# FORMULA SHEET: Fatigue, Fracture Mechanics

## Structural Mechanics

## Fatigue: Machined Components

**OR**

**Endurance limit estimates (see Dowling Table 10.1)**

Steel

Cast Iron + Cast Steels:

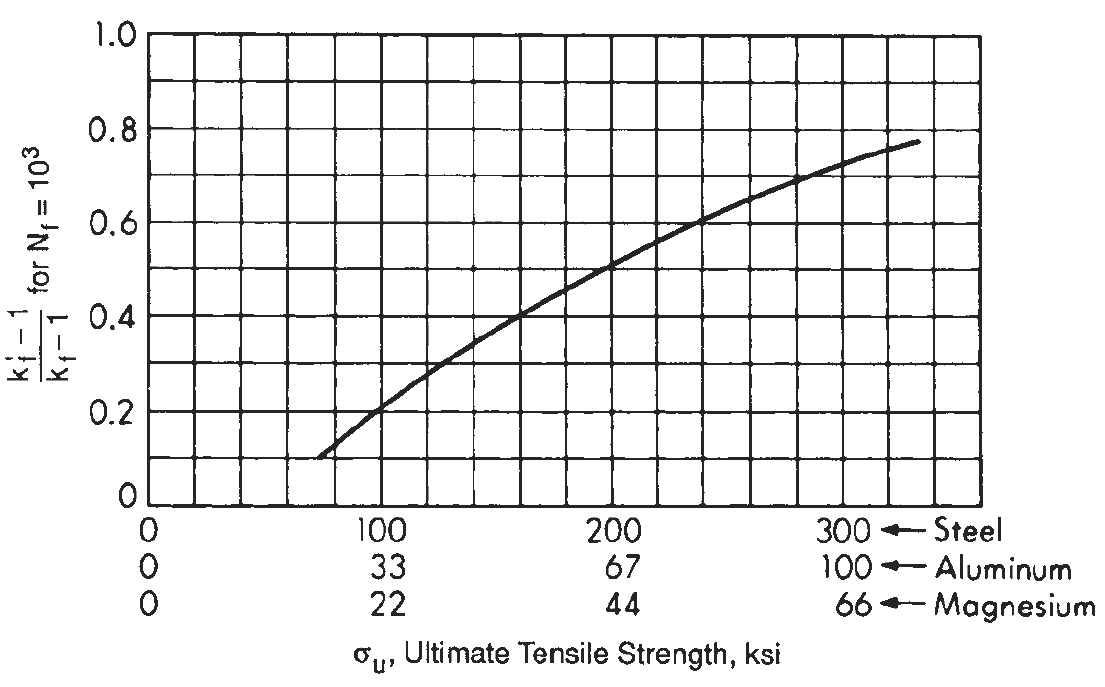
**Stress concentrations**

* :
* Approximations for :

Peterson for steels (Dowling, 2013, p. 498):

Typical values are:

* :



**Mean stress correction**

|  |  |
| --- | --- |
| **Approach** | **Equations** |
| Modified Goodman |  |
| Gerber |  |
| Morrow |  |
| SWT |  |
| Walker |  |

**Juvinall & Budynas** (Dowling, 2013, p. Table 10.1)

Juvinall

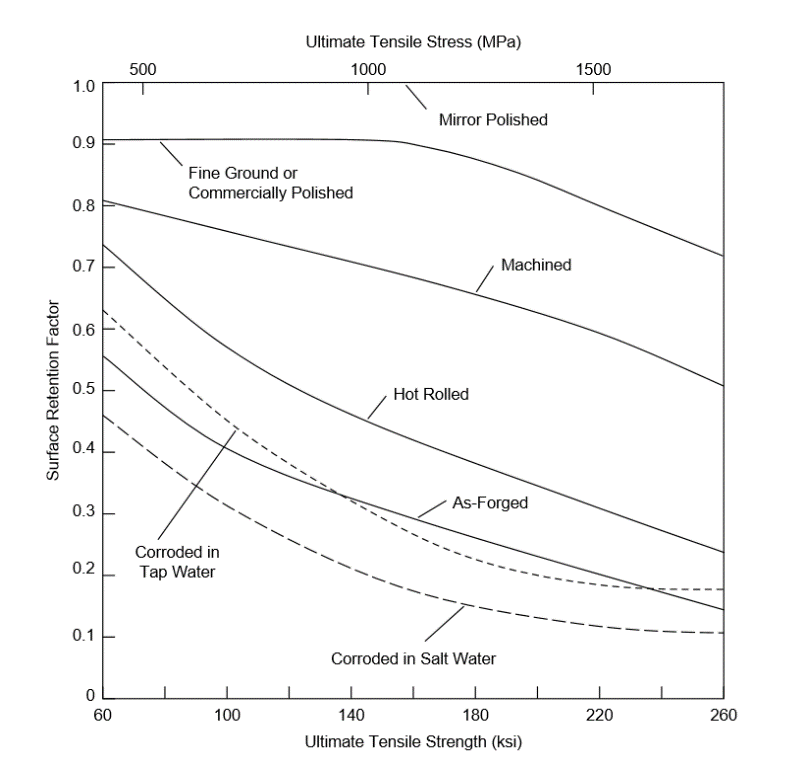
Budynas:

