L.N. 229 of 1998

QUALITY CONTROL (EXPORTS, IMPORTS AND LOCAL GOODS) ACT (CAP. 225)

Simple Pressure Vessels Order, 1998 (Order No. M35 of 1998)

IN exercise of the powers conferred by section 3 of the Quality Control (Exports, Imports and Local Goods) Act, the Malta Standardisation Authority has made the following order :-

Citation and commencement.

1.1. This Order may be cited as the Simple Pressure Vessels Order,1998 and may be referred to as Order No. M35 of 1998.

1.2. This Order shall become operative on the 1st March, 1999, which date shall be notified by the Authority in the Gazette.

1.2.1. Provided that the requirement of paragraph 6 of this order and the CE marking shall not be obligatory prior to the 1st September, 1999 in respect of:

1.2.1.1. stocks of simple pressure vessels already placed on the market prior to the1st March, 1999;

1.2.1.2. simple pressure vessels ordered before the 1st March 1999 and imported into Malta up to the 31st August, 1999.

1.2.2. Provided that the requirement of paragraph 6 of this Order and the CE marking shall not be obligatory prior to the 1st March, 2000 in respect of simple pressure vessels manufactured in Malta up to 29th February, 2000 and which are in compliance with other Orders currently in force in Malta.

Scope.

2.1. This Order shall apply to Simple Pressure Vessels, hereinafter referred to as "vessels", manufactured in series, but excluding:

2.1.1. vessels specifically designed for nuclear use, failure of which may cause an emission of radioactivity;

2.1.2. vessels specifically intended for installation in or the propulsion of ships and aircraft;

2.1.3. fire extinguishers.

3.1. In this Order – Definitions.

3.1.1. "vessel" means any welded vessel subjected to an internal gauge pressure greater than 0.5 bar which is intended to contain air or nitrogen and which is not intended for exposure to flame;

3.1.2. "the Directive" means Council Directive 87/404/EEC[1] as amended by Council Directive 90/488/EEC[2] and Council Directive 93/68/EEC[3] on the approximation of the laws of the Member States relating to simple pressure vessels;

3.1.3. "approved body" means a body approved to carry out EC type examination as laid down in this Order. The names of such approved bodies are published in the Official Journal of the European Communities;

3.1.4. "Harmonised Standard" means a technical specification adopted by the European Committee for Standardisation (CEN) or the European Committee for Electrotechnical Standardisation (CENELEC) or the European Telecommunications Standards Institute (ETSI), upon a remit from the European Commission in accordance with Council Directive 98/34/EC[4] laying down a procedure for the provision of information in the field of technical standards and regulations;

3.1.5. "National Standard transposing the Harmonised Standard" means a Standard issued by one of the members of CEN/CENELEC/ETSI which is declared and noted to be technically equivalent to the Harmonised Standard originally issued by CEN/CENELEC/ETSI;

3.1.6. "OJ" means The Official Journal of the European Communities;

3.1.7. "Community" means the European Community;

3.1.8. "CE marking" means marking as set out in Schedule II to this Order;

3.1.9. "manufacturer" means the person, who is primarily responsible for designing and manufacturing the vessels so that they comply with the requirements of this Order;

3.1.10. "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 this Order;

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[1]OJ No. L220, 08-08-87, P.48

[2]OJ No. L270, 02-10-90, P.25

[3]OJ No. L220, 30-08-93, P.1

[4]OJ No. L204, 21-07-98, P.37

3.1.11. "importer" means any person who places vessels from a foreign country on to the Maltese market so that he supplies such vessels on the first occasion that they are supplied in Malta;

3.1.12. "person who supplies vessels" means wholesalers, distributors, retailers, etc;

3.1.13. "responsible person" in relation to vessels means:

(a) the manufacturer thereof;
(b) the manufacturer's local authorised representative; or
(c) where the manufacturer is not established in Malta and he has not appointed a local authorised representative, the person who places the vessels on the local market;

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

Applicability.

4.1. The provisions of this Order are applicable to all imported vessels as well as to those manufactured for the local market.

4.2. Subject to paragraph 4.3 below, the provisions of this Order shall not apply to vessels which are intended exclusively for export.

4.3 Subject to paragraph 10 below, paragraph 4.2 above shall not apply if the CE marking or any inscription liable to be confused therewith is affixed to the vessels.

Conformity and Requirements.

