial number.

# *ANNEX II*


EEC verification mark and sign
Serial No
Minimum guaranteed capacity in litres
Mass of empty cylinder in kilograms
Test pressure in bars
Manufacturer's mark
Type of heat treatment (N = normalization)
Country of origin
Value of R in N/mm²
EEC pattern approval
X eD12 123456 CTCO 225 bar N 450 E1D7945F
80/01 D

# *ANNEX III*

## ILLUSTRATION OF BEND TEST



# *ANNEX IV*

## EEC PATTERN APPROVAL CERTIFICATE

Issued by ..... on the basis of
(Member State)

.....
(National rules)

applying Council Directive 84/525/EEC of 17 September 1984 concerning:

SEAMLESS, STEEL GAS CYLINDERS

---

EEC Approval No ..... Date .....

Type of cylinder .....
(Description of the family of cylinder which has received EEC approval)

$P_h$ ..... D ..... a .....

$L_{min}$ ..... $L_{max}$ ..... $V_{min}$ ..... $V_{max}$ .....

Manufacturer or agent .....
(Name and address of manufacturer or his agent)

.....

.....

.....

EEC pattern approval mark ε ..... Ⓔ .....

Details of the results of the examination of the pattern for EEC approval and the main features of the pattern are annexed.

All information may be obtained from .....
(Name and address of the approving body)

.....

.....

.....

Certified at ....., on .....

.....
(Signature)

# TECHNICAL ANNEX TO EEC APPROVAL CERTIFICATE

1. Results of EEC examination of the pattern with a view to EEC approval.

2. Information on the main features of the pattern, in particular:

   - longitudinal cross-section of the type of cylinder which has received pattern approval, showing:

     - the nominal external diameter, D,

     - the minimum thickness of the cylinder wall, a,

     - the minimum thickness of the base and the head,

     - the minimum and maximum length(s), $L_{min}$ , $L_{max}$ ;

   - the capacity or capacities, $V_{min}$ , $V_{max}$

   - the pressure, $P_h$;

   - the name of the manufacturer/No of the drawing and date;

   - name of the type of cylinder;

   - the steel in accordance with point 2.1 (type/chemical composition/method of manufacture/heat treatment/guaranteed mechanical characteristics (tensile strength – yield point)) of this Schedule.

# *ANNEX V*

## MODEL

## EEC VERIFICATION CERTIFICATE

Application of Council Directive 84/525/EEC of 17 September 1984.

Inspection body .....

.....

Date .....

EEC pattern approval No .....

Description of cylinders .....

.....

EEC verification No .....

Manufacturing batch No ..... to .....

Manufacturer .....
(Name and address)

.....

.....

Country ..... Mark .....
(Name and address)

Owner .....

.....

.....

Customer .....
(Name and address)

.....

.....

# VERIFICATION TESTS

## 1. MEASUREMENTS OF SAMPLE CYLINDERS

| Test No | Batch consisting of No ..... to No ..... | Water capacity (litres) | Mass empty (kg) | Minimum measured thickness | |
|---|---|---|---|---|---|
| | | | | of the wall (mm) | of the base (mm) |
| | | | | | |

## 2. MECHANICAL TESTS CARRIED OUT ON SAMPLE CYLINDERS

| Test No | Heat treatment No | Tensile test | | | | Impact test | | Bend test 180 ° without cracking | Hydraulic bursting test (bars) | Description of the fracture (Description or diagram attached) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Test-piece in accordance with EURO-NORM (a) 2-80 (b) 11-80 | Yield point $R_e$ (N/mm²) | Tensile strength $R_m$ (N/mm²) | Elongation A (%) | Charpy notched test at – 20 °C, width of test piece ... mm | | | | |
| | | | | | | Average Joules/cm² | Minimum Joules/cm² | | | |
| | | | | | | | | | | |
| | Minimum values specified | | | | | | | | | |

I, the undersigned, hereby declare that I have checked that the verification operations, tests and checks prescribes in section 5.2 of Annex I to Council Directive 84/525/EEC of 17 September 1984 have been carried out successfully.

Special remarks .....

.....

General remarks .....

.....

Date ..... Place .....

.....
(Signature of the inspector)

on behalf of .....
(Inspection body)

# Schedule VI

## Based on Directive 84/526/EEC[4]

### Scope

This Schedule shall apply to seamless, unalloyed aluminium and aluminium alloy gas cylinders, formed from a single piece, capable of being refilled and transported, with a capacity of between 0.5 and 150 litres inclusive and designed to contain compressed, liquefied and dissolved gases.

These gas cylinders are hereinafter referred to as 'cylinders'.

This Schedule shall not apply to:

cylinders manufactured from an aluminium alloy with a guaranteed minimum tensile strength greater than 500 $N/mm^2$,

cylinders to which metal is added when the base is being sealed.

### EEC pattern approval and verification

All EEC-type cylinders shall be subject to EEC pattern approval.

All EEC-type cylinders shall be subject to EEC verification with the exception of cylinders with a hydraulic test pressure of 120 bars or less and with a capacity of not more than one litre.

### Adaptation to technical progress

Any amendments necessary to adapt sections 2.1.5, 2.4, 3.1.0, 3.4, 3.5, 3.6, 3.7, 4, 5 and 6 of Annex I and the other Annexes to this Schedule and other sections of this Schedule to technical progress shall be adopted in accordance with the procedure laid down in Article 20 of the Directive.

The procedure laid down in Article 17 of the Directive may apply to section 2.3 of Annex I to this Schedule.

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[4] OJ No. L 300, 19-11-84, p. 20.

# *ANNEX I*

## 1. TERMS AND SYMBOLS USED IN THIS SCHEDULE

### 1.1. YIELD STRESS

For the purposes of this Schedule, the yield stress values used in calculations of the pressure parts shall be as follows :

- for aluminium alloys, the 0.2% proof stress $R_{p\,0.2}$ , i.e. the value of the value of the stress which gives rise to a non-proportional elongation equal to 0.2% of the gauge length of the test-piece,

- for unalloyed aluminium in the unhardened state, the 1% proof stress.

1.2. For the purposes of this Schedule, 'bursting pressure' means the pressure at plastic instability, i.e. the maximum pressure obtained during a pressure bursting test.

1.3. The symbols used in this Schedule have the following meanings :

$P_h$ = hydraulic test pressure, in bars ;

$P_r$ = cylinder busting pressure measured during the bursting test, in bars;

$P_n$ = calculated minimum theoretical busting pressure, in bars ;

$R_e$ = minimum value of the yield stress guaranteed by the cylinder manufacturer, in $N/mm^2$ ;

$R_m$ = minimum value of the tensile strength guaranteed by the cylinder manufacturer, in $N/mm^2$ ;

a = calculated minimum thickness of the wall of the cylindrical part of the cylinder, in mm ;

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

$R_{mt}$ = actual tensile strength, in $N/mm^2$ ;

d = mandrel diameter for bend tests, in mm.

## 2. TECHNICAL REQUIREMENTS

### 2.1. MATERIALS USED, HEAT AND MECHANICAL TREATMENT

2.1.1. An aluminium alloy or unalloyed shall be defined according to its method of manufacture, its nominal chemical composition and the heat treatment undergone by the cylinder, the latter's resistance to corrosion and its mechanical properties. The manufacturer shall give the corresponding information, taking account of the requirements listed below. Any change in such information shall be deemed to correspond to a change in the type of material for the purposes of EEC pattern approval.

2.1.2. The following are permitted for the manufacture of cylinders:

(a) all unalloyed aluminium containing at least 99.5% aluminium;

(b) aluminium alloys with the chemical composition set out in table 1 which have undergone the heat and mechanical treatments listed in table 2 of this Schedule;

TABLE 1

| | Chemical composition in % | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cu | Mg | Si | Fe | Mn | Zn | Cr | Ti + Zr | Ti | Total others | Al |
| Alloy B | | | | | | | | | | | |
| Min | – | 4.0 | – | – | 0.5 | – | – | – | – | | remainder |
| Max | 0.10 | 5.1 | 0.5 | 0.5 | 1.0 | 0.2 | 0.25 | 0.20 | 0.10 | 0.15 | |
| Alloy C | | | | | | | | | | | remainder |
| Min | – | 0.6 | 0.7 | – | 0.4 | – | – | – | – | | |
| Max | 0.10 | 1.2 | 1.3 | 0.5 | 1.0 | 0.2 | 0.25 | – | 0.10 | 0.15 | |

TABLE 2

| | Heat and mechanical treatments |
|---|---|
| Alloy B | In order :<br><br>1. Blank inhibition treatment :<br>- duration determined by the manufacturer,<br>- temperature between 210 and 260 °C<br><br>2. Extrusion with a degree of cold- working of at most 30%<br><br>3. Formation of head: the temperature of the metal must be no less than 300 °C at the end of the process. |
| Alloy C | 1. Placing in solution before quenching :<br>- duration determined by the manufacturer,<br>- temperature in no case less than 525 °C or above 550 °C<br><br>2. Quenching<br><br>3. Artificial ageing :<br>- duration determined by the manufacturer,<br>- temperature of between 140 and 190 °C |

(c) any other aluminium alloy may be used for the manufacture of cylinders provided that if first passes the corrosion-resistance tests described in Annex II of the Directive, which is set out in Schedule II hereto.

2.1.3. The cylinder manufacturer must obtain and provide cast-analysis certificates for the material used for the manufacture of the cylinders.

2.1.4. There must be an opportunity for making independent analyses must be carried out either on specimens taken from the semi-finished product as supplied to the cylinder manufacturer or on the finished cylinders. When it is decided to take a specimen from a cylinder, it is permissible for the specimen to be taken from one of the cylinders previously chosen for the mechanical tests specified in point 3.1 of this Annex or for the pressure bursting test specified in point 3.2 of this Annex.

2.1.5. Heat and mechanical treatment of the alloys referred to in points 2.1.2 (b) and (c) of this Annex.

2.1.5.1. The last process in the manufacture of the cylinder, apart from finish machining, shall be artificial ageing.

2.1.5.1.1. The manufacturer shall indicate the characteristics of the final treatment which he carries out, i.e. :

- nominal temperatures during solution and artificial ageing.
- nominal duration of the time effectively spent at solution and artificial ageing temperatures.

During the heat treatment the manufacturer must comply with these characteristics within the following limits :

- solution temperature : to within $\pm$ 5 °C
- artificial ageing temperature : to within $\pm$ 5 °C
- duration of time effectively spent : to within $\pm$ 10%

2.1.5.1.2. However, for solution and artificial ageing the manufacturer may indicate a range of temperatures, with the difference between the extreme values not exceeding 20 °C. For each of these extreme values, he shall indicate the nominal duration of the time effectively spent.

For each intermediate temperature the nominal duration of the time effectively spent shall be determined by linear interpolation for the duration of the placing in solution and by linear interpolation of the logarithm of the time for the duration of artificial ageing.

The manufacturer must carry out the heat treatment at a temperature included in the range indicated for a duration of time effectively spent, which shall not vary by more than 10% from the nominal duration calculated as above.

2.1.5.1.3. The manufacturer must indicate the characteristics of the final heat treatment he has carried out, in the file submitted for the purposes of EEC verification.

2.1.5.1.4. In addition to the final heat treatment, the manufacturer must also indicate all heat treatments carried out at over 200 °C.

2.1.5.2 The manufacture of the cylinder may not include quenching and artificial ageing.

2.1.5.2.1. The manufacturer must specify the characteristics of the last heat treatment he has carried out at a temperature exceeding 200 °C, taking account of differences, if necessary, between different parts of the cylinder.

He must also specify any forming operation (e.g. extrusion, drawing or head formation) in the course of which the temperature of the metal does net exceed 200 °C and which is not followed by heat treatment at a temperature higher than that value, as well as the position of the section of the formed body which has undergone most cold-working and the corresponding degree of cold working.

For the purposes of applying this provision, 'degree of cold - working' is defined as the ratio $\frac{S - s}{s}$, S being the initial section and s the final section.

The manufacturer must comply with these characteristics of the heat treatment and forming within the following limits :

- duration of the heat treatment to within ± 10% and temperature to within ± 5 °C,
- degree of cold - working of the section which had undergone most cold - working to within ± 6% if the diameter of the cylinder is equal to or less than 100 mm and to within ± 3% if the diameter is more than 100 mm.

2.1.5.2.2 However, for the heat treatment the manufacturer may indicate a range of temperatures, with the difference between the extreme values not exceeding 20 °C. For each of these extreme values he shall indicate the nominal duration of the time effectively spent. For each intermediate temperature the nominal duration of the time effectively spent shall be determined by linear interpolation. The manufacturer must carry out the heat treatment at a temperature included in the range indicated for a duration of time effectively spent which shall not vary by more than 10% from the nominal duration calculated as above.

2.1.5.2.3. The manufacturer must indicate the characteristics of the final heat treatment which he has carried out and of the forming process in the file submitted for the purposes of EEC verification.

2.1.5.3. Where the manufacturer has opted to indicate a range of temperatures for the heat treatment in accordance with points 2.1.5.1.2. and 2.1.5.2.2 of this Annex, for the purpose of EEC pattern approval he must present two sets of cylinders, one made up of cylinders which have undergone the heat treatment at the lowest temperature of those envisaged and another made up of cylinders which have undergone the heat treatment at the highest temperature and with the shortest corresponding durations.

## 2.3. CALCULATION OF THE PRESSURE PARTS

2.3.1. The thickness of the cylindrical part of the gas cylinders must not be less than that calculated by means of the formula:

$$a = \frac{P_h D}{\frac{20R}{4/3} + P_h}$$

where R is the smaller of the following two values :

- $R_e$
- $0.85\ R_m$

2.3.2. The minimum wall thickness a may in no case be less than $\frac{D}{100} + 1.5$ mm.

2.3.3 The thickness and the shape of the bottom and the top ends must be such as to satisfy the requirements of the tests laid down in points 3.2 (bursting test) and 3.3 (pressure cycling test) of this Annex.

2.3.4. In order to obtain satisfactory stress distribution, the thickness of the cylinder walls must increase progressively in the transition section between the cylindrical part and the base where the bottom is thicker than the cylindrical wall.

## 2.4. CONSTRUCTION AND WORKMANSHIP

2.4.1. The thickness of each cylinder must be checked and the condition of its internal

and external surfaces inspected by the manufacturer in order to verify that :

- the wall thickness is at no point less than that specified on the drawing,

- the internal and external surfaces of the cylinder are free from defects which would adversely affect the operating safety of the cylinder.

