

## ANNEX I

### ESSENTIAL SAFETY REQUIREMENTS SPECIFIC PRESSURE EQUIPMENT REQUIREMENTS

In addition to the applicable requirements of points 1 to 4, the following requirements apply to the pressure equipment covered by points 5 and 6.

#### 5. FIRED OR OTHERWISE HEATED PRESSURE EQUIPMENT WITH A RISK OF OVERHEATING AS REFERRED TO IN ARTICLE 4(1)

This pressure equipment includes:

- steam and hot-water generators as referred to in Article 4(1)(b), such as fired steam and hot-water boilers, superheaters and reheaters, waste-heat boilers, waste incineration boilers, electrode or immersion-type electrically heated boilers, pressure cookers, together with their accessories and where applicable their systems for treatment of feedwater and for fuel supply,
- process-heating equipment for other than steam and hot water generation falling under Article 4(1)(a), such as heaters for chemical and other similar processes and pressurised food-processing equipment.

This pressure equipment shall be calculated, designed and constructed so as to avoid or minimise risks of a significant loss of containment from overheating. In particular it shall be ensured, where applicable, that:

- (a) appropriate means of protection are provided to restrict operating parameters such as heat input, heat take-off and, where applicable, fluid level so as to avoid any risk of local and general overheating;
- (b) sampling points are provided where required to allow evaluation of the properties of the fluid so as to avoid risks related to deposits and/or corrosion;
- (c) adequate provisions are made to eliminate risks of damage from deposits;
- (d) means of safe removal of residual heat after shutdown are provided;
- (e) steps are taken to avoid a dangerous accumulation of ignitable mixtures of combustible substances and air, or flame blowback.

#### 6. PIPING AS REFERRED TO IN ARTICLE 4(1)(c)

Design and construction shall ensure:

- (a) that the risk of overstressing from inadmissible free movement or excessive forces being produced, e.g. on flanges, connections, bellows or hoses, is adequately controlled by means such as support, constraint, anchoring, alignment and pre-tension;
- (b) that where there is a possibility of condensation occurring inside pipes for gaseous fluids, means are provided for drainage and removal of deposits from low areas to avoid damage from water hammer or corrosion;
- (c) that due consideration is given to the potential damage from turbulence and formation of vortices; the relevant parts of point 2.7 are applicable;
- (d) that due consideration is given to the risk of fatigue due to vibrations in pipes;
- (e) that, where fluids of Group 1 are contained in the piping, appropriate means are provided to isolate ‘take-off’ pipes the size of which represents a significant risk;

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- (f) that the risk of inadvertent discharge is minimised; the take-off points shall be clearly marked on the permanent side, indicating the fluid contained;
  - (g) that the position and route of underground piping is at least recorded in the technical documentation to facilitate safe maintenance, inspection or repair.
7. SPECIFIC QUANTITATIVE REQUIREMENTS FOR CERTAIN PRESSURE EQUIPMENT

The following provisions apply as a general rule. However, where they are not applied, including in cases where materials are not specifically referred to and no harmonised standards are applied, the manufacturer shall demonstrate that appropriate measures have been taken to achieve an equivalent overall level of safety.

The provisions laid down in this section supplement the essential safety requirements of points 1 to 6 for the pressure equipment to which they apply.

#### 7.1. Allowable stresses

##### 7.1.1. Symbols

$R_{e/t}$ , yield limit, indicates the value at the calculation temperature of:

- the upper flow limit for a material presenting upper and lower flow limits,
- the 1,0 % proof strength of austenitic steel and non-alloyed aluminium,
- the 0,2 % proof strength in other cases.

$R_{m/20}$  indicates the minimum value of the ultimate tensile strength at 20 °C.

$R_{m/t}$  designates the ultimate tensile strength at the calculation temperature.

7.1.2. The permissible general membrane stress for predominantly static loads and for temperatures outside the range in which creep is significant shall not exceed the smaller of the following values, according to the material used:

- in the case of ferritic steel including normalised (normalised rolled) steel and excluding fine-grained steel and specially heat-treated steel,  $\frac{2}{3}$  of  $R_{e/t}$  and  $\frac{5}{12}$  of  $R_{m/20}$ ,
- in the case of austenitic steel:
  - if its elongation after rupture exceeds 30 %,  $\frac{2}{3}$  of  $R_{e/t}$
  - or, alternatively, and if its elongation after rupture exceeds 35 %,  $\frac{5}{6}$  of  $R_{e/t}$  and  $\frac{1}{3}$  of  $R_{m/t}$ ,
- in the case of non-alloy or low-alloy cast steel,  $\frac{10}{19}$  of  $R_{e/t}$  and  $\frac{1}{3}$  of  $R_{m/20}$ ,
- in the case of aluminium,  $\frac{2}{3}$  of  $R_{e/t}$ ,
- in the case of aluminium alloys excluding precipitation hardening alloys  $\frac{2}{3}$  of  $R_{e/t}$  and  $\frac{5}{12}$  of  $R_{m/20}$ .

#### 7.2. Joint coefficients

For welded joints, the joint coefficient shall not exceed the following values:

- for equipment subject to destructive and non-destructive tests which confirm that the whole series of joints show no significant defects: 1,
- for equipment subject to random non-destructive testing: 0,85,
- for equipment not subject to non-destructive testing other than visual inspection: 0,7.

If necessary, the type of stress and the mechanical and technological properties of the joint shall also be taken into account.

### 7.3. **Pressure limiting devices, particularly for pressure vessels**

The momentary pressure surge referred to in point 2.11.2 shall be kept to 10 % of the maximum allowable pressure.

### 7.4. **Hydrostatic test pressure**

For pressure vessels, the hydrostatic test pressure referred to in point 3.2.2 shall be no less than either of the following:

- that corresponding to the maximum loading to which the pressure equipment may be subject in service taking into account its maximum allowable pressure and its maximum allowable temperature, multiplied by the coefficient 1,25,
- the maximum allowable pressure multiplied by the coefficient 1,43, whichever is the greater.

### 7.5. **Material characteristics**

Unless other values are required in accordance with other criteria that shall be taken into account, a steel is considered as sufficiently ductile to satisfy point 4.1(a) if, in a tensile test carried out by a standard procedure, its elongation after rupture is no less than 14 % and its bending rupture energy measured on an ISO V test-piece is no less than 27 J, at a temperature not greater than 20 °C but not higher than the lowest scheduled operating temperature.