**Modifying factors**

**Size:**

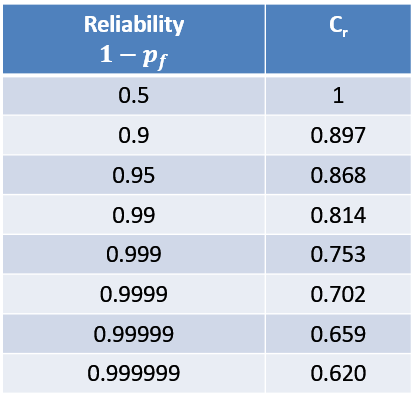
**Load:**

for axial loading if the fatigue S-N curve was obtained from completely reversed bending loading.



**Temperature:**

**Reliability:**

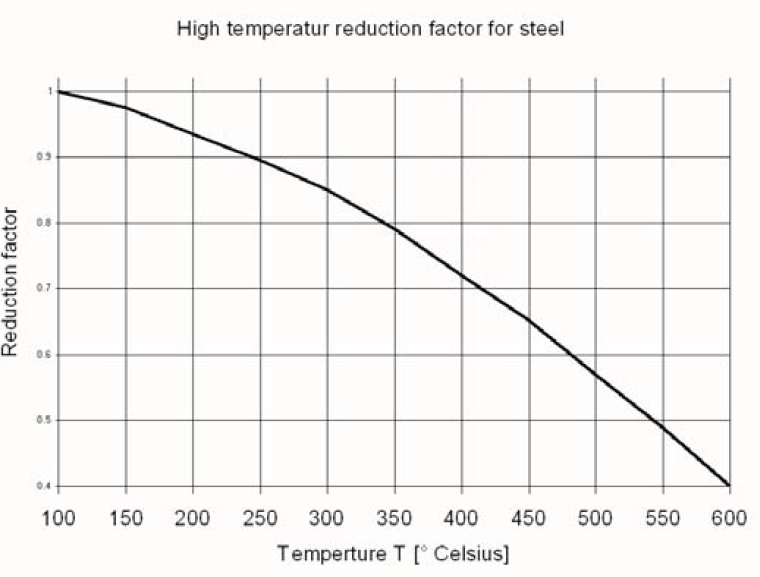


## Fatigue: Large scale manufactured components

**Partial factor for fatigue:**

|  |  |  |
| --- | --- | --- |
| **Assessment** | **Consequence of failure** | |
| **Low** | **High** |
| Damage tolerant | 1.0 | 1.15 |
| Safe life | 1.15 | 1.35 |

**Temperature:**



0.6

0.4

0.8

Grinding & TIG dressing:

Effective stress range:

Steel:

Aluminium:

Peening:

Effective stress range:

## Fracture Mechanics

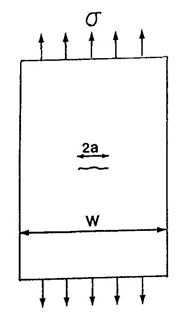
Universal equation:

Plastic collapse:

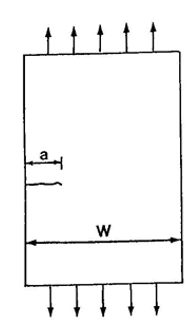
Fracture:

Stress concentration factors:

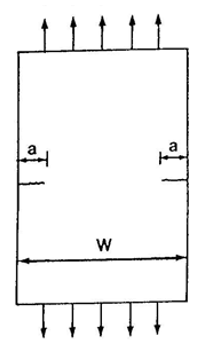
Centre cracked plate:



Single edge crack:



Double edge crack:



LEFM

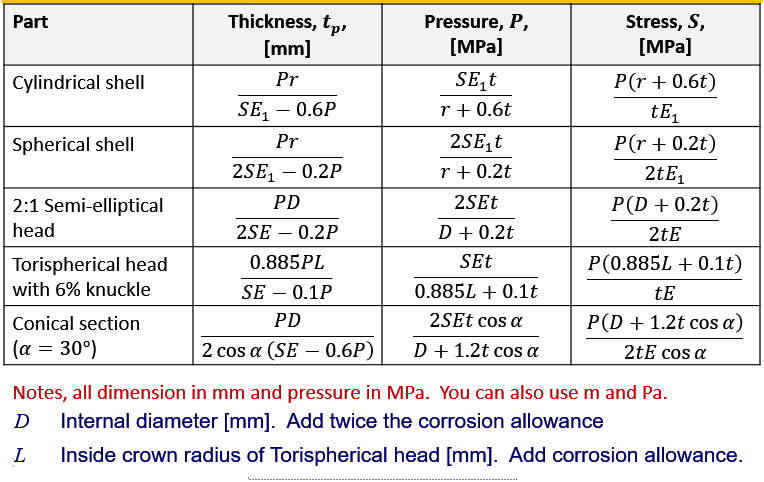
Fracture toughness estimation:

Lower limit:

Note, in Joule, in

Crack growth

## Pressure equipment

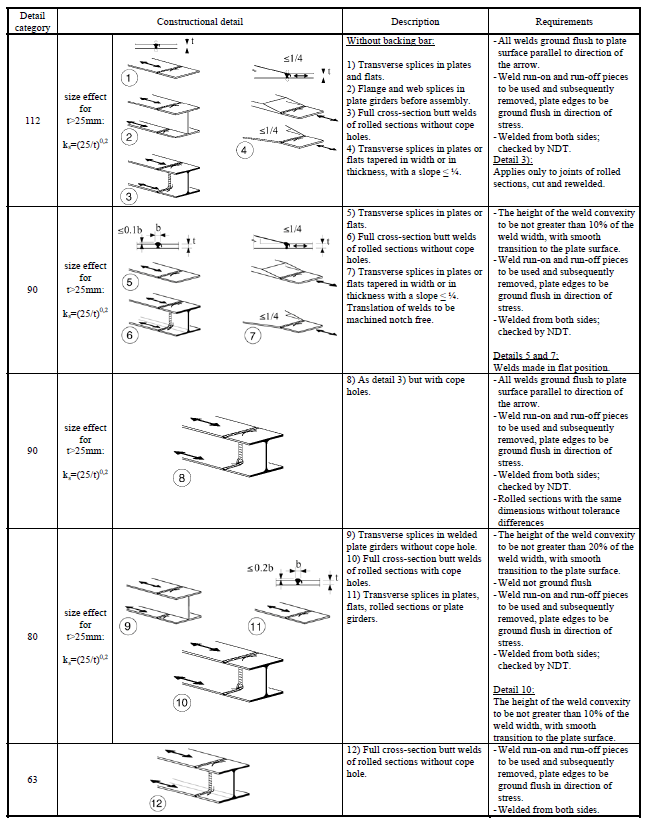


## Interpolation on a logarithmic scale using your ruler

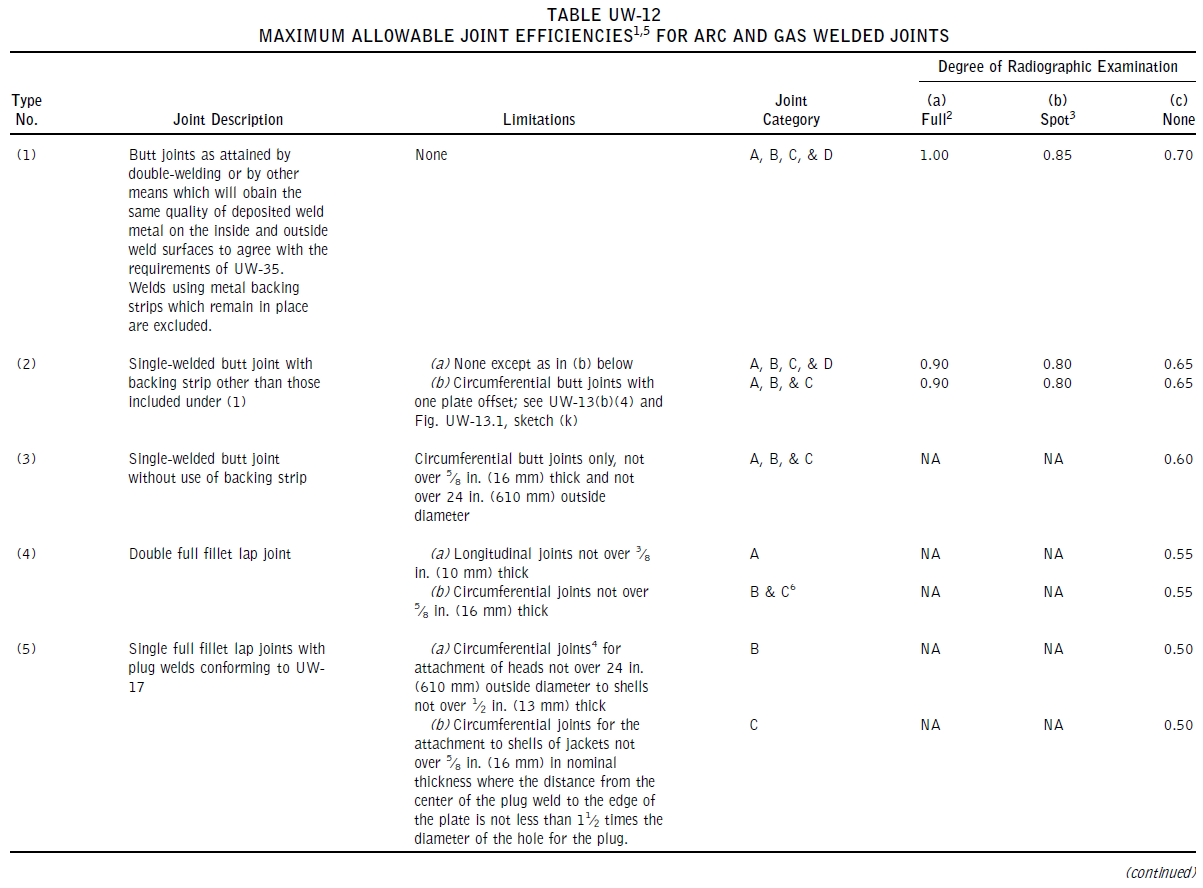
