

9 bcgHJj bYbYc[fYj UbYhU bYdcgcXYžbUa YbYbYnUnfU_`U]Xi ý_`!`%rXY.`H`U bY
dcgcXYnUgd`cybYbUa YbY

Simple unfired pressure vessels designed to contain air or nitrogen - Part 1: Pressure vessels for general purposes

Einfache unbefeuerte Druckbehälter für Luft oder Stickstoff - Teil 1: Druckbehälter für allgemeine Zwecke

iTeh STANDARD PREVIEW

Réipients a pression simples, non soumis a la flamme, destinés a contenir de l'air ou de l'azote - Partie 1: Réipients

[SIST EN 286-1:1998](https://standards.itih.ai/catalog/standards/sist/1a8f0bbc-b1b5-4ccc-8a1b-9657b4c27465/sist-en-286-1-1998)

<https://standards.itih.ai/catalog/standards/sist/1a8f0bbc-b1b5-4ccc-8a1b-9657b4c27465/sist-en-286-1-1998>

Ta slovenski standard je istoveten z: EN 286-1:1998

ICS:

23.020.30	V æ } ^Á [• [å^Ä ã • \ ^ b\ ^ } \ ^	Pressure vessels, gas cylinders
-----------	--	---------------------------------

SIST EN 286-1:1998

en

iTeh STANDARD PREVIEW **(standards.iteh.ai)**

SIST EN 286-1:1998

<https://standards.iteh.ai/catalog/standards/sist/1a8f0bbc-b1b5-4ccc-8a1b-9837b4c27465/sist-en-286-1-1998>

ICS 23.020.30

Supersedes EN 286-1:1998

Descriptors: pressure vessels, gas pressure vessels, tanks : containers, air, nitrogen, classifications, materials, steels, aluminium, aluminium alloys, design, manufacturing, welding, qualification, procedures, tests, technical notices, marking, certification

English version

Simple unfired pressure vessels designed to contain air or nitrogen - Part 1: Pressure vessels for general purposes

Réipients à pression simples, non soumis à la flamme,
destinés à contenir de l'air ou de l'azote - Partie 1:
Réipients pour usage général

Einfache unbefeuerte Druckbehälter für Luft oder Stickstoff
- Teil 1: Druckbehälter für allgemeine Zwecke

This European Standard was approved by CEN on 30 November 1997.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

SIST EN 286-1:1998

<https://standards.iteh.ai/catalog/standards/sist/1a8f0b8e-b1b5-4ccc-8a1b-9837b4c27465/sist-en-286-1-1998>



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

Contents

	Page
Foreword	4
1 Scope	5
2 Normative references	6
3 Definitions, symbols and units	8
3.1 Definitions	8
3.2 General symbols and units	10
4 Classifications and certification procedures	12
5 Materials	12
5.1 Main pressurized parts (see also 5.2)	12
5.2 Accessories contributing towards the strength of vessels	14
5.3 Non-pressurized parts	14
5.4 Welding consumables	14
6 Design	14
6.1 General	14
6.2 Weld joint design	15
6.3 Determination of wall thicknesses	19
6.4 Calculation method	21
6.5 Experimental method	57
6.6 Access and inspection openings	59
6.7 Drainage openings	62
6.8 Supports	62
7 Fabrication	66
7.1 Manufacturing and testing equipment	66
7.2 Forming of ends and shell	66
7.3 Typical connections of main body	67
7.4 Welding	70
8 Qualification of welders and welding operators	71
9 Qualification of welding procedures	71
9.1 General	71
9.2 Additional requirements for steel vessels	71
9.3 Existing welding procedures	71
10 Testing	71
10.1 Calibration	71
10.2 Vessels designed by calculation method	72
10.3 Vessels designed by experimental method	78
10.4 Testing records	79
10.5 Pressure test	80
11 Instructions to accompany the vessel	80
12 Marking	81

ITEH STANDARD PREVIEW
(standards.iteh.ai)