2.4.2. The out-of-roundness of the cylindrical shell must be limited to a value which is such that the difference between the maximum and minimum outside diameters in the same cross section is not more than 1.5% of the average of those diameters.

The maximum deviation of the cylindrical part of the shell from a straight line shall not exceed 3 mm/metre length.

2.4.3. Cylinder footrings, where provided, must be sufficiently strong and be manufactured from a material which, with regard to corrosion, is compatible with the type of material of which the cylinder is made. The shape of the footring must give the cylinder an adequate degree of stability. Footrings must not allow water to accumulate or permit water to penetrate between the ring and the cylinder.

## 3. TESTS

### 3.1. MECHANICAL TESTS

Except for the requirements set out below, the mechanical tests shall be carried out in accordance with the following EURONORMS :

| | | |
|---|---|---|
| EURONORM | 2-80 : | Tensile test for steel ; |
| EURONORM | 3-79 : | Brinell hardness test ; |
| EURONORM | 6-55 : | bend test for steel ; |
| EURONORM | 11-80 : | tensile test for steel sheet and strip less than 3 mm thick; |
| EURONORM | 12-55 : | bend test for steel sheet and strip less than 3 mm thick; |

3.1.1. General requirements

All mechanical tests for checking the quality of the metal used for gas cylinders shall be carried out on metal taken from the finished cylinders.

3.1.2. Types of test and evaluation of test results

On every test cylinder there shall be carried out one tensile test in a longitudinal direction and four band tests in a circumferential direction.

3.1.2.1. *Tensile test*

3.1.2.1.1. The test-piece on which the tensile test is carried out must conform to the provisions of :

- chapter 4 of EURONORM 2-80, where it is 3 mm thick or more,

- chapter 4 of EURONORM 11-80, where it is less than 3 mm thick. In this case, the gauge width and length of the test-piece must be 12.5 and 50 mm respectively, irrespective of the thickness of the test-piece.

The two faces of the test-piece corresponding to the internal and external walls of the cylinder may not be machined.

3.1.2.1.2. - With regard to the alloys C referred to in point 2.1.2. (b) and the alloys referred to in point 2.1.2. (c) of this Annex, elongation after fracture must not be less than 12%.

- With regard to the alloys B referred to in point 2.1.2 (b) of this Annex, the elongation after fracture must not be less than 12% where the tensile test is carried out on a single test-piece taken from the cylinder wall. The tensile test may also be carried out on four test-pieces distributed uniformly throughout the cylinder wall. The results must be as follows :

  - no individual value may be less than 11%,

  - the average of the four measurements must be at least 12.

- In the case of unalloyed aluminium, the elongation after fracture must not be less than 12%.

3.1.2.1.3. The value obtained for tensile strength must not be less than $R_m$

The yield stress to be determined during the tensile test shall be that used in accordance with point 1.1 of this Annex for the cylinder calculation.

The value obtained for the yield stress must not be less than $R_e$.

3.1.2.2. *Bend test*

3.1.2.2.1 The bend test shall be carried out on test-pieces obtained by cutting a ring of width 3a into two equal parts; in no case may the width of the test-piece be less than 25

mm. Each ring may be machined only on the edges. The latter may be rounded to a radius of no more than 1/10 of the thickness of the test-pieces or chamfered at an angle of 45%.

3.1.2.2.2. The bend test must be carried out using a mandrel of diameter d and two rollers separated by a distance of d + 3a. During the test the inside face of the ring must remain in contact with the mandrel.

3.1.2.2.3 The test-piece must not crack when bent inwards around a mandrel until the inside edges are no farther apart than the diameter of a mandrel (see diagram in Appendix 2).

3.1.2.2.4. The ratio (n) between the diameter of the mandrel and the thickness of the test-piece must not exceed the values given in the following table :

| Actual tensile strength $R_{m1}$ in $N/mm^2$ | Value of n |
|---|---|
| up to 220 inclusive | 5 |
| above 220 to 330 inclusive | 6 |
| above 330 to 440 inclusive | 7 |
| above 440 | 8 |

3.2. HYDRAULIC PRESSURE BURSTING TEST

3.2.1. Test conditions

Cylinders examined when this test is carried out must bear the markings specified in section 6 of this Annex.

3.2.1.1. The hydraulic pressure bursting test must be carried out in two successive stages, using a test-rig which allows pressure to be increased at an even rate until the cylinder bursts and the curve of pressure variation against time to be recorded. The test must be carried out at room temperature.

3.2.1.2. During the first stage, the increase in pressure shall be constant up to the level at which plastic deformation starts. This rate must not exceed 5 bars/sec.

From the start of plastic deformation (second stage), delivery from the pump must not be more than twice as much as it was in the first phase and must be maintained constant until the cylinder bursts.

3.2.2. Interpretation of test

3.2.2.1. The interpretation of the pressure bursting test shall involve :

- examination of the pressure/time curve to determine the bursting pressure,
- examination of the tear and of the shape of its edges,
- verification, in the case of cylinders with a concave base, that the base of the cylinder has not been reversed.

3.2.2.2. The measured bursting pressure ($P_r$) shall be greater than the value given by :

$$P_n = \frac{20aR_m}{D-a}$$

3.2.2.3. The bursting test must not cause fragmentation of the cylinder.

3.2.2.4. The main tear must not be of the brittle type, i.e. the edges of the fracture must not be radial but be sloping in relation to a diametral plane and must display a contraction.

A fracture shall be acceptable only if it conforms to one of the following descriptions :

- for cylinders of a thickness a of 13 mm or less :
  - the greater part of the fracture must be unmistakably longitudinal,
  - the fracture must be without multiple branches,
  - the fracture must not have a circumferential development of more than 90 °C on either side of its main part,
  - the fracture must not extend into those parts of the cylinder which are more than 1.5 times thicker than the maximum thickness measured halfway up the cylinder; however, for cylinders with convex bases the fracture must not reach the centre of the cylinder base ;
- for cylinders of a thickness a of over 13 mm the greater part of the fracture

must be longitudinal.

3.2.2.5. The tear shall not reveal any obvious defect in the metal.

3.3. PRESSURE CYCLING TEST

3.3.1. Cylinders subjected to this test must bear the markings specified in section 6 of this Annex.

3.3.2. The test shall be carried out using a non-corrosive fluid on two cylinders which are guaranteed by the manufacturer to be reasonably representative of the minimum values specified in the design.

3.3.3. This test shall be cyclical. The maximum cyclic pressure shall be equal to either the pressure $P_h$ or two-thirds thereof.

The lower cyclic pressure must not exceed 10% of the upper cyclic pressure.

The minimum number of cycles and the maximum test frequency are shown in the following table :

| Maximum applied pressure | $P_h$ | 2/3 $P_h$ |
|---|---|---|
| Minimum number of cycles | 12 000 | 80 000 |
| Maximum frequency in cycles per minute | 5 | 12 |

The temperature measured on the outer wall of the cylinder must not exceed 50 °C during the test.

The test shall be considered satisfactory of the cylinder attains the required number of cycles without developing a leak.

3.4. HYDRAULIC TEST

3.4.1. The water pressure in the cylinder must increase at an even rate until the pressure $P_h$ is reached.

3.4.2. The cylinder must remain under the pressure $P_h$ long enough to make it possible to establish that the pressure shows no tendency to fall and that there are no leaks.

3.4.3. After the test the cylinder must show no permanent deformation.

3.4.4. Any tested cylinder which does not fulfil the test requirements shall be rejected.

3.5. CHECK ON THE HOMOGENEITY OF A CYLINDER

This test involves checking that any two points on the metal of the external surface of the cylinder do not differ in hardness by more than 15 HB. The check must be carried out on two transverse sections of the cylinder near the head and the base, at four evenly- spaced points.

3.6. CHECK ON THE HOMOGENEITY OF A BATCH

This test, which is carried out by the manufacturer, involves checking by means of a hardness test or some other appropriate means that no error has been made in the choice of the original billets or in carrying out the heat treatment.

3.7. CHECK OF BASES

A meridian section shall be made in the base of the cylinder and polished for examination at a magnification of between 5 and 10.

The cylinder must be regarded as defective if the presence of fissures is detected. It is also to be regarded as defective if the dimensions of any pores or inclusions present reach values considered to pose a threat to safety.

## 4. EEC PATTERN APPROVAL

The EEC pattern approval referred to in this Schedule may be issued for types or for families of cylinders.

'Family of cylinders' means cylinders from the same factory differing only in length but within the following limits :

- the minimum overall length must not be less than 3 times the external diameter of the cylinder,

- the maximum overall length must not be more than 1.5 times the overall length of the tested cylinder.

4.1. The applicant for EEC pattern approval shall, for each family of cylinders, submit the documentation necessary for the checks specified below and make available to the Member State a batch of 50 or two batches of 25 cylinders in accordance with point 2.1.5.3 of this Annex, from which the number of cylinders required for the tests referred to below will be taken, together with any additional information required by the Member State.

In particular, the applicant must indicate the type of heat treatment and mechanical treatment, and the temperature and the duration of treatment under point 2.1.5 of this Annex. He must provide cast analysis certificates for materials used in the manufacture of the cylinders.

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

4.2.1. verify that :

- the calculations specified in point 2.3 of this Annex are correct,

- the thickness of the walls of two of the cylinders taken for tests meets the requirements of point 2.3 of this Annex, the measurements being taken on three transverse sections of the base and the head,

- the requirements of point 2.1 and point 2.4.3 of this Annex are complied with,

- the requirements of point 2.4.2 of this Annex are complied with for all cylinders selected by the Member State,

- the internal and external surfaces of the cylinders are free of any defect which might make them unsafe to use ;

4.2.2. Carry out the following tests on the cylinders selected :

- the tests for resistance to corrosion : intercrystalline corrosion and stress corrosion on 12 test-pieces as described in Annex II to this Schedule,

- the tests specified in point 3.1 of this Annex, on two cylinders ; however, where the length of the cylinder is 1 500 mm or more, the tensile tests in a longitudinal direction and the bend tests shall be carried out on test-pieces taken from the upper and lower regions of the shell,

- the test specified in point 3.2 of this Annex, on two cylinders,
- the test specified in point 3.3 of this Annex, on two cylinders,
- the test specified in point 3.5 of this Annex, on one cylinder,
- the test specified in point 3.7 of this Annex, on all the sample cylinders.

4.3. If the results of the checks are satisfactory, the Member State shall issue an EEC pattern approval certificate in accordance with the model given in Annex III to this Schedule.

## 5. EEC VERIFICATION

5.1. For the purpose of EEC verification, the cylinder manufacturer shall provide the inspection body with :

5.1.1. the EEC pattern approval certificate ;

5.1.2. cast ingot analysis certificates of the materials used for the manufacture of the cylinders ;

5.1.3. means of identifying the cast of the material from which each cylinder was made ;

5.1.4. the documents relating to heat treatment and mechanical treatment applied in accordance with point 2.1.5 of this Annex ;

5.1.5. a list of the cylinders, giving the numbers and inscriptions as required in section 6 of this Annex.

5.2. During EEC verification :

5.2.1. The inspection body shall :

- ascertain that the EEC pattern approval certificate has been obtained and that the cylinders conform to it.
- check the documents which give data concerning the materials,
- check whether the technical requirements set out in section 2 of this Annex have been met, and in particular check by an external, and if possible internal, visual examination of the cylinders whether their construction and the checks carried out by the manufacturer in accordance with point 2.4.1 of this Annex

are satisfactory ; the visual examination shall cover at least 10% of the cylinders manufactured,

- carry out the intercrystalline corrosion resistance test on three test-pieces, using one test-piece per section (head, body, base ) in accordance with section 1 of Annex II to this Schedule, on the alloys referred to in point 2.1.2 (c) of this Schedule,

- carry out the tests specified in points 3.1 and 3.2 of this Annex,

- check whether the information supplied by the manufacturer in the list referred to in point 5.1.5 of this Annex is correct. This shall be done by means of a random check,

- assess the result of the checks on the homogeneity of the batch carried out by the manufacturer in accordance with point 3.6 of this Annex.

If the results of the checks are satisfactory, the inspection body shall issue an EEC verification certificate conforming to the model given in Annex IV to this Schedule.

5.2.2. For the two types of test prescribed in points 3.1 and 3.2 of this Annex, two cylinders shall be taken at random from each batch of 202 cylinders or part thereof that have been made from the same cast and have undergone the specified heat treatment in identical circumstances.

One of the cylinders shall be subjected to the tests in point 3.1 (mechanical tests) and the other to the test prescribed in point 3.2 (bursting test) of this Annex. If it is proved that a test has been carried out incorrectly or that a measuring error has been made, the test must be repeated.

If one or more tests prove even partially unsatisfactory the cause must be investigated by the manufacturer under the supervision of the inspection body.

5.2.2.1 If the failure is not due to the heat treatment applied, the batch must be rejected.

5.2.2.2. If the failure is due to the heat treatment applied, the manufacturer may subject all the cylinders in the batch to a further heat treatment. There may be only one such further treatment.

In that event :

- the manufacturer shall carry out the check provided for in point 3.6 of this Annex,

- the inspection body shall carry out all the tests provided for in point 5.2.2 of this Annex.

The results of the tests carried out following this further treatment must satisfy the requirements of this Schedule.

5.2.3. This selection of specimens and all the tests shall be carried out in the presence and under the supervision of a representative of the inspection body. However, in respect of the test specified in the fourth indent of point 5.2.1 of this Annex, the approved body may confine itself to being represented merely at the selection of specimens and examination of the results.

5.2.4. After all the tests specified have been carried out, all the cylinders in the batch must be subjected to the hydraulic test specified in point 3.4 of this Annex in the presence and under the supervision of a representative of the inspection body.

5.3. EXEMPTION FROM EEC VERIFICATION

In respect of the cylinders referred to in this Schedule, and in accordance with Article 15 (a) of the Directive, all the test and inspection operations prescribed in point 5.2 of this Annex must be carried out by the manufacturer on his own responsibility.

The manufacturer must provide the inspection body with all the documents mentioned in the EEC pattern approval and the test and inspection reports.

## 6. MARKS AND INSCRIPTIONS

The marks and inscriptions specified in this section must be affixed to the head of the cylinder.

In respect of cylinders with a diameter of less than 75 mm, such marks must be 3 mm high.

Notwithstanding the requirements of section 3 of Schedule I to these regulations, the manufacturer must make the EEC pattern approval mark in the following order :

- for the cylinders referred to in this Schedule:
  - the stylised letter Ɛ.

