7.2 The tightness test on the tubes is verified by a certificate of compliance with the order[11]).

7.3 The following proof shall be provided for the mechanical properties, visual examination and dimensional check:

7.3.1 For unalloyed aluminium materials as specified in 2.1, inspection certificate 3.1.B.

7.3.2 For wrought aluminium alloys 3003, 3103, 6060, 5754, 5049 and 5083 as specified in 2.1, test certificates 3.1.C/3.2 according to DIN EN 10204. An inspection certificate 3.1.B is adequate if the manufacturer has provided the relevant third party with proof of adequate statistical reliability and has kept the results available for inspection at any time.

Confirmation of a change to an inspection certificate 3.1.B shall be indicated to the manufacturer and can also be initiated for each size group in agreement with the relevant third party. If use is made of this procedure, the confirmation letter from the relevant third party shall be included in the inspection certificate 3.1.B.

At specific intervals, (approximately 1 or 2 years) the relevant third party shall satisfy itself that the preconditions continue to be met assuming this does not happen within the framework of continuous inspection tests.

7.3.3 For materials specified in 2.2 and 2.3, test certificates 3.1.C/3.2 according to DIN EN 10204 as long as nothing else is specified in the report of the relevant third party.

8 Design strength values

8.1 Table 3 applies to calculation values. The calculation values given in table 3 for the temperature range from −196 or −270 to +20 °C also apply to pressure vessels operated under ambient conditions.

Linear interpolation shall be effected between the values given for operating temperatures > 20 °C, the strength values being rounded down to the nearest full unit.

The temperature is rounded to the next full 5 °C in the range of longterm values. The interpolated strength values shall be rounded down to the nearest full unit.

8.2 As safety factor $S = 1{,}5$ shall be included for the calculation (internal pressure stress).

Table 1. Suitable materials; composition, delivery condition and field of application

EN symbol	Composition according to	Delivery condition according to product form (see Table 2)	Working temperature range
A. Materials for general application			
EN AW-1098	DIN EN 573-3	O/H111, H112	−270 °C to 100 °C
EN AW-1080A	DIN EN 573-3	O/H111, H112	−270 °C to 100 °C
EN AW-1070A	DIN EN 573-3	O/H111, H112	−270 °C to 100 °C
EN AW-1050A	DIN EN 573-3	O/H111, H112	−270 °C to 300 °C
EN AW-5754	DIN EN 573-3	O/H111, H112	−270 °C to 150 °C
EN AW-5049	DIN EN 573-3	O/H111, H112	−270 °C to 250 °C
EN AW-5083	DIN EN 573-3	O/H111, H112	−270 °C to 80 °C[1])
B. Materials for certain low-temperature applications (see Table C.2)			
EN AW-3003	DIN EN 573-3	F, O	−270 °C to 50 °C[1])
EN AW-3103	DIN EN 573-3	O/H111, H112	−270 °C to 50 °C[1])
EN AW-6060	DIN EN 573-3	T4	−196 °C to 50 °C[1])

[1]) For short periods, higher temperatures are permitted (e.g. when defrosting refrigerating plant) up to 150 °C are permissible provided that the pressure is reduced to half the working pressure for a period up to 8 hours and to atmospheric pressure for a period up to 24 hours.

Table 2. Mechanical properties at room temperature (minimum values)[1]

A. Semi-finished products in the soft state[2]

Material	Product forms and dimensional limits						Mechanical properties						
	Plates[3] Thickness	Tubes Wall Thickness	Bars				0,2-%-limit	1,0-%-limit	Tensile strength	Elongation after fracture A[6]			Notched bar impact strength DVM
			Round Diameter	Square Edge-length	Hexagonal Width-across-flats	Rectangular Thickness				Plates	Tubes	Bars (round, flat. etc.)	
	mm	mm	mm	mm	mm	mm	MPQ	MPQ	MPQ	%	%	%	J/cm²
EN AW-1098 0/H111	≤ 5	–	1 to 30	2 to 30	3 to 30	2 to 6	–	17	40	33	–	29	–
EN AW-1098 0/H111	> 5 to 20	–	–	–	–	–	–	17	40	30	–	–	–
EN AW-1080A 0/H111	≤ 6	0,3 to 16	2 to 30	2 to 30	3 to 30	2 to 6	–[4]	22	60	40	27	27	–
EN AW-1080A H112	≤ 25	–	–	–	–	–	18	22	60	21	–	–	–
EN AW-1070A 0/H111	≤ 6	–	–	–	–	–	–[4]	25	60	40	–	–	–
EN AW-1070A H112	≤ 25	–	–	–	–	–	18	25	60	21	–	–	–
EN AW-1050A 0/H111	≤ 25	0,3 to 16	2 to 30	2 to 30	3 to 30	2 to 6	20[4]	30	65	35	25	25	–
EN AW-1050A H112	≤ 50	–	–	–	–	–	20	30	75	20	–	–	–
EN AW-5754 0/H111	–	0,3 to 10	2 to 100	2 to 60	3 to 60	2 to 20	80	–	180	–	17	16	30
EN AW-5754 0/H111	≤ 25	–	–	–	–	–	80	–	190	18	–	–	30
EN AW-5754 H112	25 to 50	–	–	–	–	–	80	–	190	14	–	–	30
EN AW-5049 0/H111	–	0,3 to 10	–	–	–	–	80	–	180	–	17	–	30
EN AW-5049 0/H111	≤ 25	–	–	–	–	–	80	–	190	18	–	–	30
EN AW-5049 H112	25 to 50	–	–	–	–	–	80	–	190	14	–	–	30
EN AW-5083 0/H111[5]	≤ 50	–	–	–	–	–	125	–	275	17	–	–	25
EN AW-5083 0/H111	–	to 10	to 100	to 100	to 100	2 to 50	110	–	270	–	14	14	25
EN AW-5083 H112	≤ 30	–	–	–	–	–	125	–	275	14	–	–	25