SIST EN 286-1:1998
<https://standards.iteh.ai/catalog/standards/sist/1a8f0bbc-b1b5-4ccc-8a1b-7637b4c27405/sist-286-1-1998>

Annex A (normative)	Verification	82
Annex B (normative)	Declaration of conformity - Surveillance	83
Annex C (normative)	Design and manufacturing schedules	86
Annex D (normative)	Type examination	87
Annex E (normative)	Content of the manufacturing record	87
Annex F (normative)	Test of the protection against corrosion	89
Annex G (informative)	Essential safety requirements	91

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST EN 286-1:1998](https://standards.iteh.ai/catalog/standards/sist/1a8f0bbc-b1b5-4ccc-8a1b-9837b4c27465/sist-en-286-1-1998)
<https://standards.iteh.ai/catalog/standards/sist/1a8f0bbc-b1b5-4ccc-8a1b-9837b4c27465/sist-en-286-1-1998>

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 54 "Unfired pressure vessels", the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 1998, and conflicting national standards shall be withdrawn at the latest by August 1998.

It is the revision of the standard adopted by CEN in 1991. Main changes concern:

- scope;
- materials;
- weld joint design;
- calculations coefficient;
- flange calculations;
- reinforcement of openings;
- supports;
- testing and inspection;
- instruction and marking;
- corrosion allowance.

Although the requirements of this standard support the essential safety requirements of the Simple pressure vessel Directive 87/404/EEC, that directive does not make compliance with this standard mandatory. This standard includes an interpretation of the conformity assessment requirements of the directive and thus the national implementing legislation. These interpretations cannot be taken as having any formal status and carry the risk of misinterpretation. Users of this standard should, therefore, refer to the applicable national legislation for the definitive conformity assessment requirements. A further revision of this standard is being prepared to remove any misleading provisions.

This standard 'Simple unfired pressure vessels designed to contain air or nitrogen' is one of a series of four. The other standards cover :

Part 2 : pressure vessels for air braking equipment and auxiliary systems for motor vehicles and their trailers ;

Part 3 : steel pressure vessels designed for air braking equipment and auxiliary pneumatic equipment for railway rolling stock ;

Part 4 : aluminium alloy pressure vessels designed for air braking equipment and auxiliary pneumatic equipment for railway rolling stock.

This Part of this European Standard has been prepared for use in conjunction with the informative annex G of this European Standard.

No rules of construction can be written in sufficient detail to ensure good workmanship and construction. Each manufacturer is responsible for taking every necessary step to make sure that the quality of workmanship and construction is such as to ensure compliance with good engineering practice. Aspects of quality assurance are dealt with in various clauses and annexes of this standard, for example in clause 10, Testing, and annexes A, Verification, B, Declaration of conformity - surveillance ; C, Design and manufacturing schedule, D, Type examination ; E, Content of manufacturing record, all of which form part of this standard. These are minimum requirements, having taken into account EN ISO 9002 *Quality systems - Model for quality assurance in production, installation and servicing* and EN ISO 9003 *Quality systems - Model for quality assurance in final inspection and test*, but it is not implied that a quality system in accordance with EN ISO 9002 and EN ISO 9003 is necessary.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

The general layout of the standard was not changed and accordingly is not in full conformity with the recent CEN rules for harmonised standards.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

1.1 This Part of this European Standard applies to the design and manufacture of welded, simple unfired pressure vessels manufactured in series, with a single compartment, here-in-after referred to as vessels, the essential safety requirements of which are given in annex G.

It only applies to vessels that :

- a) include fabrication by welding, but some designs can entail the use of bolts ;
- b) have a simple geometry enabling simple-to-use production procedures. This is achieved by either
 - 1) a cylindrical part of circular cross section closed by outwardly dished and/or flat ends which revolve around the same axis as the cylindrical part ; or
 - 2) two outwardly dished ends revolving around the same axis ;
- c) have branches not larger in diameter than 0,5 of the diameter of the cylinder to which they are welded.

