

ANNEX I

ESSENTIAL SAFETY REQUIREMENTS

2. **Vessel design**

(a) The manufacturer shall, when designing the vessel, define the use to which it will be put, and select:

- (i) the minimum working temperature T_{\min} ;
- (ii) the maximum working temperature T_{\max} ;
- (iii) the maximum working pressure PS.

However, should a minimum working temperature exceeding $-10\text{ }^{\circ}\text{C}$ be selected, the qualities required of the materials shall be satisfied at $-10\text{ }^{\circ}\text{C}$.

(b) The manufacturer shall also take account of the following provisions:

- (i) it shall be possible to inspect the inside of vessels;
- (ii) it shall be possible to drain the vessels;
- (iii) the mechanical qualities shall be maintained throughout the period of use of the vessel for the intended purpose;
- (iv) the vessels shall, bearing in mind their prescribed use, be adequately protected against corrosion.

(c) The manufacturer shall take account of the fact that under the conditions of use envisaged:

- (i) the vessels shall not be subjected to stresses likely to impair their safety in use;
- (ii) internal pressure shall not permanently exceed the maximum working pressure PS. However, it may momentarily do so by up to 10 %.

(d) Circumferential and longitudinal seams shall 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 of $PS \times V$ is not more than 3 000 bar.L, the manufacturer shall select one of the methods described in points 2.1.1 and 2.1.2 for determining vessel wall thickness; if the product of $PS \times V$ is more than 3 000 bar.L, or if the maximum working temperature exceeds $100\text{ }^{\circ}\text{C}$, such thickness shall be determined by the method described in point 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 shall be calculated having regard to the intensity of the stresses and to the following provisions:

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- (a) the calculation pressure to be taken into account shall not be less than the maximum working pressure PS selected;
- (b) the permissible general membrane stress shall not exceed the lower of the values $0,6 R_{eT}$ or $0,3 R_m$. The manufacturer shall use the R_{eT} and R_m minimum values guaranteed by the producer of the material 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 referred to in the first paragraph shall be multiplied by the coefficient 1,15.

2.1.2. *Experimental method*

Wall thickness shall 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 %.