5.1. Vessels referred to in paragraphs 2 and 3 of this Order may be placed on the market and taken into service only if they do not compromise the safety of persons, domestic animals or property when properly installed and maintained and when used for the purposes for which they are intended

5.2. Vessels in respect of which the product of PS and V exceeds 50 bar.litre must satisfy the essential safety requirements set out in Schedule I to this Order.

5.3. Vessels in respect of which the product of PS and V is 50 bar.litre or less must be manufactured in accordance with sound engineering practice and bear markings as laid down in section 1 of Schedule II to this Order, with the exception of the CE marking referred to in paragraph 10.

5.4. The parts and assemblies contributing to the strength of the vessel under pressure shall be made either of non-alloy quality steel or of non-alloy aluminium or non-age hardening aluminium alloys.

5.5. The vessel shall be made of:

5.5.1. either a cylindrical part of circular cross-section closed by outwardly dished and/or flat ends which revolve around the same axis as the cylindrical part.

5.5.2. or two dished ends revolving around the same axis.

5.6. The maximum working pressure of the vessel shall not exceed 30 bar and the product of that pressure and the capacity of the vessel (PS.V) shall not exceed 10 000 bar.litre.

5.7. The minimum working temperature must be no lower than –50 °C and the maximum working temperature shall not be higher than 300 °C for steel and 100 °C for aluminium or aluminium alloy vessels.

CE marking and certificates of conformity.

6.1. Vessels bearing the CE marking shall be presumed to comply with all the provisions of this Order, including the conformity assessment procedures referred to in paragraphs 8 and 9 of this Order and Article 9 of the Directive.

6.1.1. Conformity of vessels with the National Standards transposing the Harmonised Standards, the reference numbers of which have been published in the Official Journal of the European Communities, shall result in a presumption of conformity to the essential safety requirements referred to in paragraphs 5.2 and 5.3 of this Order.

6.2. Vessels in respect of which the manufacturer has not applied, or has applied only in part, the standards referred to in paragraph 6.1.1 above, or for which no such standards exist, shall be presumed to comply with the essential requirements referred to in paragraphs 5.2 and 5.3 of this Order where, after receipt of an EC type-examination certificate, their conformity with the approved model has been certified by the affixation of the CE marking.

6.3. Where the vessels are subject to other Directives covering other aspects and which also provide for the affixing of the CE marking, the latter shall indicate that the vessels in question are also presumed to conform to the provisions of those other Directives.

6.3.1. However, where one or more of those Directives allow the manufacturer, during a transitional period, to choose which arrangements to apply, the CE marking shall indicate conformity only to the Directives applied by the manufacturer. In this case, particulars of the Directives applied, as published in the Official Journal of the European Communities, must be given in the documents, notices or instructions required by the Directives and accompanying such vessels.

Withdrawal and prohibition from market.

7.1. If it is discovered that vessels bearing the CE marking and used in accordance with their intended purpose might compromise the safety of individuals, domestic animals or property, all necessary measures shall be taken to withdraw those products from the market or to prohibit or restrict their being placed on the market.

Certification procedures, type-examination and verification.

8.1. Prior to production of vessels of which the product of PS and V exceeds 50 bar.litre, manufactured:

8.1.1. in accordance with the standards referred to in paragraph 6.1.1, the responsible person, at his own choice:

8.1.1.1. shall either inform an approved inspection body as referred to in Article 9 of the Directive, which after examining the design and manufacturing schedule referred to in section 3 of schedule II to this Order, shall draw up a certificate of adequacy attesting that the schedule is satisfactory,

8.1.1.2. or shall submit a prototype vessel for the EC type-examination referred to in paragraph 8.4.

8.1.2. not, or only partly, in accordance with the standards referred to in paragraph 6.1.1, the responsible person must submit a prototype vessel for the EC type-examination referred to in paragraph 8.4.

8.2. Vessels manufactured in accordance with the standards referred to in paragraph 6.1.1 or with the approved prototype shall, prior to their being placed on the market, be subject:

8.2.1. to the EC verification referred to in paragraphs 8.5, 8.6 and 8.7 of this Order, where the product of PS and V exceeds 3000 bar.litre

8.2.2. at the choice of the manufacturer, where the product of PS and V does not exceed 3000 bar.litre but exceeds 50 bar.litre:

- either to the EC declaration of conformity referred to in paragraphs 9.1 and 9.2 of this Order, or

- to the EC verification referred to in paragraphs 8.5, 8.6 and 8.7 of this Order.

8.3. The records and correspondence relating to the certification procedures referred to in paragraphs 8.1 and 8.2 shall be drafted in at least Maltese and/or English.