1.2 It applies to vessels which are intended to contain air or nitrogen which are not intended to be fired and which operate within the following constraints :

- a) subjected to an internal gauge pressure greater than 0,5 bar ;
- b) the parts and assemblies contributing to the strength of the vessel under pressure to be made either of non-alloy quality steel or of non-alloy aluminium or non-age hardening aluminium alloys ;

NOTE: In this part of the Standard, the use of “aluminium” covers non-alloy aluminium and aluminium alloys.

- c) the maximum working pressure is not greater than 30 bar. The product of the maximum working pressure and the capacity of the vessel ($PS.V$) is greater than 50 bar.l but does not exceed 10 000 bar.l. Below 50 bar.l use of this standard is considered to fulfil the requirements of sound engineering practice ;
- d) the minimum working temperature is not lower than -50 °C and maximum working temperature not higher than 300 °C for steel and 100 °C for aluminium or aluminium alloy vessels.

It does not apply to vessels specifically designed for nuclear use, to vessels specifically intended for installation in or the propulsion of ships and aircraft, or to fire extinguishers.

The standard does not apply to transportation vessels nor to vessels which also contain substances other than air or nitrogen which could adversely effect their safety. For vessels to contain compressed air for braking systems of road vehicles and their trailers see also EN 286-2. For vessels to contain compressed air for braking systems of rail mounted vehicles see also EN 286-3 and EN 286-4.

SIST EN 286-1:1998

1.3 It applies to the vessel proper, from the inlet connection to the outlet connection and to all other connections required for valves and fittings. If bosses/pipes are used the requirements specified herein begin or end at the weld where flanges, if used, would have been fitted.

1.4 For the purposes of calculations required to be made in accordance with this standard, dimensions are in millimetre, pressures are in bar (except otherwise specified), stresses are in newton per square millimetre and temperatures are in degree Celsius.

2 Normative references

This European Standard incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

- EN 287-1 Approval testing of welders : Fusion welding - Part 1 : Steels.
- EN 287-2 Approval testing of welders : Fusion welding - Part 2 : Aluminium and aluminium alloys.
- EN 288-2 Specification and approval of welding procedures for metallic materials - Part 2 : Welding procedure specification for arc welding.
- EN 288-3 Specification and approval of welding procedures for metallic materials - Part 3 : Welding procedure tests for arc welding of steels.
- EN 288-4 Specification and approval of welding procedures for metallic materials - Part 4 : Welding procedure tests for arc welding of aluminium and its alloys.
- EN 473 Qualification and certification of NDT personnel - General principles
- EN 485-2 Aluminium and aluminium alloys - Sheet, strip and plates - Part 4: Tolerances on shape and dimensions for cold rolled products
- EN 573-3 Aluminium and aluminium alloys - Chemical composition and form of wrought products - Part 3: Chemical composition
- EN 573-4 Aluminium and aluminium alloys - Chemical composition and form of wrought products - Part 4: Forms of products
- EN 754-2 Aluminium and aluminium alloys - Wrought products - Cold drawn rod/bar and tubes - Part 2: Mechanical properties
- EN 755-2 Aluminium and aluminium alloys - Wrought products - Extruded rod/bar, tube and profile - Part 2: Mechanical properties
- EN 875 Welding - Welded joints in metallic materials - Specimen location and notch orientation for impact tests
- EN 910 Welding - Welded butt joints in metallic materials - Bend tests
- EN 1418 Welding personnel - Approval testing of welding personnel for fully mechanized and automatic welding of metallic materials
- EN 1435 Non destructive examination of welds - Radiographic examination of welded joints
<https://standards.iteh.ai/catalog/standards/sist/1a8f0bbc-b1b5-4ccc-8a1b-7452a1c10101>
- EN 10002-1 Metallic materials - Tensile testing - Part 1 - Method of test (at ambient temperature).
- EN 10028-2 Flat products made of steels for pressure purposes - Part 2: Non-alloy and alloy steels with specified elevated temperature properties

