SLOVENSKI STANDARD
SIST EN 1011-4:2001

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Varjenje - Priporočila za varjenje kovinskih materialov - 4. del: Obločno varjenje aluminija in aluminijevih zlitin

Welding - Recommendations for welding of metallic materials - Part 4: Arc welding of aluminium and aluminium alloys

Schweißen - Empfehlungen zum Schweißen metallischer Werkstoffe - Teil 4: Lichtbogenschweißen von Aluminium und Aluminiumlegierungen

Soudage - Recommandations pour le soudage des matériaux métalliques - Partie 4: Soudage a l'arc de l'aluminium et des alliages d'aluminium

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Welding - Recommendations for welding of metallic materials - Part 4: Arc welding of aluminium and aluminium alloys

Soudage - Recommandations pour le soudage des matériaux métalliques - Partie 4: Soudage à l'arc de l'aluminium et des alliages d'aluminium

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This European Standard was approved by CEN on 14 August 2000.

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.

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

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Contents

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 121 "Welding", the secretariat of which is held by DS.

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of an identical text or by endorsement, at the latest by March 2001, and conflicting national standards shall be withdrawn at the latest by March 2001.

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).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this standard.

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.

This European Standard is composed of the following parts:

Part 1: General guidance for arc welding

Part 2: Arc welding of ferritic steels

Part 3: Arc welding of stainless steels

Part 4: Arc welding of aluminium and aluminium alloys

Annexes A and B are informative.

Introduction

This European Standard has been issued with several annexes in order to cover aluminium and the different types of its alloys in all forms which will be produced to the relevant European standards.

In this standard the term aluminium stands for aluminium and its alloys.

This standard gives general guidance for the satisfactory design, production and control of welding and details the possible detrimental effects which may occur, together with advice on methods by which they may be avoided. Generally it is applicable to all types of aluminium materials and is appropriate regardless of the type of fabrication involved, although the application standard/contract may have additional requirements.

Permissible design stresses in welds, methods of testing and acceptance levels are not included because they depend on the service conditions of the fabrication. These details should be obtained from the design specification.

Informative annexes give information on detrimental effects (see annex A) and choice of consumables (see annex B).

This document details only welding related matters and does not give any details of mechanical properties of the welded joint.

This standard identifies the main factors that affect the welding of aluminium. This will be influenced by parent metal, consumables, design, welding procedure, welding equipment, joint preparation etc.

General requirements for fusion welding of metallic materials are detailed in EN 1011-1, in particular:

- tack welds;
- temporary attachments;
- arcing;
- inter-run cleaning and treatment;
- welding procedures;
- identification;
- inspection and testing;
- quality requirements;
- correction of non-conformity;
- distortion;
- post-weld heat treatment;
- abbreviations and symbols;
- run-on/ run-off plates.

1 Scope

This European Standard gives general recommendations for the manual, mechanized and automatic fusion welding of wrought and cast aluminium alloys and combinations thereof.

For general guidelines, see EN 1011-1.

In this standard the word "pipe" alone or in combinations is used to mean "tube" or "hollow section", although these terms are often used for different categories of product by different industries.

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 (including amendments).

EN 287-2	Approval testing of welders - Fusion welding - Part 2: Aluminium and aluminium alloys
EN 288-1	Specification and approval of welding procedures for metallic materials - Part 1 : General rules for fusion welding
EN 288-2	Specification and approval of welding procedures for metallic materials - Part 2 : Welding procedure specification for arc welding
EN 288-4	Specification and approval of welding procedures for metallic materials - Part 4: Welding procedure tests for the arc welding of aluminium and its alloys
EN 439	Welding consumables - Shielding gases for arc welding and cutting
EN 573-1	Aluminium and aluminium alloys - Chemical composition and forms of wrought products - Part 1: Numerical designation system
EN 573-2	Aluminium and aluminium alloys - Chemical composition and forms of wrought product - Part 2: Chemical symbol based designation system
EN 573-3	Aluminium and aluminium alloys - Chemical composition and forms of wrought product - Part 3: Chemical composition
EN 573-4	Aluminium and aluminium alloys - Chemical composition and forms of wrought product - Part 4: Forms of products