- the serial number 2 of this Schedule,

- the capital letter (s) identifying the Member State which has granted,

- the number of the EEC pattern approval (e.g.Ɛ 2 D 79 45);

- for the cylinders subject only to EEC pattern approval :

  - the stylised letter Ɛ surrounded by a hexagon,

  - the serial number 2 of this Schedule,

  - the capital letter (s) identifying the Member State which has granted EEC pattern approval and the last two figures of the year in which the pattern approval and the last two figures of the year in which the pattern approval was granted,

  - the number of the EEC pattern approval (e.g. ⟨Ɛ⟩ 2 D 79 54).

Notwithstanding the requirements of section 3 of Annex II of the Directive, which is set out in Schedule III to these regulations, the inspection body must affix the EEC verification mark in the following order :

- the small letter 'e',

- the capital letter (s) identifying the Member State in which the verification is carried out with, where necessary, one or two numbers identifying a territorial subdivision ,

- the mark of the inspection body affixed by the verifying agent if appropriate,

- a hexagon,

- the date of verification : year, month (e.g. e D 12 48 ⬡ 80/01).

6.1. INSCRIPTIONS RELATING TO THE CONSTRUCTION

6.1.1. As regards the metal :

A number indicating the value of R in $N/mm^2$ on which the calculation was based ;

6.1.2. As regards the hydraulic test :

The test pressure in bars followed by the symbol 'bar' ;

6.1.3. As regards the type of cylinder :

The mass of the cylinder, including all integral parts but excluding valve and tap, in kilograms, and the minimum capacity guaranteed by the manufacturer of the cylinder in litres.

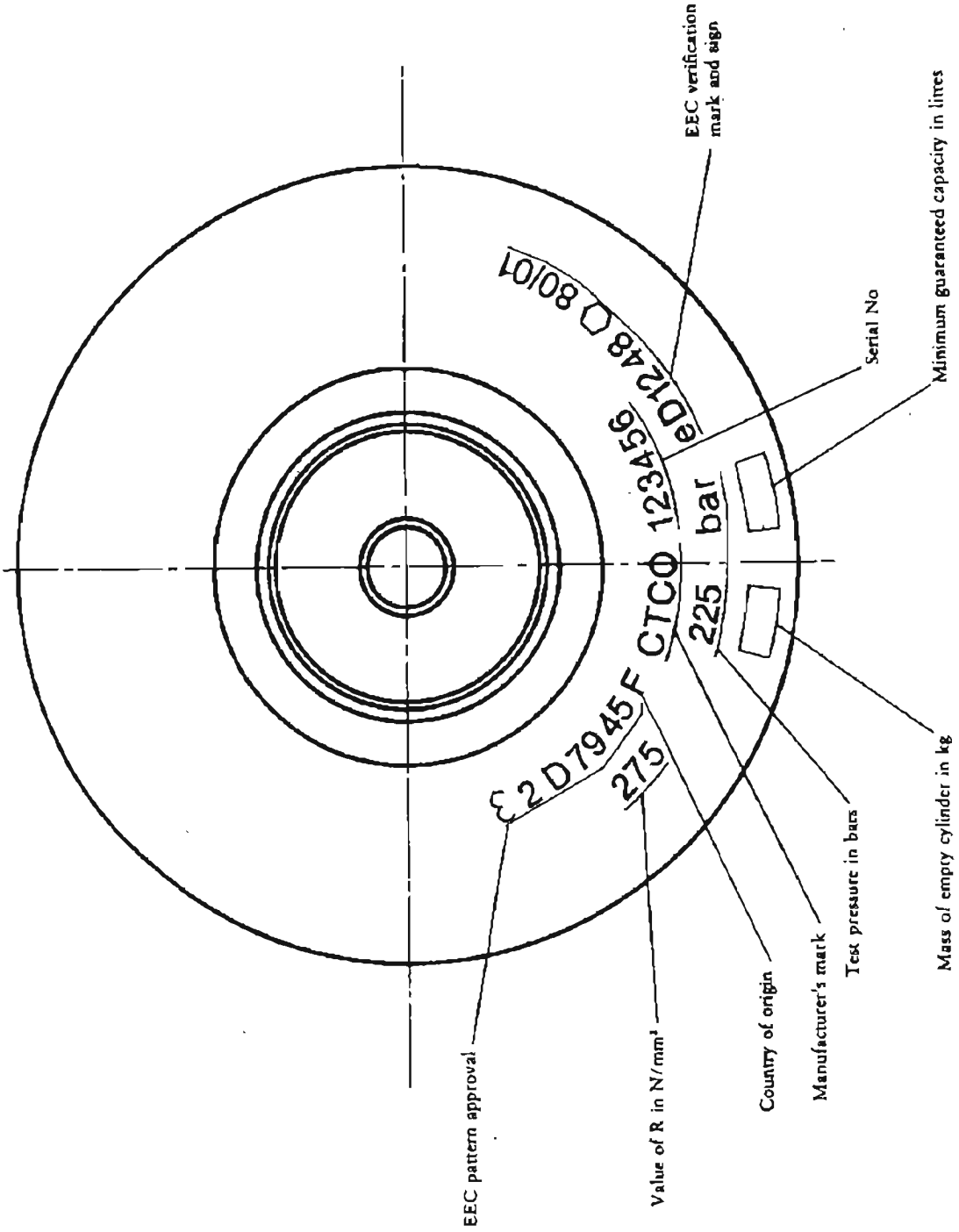
The figures for mass and capacity must be given to one decimal place. This value is to be rounded down for the capacity and up for the mass ;

6.1.4. As regards origin :

The capital letter (s) indicating the country of origin, followed by the manufacturer's mark and the serial number.

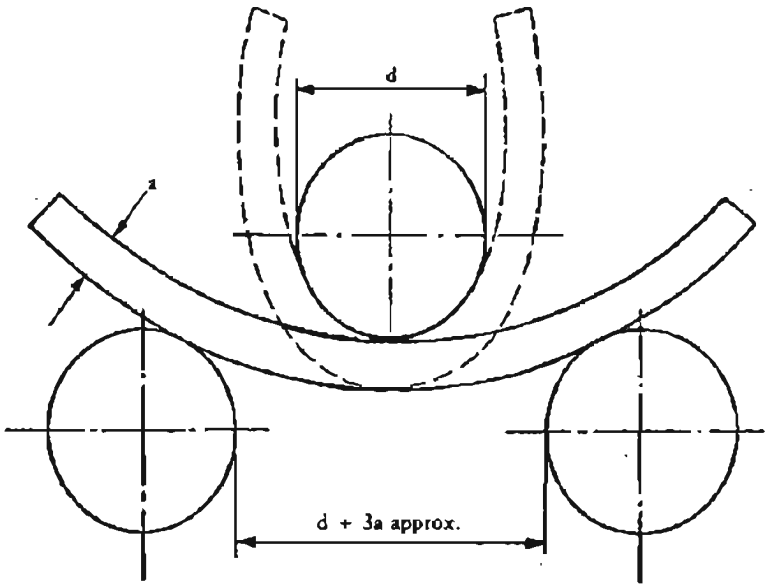
6.2. A diagram showing examples of the marks and inscriptions is given in Appendix 1.

*Appendix 1*


EEC verification mark and sign
Serial No
Minimum guaranteed capacity in litres
80/01
eD 12 48
123456
CTCΦ
bar
225
E 2 D7945F
275
EEC pattern approval
Value of R in N/mm²
Country of origin
Manufacturer's mark
Test pressure in bars
Mass of empty cylinder in kg

*Appendix 2*

## Illustration of bend test



# *ANNEX II*

## CORROSION TESTS

## 1. TEST FOR ASSESSING SUSCEPTIBILITY TO INTERCRYSTALLINE CORROSION

The method described below consists of simultaneously immersing the specimens taken from the finished cylinder under test in two different corrosive solutions and examining them after a specified etching time in order to detect any signs of intercrystalline corrosion and determine the nature and degree of such corrosion. The propagation of intercrystalline corrosion is determined metallographically on polished surfaces cut transversely to the etched surface.

### 1.1. TAKING SPECIMENS

Specimens are taken from the head, body and base of the cylinder (figure 1), so that the tests with solution A as defined in point 1.3.2.1 or solution B as defined in point 1.3.2.2 of this Annex can be carried out on metal from three parts of the cylinder.

Each specimen must be of the general shape and the dimensions indicated in figure 2.

The faces a1 a2 a3 a4, b1 b2 b3 b4, a1 a2 b2 b1, a4 a3 b3 b4 are all sawn with a band-saw and then carefully trimmed with a fine file. The surfaces a1 a4 b4 b1 and a2 a3 b3 b2 which correspond respectively to the inner and outer faces of the cylinder are left in their rough manufactured state.

### 1.2. PREPARATION OF SURFACE BEFORE CORROSIVE ETCHING

#### 1.2.1. Products required

$HNO_3$ for analysis, density 1.33,

HF for analysis, density 1.14 (at 40%),

de-ionised water.

#### 1.2.2. Method

Prepare the following solution in a beaker :

$HNO_3$: 63 $cm^3$,

HF: 6 $cm^3$,

$H_2O$: 929 $cm^3$

Bring the solution to a temperature of 95 °C.

Treat each specimen, suspended on an aluminium wire, in this solution for one minute.

Wash in running water and then in de-ionised water.

Immerse the specimen in nitric acid, as defined in point 1.2.1 of this Annex, for 1 minute at room temperature to remove any copper deposit which may have formed.

Rinse in de-ionised water.

To prevent oxidation of specimens, they should be plunged, as soon as they have been prepared, in the corrosion bath intended for them (see point 1.3.1 of this Annex).

1.3. PERFORMANCE OF TEST

1.3.1. One of the following two corrosive solutions is to be used, at the discretion of the inspection body : one with 57 g/l sodium chloride and 3 g/l hydrogen peroxide (solution A), and the other with 30 g/l sodium chloride and 5 g/l hydrochloric acid (solution B).

1.3.2. Preparation of corrosive solutions

1.3.2.1. *Solution A*

1.3.2.1.1. Products required

NaCl crystallized, for analysis,

$H_2O_2$ 100 to 110 volumes - medicinal,

$KMnO_4$ for analysis,

$H_2SO_4$ for analysis, density 1.83,
de-ionised water.

1.3.2.1.2. Titration of hydrogen peroxide

Since hydrogen peroxide is not very stable, it is essential to check its titre each time before use. To do this :

take 10 $cm^3$ of hydrogen peroxide with a pipette, dilute to 1 000 $cm^3$ (in a gauged flask) with de-ionised water, thus obtaining a hydrogen peroxide solution which will be called C. With a pipette, place in an Erlenmeyer flask :

- 10 $cm^3$ of the hydrogen peroxide solution C,
- 2 $cm^3$ approximately of sulphuric acid, density 1.83.

A solution of permanganate at 1.859 g/l is used for the titration. The permanganate itself serves as an indicator.

1.3.2.1.3. Explanation of titration

The reaction of the permanganate on the hydrogen peroxide in a sulphuric medium is expressed as :

$$2\,KMnO_4 + 5\,H_2O_2 + 3\,H_2SO_4 \rightarrow K_2SO_4 + 2\,MnSO_4 + 8\,H_2O + 5\,O_2$$

which gives the equivalence : 316 g $KMnO_4$ = 170 g $H_2O_2$

Therefore 1 g of pure hydrogen peroxide reacts on 1 859 g of permanganate; hence the use of a 1.859 g/l solution of permanganate, which saturates, volume for volume, 1 g/l hydrogen peroxide. Since the hydrogen peroxide was diluted 100 times to begin with, the 10 $cm^3$ of the test sample represent 0.1 $cm^3$ of the original hydrogen peroxide.

By multiplying by 10 the number of cubic centimetres of permanganate solution used for the titration, the titre T of the original hydrogen peroxide in g/l is obtained.

1.3.2.1.4. Preparation of the solution

Method for 10 litres :

Dissolve 570 g of sodium chloride in de-ionised water to obtain a total volume of about 9 litres. Add the quantity of hydrogen peroxide calculated below. Mix and then make up the volume to 10 litres with de-ionised water.

*Calculation of the volume of hydrogen peroxide to be put into the solution*

Quantity of pure hydrogen peroxide required : 30 g.

If the hydrogen peroxide contains T grams of $H_2O_2$ per litre, the volume required, expressed in cubic centimetres, will be :

$$\frac{1\,000 \cdot 30}{T}$$

1.3.2.2. *Solution B*

1.3.2.2.1. Products required :

NaCl, crystallized, for analysis,

HCl, pure concentrated, 37% HCl,

de-ionised water.

1.3.2.2.2. Preparation of the solution :

Method for 10 l of solution :

Dissolve 30 g of sodium chloride and 50 g of HCl (50 g = 0.5%) in 9 l of de-ionised water, mix well and make up to 10 l.

1.3.3. Etching conditions

1.3.3.1 *Etching in solution A*

The corrosive solution is placed in a crystalliser (or possibly a large beaker), itself placed in the solution so that it rests only on the corners, the second method being preferable. The etching time is six hours and the temperature fixed at 30 ± 1 °C. Care should be taken to ensure that the quantity of reagent is at least 10 $cm^3$ per $cm^2$ of specimen surface.

After etching, the specimen is washed in water, immersed for about 30 seconds in 50% dilute nitric acid, washed again in water and dried with compressed air.

1.3.3.2. A number of specimens can be etched at the same time provided that they are of the same type of alloy and that they are not in contact. The minimum quantity of reagent per unit of specimen surface must, of course, be adhered to.

1.3.3.3. *Etching in solution B*

The corrosive solution is poured into a suitable glass container (e.g. a beaker). The test is carried out at room temperature. If it is impossible to avoid variations in room temperature during the test, it is preferable to carry out the test in a water bath, the temperature of which is adjusted to 23 °C by means of a thermostat. Etching time is 72 hours.

The fixing of specimens in the corrosive solution is in accordance with point 2.3.1 of this Annex. After etching, the specimens are very carefully washed with de-ionised water and dried with greasefree compressed air. Care must in any event be taken to see that the ratio of quantity of corrosive solution to specimen surface in ml/cm$^2$ is 10 : 1 (see point 2.3.1 of this Annex).