- EN 10204 Metallic products - Types of inspection documents
- EN 10207 Steels for simple pressure vessels - Technical delivery requirements for plates, strips and bars.
- EN 10216-1 Seamless steel tubes for pressure purposes - Technical delivery conditions - Part 1: Non alloy steels with specified room temperature properties (based on ISO 9329-1)
- EN 10217-2 Welded steel tubes for pressure purposes - Technical delivery conditions - Part 2: Unalloyed and alloyed steels with specified elevated temperature properties (based on ISO 9330-2)
- EN 10222-4 Steel forgings for pressure purposes - Part 4: Weldable fine grain steel with high proof strength
- EN 10226-1 Pipe threads where pressure tight joints are made on the thread - Part 1: Designation, Dimensions and tolerances
- EN 20898-1 Mechanical properties of fasteners - Part 1 : Bolts, screws and studs.
- EN 20898-2 Mechanical properties of fasteners - Part 2 : Nuts with specified proof load values.
- EN 25817 Arc-welded joints in steel - Guidance on quality level for imperfections
- EN 30042 Arc-welded joints in aluminium and its weldable alloys - Guidance on quality levels for imperfections
- EN ISO 2409:1994 Paints and varnishes - Cross-cut test
- ISO 228-1 Pipe threads where pressure tight joints are not made on the threads - Part 1 : Designation, dimensions and tolerances.
- ISO 3057 Non destructive testing - Metallographic replica techniques of surface examination
- ISO 7005-1 Metallic flanges - Part 1 : Steel flanges.
- ISO 7253:1996 Paints and varnishes - Determination of resistance to neutral salt spray

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST EN 286-1:1998](https://standards.iteh.ai/catalog/standards/sist/1a8f0bbc-b1b5-4ccc-8a1b-9837b4c27465/sist-en-286-1-1998)

<https://standards.iteh.ai/catalog/standards/sist/1a8f0bbc-b1b5-4ccc-8a1b-9837b4c27465/sist-en-286-1-1998>

3 Definitions, symbols and units

3.1 Definitions

For the purposes of this Standard the following definitions apply:

3.1.1 automatic welding : Welding in which all the welding parameters are automatically controlled, some of these parameters may be adjusted to a limited amount (manually or automatically by mechanical or electronic devices) during welding to maintain the specified welding conditions.

3.1.2 non-automatic welding : All types of welding other than that defined in 3.1.1.

3.1.3 batch : A batch of vessels consists at the most of 3000 vessels of the same type.

3.1.4 type of vessel : Vessels are of the same type if the 5 following conditions are met :

- have similar geometrical form (i.e shell rings and ends or only ends, in both cases ends of the same shape) ;
- belong to the same class (see clause 4) ;
- have wall material and thickness within the limit of validity of the weld procedure, including those for branches, nozzles and inspection opening ;
- have the same type of inspection openings, (sightholes, handholes, headholes and manholes are examples of different types of inspection openings) ;
- have the same design temperature limitations.

3.1.5 declaration of conformity : The procedure whereby the manufacturer certifies vessels to be in conformity with this European Standard (see annex B).

3.1.6 verification : The procedure adopted to check and certify that vessels manufactured comply with this European Standard (see annex A).

3.1.7 surveillance : The procedure carried out by an approved inspection body during manufacture to ensure that the manufacturer duly fulfils the requirements of this European Standard (see B.3.2).

3.1.8 type examination : The procedure by which an approved inspection body ascertains and certifies that a specimen of a vessel satisfies the provisions of this European Standard (see annex D).

3.1.9 design and manufacturing schedule : A schedule, issued by the manufacturer, the purpose of which is to describe the construction, material and fabrication including the certificates (see annex C).

3.1.10 manufacturing record : A record kept by the manufacturer of all the relevant information on the vessels manufactured to this standard.

3.1.11 design temperature

3.1.11.1 maximum design temperature : The temperature that is used in the design calculations, and which is never less than the maximum working temperature.

3.1.11.2 minimum design temperature : The lowest temperature used in the selection of materials, and which is never greater than the minimum working temperature.