## CONVERSIONS

1 ksi = 6.89 MPa

## Detail catgories



## Joint efficiencies



## Vessels – Dangerous gas

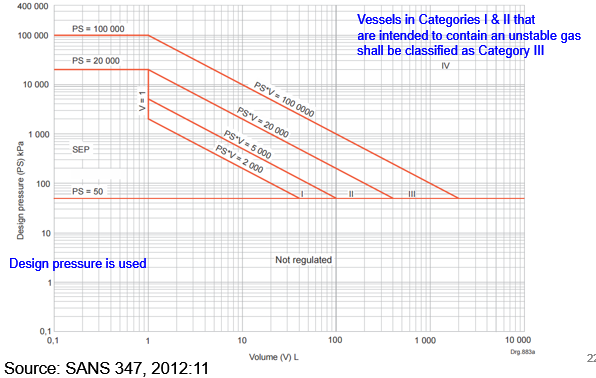
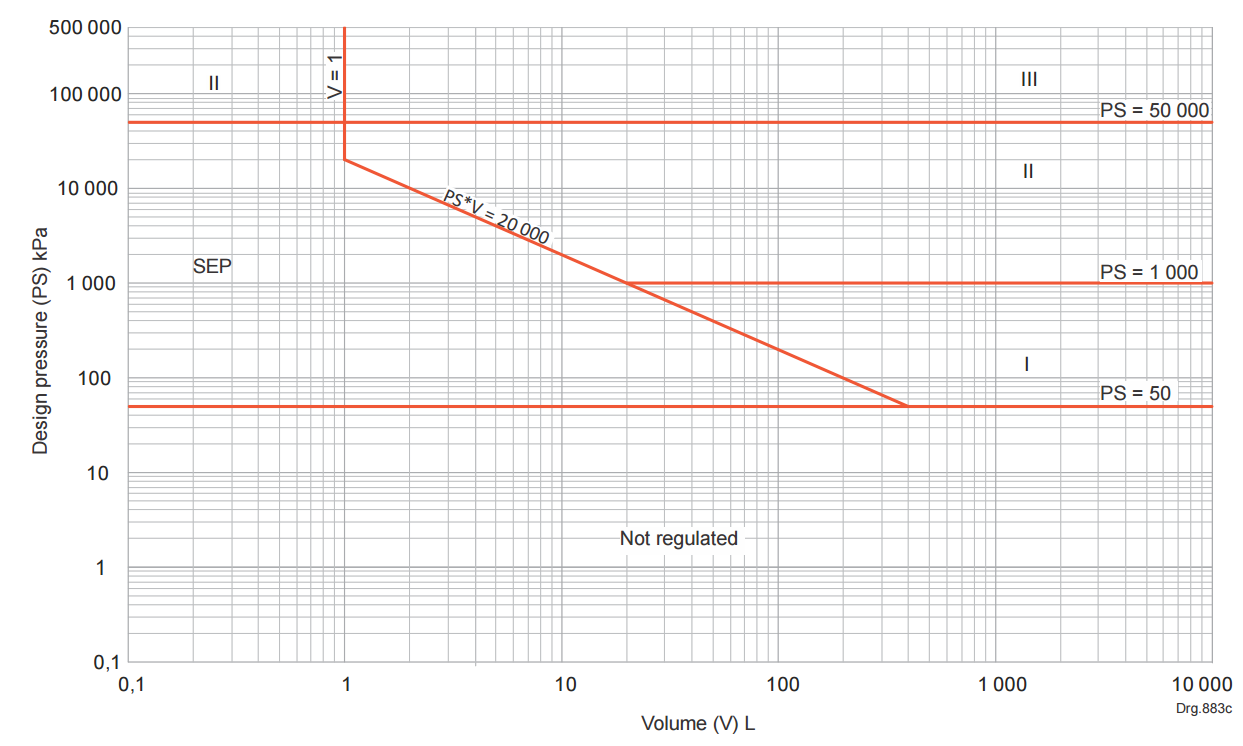