8.4. EC type-examination is the procedure by which an approved inspection body ascertains and certifies that a prototype vessel satisfies the provisions of this Order which apply to it, as laid down in Article 10 of the Directive.

8.5. EC verification is the procedure whereby a responsible person ensures and declares that the vessels which have been checked in accordance with Article 11 of the Directive are in conformity to the type described in the EC type-examination certificate or with the design and manufacturing schedule referred to in section 3 of Schedule II to this Order, having received a certificate of adequacy.

8.6. The manufacturer shall take all the necessary measures for the manufacturing process to ensure that the vessels conform to the type described in the EC type-examination certificate or to the design and manufacturing schedule referred to in section 3 of Schedule II to this Order. The responsible person shall affix the CE marking to each vessel and draw up a declaration of conformity.

8.7. The responsible person must be able to supply on request the approved body's certificates of conformity referred to in Article 11 of the Directive.

EC Declaration of Conformity.

9.1. A manufacturer fulfilling the obligations arising out of paragraphs 9.3 and 9.4 shall affix the CE marking provided for in paragraph 10 to vessels which he declares to be in conformity:

9.1.1. to the design and manufacturing schedule referred to in section 3 of Schedule II to this Order, and on which a certificate of adequacy has been drawn up, or

9.1.2. with an approved prototype.

9.2. The purpose of EC surveillance is to ensure, as required by Article 14 of the Directive, that the manufacturer duly fulfils the obligations arising out of paragraph 9.4 below. Surveillance shall be performed by the approved body which issued the EC type-examination certificate referred to in paragraph 8 of this Order, where the vessels have been manufactured in accordance with an approved prototype or, if this is not the case, by the approved body to which the design and manufacturing schedule was sent in accordance with paragraph 8.1.1.1 of this Order.

9.3. Where a manufacturer makes use of the procedure referred to in paragraphs 9.1 and 9.2, he must, before commencing manufacture, send the approved body which issued the EC type-examination certificate or the certificate of adequacy a document describing the

manufacturing processes and all of the pre-determined systematic measures taken to ensure conformity of the pressure vessels to the standards referred to in paragraph 6.1.1 or the approved prototype.

9.3.1. This document shall include:

9.3.1.1. a description of the means of manufacture and checking appropriate to the construction of the vessels;

9.3.1.2. an inspection document describing the appropriate examinations and tests to be carried out during manufacture, together with the procedures therefor and the frequency with which they are to be performed;

9.3.1.3. an undertaking to carry out the examinations and tests in accordance with the inspection document referred to above and to have a hydrostatic test or, subject to the agreement of the Malta Standardisation Authority, a pneumatic test carried out on each vessel manufactured at a test pressure equal to 1.5 times the design pressure. These examinations and tests shall be carried out under the responsibility of qualified staff who are sufficiently independent from production personnel, and shall be covered by a written report;

9.3.1.4. the addresses of the places of manufacture and storage and the date on which manufacture is to commence.

9.4. In addition, when the product of PS and V exceeds 200 bar.litre, manufacturers shall authorise access to the said places of manufacture and storage by the body responsible for EC surveillance, for inspection purposes, and shall allow that body to select sample vessels and shall provide it with all necessary information, and in particular:

- the design and manufacturing schedule,
- the inspection report,
- the EC type-examination certificate or certificate of adequacy, where appropriate,
- a written report on the examinations and tests carried out.

9.5. In Malta, the responsible person for vessels must retain, for a period of at least 10 years from the date on which the last vessel in the series is manufactured and/or placed on the market:

9.5.1. copies of all documentation submitted by him to an approved body for the purpose of obtaining any of the EC certificates referred to above in this Order;

9.5.2. any certificates issued by an approved body to him under this Order;

9.5.3. any documents accompanying any such certificate so issued and EC declarations of conformity.

9.6. The person who supplies vessels in the course of a business in Malta shall ensure that the vessels that he supplies:

- satisfy the safety requirements; and

- bear CE marking with access to the declaration of conformity.

Conformity Marking.

10.1. The CE conformity marking shall consist of the initials "CE" in the form shown in the specimen in Schedule II to this Order. The CE marking shall be followed by the distinguishing number referred to in Article 9 (1) of the Directive, of the approved inspection body responsible for EC verifications or EC surveillance.

10.2. The CE marking and the inscriptions provided for in section 1 of Schedule II to this Order shall be affixed in a visible, easily legible and indelible form to the vessel or to a data plate attached to the vessel in such a way that it cannot be removed.