3.1.12 minimum working temperature, T_{\min} : The lowest stabilized temperature in the wall of the vessel under normal conditions of use.

3.1.13 maximum working temperature, T_{\max} : The highest stabilized temperature which the wall of the vessel can attain under normal conditions of use.

3.1.14 design pressure, P : The pressure used in design calculations, and which is never less than the maximum working pressure PS .

3.1.15 maximum working pressure, PS : The maximum gauge pressure which may be exerted under normal conditions of use. (The set pressure of the pressure relief device is never greater than PS , but after pressure relief has commenced the pressure can exceed PS by 10 % maximum).

3.1.16 manufacturer's inspector : A person(s) employed and authorized by the manufacturer, but independent from the production personnel, qualified and responsible for inspections, examinations and tests to be carried out by him on vessels.

Qualification means technical competency on the different inspections, examinations and tests to be carried out under the manufacturer's responsibility as well as necessary experience. It is the responsibility of the manufacturer to ascertain that the inspector is competent.

3.1.17 report on the examinations and tests : A report of the examinations and tests carried out by the manufacturer.

3.1.18 test report: Document in which the manufacturer certifies that the products supplied are in compliance with the requirements of the order and in which he supplies test results based on non specific inspection and testing [2.2 in EN 10204].

NOTE 1: This corresponds to "inspection slip" defined in the Directive.

NOTE 2: In this definition, manufacturer means material manufacturer.

3.1.19 series manufacture : More than one vessel of the same type manufactured during a given period by a continuous manufacturing process in accordance with a common design and using the same manufacturing process.

3.1.20 main body : Main body means main shell and/or ends.

3.2 General symbols and units

International System (S.I.) units are used in the standard as follows :

- dimensions (thickness, diameter, length, ...)	: mm
- areas	: mm ²
- loads, forces	: N
- moments	: N.mm
- pressures	: bar or N/mm ² (see note)
- stresses, yield strength, tensile strength,...	: N/mm ²

NOTE : Concerning the design pressure P , the unit N/mm² is used throughout the subclause 6.4 in order to have a coherent system of units for the formula. The unit bar is used throughout the other clauses in order to meet the terminology of the Directive.

The following general symbols are used (specific symbols are defined in the relevant clauses) :

A elongation after rupture

D_i inside diameter of main body

D_o outside diameter of main body

d diameter of openings

d_{ib} internal diameter of branch

d_{ob} external diameter of branch

d_{ip} internal diameter of pad

d_{op} external diameter of pad

iTeh STANDARD PREVIEW
(standards.iteh.ai)

SIST EN 286-1:1998

<https://standards.iteh.ai/catalog/standards/sist/1a8f0bbc-b1b5-4ccc-8a1b-9837b4c27465/sist-en-286-1-1998>

d_{is}	internal diameter of shell
e	nominal thickness of wall
e_s	nominal thickness of shell
e_b	nominal thickness of branch
e_p	nominal thickness of compensating plate or of pad
e_c	calculated thickness
e_a	actual thickness
e_{as}	actual thickness of shell
e_{ab}	actual thickness of branch
e_{am}	actual thickness of main body
e_{ap}	actual thickness of compensating plate or of pad
f	nominal design stress at design temperature
K_C	calculation coefficient, which depends on the welding process (see subclause 6.4.2)
K_s	shell coefficient, which depends on the extent of testing (see subclause 6.4.2)
KCV	impact energy
l_b	effective length of branch contributing to reinforcement
l_{bi}	effective length for inside part of set-through branch
l_m	effective length of main body, contributing to reinforcement
l_p	width of compensating plate,
l_{rp}	width of pad minus corrosion allowance and tolerances
P	design pressure (never less than PS), in bar or in newton per square millimetre (see note at the beginning of 3.2)
PS	maximum working pressure
Re_T	value at the maximum working temperature T_{max} - of the upper yield point R_{eH} , for a material with both a lower and upper yield point, - of the proof stress $R_{p0,2}$ - or of the proof stress $R_{p1,0}$ in the case of non-alloy aluminium
R_m	minimum value of tensile strength at room temperature specified in the material standard

iTeh STANDARD PREVIEW
(standards.iteh.ai)

<https://standards.iteh.ai/catalog/standards/sist/1a8f0bbc-b1b5-4ccc-8a1b-9837b4c27465/sist-en-286-1-1998>

4 Classifications and certification procedures

This standard specifies three classes of vessels, for which the applicable certification procedures are shown in table 4-1.