[1] Values applicable for longitudinal and transverse directions.

[2] The term "soft" is used to designate a material state which is achieved by soft annealing following cold- and hot-working, or which is achieved directly without any soft annealing by hot-working with such high degrees of deformation and at such high temperatures that the guaranteed procperties specified in Table 2A are maintained.

[3] Also applicable for strip up to 10 mm.

[4] The following maximum values shall be noted: EN AW-1080 0/H111 max. 50 MPa, EN AW-1070 A0/H111 max. 50 MPa, EN AW-1050 A, plates max. 55 MPa, tubes, bars max. 60 MPa.

[5] For a plate thickness ≤ 30 mm, a reduction of area ≥ 30 % shall be ensured and for a plate thickness > 30 ≤ 50 mm, a reduction of area ≥ 20 %.

[6] As a deviation from the provisions of the relevant DIN ENs, specifying a gauge length of 50 mm (A50) for wall thicknesses ≤ 12,5 mm ≥ 3 mm, testing with a proportional test piece (A) is generally specified in this AD 2000-Merkblatt.

Table 3. Design characteristic values in N/mm²

Material and state	Characteristic	Design temperatur in °C						
		−270[6]) to 20	50	100	150	200	250	300
EN AW-1098 0/H111 and H112	$R_{p1,0}$	17	15	13	–	–	–	–
EN AW-1080A 0/H111 and H112	$R_{p1,0}$	22	20	18	–	–	–	–
EN AW-1070A 0/H111 and H112	$R_{p1,0}$	25	23	20	–	–	–	–
EN AW-1050A 0/H111 and H112	$R_{p1,0}$	30	29	27	–	–	–	–
EN AW-1050A 0/H111 and H112	$R_{m/10}$[5]	–	–	27	18	11	8	(3)
EN AW-3003 0/H111[2])[5])	$R_{p0,2}$	35	35	–	–	–	–	–
EN AW-3103 0/H111 and H112	$R_{p0,2}$	35	35	–	–	–	–	–
EN AW-6060 T4	$R_{p0,2}$	65	65	–	–	–	–	–
EN AW-5754 0/H111 and H112	$R_{p0,2}$	80	80	70	–	–	–	–
EN AW-5754 0/H111 and H112	$R_{m/10}$[5]	–	–	(80)	45	–	–	–
EN AW-5049 0/H111 and H112	$R_{p0,2}$	80	80	70	–	–	–	–
EN AW-5049 0/H111 and H112	$R_{m/10}$[5]	–	–	(100)	48	22	16	–
EN AW-5049 and H112[1])	$R_{p0,2}$	100	100	90	–	–	–	–
EN AW-5049 and H112[1])	$R_{m/10}$[5]	–	–	(120)	60	25	20	–
EN AW-5083 0/H111 and H112[2])	$R_{p0,2}$	125	125	(120)	–	–	–	–
EN AW-5083 H112[3])	$R_{p0,2}$	130	130	(120)	–	–	–	–
EN AW-5083 0/H111 and H112[4])[5])	$R_{p0,2}$	110	110	(120)	–	–	–	–
Modulus of elasticity E		70 000	69 000	68 000	66 000	63 000	57 000	(50 000)

[1]) The design characteristic values also apply to welded components as the material is not in the work-hardened state.
[2]) Plates soft and hot-rolled as specified in DIN EN 485-2
[3]) Tubes, bars and profiles, pressed as specified in DIN EN 765-2
[4]) Forgings as specified in DIN EN 586-2
[5]) Tubes, bars and profiles, soft as specified in DIN EN 755-2
[6]) For material EN AW-6060, −196 °C to 20 °C applies