10.3. The affixing of markings on the vessels which are likely to deceive third parties as to the meaning and form of the CE marking shall be prohibited. Any other marking may be affixed to the vessels or data plate provided that the visibility and legibility of the CE marking is not thereby reduced.

10.4. Without prejudice to paragraph 7:

10.4.1. where it is established that the CE marking has been affixed unduly, the responsible person shall be obliged to make the product conform as regards the provisions concerning the CE marking and to end the infringement.

10.4.2. where non-conformity continues, all appropriate measures shall be taken to restrict or prohibit the placing on the market of the product in question or to ensure that it is withdrawn from the market in accordance with the procedures laid down in paragraph 7.

10.5. A person who imports and/or supplies vessels manufactured prior to 31st December 1993, and for this reason does not bear the CE marking shall, prior to such vessels being sold or otherwise distributed, including distribution free of charge, submit to the Malta Standardisation Authority a Declaration of Conformity containing the following elements:

- name and address of the person who is importing and/or supplying the vessels in question,
- a description of the vessels,
- reference to the harmonised standards,
- where appropriate, references to the specifications with which conformity is declared,
- signature of the person importing and/or supplying such vessels in Malta.

SCHEDULE I

Based on Annex I of the Directive

The essential safety requirements for the vessels are set out below:

1. MATERIALS

Materials must be selected according to the intended use of the vessels and in accordance with sections 1.1 to 1.4.

1.1. Pressurised parts

The materials referred to in paragraph 5 used for manufacturing the pressurised parts must be:—

- capable of being welded,
- ductile and tough, so that a rupture at minimum working temperature does not give rise to either fragmentation or brittle-type fracture,
- not adversely affected by ageing.

For steel vessels, the materials must in addition meet the requirements set out in section 1.1.1 and, for aluminium or aluminium alloy vessels, those set out in section 1.1.2.

They must be accompanied by an inspection slip drawn up by the producer of the materials as described in Schedule II.

1.1.1. *Steel vessels*

Non-alloy quality steels shall meet the following requirements:

(a) they must be non-effervescent and be supplied after normalisation treatment, or in an equivalent state;

(b) the content per product of carbon must be less than 0.25% and that of sulphur and phosphorus must each be less than 0.05 %;

(c) they must have the following mechanical properties per product:

- the maximum tensile strength $R_{m,max}$ must be less than 580 N/mm^2,
- the elongation after rupture must be:

- if test pieces are taken parallel to the direction of rolling:

  thickness ≥ 3 mm: $A \geq 22$ %,

  thickness < 3 mm: $A_{80\,mm} \geq 17$ %,

- if test pieces are taken perpendicular to the direction of rolling:

  thickness ≥ 3 mm: $A \geq 20$ %,

  thickness < 3 mm: $A_{80\,mm} \geq 15$ %,

• the average failure energy KCV for three longitudinal test pieces at minimum working temperature must not be less than 35 J/cm^2. Not more than one of the three figures may be less than 35 J/cm^2, with a minimum of 25 J/cm^2.

In the case of steels used in the manufacture of vessels whose minimum working temperature is lower than -10 °C and whose wall thickness exceeds 5 mm, this property must be checked.

1.1.2. *Aluminium vessels*

Non-alloy aluminium must have an aluminium content of at least 99.5 % and those alloys described in paragraph 5 must display adequate resistance to intercrystalline corrosion at maximum working temperature.

Moreover these materials must satisfy the following requirements:

(a) they must be supplied in an annealed state; and

(b) must have the following mechanical characteristics per product:

• the maximum tensile strength $R_{m,max}$ must be no more than 350 N/mm^2,

• the elongation after rupture must be:

- $A \geq 16$ % if the test piece is taken parallel to the direction of rolling,

- $A \geq 14$ % if the test piece is taken perpendicular to the direction of rolling.

1.2. Welding materials

The welding materials used to manufacture the welds on or of the vessel must be appropriate to and compatible with the materials to be welded.

1.3. Accessories contributing towards the strength of the vessel

These accessories (e. g. bolts and nuts) must be made of a material specified in section 1.1 or of other kinds of steel, aluminium or an appropriate aluminium alloy compatible with materials used for the manufacture of pressurised parts.

The latter materials must at minimum working temperature have an appropriate elongation after rupture, and toughness.

1.4. Non-pressurised parts

All unpressurised parts of welded vessels must be of materials which are compatible with that of the components to which they are welded.

2. VESSEL DESIGN

The manufacturer must, when designing the vessel, define the use to which it will be put, and select:

- the minimum working temperature T_{min},
- the maximum working temperature T_{max},
- the maximum working pressure PS.