## 1.4. PREPARATION OF SPECIMENS FOR EXAMINATION

### 1.4.1. Products required

Casting dishes with, for example, the following dimensions :

- external diameter: 40 mm,
- height: 27 mm,
- wall thickness: 2.5 mm,

Araldite DCY 230
Hardener HY 951
} or equivalent

### 1.4.2. Method

Each specimen is placed vertically in a casting dish so that it rests on its face a1 a2 a3 a4, preferably by lathe, so that the section a'1 a'2 a'3 a'4 examined under the microscope cannot show corrosion from the surface a1 a2 a3 a4. The distance between the faces a1 a2 a3 a4 and a'1 a'2 a'3 a'4 i.e. the thickness removed by the lathe, must be at least 2 mm (figures 2 and 3).

The section for examination is polished mechanically with alumina first on paper and then on felt.

## 1.5. MICROGRAPHIC EXAMINATION OF SPECIMENS

The examination consists of noting the intensity of intercrystalline

corrosion on the part of the perimeter of the section to be examined under point 1.6 of this Annex. When doing this, account is taken of the properties of the metal both on the outer and inner surfaces of the cylinder and in the thickness of the latter.

The section is first examined at low magnification (x 40 for example) in order to locate the most corroded areas, and then at a higher magnification, usually about x 300, in order to assess the nature and extent of the corrosion.

1.6. INTERPRETATION OF THE MICROGRAPHIC EXAMINATION

This consists in verifying that intergranular corrosion is superficial :

1. For alloys with equiaxed crystallization, the depth of corrosion round the entire perimeter of the section must not exceed the higher of the following two values :

   - three grains in the direction perpendicular to the face examined,

   - 0.2 mm ;

   however, it is permissible for these values to be exceeded locally provided that they are not exceeded in more than four fields of examination at x 300 magnification ;

2. for alloys with crystallization set in one direction through cold-working, the depth of the corrosion into each of the two faces which make up the internal and external surfaces of the cylinder must not exceed 0.1 mm.

*Appendix 1*

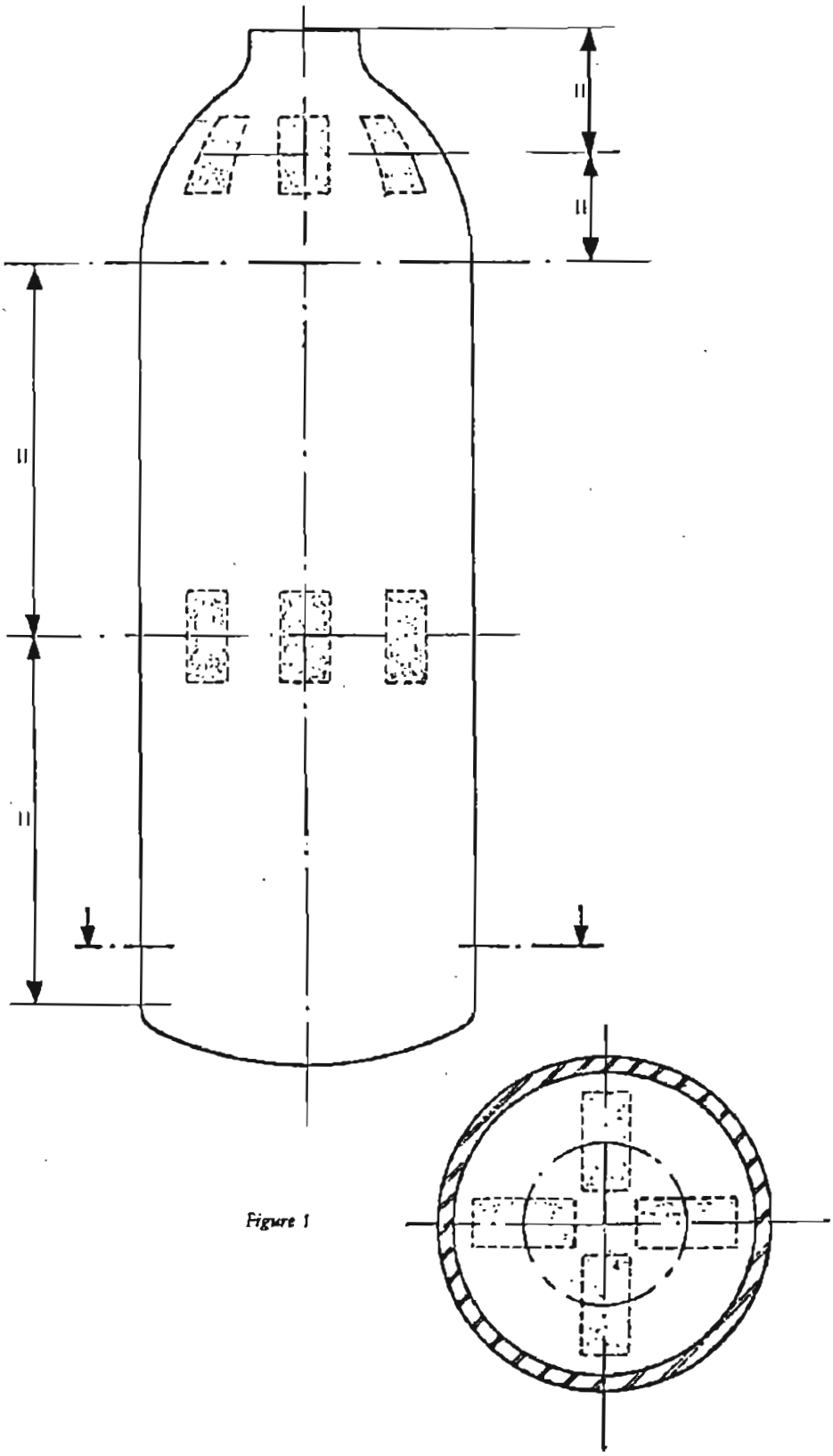



*Figure 1*

## *Appendix 2*

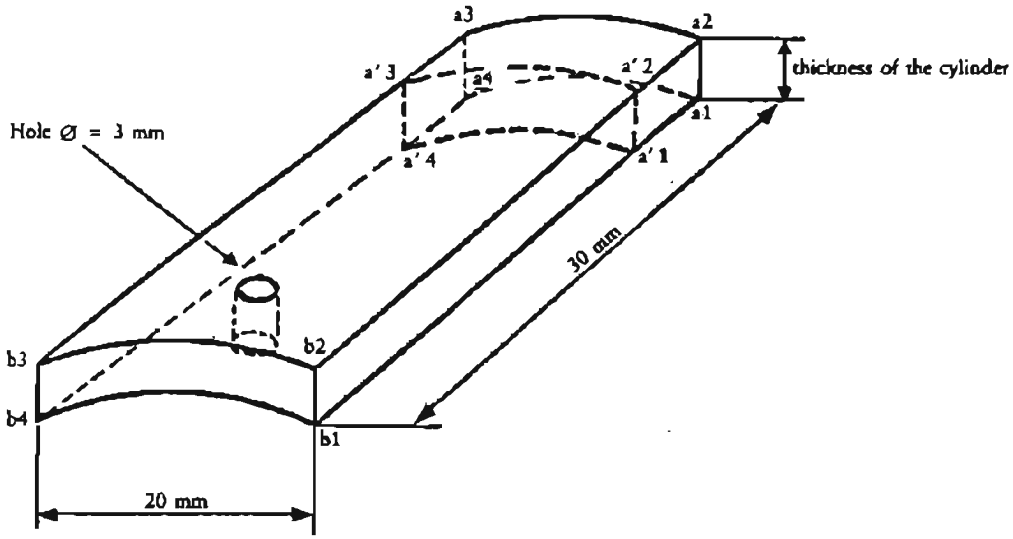



*Figure 2*

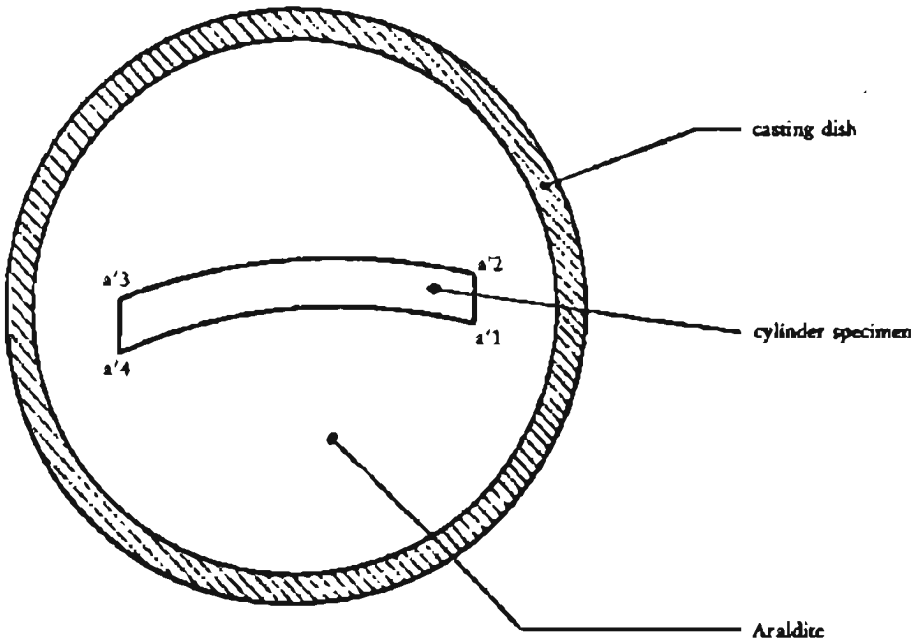



*Figure 3*

## 2. TESTS FOR ASSESSING SUSCEPTIBILITY TO STRESS CORROSION

The method described below consists of the subjection of rings cut from the cylindrical part of the cylinder to stress, their immersion in brine for a specified period, followed by removal of the brine and exposure to the air for a longer period and repetition of this cycle for 30 days. If there are no cracks in the rings after the period of 30 days, the alloy can be considered suitable for the manufacture of gas cylinders.

### 2.1. TAKING SPECIMENS

Six rings with a width of 4a or 25 mm, whichever is the greater, are to be cut from the cylindrical part of the cylinder (see figure 1). The specimens must have a 60 °cut-out and be subjected to stress by means of a threaded bolt and two nuts (see figure 2).

Neither inner nor outer surfaces of the specimens are to be machined.

### 2.2. SURFACE PREPARATION BEFORE CORROSION TEST

All traces of grease, oil and adhesive used with stress gauges (see point 2.3.2.4 of this Annex) must be removed with a suitable solvent.

### 2.3. PERFORMANCE OF THE TEST

2.3.1. Preparation of the corrosive solution

2.3.1.1. The brine is prepared by dissolving $3.5 \pm 0.1$ parts by mass of sodium chloride in 96.5 parts by mass of water.

2.3.1.2. The pH value of the freshly prepared solution must be in the range 6.4 to 7.2.

2.3.1.3. The pH may be corrected only by using dilute hydrochloric acid or dilute soda.

2.3.1.4. The solution must not be topped up by adding the salt solution described in point 2.3.1.1 of this Annex but only by adding distilled water up the initial level in the vessel. Topping up may be carried out daily if necessary.

2.3.1.5. The solution must be completely replaced every week.

2.3.2. Applying the stress to the rings

2.3.2.1. Three rings are to be compressed so that the inner surface is under stress.

2.3.2.2. Three rings are to be opened so that the inner surface is under stress.

2.3.2.3. The amount of stress must be the maximum permissible stress in the following wall-thickness calculation :

$\frac{R_e}{1.3}$ where Re is the guaranteed minimum value of the yield stress 0.2% in $N/mm^2$.

2.3.2.4. The actual stress can be measured by electric stress gauges.

2.3.2.5. The stress can also be calculated using the following formula :

$$D^1 = D \pm \frac{\pi R(D-a)^2}{4Eaz}$$

in which

$D^1$ = diameter of the ring when compressed (or opened) ;
D = external diameter of the cylinder in mm ;
a = cylinder wall thickness in mm ;
R = $\frac{R_e}{1.3}$ $N/mm^2$ ;
E = modulus of elasticity in $N/mm^2$ = 70 000 $N/mm^2$ ;
z = correction factor (figure 3).

2.3.2.6 It is essential for the nuts and bolts to be electrically insulted from the rings and protected from corrosion by the solution.

2.3.2.7. The six rings must be completely immersed in the saline solution for 10 minutes.

2.3.2.8. They are then removed from the solution and exposed to the air for 50 minutes.

2.3.2.9. This cycle must be repeated for 30 days or until the ring breaks, whichever happens first.

2.3.2.10 The specimens are to be inspected visually for any cracks.

## 2.4. INTERPRETATION OF THE RESULTS

The alloy will be considered acceptable for the manufacture of gas cylinders if none of the rings subjected to stress develops any cracks visible to the naked eye, or visible at low magnification (10 to 30), at the end of the test : 30 days.

## 2.5. POSSIBLE METALLOGRAPHICAL EXAMINATION

2.5.1. In the event of doubt about the presence of cracks (e.g. line of pitting), uncertainty can be removed by means of an additional metallographical examination of a section taken perpendicular to the axis of the ring in the suspect area. A comparison is made of the form (inter-or transcrystalline) and depth of penetration of the corrosion on the faces of the ring subject to tensile and compressive stress.

2.5.2. The alloy will be considered acceptable if the corrosion on both faces of the ring is similar.

On the other hand, if the face of the ring subject to tensile stress reveals inter-crystalline cracks which are clearly deeper than the corrosion affecting the face subject to compressive stress, the ring can be considered to have failed the test.

## 2.6. REPORTS

2.6.1. The name of the alloy and / or its standard number must be indicated.

2.6.2. Composition limits of the alloy must be given.

2.6.3. The actual analysis of the cast from which the cylinders were manufactured must be mentioned.

2.6.4. The actual mechanical properties of the alloy must be reported, together with the minimum mechanical property requirements.