Figure : Design categorization of vessels containing dangerous gas

## Vessels – Dangerous liquids

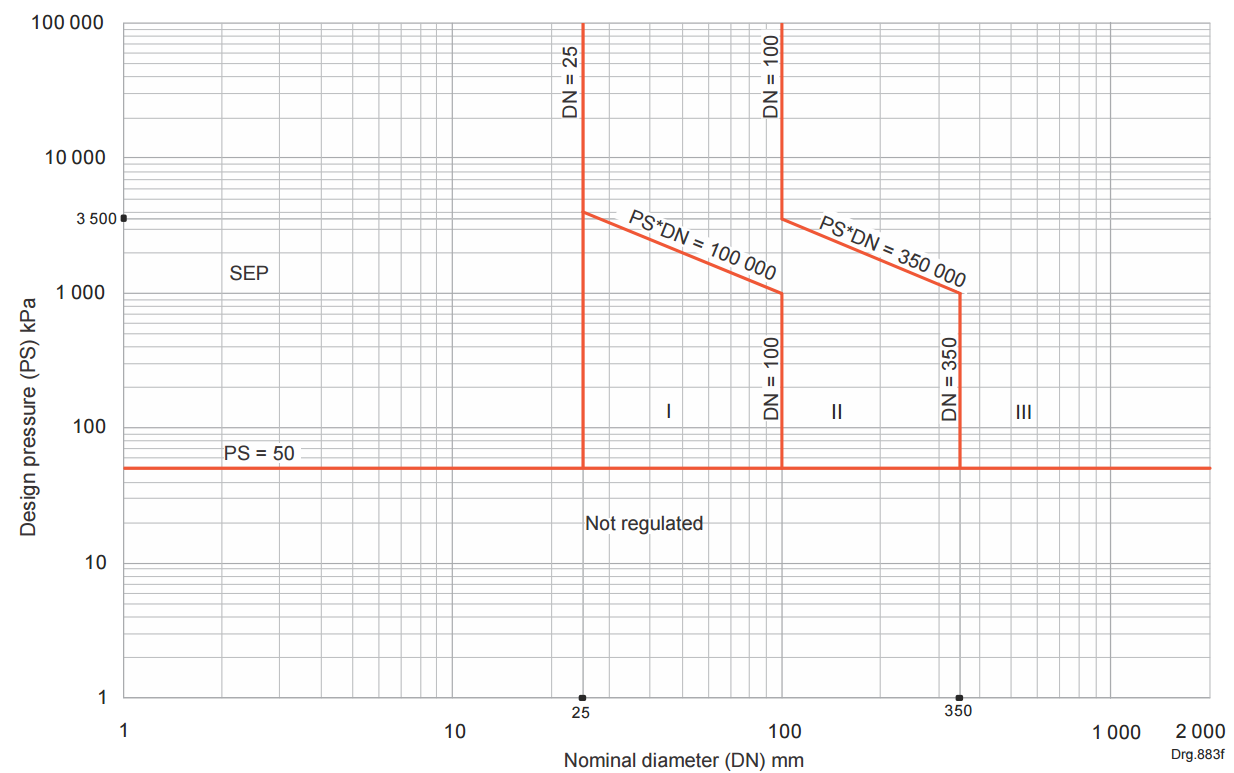


Source: (SANS 347, 2012)

Figure : Design categorization of vessels containing dangerous liquids

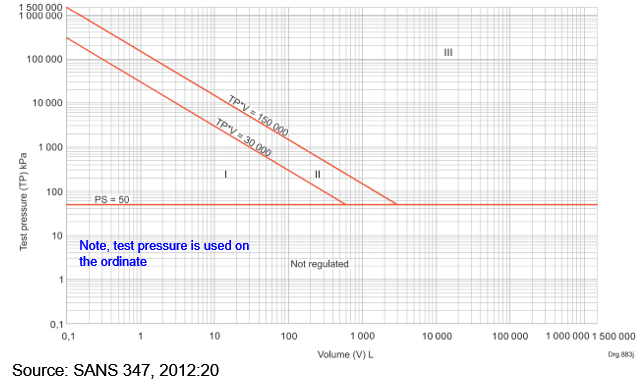
## Piping – Dangerous gas

Similar graphs are available for piping of non-dangerous gas, dangerous liquids and non-dangerous liquids.

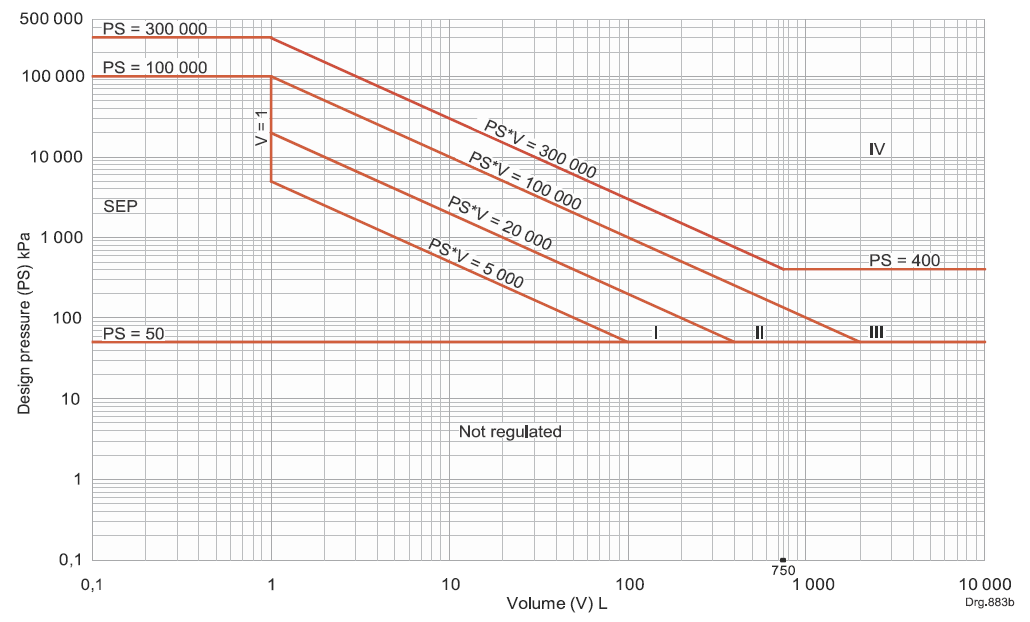


Source: (SANS 347, 2012, p. 16)

## Transportable container and vessels for dangerous gas



## Vessels: Non-dangerous gas



Source: (SANS 347, 2012, p. 12)

Figure : Design categorization of vessels: non-dangerous gas