However, should a minimum working temperature exceeding -10 °C be selected, the qualities required of the materials must be satisfied at -10 °C.

The manufacturer must also take account of the following provisions:

- it must be possible to inspect the inside of vessels,
- it must be possible to drain the vessels,
- the mechanical qualities shall be maintained throughout the period of use of the vessel for the intended purpose,
- the vessels shall, bearing in mind their prescribed use, be adequately protected against corrosion,

and the fact that under the conditions of use envisaged –

- the vessels will not be subjected to stresses likely to impair their safety in use,

- internal pressure will not permanently exceed the maximum working pressure PS; however, it may momentarily do so by up to 10 %.

Circular and longitudinal seams must be made using full penetration welds or welds of equivalent effectiveness. Convex ends other than hemispherical ones shall have a cylindrical edge.

2.1. **Wall thickness**

If the product PS.V is not more than 3 000 bar.litre, the manufacturer must select one of the methods described in sections 2.1.1 and 2.1.2 for determining vessel wall thickness; if the product of PS and V is more than 3 000 bar.litre, or if the maximum working temperature exceeds 100 °C, such thickness must be determined by the method described in section 2.1.1.

The actual wall thickness of the cylindrical section and ends shall, however, be not less than 2 mm in the case of steel vessels and not less than 3 mm in the case of aluminium or aluminium alloy vessels.

2.1.1. *Calculation method*

The minimum thickness of pressurised parts must be calculated having regard to the intensity of the stresses and to the following provisions:

- the calculation pressure to be taken into account must not be less than the maximum working pressure selected,

- the permissible general membrane stress must not exceed the lower of the values 0.6 R_{ET} or 0.3 R_m. The manufacturer must use the R_{ET} and R_m minimum values guaranteed by the material manufacturer in order to determine the permissible stress.

However, where the cylindrical portion of the vessel has one or more longitudinal welds made using a non-automatic welding process, the thickness calculated as above must be multiplied by the coefficient 1.15.

2.1.2. *Experimental method*

Wall thickness must be so determined as to enable the vessels to resist at ambient temperature a pressure equal to at least five times the maximum working pressure, with a permanent circumferential deformation factor of no more than 1 %.

3. MANUFACTURING PROCESSES

Vessels shall be constructed and subjected to production checks in accordance with the design and manufacturing record referred to in section 3 of Schedule II to this Order.

3.1. Preparation of the component parts

Preparation of the component parts (e.g. forming and chamfering) must not give rise to surface defects or cracks or changes in the mechanical characteristics likely to be detrimental to the safety of the vessels.

3.2. Welds on pressurised parts

The characteristics of welds and adjacent zones must be similar to those of the welded materials and shall be free of any surface or internal defects detrimental to the safety of the vessels.

Welds must be performed by qualified welders or operators possessing the appropriate level of competence, in accordance with approved welding processes. Such approval and qualification tests must be carried out by approved inspection bodies.

The manufacturer must also, during manufacture, ensure consistent weld quality by conducting appropriate tests using adequate procedures. These tests must be the subject of a written report.

4. PLACING IN SERVICES OF THE VESSELS

Vessels must be accompanied by the instructions drawn up by the manufacturer, as referred to in section 2 of Schedule II to this Order.

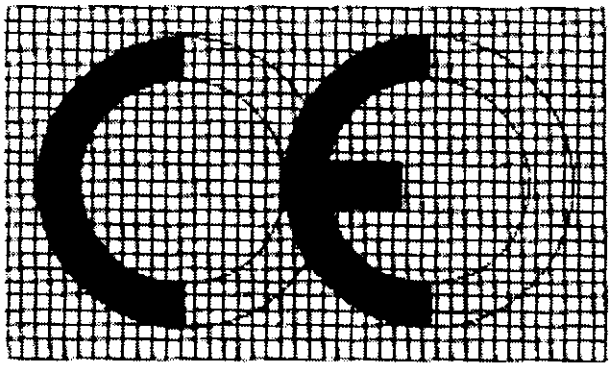
SCHEDULE II

Based on Annex II of the Directive

1. CE MARKING AND INSCRIPTIONS

1. (a) CE conformity marking

The CE conformity marking shall consist of the initials "CE" in the following form:



For the avoidance of doubt, it is hereby declared that the grid providing the background in the above graduated drawing is not part of the CE marking.

If the CE marking is reduced or enlarged the proportions given in the above graduated drawing must be respected.

