P1 Rules for pipes

(Rev 2 1997) (Rev 3 May 1998) (Rev.4 June 2000) (Rev.5 Nov. 2001)

P1.1 Scope

(1987)

This requirement is applicable to all piping systems covered by classification unless superseded by other UR and interpretation applicable to specific piping systems.
Chemical cargo and process piping are excluded from the scope of the present requirement.

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P1.2 Strength of pipes

(1972 Rev. 1 1987 Rev. 2 1997 Rev. 3 May, 1998) (Rev.4, June 2000) (Rev.5, Nov.2001)

P1.2.1 Required wall thickness

The minimum wall thickness of pipes is not to be less than the greater of the values obtained by P1.2.2, P1.2.3, as applicable, or the minimum wall thickness required by P1.2.4.

P1.2.2 Calculated wall thickness

The following requirements apply for pipes where the ratio outside-diameter to inside-diameter does not exceed the value 1.7.
The calculated wall thickness for straight or bent pressure pipes is not to be less than determined from the following formula, as applicable:

$$t = t_0 + b + c \quad (1)$$

where t = minimum calculated thickness(mm)
t_0 = thickness calculated by the following basic formula (mm)

$$t = \frac{PD}{20\,Ke + P} \quad (2)$$

P = design pressure (bar) (see P1.2.7)
D = outside diameter (mm)
K = permissible stress (N/mm^2) (from P1.2.5 and P1.2.6)
e = efficiency factor
(i) e = 1 for seamless pipes and for welded pipes delivered by manufacturers approved for making welded pipes which are considered an equivalent to seamless pipes.
(ii) for other welded pipes the Classification Society will consider an efficiency factor value depending upon the service and the welding procedure.
b = allowance for bending
The value for this allowance is to be chosen in such a way that the calculated stress in the bend, due to the internal pressure only, does not exceed the permissible stress.
When this allowance is not determined by a more accurate procedure, it is to be taken as not less than:

$$b = \frac{1}{2{,}5}\,\frac{D}{R}\,t_0 \quad (3)$$

where R = mean radius of the bend (mm)
c = corrosion allowance (mm) (from Tables 1 and 2).

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P1.2.3 Manufacturing tolerance

The value of *t*, calculated above, does not account for any negative manufacturing tolerance; therefore the said thickness shall be increased considering the negative manufacturing tolerance by means of the following formula:

$$t_1 = \frac{t}{1 - a/100} \quad (4)$$

where t_1 = minimum thickness in the case of negative tolerance(mm)
t = minimum thickness calculated by formula (1) (mm)
a = percentage negative manufacturing tolerance.

P1.2.4 Minimum wall thickness

The minimum wall thickness is to be as indicated in Tables 3-6. For pipes subject also to Load Line Regulations see LL36.

Table 1 Corrosion allowance *c* for steel pipes

Piping service	c (mm)
Superheated steam systems	0,3
Saturated steam systems	0,8
Steam coil systems in cargo tanks	2
Feed water for boilers in open circuit systems	1,5
Feed water for boilers in closed circuit systems	0,5
Blow down (for boilers) systems	1,5
Compressed air systems	1
Hydraulic oil systems	0,3
Lubricating oil systems	0,3
Fuel oil systems	1
Cargo oil systems	2
Refrigerating plants	0,3
Fresh water systems	0,8
Sea water systems in general	3

NOTE
1. For pipes passing through tanks an additional corrosion allowance is to be considered according to the figures given in the Table, and depending on the external medium, in order to account for the external corrosion.
2. The corrosion allowance may be reduced where pipes and any integral pipe joints are protected against corrosion by means of coating,, lining, etc.
3. In the case of use of special alloy steel with sufficient corrosion resistance, the corrosion allowance may be reduced to zero.

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Table 2 Corrosion allowance *c* for non-ferrous metal pipes

Piping material	c (mm)
Copper, brass and similar alloys, copper-tin alloys except those with lead contents	0,8
Copper-nickel alloys (with Ni ≥ 10%)	0,5

NOTE
For media without corrosive action in respect of the material employed and in the case of special alloys with sufficient corrosion resistance the corrosion allowance may be reduced to zero.