2.6.5. The results of the test must be given.

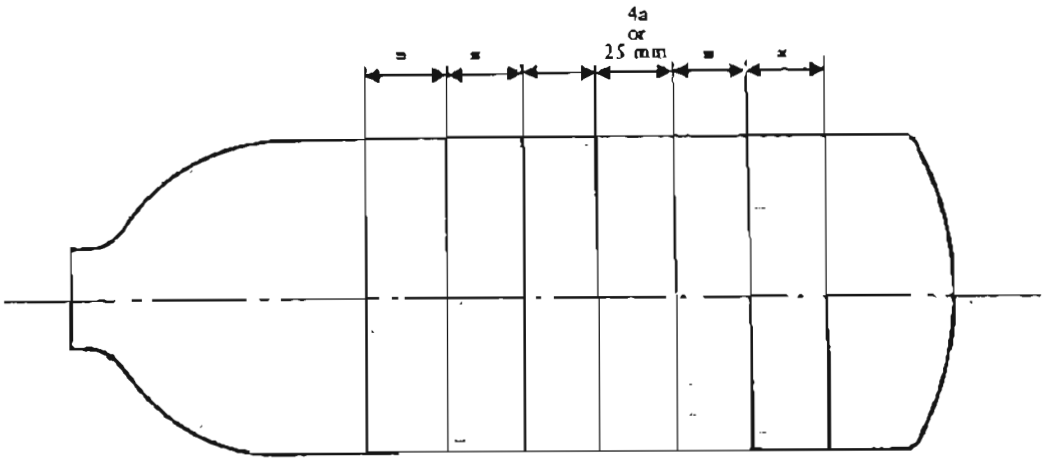



*Figure 1*

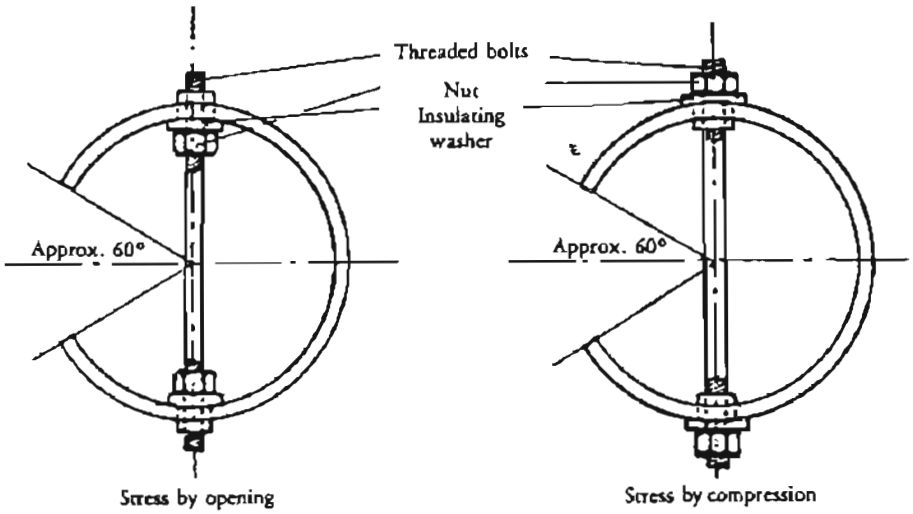



*Figure 2*

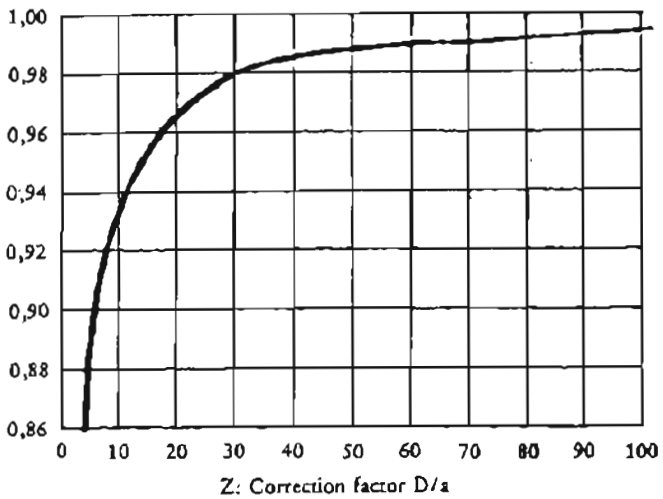



*Figure 3*

# *ANNEX III*

## EEC PATTERN APPROVAL CERTIFICATE

Issued by ..... on the basis of
(Member State)

.....
(National rules)

applying Directive 84/526/EEC of 17 September 1984 concerning

SEAMLESS, UNALLOYED ALUMINIUM AND ALUMINIUM ALLOY GAS CYLINDERS

---

Approval No ..... Date .....

Type of cylinder .....
(Description of the family of cylinders which has received EEC approval)

$P_h$ ..... D ..... s .....

$L_{min}$ ..... $L_{max}$ ..... $V_{min}$ ..... $V_{max}$ .....

Manufacturer or agent .....
(Name and address of manufacturer or his agent)

.....

.....

.....

EEC pattern approval mark Ɛ ..... Ⓔ .....

Details of the results of the examination of the pattern for EEC approval and the main features of the pattern are annexed.

All information may be obtained from .....
(Name and address of the approving body)

.....

.....

.....

Date ..... Place .....

.....
(Signature)

# TECHNICAL SCHEDULE TO EEC PATTERN APPROVAL CERTIFICATE

1. Results of EEC examination of the pattern with a view to EEC approval.

2. Main features of the pattern, in particular :

- longitudinal cross-section of the type of cylinder which has received pattern approval, showing :
  - the nominal external diameter, D, with an indication of the design tolerances laid down by the manufacturer,
  - the minimum thickness of the cylinder wall, a,
  - the minimum thickness of the base and the head, with an indication of the design tolerances laid down by the manufacturer,
  - the minimum and maximum length(s), $L_{min}$, $L_{max}$;
- the capacity or capacities, $V_{min}$ , $V_{max}$ ;
- the pressure, $P_h$;
- the name of the manufacturer / No of the drawing and date;
- name of the type of cylinder;
- the alloy in accordance with section 2.1 of this Annex (nature / chemical composition /method of manufacture/heat treatment / guaranteed mechanical characteristics (tensile strength - yield point).

# *ANNEX IV*

## MODEL

## EEC VERIFICATION CERTIFICATE

Application of Council Directive 84/526/EEC of 17 September 1984

Inspection body .....

.....

Date .....

EEC pattern approval No .....

Description of vessels .....

.....

EEC verification No .....

Manufacturing batch No ..... to .....

Manufacturer .....
(Name and address)

.....

.....

Country ..... Mark .....

Owner .....
(Name and address)

.....

.....

Customer .....
(Name and address)

.....

.....

# VERIFICATION TESTS

## 1. MEASUREMENTS OF SAMPLE CYLINDERS

| Test No | Batch consisting of No ..... to No ..... | Water capacity (litres) | Mass empty (kg) | Minimum measured thickness | |
|---|---|---|---|---|---|
| | | | | of the wall (mm) | of the base (mm) |
| | | | | | |

## 2. MECHANICAL TESTS CARRIED OUT ON SAMPLE CYLINDERS

| Test No | Heat treatment No | Tensile test | | | | Bend test 180 ° without cracking | Hydraulic bursting test (bars) | Description of the fracture (Description or diagram attached) |
|---|---|---|---|---|---|---|---|---|
| | | Test-piece in accordance with EURO-NORM (a) 2-80 (b) 11-80 | Yield point $R_e$ (N/mm²) | Tensile strength $R_m$ (N/mm²) | Elongation A (%) | | | |
| | | | | | | | | |
| | Minimum values specified | | | | | | | |

I, the undersigned, hereby declare that I have checked that the verification operations, tests and checks prescribed in section 5.2 of Annex I to Directive 84/527/EEC have been carried out successfully.

Special remarks .....

.....

General remarks .....

.....

Certified on (date) ....., ..... (Place)

..... (Signature of the inspector)

on behalf of ..... (Inspection body)

# Schedule VII

## Based on Directive 84/527/EEC[5]

### Scope

This Schedule shall apply to welded, unalloyed steel gas cylinders formed from several pieces, of an actual thickness of 5 mm or less, capable of being refilled several times, with a capacity ranging from 0.5 from 150 litres inclusive and designed to contain and transport compressed, liquefied or dissolved gases except liquefied gases at very low temperatures and acetylene. The design pressure ($P_h$) of these cylinders shall not exceed 60 bars.

These gas cylinders are hereinafter referred to as 'cylinders'.

### EEC pattern approval and verification

All EEC-type cylinders shall be subject to EEC pattern approval.

All EEC-type cylinders shall be subject to EEC verification with the exception of cylinders with a hydraulic test pressure of 120 bars or less and with a capacity of not more than one litre.

### Adaptation to technical progress

Any amendments necessary to adapt sections 1, 2.1.1, 2.3 except for 2.3.3, 2.4 except for 2.4.1 and 2.4.2.1, 3.1.1, 3.1.2, 3.3, 3.4, 3.5, 5 except for 5.2.2 and 5.3, and 6 of Annex I and Annexes II and III to this Schedule to technical progress shall be adopted in accordance with the procedure laid down in Article 20 of the Directive.

The procedure laid down in Article 17 of the Directive may apply to sections 2.2, 2.3.2 and 3.4.1.1 of Annex I to this Schedule.

---

[5] OJ No. L300, 19-11-84, P.48

# *ANNEX I*

## 1. SYMBOLS AND TERMS USED IN THIS ANNEX

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

$P_h$ = hydraulic test pressure (design pressure), in bars;

$P_r$ = cylinder bursting pressure measured during the bursting test, in bars,

$P_{rt}$ = calculated minimum theoretical bursting pressure, in bars,

$R_e$ = minimum value of yield stress guaranteed by the cylinder manufacturer for the finished cylinder, in $N/mm^2$;

$R_m$ = minimum tensile strength guaranteed by the material standard, $N/mm^2$;

$R_{mi}$ = actual tensile strength, in $N/mm^2$;

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

b = calculated minimum thickness of barrelled ends, in mm;

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

R = inside radius of curvature of convex base, in mm;

r = inside radius of junction of convex base, in mm;

H = outside height of dished part of cylinder end, in mm;

h = height of cylindrical part of dished end in mm;

L = length of cylinder's stress-resistant shell, in mm;

A = elongation value of parent metal, in %;

$V_o$ = initial volume of the cylinder at the moment when the pressure is increased in the bursting test, in litres;

V = final volume of the cylinder on bursting, in litres;

Z = stress reduction factor.

1.2. For the purpose of these regulations, 'bursting pressure' means the pressure at plastic instability, i.e. the maximum pressure obtained during a burst test.

1.3. NORMALIZATION

The term 'normalization' is used in these regulations as defined in paragraph 68 of EURONORM 52-83.

1.4. STRESS RELIEVING

The term 'stress relieving' relates to 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 REQUIRMENTS

2.1. MATERIALS

2.1.1. The material used for the manufacture of the stress-resistant cylinder shell must be steel as specified in EURONORM 120-83.

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

2.1.3. The filler materials must 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 must obtain and provide chemical cast analysis certificates in respect of the steel supplied for the manufacturer of the pressure parts.

2.1.5. It must be possible for independent analyses to be made. These analyses must be carried out either on specimen taken from the materials as supplied to the cylinder manufacturer or on the finished cylinders.

2.1.6. The manufacturer must make available to the inspection body the results of metallurgical and mechanical tests and analyses carried out on welds and must also provide it with a description of the welding methods and processes adopted which can be regarded as representative of the welds made during production.

2.2. HEAT TREATMENT

Cylinders shall be delivered in either the normalized or the stress-relieved condition. The cylinder manufacturer shall certify that the cylinder have been treated after completion of all welding and shall certify the process of heat treatment applied. Localized heat treatment is not permitted.

2.3. CALCULATIONS FOR THE PRESSURE PARTS

2.3.1. The thickness of the cylindrical shell wall at any point on the stress-resistant shall of the gas cylinders must not be less than calculated by the formula:

2.3.1.1. for cylinders without longitudinal welds:

$$a = \frac{P_h \cdot D}{20\frac{R_e}{4/3} + P_h}$$

2.3.1.2. for cylinders with longitudinal welds:

$$a = \frac{P_h \cdot D}{20\frac{R_e}{4/3}Z + P_h}$$

Z being equal to:

- 0.85, where the manufacturer radiographs the intersection of the welds for a distance of 100 mm beyond the intersection in the case of the longitudinal weld and of 50 mm (25 mm on each side) in the case of the circumferential welds. One cylinder selected at the beginning and one at the end of each shift period and per machine is to be radiographed,

- 1 where the manufacturer spot radiographs the intersection of the welds for a distance of 100 mm beyond the intersection in the case of the longitudinal weld and of 50 mm (25 mm on each side) in the case of the circumferential welds.

  This examination shall be carried out on 10% of cylinders manufactured, chosen at random.

Should these radiograph tests reveal unacceptable defects, as defined in point 3.4.1.4 of this Annex, all the necessary steps must be taken to examine the production run in question and eliminate the defects.

2.3.2. Dimensions and calculations of ends (see figures in Appendix 1)

2.3.2.1. The cylinder ends must fulfill the following conditions:

- *torispherical ends*

  simultaneous limits: $0.003\ D \leq b \leq 0.08\ D$
  $r \geq 0.1\ D$
  $R \leq D$
  $H \geq 0.18\ D$
  $r \geq 2\ b$
  $h \geq 4\ b$

- *elliptical ends*

  simultaneous limits: $0.003\ D \leq b \leq 0.08\ D$
  $H \geq 0.18\ D$
  $H \geq 4\ b$

- *hemispherical ends*

  limits: $0.003\ D \leq b \leq 0.16\ D$

2.3.2.2. The thickness of these dished ends must not at any point be less than the figure calculated by means of the following formula:

$$b = \frac{P_h \cdot D}{20 \frac{R_e}{4/3}} C$$

The coefficient of form C to be used for full ends is given in the table Appendix 1.

However, the nominal thickness of the cylindrical edge of the ends of the ends must not be less than the nominal thickness of the cylindrical part.

2.3.3. The nominal wall thickness of the cylindrical part and of the dished end may not, under any circumstances, be less than:

$$- \frac{D}{250} + 0.7 \text{ mm where } P_h < 30 \text{ bar}$$

$$- \frac{D}{250} + 1 \text{ mm where } P_h \geq 30 \text{ bar}$$

with a minimum of 1.5 mm in both cases.

2.3.4. The cylinder body, excluding the value seat, may be made up of two or three parts. The ends must be in one piece and convex.

2.4. CONSTRUCTION AND WORKMANSHIP

2.4.1. General requirements

2.4.1.1. The manufacturer guarantees on his own responsibility that he has the manufacturing facilities and processes to ensure that cylinders produced satisfy the requirements of this Schedule.

2.4.1.2. The manufacturer must ensure through adequate supervision that the parent plates and pressed parts used to manufacture the cylinders are free from any defects likely to adversely affect the operating safety of the cylinder.