The various components of the CE marking must have substantially the same vertical dimension, which may not be less than 5mm.

1. (b) Inscriptions

The vessel or data plate must bear the CE marking provided for in paragraph 10, together with at least the following information:

- the maximum working pressure PS in bar
- the maximum working temperature T_{max} in °C
- the minimum working temperature T_{min} in °C
- the capacity of the vessel V in L
- the name or mark of the manufacturer
- the type and serial or batch identification of the vessel
- the last two digits of the year in which the CE marking was affixed.

Where the data plate is used, it must be so designed that it cannot be re-used and must include a vacant space to enable other information to be provided.

2. INSTRUCTIONS

The instructions must provide the following information:

- the particulars given in 1 above except for the vessel's serial identification,
- the intended use of the vessel,
- the maintenance and installation requirements for vessel safety.

These must be, at least, in Maltese and/or English.

3. DESIGN AND MANUFACTURING SCHEDULES

The design and manufacturing schedules must contain a description of the techniques and operations employed in order to meet the essential requirements referred to in paragraphs 5.2 and 5.3 or the standards referred to in paragraph 6.1.1 of this Order and, in particular:

(a) a detailed manufacturing drawing of the vessel type;

(b) the instructions;

(c) a document describing:

- the materials selected,
- the welding processes selected,
- the checks selected,
- any pertinent details as to the vessel design.

When the procedures laid down in paragraphs 8.5, 8.6 and 8.7 and in paragraph 9 of this Order are used, the schedule must also include:

(i) the certificates relating to the suitable qualification of the welding operations and of the welders or operators;

(ii) the inspection slip for the materials used in the manufacture of parts and assemblies contributing to the strength of the pressure vessel;

(iii) a report on the examinations and tests performed or a description of the proposed checks.

4. DEFINITIONS AND SYMBOLS

4.1. Definitions

(a) The design pressure 'P' is the gauge pressure chosen by the manufacturer and used to determine the thickness of the pressurised parts.

(b) The maximum working pressure 'PS' is the maximum gauge pressure which may be exerted under normal conditions of use.

(c) The minimum working temperature 'T_{min}' is the lowest stabilised temperature in the wall of the vessel under normal conditions of use.

(d) The maximum working temperature 'T_{max}' is the highest stabilised temperature which the wall of the vessel may attain under normal conditions of use.

(e) The yield strength 'R_{ET}' is the value at the maximum working temperature T_{max}

- of the upper yield point R_{eH}, for a material with both a lower and an upper yield point,
- or of the proof stress $R_p0.2$,
- or of the proof stress $R_p1.0$ in the case of non-alloy aluminium.

(f) Families of vessels:

Vessels form part of the same family if they differ from the prototype only in diameter, provided that the permissible requirements referred to in sections 2.1.1 or 2.1.2 of Schedule I to this Order are complied with and/or in the length of their cylindrical portion within the following limits:

- where a prototype has one or more shell rings in addition to the ends, variants in the family must have at least one shell ring,
- where a prototype has just two dished ends, variants in the family must have no shell rings.

Variations in length causing the apertures and/or penetrations to be modified must be shown in the drawing for each variant.

(g) A batch of vessels consists at the most of 3,000 vessels of the model of the same type.

(h) There is series manufacture within the meaning of this Order if more than one vessel of the same type is manufactured during a given period by a continuous manufacturing process, in accordance with a common design and using the same manufacturing processes.

(i) Inspection slip: document by which the producer certifies that the products delivered meet the requirements of the order and in which he sets out the results of the routine in-plant inspection test, in particular chemical composition and mechanical characteristics performed on products made by the same production process as the supply, but not necessarily on the products delivered.

4.2. SYMBOLS

A	elongation after rupture ($L_o = 5.65\sqrt{S_o}$)	%
A 80 mm	elongation after rupture (L_o = 80 mm)	%
KCV	rupture energy	J/cm^2
P	design pressure	bar
PS	working pressure	bar
P_h	hydrostatic or pneumatic test pressure	bar
$R_p0.2$	proof stress at 0.2%	N/mm^2
R_{ET}	yield strength at maximum working temperature	N/mm^2
R_{eH}	upper yield point	N/mm^2
R_m	tensile strength	N/mm^2
T_{max}	maximum working temperature	°C
T_{min}	minimum working temperature	°C
V	capacity of the vessel	L
$R_{m,max}$	maximum tensile strength	N/mm^2
$R_p1.0$	proof stress at 1.0%	N/mm^2.