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Table 3 Minimum wall thickness for steel pipes (All dimensions in mm)

Nominal size	Outside diameter	Wall thickness			
		A	B	C	D
6	10,2	1,6			
	12	1,6			
8	13,5	1,8			
10	17,2	1,8			
	19,3	1,8			
	20	2			
15	21,3	2		3,2	
	25	2		3,2	
20	26,9	2		3,2	
25	33,7	2		3,2	
	38	2	4,5	3,6	6,3
32	42,4	2	4,5	3,6	6,3
	44,5	2	4,5	3,6	6,3
40	48,3	2,3	4,5	3,6	6,3
	51	2,3	4,5	4	6,3
50	60,3	2,3	4,5	4	6,3
	63,5	2,3	4,5	4	6,3
	70	2,6	4,5	4	6,3
65	76,1	2,6	4,5	4,5	6,3
	82,5	2,6	4,5	4,5	6,3
80	88,9	2,9	4,5	4,5	7,1
90	101,6	2,9	4,5	4,5	7,1
	108	2,9	4,5	4,5	7,1
100	114,3	3,2	4,5	4,5	8
	127	3,2	4,5	4,5	8
	133	3,6	4,5	4,5	8
125	139,7	3,6	4,5	4,5	8
	152,4	4	4,5	4,5	8,8
150	168,3	4	4,5	4,5	8,8
	177,8	4,5	5	5	8,8
175	193,7	4,5	5,4	5,4	8,8
200	219,1	4,5	5,9	5,9	8,8
225	244,5	5	6,3	6,3	8,8
250	273	5	6,3	6,3	8,8
	298,5	5,6	6,3	6,3	8,8
300	323,9	5,6	6,3	6,3	8,8
350	355,6	5,6	6,3	6,3	8,8
	368	5,6	6,3	6,3	8,8
400	406,4	6,3	6,3	6,3	8,8
450	457,2	6,3	6,3	6,3	8,8

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Notes of Table 3

Columns A, B, C and D in the table apply to the following services:

A Pipes in general

B Vent, overflow and sounding pipes for integral tanks

C Bilge, ballast and sea water pipes

D Bilge, ballast, vent, overflow and sounding pipes passing through fuel tank. Bilge, vent, overflow, sounding and fuel pipes passing through ballast tanks.

Notes:

1. The nominal sizes, pipe diameters and wall thicknesses given in the table are many of the common sizes based on international standards. Notwithstanding the requirements of Table 3, diameter and thickness according to other national or international standards may be accepted.

2. Where pipes and any integral pipe joints are protected against corrosion by means of coating, lining etc. at the discretion of the Classification Society, the thickness may be reduced by not more than 1 mm.

3. For sounding pipes, except those for flammable cargoes, the minimum wall thickness in column B is intended to apply only to the part outside the tank.

4. The minimum thicknesses listed in this table are the nominal wall thickness. No allowance needs to be made for negative tolerance or for reduction in thickness due to bending.

5. For threaded pipes, where allowed, the minimum wall thickness is to be measured at the bottom of the thread.

6. The minimum wall thickness for bilge lines and ballast lines through deep tanks will be subject to special consideration by the Classification Society. The minimum wall thickness for ballast lines through oil cargo tanks is not to be less than that specified by UR F15.

7. The minimum wall thickness for pipes larger than 450mm nominal size is to be in accordance with a national or international standard and in any case not less than the minimum wall thickness of the appropriate column indicated for 450 mm pipe size.

8. The minimum internal diameter for bilge, sounding, venting and overflow pipes shall be:

Bilge	50 mm bore
Sounding	32 mm bore
Venting and overflow	50 mm bore

9. Exhaust gas pipe minimum wall thickness will be subject to special consideration by the Classification Society.

10. The minimum wall thickness for cargo oil lines will be subject to special consideration by the Classification Society.

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Table 4 Minimum wall thickness for austenitic stainless steel pipes

External diameter D (mm)	Minimum wall thickness (mm)	External diameter D (mm)	Minimum wall thickness (mm)
10.2 to 17.2	1.0	219.1	2.6
21.3 to 48.3	1.6	273.0	2.9
60.3 to 88.9	2.0	323.9 to 406.4	3.6
114.3 to 168.3	2.3	over 406.4	4.0

Note: Diameters and thicknesses according to national or international standards may be accepted.

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Table 5 Minimum wall thickness for steel pipes for CO_2 fire extinguishing

External diameter D (mm)	From bottles to distribution station	From distribution station to nozzles
21,3 - 26,9	3,2	2,6
30 - 48,3	4	3,2
51 - 60,3	4,5	3,6
63,5 - 76,1	5	3,6
82,5 - 88,9	5,6	4
101,6	6,3	4
108 - 114,3	7,1	4,5
127	8	4,5
133 - 139,7	8	5
152,4 - 168,3	8,8	5,6

NOTES

1. Pipes are to be galvanized at least inside,except those fitted in the engine room where galvanizing may not be required at the discretion of the Classification Society.
2. For threaded pipes, where allowed, the minimum wall thickness is to be measured at the bottom of the thread.
3. The external diameters and thicknesses have been selected from ISO Recommendations R336 for smooth welded and seamless steel pipes. Diameter and thickness according to other national or international standards may be accepted.
4. For larger diameters the minimum wall thickness will be subject to special consideration by the Classification Society.
5. In general the minimum thickness is the nominal wall thickness and no allowance need be made for negative tolerance or reduction in thickness due to bending.