2.4.2. Pressure parts

2.4.2.1. The manufacturer must describe the welding and processes used and indicate the inspections carried out during production.

2.4.2.2. *Technical welding requirements*

The butt welds must be executed by an automatic welding process.

The butt welds on the stress-resistant shell may not be located in any area where there are changes of profile.

Fillets welds may not be superimposed on butt welds and must be at least 10 mm away from them.

Welds joining parts making up the shell of the cylinder must satisfy the following conditions (see figures given as examples in Appendix 2):

- longitudinal welds: this weld is executed in the form of a butt weld on the full section of the metal of the wall,

- circumferential weld other than those fixing the valve flange collar to the upper end: this weld is executed in the form of a butt weld on the full section of the metal to the wall. A joggle joint weld is considered to be a special type of butt weld.

- circumferential weld fixing the valve flange collar to the upper end: this weld may either be a butt or a fillet weld. If it is a butt weld, it must be applied on the full section of the metal of the wall. A joggle joint weld is regarded as a special type of butt weld.

  The requirements of this indent are not applicable where the upper end has a seat within the cylinder and where the seat is fixed to the end by a weld which is unrelated to the leak-tightness of the cylinder (see Appendix 2 hereto, figure 4).

In the case of butt welds, the misalignment of the joint faces may not exceed one-fifth the thickness of the wall (1/5 a).

2.4.2.3. *Inspection of welds*

The manufacturer must ensure that the welds show continuous penetration without any deviation of the weld seam, and that they are free of defects likely to jeopardize the safe use of the cylinder.

For two-piece cylinders, and with the exception of welds complying with figure 2A in Appendix 2, the circular butt welds should be radio graphed over a length of 100 mm, on one cylinder selected at the beginning and one end of each shift period during continuous production and, in the event of production interrupted for a period of more than 12 hours, on the first cylinder welded.

2.4.2.4 *Out-of-roundness*

The out-of-roundness of the cylindrical shell of the cylinder must be limited so that the difference between the maximum and minimum outside diameter of the same cross section in not more than 1 % of the average of those diameters.

2.4.3. Fittings

2.4.3.1. The carrying handles and protective collars must be manufactured and welded to the cylinders body in such a way as not to cause dangerous concentrations of stresses or be conducive to the collection of water.

2.4.3.2. The base of the cylinder must be efficiently strong and made of metal compatible with the type of steel used for the cylinder; the form of the base must give the cylinder sufficient stability. The top edge of the base must be welded to the cylinder in such a way as not be conductive to collection of water nor to allow water to penetrate between the base and the cylinder.

2.4.3.3. Where fitted, identification plates must be fixed on the stress-resistant shell and not be removable; all the necessary corrosion prevention measures must be taken.

2.4.3.4. Any other material, however, may be used for the manufacture of the bases, carrying handles or protective collars, provided that their strength is assured and that all risk of the cylinder end corroding is eliminated.

2.4.3.5. *Protection of the cock or valve*

The cylinder cock or valve must be effectively protected either by its design or by the design on the cylinder itself (e.g. protective collar), or by means of a protective cap or a securely attached cover.

## 3. TESTS

### 3.1. MECHANICAL TESTS

3.1.1. General requirements

3.1.1.1. Where not covered the requirements contained in this Schedule, the mechanical tests are to be carried out in accordance with EURONORMS:

(a) 2-80 or 11-80 respectively in the case of the tensile test, according to whether the thickness of the test-piece is 3 mm or above, or less than 3 mm;

(b) 6-55 or 12-55 respectively in the case of the bend test, according to whether the thickness of the test-piece is 3 mm or above, or less than 3 mm.

3.1.1.2. All the mechanical tests for checking the properties of the parent metal and welds of the stress-resistant shells of the gas cylinders out on test-pieces taken from 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 test:

(A) *For cylinders containing only circumferential welds* (two-piece cylinders), on test-pieces taken from the places shown in figure 1 of Appendix 3:

| | |
|---|---|
| 1 tensile test: | parent metal in the geometric longitudinal direction of the cylinder (a); or if it is not possible, in the circumferential direction; |
| 1 tensile test: | perpendicular to the circumferential weld (b); |
| 1 bend test: | on the back of the circumferential weld (c); |
| 1 bend test: | on the font of the circumferential weld (d); |
| 1 macroscopic test: | on the welded section. |

(B) *For cylinders with longitudinal and circumferential welds* (three-piece cylinders), on test-pieces taken from the places shown in figure 2 of Appendix 3:

| | |
|---|---|
| 1 tensile test: | parent metal of cylindrical part in the longitudinal direction (a); or, if this is not possible, in a circumferential direction; |
| 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: | back of longitudinal weld (e); |
| 1 bend test: | front of longitudinal weld (f); |
| 1 bend test: | back of circumferential weld (g); |
| 1 bend test: | front of circumferential weld (h); |
| 1 macroscopic test: | of the welded section. |

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 shall be machined flush, to trim the surplus.

3.1.2.2. *Tensile test*

3.1.2.2.1. Tensile test on parent metal

3.1.2.2.1.1. The procedure for carrying out the tensile test is that given in the appropriate EURONORM in accordance with point 3.1.1.1 of this Annex.

The two faces of the test-piece representing the inside and outside walls of the cylinder respectively must not be machined.

3.1.2.2.1.2. The values determined for yield stress must be at least equal to the minimum values guaranteed by the cylinder manufacturer.

The values determined for tensile strength and elongation after the test-piece of the parent metal fractures must comply with EURONORM 120-83 (table III).

3.1.2.2.2. Tensile test on welds

3.1.2.2.2.1. The tensile test perpendicular to the weld must be carried out on a test-piece having a reduced cross section 25 mm in width for a length extending up to 15 mm beyond the edges of the weld, as shown in the figure in Appendix 4. Beyond this central part the width of the test-piece must increase progressively.

3.1.2.2.2.2. The tensile strength value obtained must be at least equal to that guaranteed for the parent metal irrespective of where the fracture occurs section of the central part of test-piece.

3.1.2.3. *Bend test*

3.1.2.3.1. The procedure for carrying out the bend test is that given in the appropriate EURONORM in accordance with point 3.1.1.1 of this Annex. The bend test must, however, be carried out transversely to the weld on a test-piece 25 mm in width. The mandrel must be placed in the center of the weld while the test is being performed.

3.1.2.3.2. Cracks must not appear in the test-piece when it is bent round a mandrel such that the inside edges are separated by a distance not greater than the diameter of the mandrel (see figure 2 in Appendix 5).

3.1.2.3.3. The ratio (n) between the diameter of the mandrel and the thickness of the test-piece must not exceed the value given in the following table:

| Actual tensile strength $R_{mi}$ in N/mm$^2$ | Value of n |
|---|---|
| up to 440 inclusive | 2 |
| above 440 to 520 inclusive | 3 |
| above 520 | 4 |

3.2. BURST TEST UNDER HYDRALIC PRESSURE

3.2.1. Test conditions

Cylinders subjected to this test must bear the inscriptions, which it is proposed to make on the section of the cylinder subjected to pressure.

3.2.1.1. The burst test under hydraulic pressure must be carried out with equipment, which enables the pressure to be increased at an even rate until the cylinder bursts and the change in pressure over time to be recorded.

3.2.2. Interpretation of test

3.2.2.1. The criteria adopted for the interpretation of the burst test are as follows:

3.2.2.1.1. Volumetric expansion of the cylinder; this equals:

- the volume of water used between the time when the pressure starts to rise and the time of bursting for cylinders of a capacity ≥ 6.5 litres,

- the difference between the volume of the cylinders at the beginning and the end of the test for cylinders of a capacity < 6.5 litres;

3.2.2.1.2. Examination of the tear and the shape of its edges.

3.2.3. Minimum test requirements

3.2.3.1. The measured bursting pressure ($P_r$) must not under any circumstances be less than 9/4 of the test pressure ($P_h$).

3.2.3.2. Ratio of the volumetric expansion of the cylinder to its initial volume:
- 20% if the length of the cylinder is greater than the diameter,
- 17% if the length of the cylinder is equal to or less than the diameter.

3.2.3.3. The burst test must not cause any fragmentation of the cylinder.

3.2.3.3.1. The main fracture must not show any brittleness, i.e. the edges of the fracture must not be radial but must be at an angle to a diametral plane and display a reduction of area throughout their thickness.

3.2.3.3.2. The fracture must not reveal a clear defect in the metal.

3.3. HYDRAULIC TEST

3.3.1. The water pressure in the cylinder must increase at even rate until the test pressure is reached.

3.3.2. The cylinder must remain under the test pressure long enough to make it possible to establish that the pressure is not falling off and that the cylinder can be guaranteed leak-proof.

3.3.3. After the test of the cylinder must show no signs of permanent deformation.

3.3.4. Any cylinder tested, which does not pass the test, must be rejected.

3.4. NON-DESTRUCTIVE EXAMINATION

3.4.1. Radiographic examination

3.4.1.1. Welds must be radio graphed in accordance with MSA ISO 1106-1:2002.

3.4.1.2. When a wire-type indicator is used, the smallest diameter of visible wire may not exceed 0.10mm.

When a stepped and holed type indicator is used, the diameter of the smallest visible hole may not exceed 0.25mm.

3.4.1.3. Assessment of the weld radiographs must be based on the original films in accordance with the practice recommended in MSA ISO 2504:2002.

3.4.1.4. The following defects are not acceptable:

- cracks, inadequate welds or inadequate penetration of the weld.

The inclusions listed below are regarded as unacceptable:

- any elongated inclusions or any group of rounded inclusions in a row where the length represented (over a weld length of a 12 a) is greater than 6mm,

- any gas inclusions measuring more than a/3mm which is more than 25 mm from any other gas inclusion,

- any other gas inclusion measuring more than a/4 mm,

- gas inclusions over any 100 mm weld length, where the total area of all the figures is greater than 2 a $mm^2$.

3.4.2. Macroscopic examination

The macroscopic examination of a full transverse section of the weld must show a complete fusion on the surface treated with any acid from the macro-preparation and must not show any assembly fault or a significant inclusion or other defects.

In case of doubt, a microscopic examination should be made of the suspect area.

3.5. EXAMINATION OF THE OUTSIDE OF THE WELD

3.5.1. This examination is carried out when the weld has been completed. The welded examined must be well illuminated, and must be free from grease, dust, scale residue or protective coating of any kind.

The fusion of the welded metal with the parent metal must be smooth and free from etching. There must be no cracks, notching or porous patches in the welded surface adjacent to the wall. The welded surface must be regular and even. Where a butt weld has been used, the excess thickness must not exceed ¼ of the width of the weld.

## 4. EEC PATTERN APPROVAL

4.1. The EEC pattern approval referred to in this Schedule may be issued for types or families of cylinders.

'Type of cylinder' means cylinders of the same design and thickness, equipped with the same accessories, manufactured in the same workshops from sheet metal of identical technical specification, welded by the same process and heat-treated under the same conditions.

'Family of cylinders' means three-piece cylinders from the same factory which differ in length alone, within the following limits:

- the minimum length must not be less than 3 times the diameter of the cylinder,

- the maximum length must not be more than 1.5 times the length of the tested cylinders.

4.2. The applicant for pattern must, for each type of cylinder or family of cylinder, submit the documentation necessary for the verification prescribed below and make available to the Member State a batch of 50 cylinders from which the number required by the Member State. The applicant must indicate the type and duration of heat treatment, the temperature used and the welding process. He must obtain and provide cast analysis certificates for steel supplied for cylinder manufacture.

4.3. In the course of the EEC pattern approval process, it shall be verified that:

- the calculations prescribed in point 2.3 of this Annex are correct,

- the conditions prescribed in points 2.1, 2.2 and 2.4 and 3.5 of this Annex are fulfilled.

The following must be carried out on the cylinders submitted as prototypes:

- the test prescribed in point 3.1 of this Annex on one cylinder,

- the test prescribed in point 3.2 of this Annex on one cylinder,

- the test prescribed in point 3.4 of this Annex on one cylinder.

If the result of the checks are satisfactory, the Member State shell issue the EEC pattern approval certificate in accordance with the specimen contained in Annex II to this Schedule.

## 5. EEC VERIFICATION

5.1. For the purpose of EEC verification the cylinder manufacturer must make available to the inspection body:

5.1.1. the EEC pattern approval certificate;

5.1.2. the cast analysis certificates for the steel supplied for the manufacturer of the cylinders;

5.1.3. means of identifying the cast of steel from which each cylinder has come;

5.1.4. the documentation – in particular the documents relating to heat treatment – on the cylinders supplied by him, stating the process used in accordance with point 2.2 of this Annex;

5.1.5. a list of the cylinders, giving the numbers and inscriptions prescribed in section 6 of this Annex;

5.1.6. the results of the non- destructive tests carried out during production and the welding methods used to ensure good reproductivity of cylinders during manufacture. The manufacturer must also provide a statement to the effect that for series production he undertakes to use a welding identical to that which he used for the cylinders submitted for EEC pattern approval.

5.2. DURING EEC VERIFICATION

5.2.1. The inspection body must:

- ascertain that the EEC pattern approval certificate has been obtained and that the cylinders conform to it,
- verify the documents giving information about the materials and the manufacturing processes, in particular those specified in point 2.1.6 of this Annex.
- check whether the technical requirements set out in section 2 of this Annex have been met and carried out a visual external and internal examination of each cylinder of a random sample,
- be present at the tests prescribed in points 3.1 and 3.2 of this Annex and check their progress,

- check whether the information supplied by the manufacture mentioned in point 5.1.6 of this Annex is correct, and whether the verifications he has carried out are satisfactory,

- issue the EEC verification certificate on the lines of the specimen set out in Annex III to this Schedule.

5.2.2. For the purpose of carrying out the tests, a random sample of cylinders as indicated below shall be taken from each batch.

A batch shall consist of a maximum of 3 000 cylinders of the same type as defined in the second paragraph of point 4.1 of this Annex, manufactured on the same day or on consecutive days.

TABLE 1

| Actual N in batch | Cylinders taken as samples | Cylinders subjected to the | |
|---|---|---|---|
| | | Mechanical tests | Burst tests |
| $N \leq 500$ | 3 | 1 | 2 |
| $500 < N \leq 1\,500$ | 9 | 2 | 7 |
| $1\,500 < N \leq 3\,000$ | 18 | 3 | 15 |

Depending on the size of the batch, the sample cylinders shall be subjected to mechanical tests provided for in point 3.1 of this Annex and to the hydraulic pressure bursts test provided for in point 3.2 of this Annex, according to the distribution indicated in table 1.