Table 4-1 : Classification of vessels

Classification	PS. V	Certification procedure ¹⁾	
		Design stage	Fabrication stage
Class 1	Above 3 000 bar.l up to and including 10 000 bar.l	At manufacturer's choice : Type Examination (see annex D) or Design and Manufacturing Schedules Approval (see annex C.2)	Verification (see annex A)
Class 2	Above 200 bar.l up to and including 3 000 bar.l		At manufacturer's choice : Verification ²⁾ (see annex A) or Declaration of Conformity and Surveillance (see annex B), and special documents
Class 3	Above 50 bar.l up to and including 200 bar.l		At manufacturer's choice : Verification ²⁾ (see annex A) or Declaration of Conformity (see annex B), and special documents
	Below or equal to 50 bar. l	See note	

1) This requirement is not part of the EC Directive and therefore is not part of the harmonised standard

2) For those vessels subject to verification the identification of the approved inspection body shall be stamped on the data plate (see clause 12).

NOTE : Use of this standard is considered to fulfil the requirements of sound engineering practice. It is the responsibility of the manufacturer to comply with the rules of this standard and to mark the vessel in accordance with clause 12, with the exception of the CE marking and of the approved inspection body mark.

standards.iteh.ai

5 Materials

SIST EN 286-1:1998
<https://standards.iteh.ai/catalog/standards/sist/1a8f0bbc-b1b5-4ccc-8a1b-9837b4c27465/sist-en-286-1-1998>

5.1 Main pressurized parts (see also 5.2)

5.1.1 General

The essential requirements for materials are given in annex G.

The materials shall be delivered with at least a test report (type 2.2 in accordance with EN 10204). Inspection certificates of types 3.1.A, 3.1.B or 3.1.C are also acceptable.

5.1.2 Steel vessels

The following materials should be used :

- a) plate, strip and bar: steel grades P 235 S, P 265 S, and P 275 SL in accordance with EN 10207; steel grades P 275 N, P 275 NH, P 275 NL1 and P 275 NL2 in accordance with EN 10028-2 ;
- b) tubes: steel grades P 235 T2 and P 265 T2 in accordance with EN 10216-1 and EN 10217-2 ;
- c) forgings: steel grade P 285 QH in accordance with EN 10222-4.

5.1.3 Aluminium vessels

The materials stated in table 5-2, in accordance with EN 573-4, should be used :

- a) plates in accordance with EN 485-2;
- b) bars in accordance with EN 755-2.

Table 5-2 : Aluminium materials in accordance with EN 573-4

Material designation		Maximum working temperature
numerical	chemical symbol	
EN AW-1080A EN AW-1070A EN AW-1050A	EN AW-Al 99,8(A) EN AW-Al 99,7 EN AW-Al 99,5	100 °C 100 °C 100 °C
EN AW-5005 EN AW-5251 EN AW-5049 EN AW-5052 EN AW-5754	EN AW-Al Mg1(B) EN AW-Al Mg2 EN AW-Al Mg2Mn0,8 EN AW-Al Mg2,5 EN AW-Al Mg3	100 °C 100 °C 100 °C 100 °C 100 °C
EN AW-5454 EN AW-5154A EN AW-5086 EN AW-5083	EN AW-Al Mg3Mn EN AW-Al Mg3,5(A) EN AW-Al Mg4 EN AW-Al Mg4,5Mn0,7	100 °C 100 °C 65 °C 65 °C
EN AW-3103 EN AW-3105	EN AW-Al Mn1 EN AW-Al Mn0,5Mg0,5	100 °C 100 °C