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Table 6 Minimum wall thickness for copper and copper alloy pipes

External diameter D (mm)	Minimum wall thickness (mm)	
	Copper	Copper alloy
8 - 10	1	0,8
12 - 20	1,2	1
25 - 44,5	1,5	1,2
50 - 76,1	2	1,5
88,9 - 108	2,5	2
133 - 159	3	2,5
193,7 - 267	3,5	3
273 - 457,2	4	3,5
(470)	4	3,5
508	4,5	4

NOTE
The external diameters and the thicknesses have been selected from ISO Standards.
Diamter and thickness according to other national or international standards may be accepted.

P1.2.5 Permissible stress k for carbon steel and alloy steel pipes

The permissible stress for carbon steel and alloy steel pipes to be considered in formula (2) of P1.2.2 is to be chosen as the lowest of the following values:

$R_{20}/2,7$
$E_T/1,6$ up to $E_T/1,8$
$\sigma_{R/100\,000}/1,6$ up to $\sigma_{R/10\,000}/1,8$
$\sigma_{R/100\,000}/1$accordingly.

where R_{20} = specified minimum tensile strength (N/mm^2) at room temperature, i.e. 20°C
E_T = specified minimum yield stress or 0,2% proof stress (N/mm^2) at the design temperature (see P1.2.8)
$\sigma_{R/100\,000}$ = average stress (N/mm^2) to produce rupture in 100 000 hours at the design temperature (see P1.2.8)
$\sigma_{1/100\,000}$ = average stress (N/mm^2) to produce 1% creep in 100 000 hours at the design temperature (see P1.2.8)

NOTES
1. The values of yield stress or 0,2% proof stress given by national and international standards for steel pipes may be adopted. .

2. The values in the range between 1,6 and 1,8 are to be chosen at the discretion of the Classification Society.
3. The value of $\sigma_{1/100\,000}/1$ may be used at discretion of the Classification Society on the basis of its reliability, and if deemed necessary.

P1.2.6 Permissible stress K for copper and copper alloys

The permissible stress for copper and copper alloy pipes to be considered in formula (2) of P1.2.2 is to be taken from Table 7, depending upon design temperature (see P1.2.8). ▶

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Table 7 Permissible stress limits *K* for copper and copper alloys

Pipe material		Copper	Aluminium brass	Copper nickel Cu Ni 5 Fe 1 Mn Cu Ni 10 Fe 1 Mn	Copper nickel Cu Ni 30
Material condition		Annealed	Annealed	Annealed	Annealed
Minimum tensile strength (N/mm^2)		215	325	275	365
Permissible stress K (N/mm^2)	50°C	41	78	68	81
	75°C	41	78	68	79
	100°C	40	78	67	77
	125°C	40	78	65,5	75
	150°C	34	78	64	73
	175°C	27,5	51	62	71
	200°C	18,5	24,5	59	69
	225°C	–	–	56	67
	250°C	–	–	52	65,5
	275°C	–	–	48	64
	300°C	–	–	44	62

NOTES
1. Intermediate values may be determined by linear interpolation.
2. For materials not included in the Table, the permissible stress shall be specially considered by the Classification Society.

P.1.2.7 Design pressure

The design pressure *P* to be considered in formula (2) of P1.2.2 is the maximum working pressure and it is not to be less than the highest set pressure of any safety relief valve. For special cases, the design pressure will be specially considered. For pipes containing fuel oil, the design pressure is to be taken in accordance with Table 8.

Table 8. Definition of the design pressure for fuel oil systems

Working temperature / Working Pressure	$T \leq 60^0$ C	$T > 60^0$ C
P ≤ 7 bar	3 bar or max. working pressure, whichever is the greater	3 bar or max. working pressure, whichever is the greater
P > 7 bar	max. working pressure	14 bar or max. working pressure, whichever is the greater

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P1.2.8 Design temperature

The design temperature to be considered for determining the permissible stress in P1.2.5 and P1.2.6 is in general the maximum temperature of the medium inside the pipes. For special cases, the design temperature will be specially considered.

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P1.3 (1972 (Rev. 1 1987)

P1.3 Flanges

The dimensions of flanges and relative bolts are to be chosen in accordance with the national standards. For special application the dimensions of flanges and relative bolts will be subject to special consideration*.

*For special applications, when the temperature, the pressure and the size of the flange have values above certain limits, to be fixed, the complete calculation of bolts and flanges is to be carried out.

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P1.4 (Nov. 2001)

P1.4 Valves and Fittings

Valves and fittings in piping systems are to be compatible with the pipes to which they are attached in respect of their strength (see P1.2.7 for design pressure) and are to be suitable for effective operation at the maximum working pressure they will experience in service.

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