If two or more cylinders fail the tests, the batch must be rejected.

Should one of the cylinders fail either the mechanical tests or the burst test, a number of cylinders as indicated in table 2 shall be selected at random, and the tests carried out according to the distribution in table 1.

TABLE 2

| Number N in batch | Cylinders taken as sample | Unsatisfactory tests | Cylinders subjected to the | |
|---|---|---|---|---|
| | | | mechanical test | burst test |
| 250 < N≤ 500 | 3 | mechanical tests | 2 | 1 |
| | | burst tests | 1 | 2 |
| 500 < N ≤ 1500 | 9 | mechanical tests | 5 | 4 |
| | | burst tests | 2 | 7 |
| 1500 < N ≤ 3000 | 18 | mechanical tests | 9 | 9 |
| | | burst tests | 3 | 15 |

If one or more of these cylinders are not satisfactory, the batch must be rejected.

5.2.3. The selection of samples and all the tests are to be performed in the presence of a representative of the inspection body.

5.2.4. All the cylinders in the batch must undergo the hydraulic test specified in point 3.3 of this Annex in the presence and under the supervision of a representative of the inspection body.

5.3. EXEMPTION FROM EEC VERIFICATION

In the case of cylinders of less than 1 litre capacity, all the tests and checks specified in section 5 of this Annex must be carried out by the manufacture on his own responsibility. The manufacture must make available to the inspection body all the documents and reports elating to the tests and checks.

## 6. MARKS AND INSCRIPTIONS

6.1. When the inspection body has carried out all the prescribed checks and if the results are satisfactory, it must issue a certificate stating the checks which have been performed.

6.2. For cylinders of less than 6.5 litres capacity, the marks and inscriptions relating to the cylinder construction may be made on the base; for other

cylinders, they shall be made on the head or a reinforced part of the cylinder or on an identification plate. However, some of these inscriptions may be made on the dished end during forming provided the integrity of the cylinders not weakened.

6.3. EEC PATTERN APPROVAL MARK

By the derogation from the requirements of section 3 of Annex I of the Directive, which is set out in Schedule I to these regulations, the manufacturer must make the EEC pattern approval mark in the following order:

- the stylized letter Ɛ,
- the number 3 identifying this Schedule,
- the capital letter(s) identifying the Member State which has granted EEC pattern approval and the final two figures of the year in which pattern approval was granted,
- the number identifying the EEC pattern approval (e.g. Ɛ 3 D 79 45).

6.4. EEC VERIFICATION MARK

By way of derogation fro m the requirements of section 3 of Annex II of the Directive, which is set out in Schedule II to these regulations, the inspection body must make the EEC verification mark in the following order:

- the small letter 'e';
- the capital letter(s) identifying the Member State in which the verification is carried out, together, where necessary, with one or two figures identifying a territorial subdivision;
- the mark of the inspection body made by the verifying agent, together with the mark of the verifying agent if appropriate;
- a nexagon;
- the date of verification: year, month (e.g. e D 12 48 ⬡ 80/01).

6.5. CONSTRUCTION INSCRIPTIONS

6.5.1. As regards the steel

- A number indicating the value $R_e$ in $N/mm^2$ on which the calculation was based;

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

6.5.2. As regards the hydraulic test

The value capacity in litres, guaranteed by the manufacture of the cylinder.

6.5.3. As regards the type of cylinder

The minimum capacity in litres, guaranteed by the manufacturer of the cylinder.

This capacity must be given to one decimal place and rounded down.

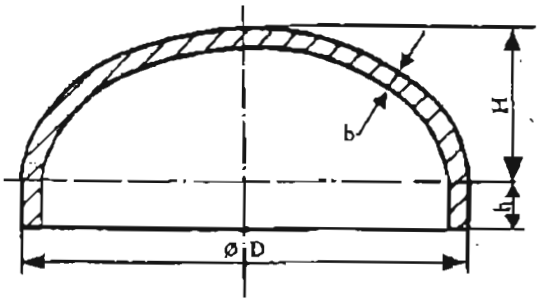
6.5.4. As regards origin

The capital letter(s) indicating the country of origin followed by the manufacturer's mark and the serial number.

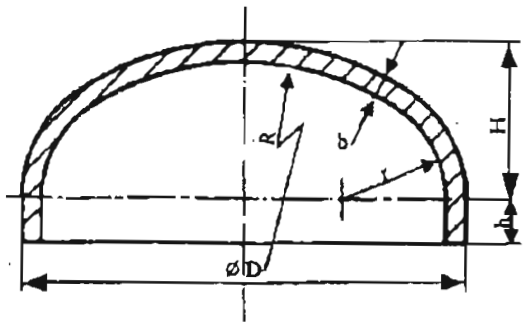
6.6. OTHER INSCRIPTIONS

Where other inscriptions relating neither to the construction nor to the inspection thereof are required under national rules, they must be made on the cylinders in accordance with point 6.2 of this Annex.

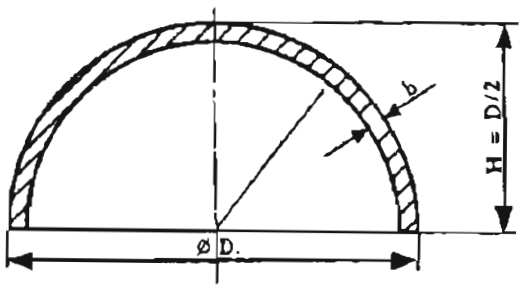
*Appendix 1*




Elliptical ends




Torispherical ends




Hemispherical ends

# COEFFICIENT OF FORM C FOR DISHED ENDS

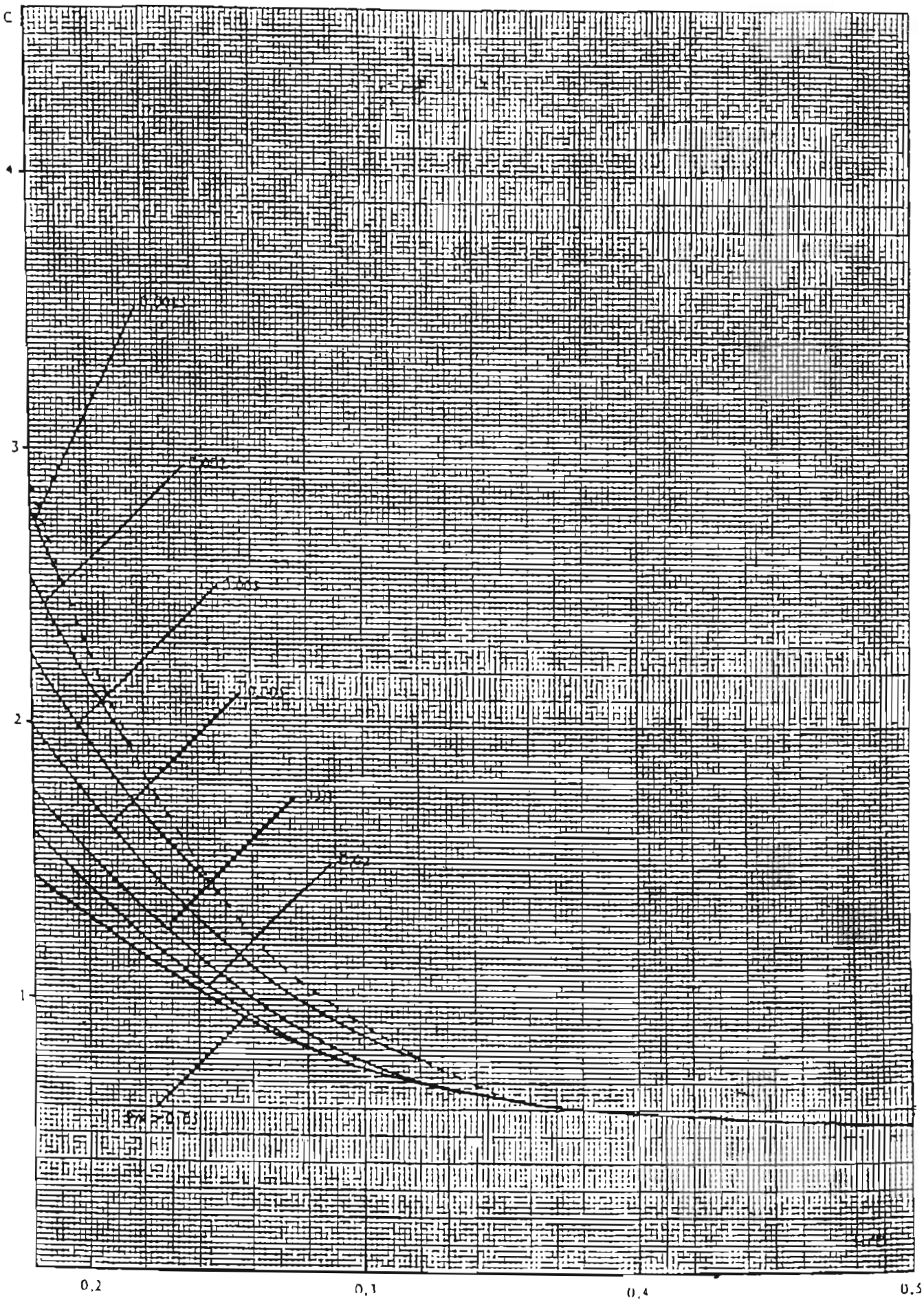
| H/D | $P_h / 10 f = 0.001$ a/D | C | $P_h / 10 f = 0.0012$ a/D | C | $P_h / 10 f = 0.0015$ a/D | C | $P_h / 10 f = 0.002$ a/D | C |
|---|---|---|---|---|---|---|---|---|
| 0.180 | | | | | 0.00211 | 2.81 | 0.00255 | 2.55 |
| 0.200 | | | | | | | 0.00218 | 2.18 |

| H/D | $P_h / 10 f = 0.003$ a/D | C | $P_h / 10 f = 0.004$ a/D | C | $P_h / 10 f = 0.005$ a/D | C | $P_h / 10 f = 0.01$ a/D | C |
|---|---|---|---|---|---|---|---|---|
| 0.180 | 0.00340 | 2.27 | 0.00423 | 2.12 | 0.00500 | 2.00 | 0.0088 | 1.76 |
| 0.190 | 0.00316 | 2.11 | 0.00395 | 1.98 | | | | |
| 0.200 | 0.00290 | 1.93 | 0.00364 | 1.82 | 0.00433 | 1.73 | 0.0077 | 1.54 |
| 0.210 | 0.00273 | 1.82 | 0.00342 | 1.71 | | | | |
| 0.220 | 0.00256 | 1.71 | 0.00320 | 1.60 | 0.00382 | 1.53 | 0.0068 | 1.38 |
| 0.230 | 0.00236 | 1.57 | 0.00295 | 1.48 | | | | |
| 0.240 | 0.00220 | 1.47 | 0.00276 | 1.38 | | | | |
| 0.250 | | | | | 0.00307 | 1.23 | 0.0055 | 1.10 |
| 0.300 | | | | | 0.00220 | 0.88 | 0.00395 | 0.79 |
| 0.350 | | | | | | | 0.00325 | 0.65 |
| 0.400 | | | | | | | 0.0030 | 0.60 |
| 0.450 | | | | | | | 0.0028 | 0.56 |
| 0.500 | | | | | | | 0.0027 | 0.54 |

| H/D | $P_h / 10 f = 0.02$ a/D | C | $P_h / 10 f = 0.05$ a/D | C | $P_h / 10 f = 0.0015$ a/D | C | $P_h / 10 f = 0.2$ a/D | C |
|---|---|---|---|---|---|---|---|---|
| 0.180 | 0.0160 | 1.60 | 0.0366 | 1.46 | 0.0730 | 1.46 | 0.147 | 1.47 |
| 0.200 | 0.0141 | 1.41 | 0.0330 | 1.32 | 0.0650 | 1.30 | 0.130 | 1.30 |
| 0.220 | 0.0125 | 1.25 | 0.0292 | 1.17 | 0.0585 | 1.17 | 0.118 | 1.18 |
| 0.250 | 0.0102 | 1.02 | 0.0250 | 1.00 | 0.0500 | 1.00 | 0.101 | 1.01 |
| 0.300 | 0.0077 | 0.77 | 0.0193 | 0.77 | 0.0385 | 0.77 | 0.077 | 0.77 |
| 0.350 | 0.0065 | 0.65 | 0.0162 | 0.65 | 0.0325 | 0.65 | 0.65 | 0.65 |
| 0.400 | 0.0059 | 0.59 | 0.0149 | 0.60 | 0.0295 | 0.59 | 0.059 | 0.59 |
| 0.450 | 0.0056 | 0.56 | 0.0140 | 0.56 | 0.0280 | 0.56 | 0.056 | 0.56 |
| 0.500 | 0.0054 | 0.54 | 0.0136 | 0.54 | 0.0270 | 0.54 | 0.054 | 0.54 |

| H/D | $P_h / 10 f = 0.5$ a/D | C |
|---|---|---|
| 0.350 | 0.163 | 0.65 |
| 0.400 | 0.150 | 0.60 |
| 0.450 | 0.140 | 0.56 |
| 0.500 | 0.136 | 0.54 |

$f = \frac{R_e}{4/3}$ in N/mm$^2$




(For purposes of illustration)

# *Appendix 2*

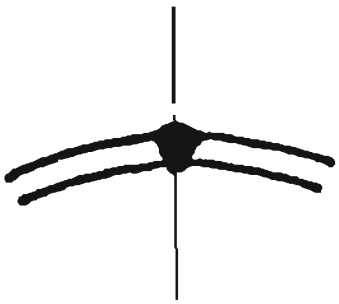


*Figure 1*

Longitudinal weld

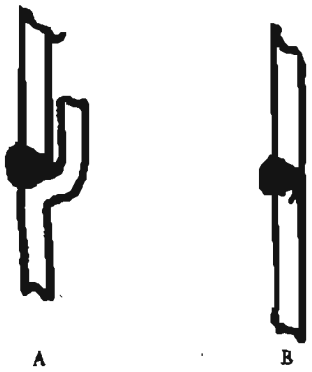



Figure 2

Circumferential weld

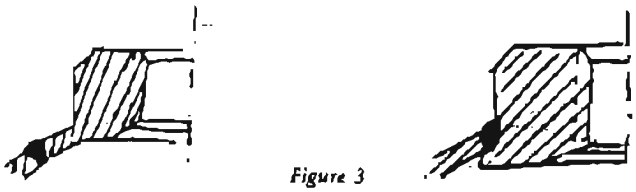


*Figure 3*

Seat weld

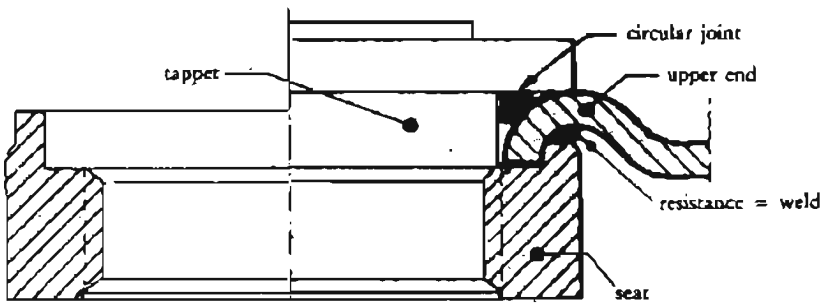



*Figure 4*

Valve-seat

## *Appendix 3*

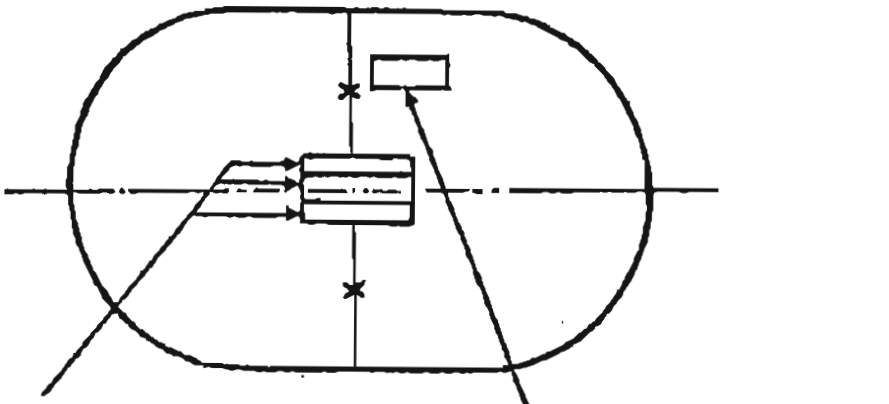



*Figure 1*

Test-pieces taken from two-piece cylinders

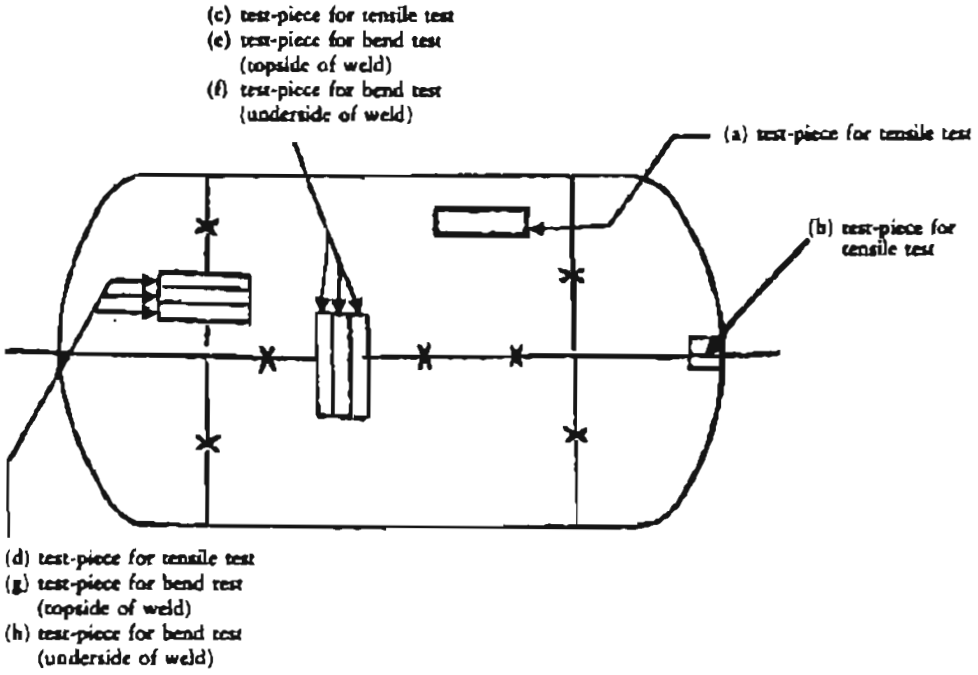
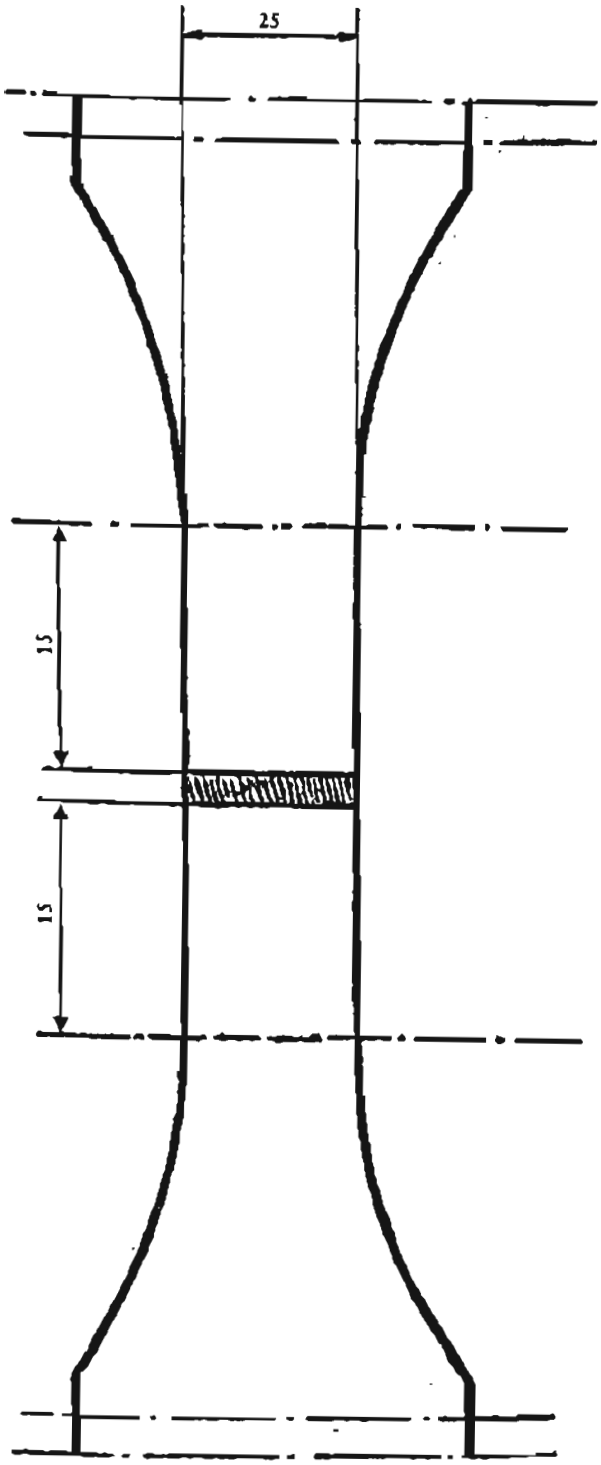



*Figure 2*

Test-pieces taken from three-piece cylinders

*Appendix 4*




Test-piece for tensile test perpendicular to the weld (section 3.1.2.2.2)

## *Appendix 5*

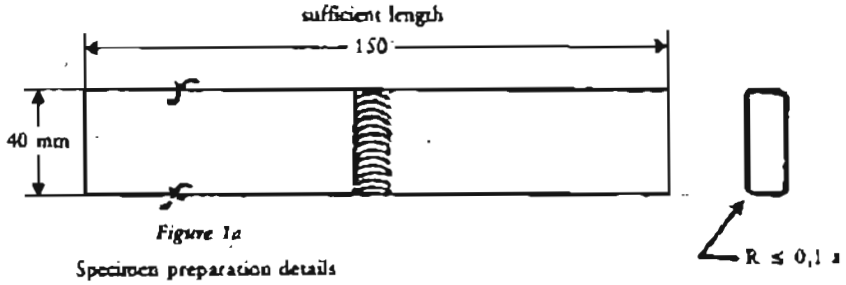



*Figure 1a*

Specimen preparation details

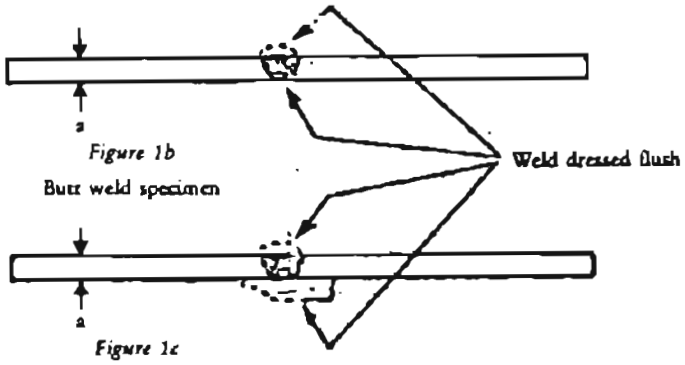



*Figure 1b*

Butt weld specimen

*Figure 1c*

Joggle joint weld specimen

*Figure 1*

Transverse guided bend test

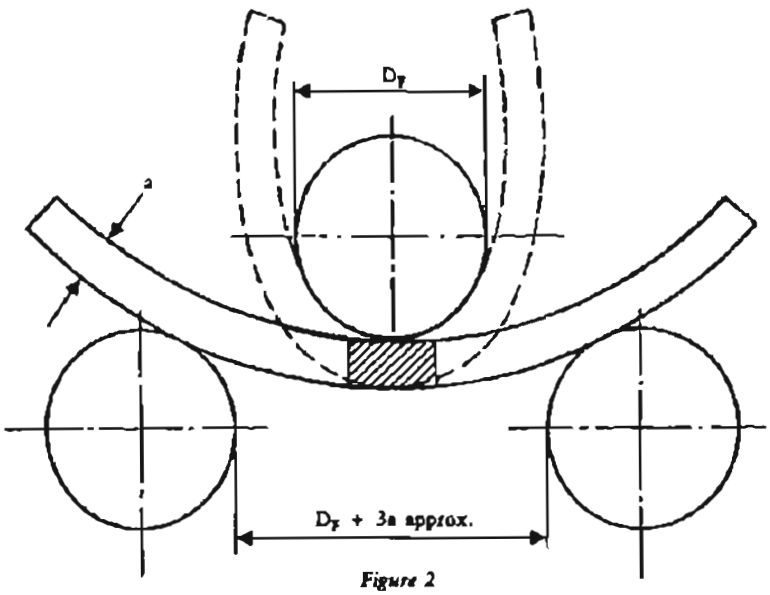



*Figure 2*

Illustration of bend test

# *ANNEX II*

## EEC PATTERN APPROVAL CERTIFICATE

Issued by ..... on the basis of
(Member State)

.....
(National rules)

applying Council Directive 84/527/EEC concerning:

**WELDED UNALLOYED STEEL GAS CYLINDERS**

---

Approval No ..... Date .....

Type of cylinder .....
(Description of the family of cylinders which has received EEC approval)

$P_h$ ..... D ..... s .....

$L_{min}$ ..... $L_{max}$ ..... $V_{min}$ ..... $V_{max}$ .....

Manufacturer or authorized representative .....
(Name and address of manufacturer or his authorized representative).

.....

.....

.....

EEC pattern approval mark $\varepsilon$ ..... Ⓔ .....

Details of the results of the examination of the pattern for EEC approval and the main features of the pattern are annexed.

All information may be obtained from .....
(Name and address of the approving body)

.....

.....

.....

Certified at ..... on .....

.....
(Signature)

# TECHNICHAL ANNEX TO EEC PATTERN APPROVAL CERTIFICATE

1. Results of EEC examination of the pattern with a view to EEC pattern approval.

2. main features of the pattern, in particular:

   - longitudinal cross-section of the type of cylinder which has received pattern approval showing:

     - the nominal external diameter, D,
     - the minimum thickness of the cylinder wall, a,
     - the minimum thickness of the base and the head,
     - the minimum and maximum length(s), $L_{min}$, $L_{max}$,
     - the external height of the curved part of the base of cylinder H, in mm,

   - the capacity or capacities, $V_{min}$, $V_{max}$;

   - the pressure, $P_h$;

   - the name of the manufacturer/No of the drawing and date;

   - name of the type of cylinder;

   - the steel in accordance with point 2.1 of Annex to this Schedule.

# *ANNEX III*

## MODEL

## EEC VERIFICATION CERTIFICATE

Application of Council Directive 84/527/EEC of 17 September 1984

Inspection body .....

.....

Date .....

EEC pattern approval No .....

Description of cylinders .....

.....

EEC verification No .....

Manufacturing batch No ..... to .....

Manufacturer .....

.....

.....
(Name and address)

Country ..... Mark .....

Owner .....

.....

.....
(Name and address)

Customer .....

.....

.....
(Name and address)

# VERIFICATION TESTS

## 1. MEASUREMENTS OF SAMPLE CYLINDERS

| Test No | Batch consisting of No ..... to No ..... | Water capacity (litres) | Mass empty (kg) | Minimum measured thickness | |
|---|---|---|---|---|---|
| | | | | of the wall (mm) | of the base (mm) |
| | | | | | |

## 2. MECHANICAL TESTS CARRIED OUT ON SAMPLE CYLINDERS

| Test No | Heat treatment No | Tensile test | | | | Bend test 180 ° without cracking | Hydraulic bursting test (bars) |
|---|---|---|---|---|---|---|---|
| | | Test-piece in accordance with EURONORM (a) 2-80 (b) 11-80 | Yield point $R_e$ (N/mm²) | Tensile strength $R_m$ (N/mm²) | Elongation A (%) | | |
| | | | | | | | |
| | Minimum values specified | | | | | | |

I, the undersigned, hereby declare that I have checked that the verification operations, tests and checks prescribed in section 5.2 of Annex I to Directive 84/527/EEC have been carried out successfully.

Special remarks .....

.....

General remarks .....

.....

Certified on ..... at .....

.....
(Signature of the inspector)

on behalf of .....
(Inspection body)

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