EN 719	Welding coordination - Tasks and responsibilities
EN 729-2	Quality requirements for welding - Fusion welding of metallic materials - Part 2: Comprehensive quality requirements
EN 729-3	Quality requirements for welding - Fusion welding of metallic materials - Part 3: Standard quality requirements
EN 1011-1	Welding - Recommendations for welding of metallic materials – Part 1: General guidance for arc welding
EN 1289	Non-destructive examination of welds - Penetrant testing of welds - Acceptance levels
EN 1418	Welding personnel - Approval testing of welding operators for fusion welding and resistance weld setters for fully mechanized and automatic welding of metallic materials
EN 1706	Aluminium and aluminium alloys - Casting - Chemical composition and mechanical properties
EN 1780-1	Aluminium and aluminium alloys - Designation of unalloyed and alloyed aluminium ingots for remelting, master alloys and castings - Part 1: Numerical designation system
EN 1780-2	Aluminium and aluminium alloy-Designation of unalloyed and alloyed aluminium ingots for remelting, master alloys and casting - Part 2 : Chemical symbol based designation system
EN 1780-3	Aluminium and aluminium alloys -Designation of unalloyed and alloyed aluminium ingots for remelting, master alloys and castings - Part 3: Writing rules for chemical composition
EN 30042	Arc-welded joints in aluminium and its weldable alloys - Guidance on quality levels for imperfections (ISO 10042 : 1992)
EN ISO 4063	Welding and allied processes - Nomenclature of processes and reference numbers (ISO 4063 : 1998)
EN ISO 6520-1	Welding and allied processes - Classification of geometric imperfections in metallic materials – Part 1: Fusion welds (ISO 6520-1 : 1998)
EN ISO 6947	Welds, working positions - Definitions of angles of slope and rotation (ISO 6974 : 1993)
prEN ISO 9692-3:1998	Welding and allied processes – Joint preparation – Part 3: Metal arc inert gas welding and tungsten inert gas arc welding of aluminium and its alloys (ISO/DIS 9692-3:1998)

CR ISO 15608 Welding - Guidelines for a metallic material grouping system (ISO/TR 15608 : 2000)

prEN ISO 15614-4 :2000 Specification and approval of welding procedures for metallic materials - Welding procedure test - Part 4 : Finishing welding of aluminium castings (ISO/FDIS 15614-4 : 2000)

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions in EN 1011-1 apply.

4 Provision of quality requirements

To ensure the quality of work it shall be performed by approved personnel in accordance with e.g. EN 287-2, EN 1418 and EN 719 using approved procedures e.g. EN 288-1, EN 288-2, EN 288-4 and prEN ISO 15614-4:2000.

5 Parent metal

5.1 General

This standard applies to wrought, cast and combinations of aluminium, e.g. according to EN 287-2, EN 1418, EN 288-4 and prEN ISO 15614-4:2000. The principles of this standard can be applied to other non-standard or proprietary aluminium alloys, which can include the advanced superplastic alloys and metal matrix composites, provided the composition of the alloy falls within the parent metal groups listed in annex B. In such cases the use of this standard shall be in accordance with the design specification.

Material standards do not fully take into account welding requirements. For this reason it is sometimes necessary to specify additional requirements for the material when placing the order. This can include selection/restriction of composition/mechanical properties (within certain additional limits to the basic standard requirements) and additional cleanliness of the components.

Permanent backing material and temporary attachments shall be compatible with the parent metal.

5.2 Storage and handling

Contact with ferritic materials and copper should be avoided, in order to prevent corrosion.

To avoid the use of incorrect materials, they shall be stored so that the alloy type is known (see warning on hard stamping in EN 1011-1).

6 Factors affecting properties of welded structures and assemblies

A short list of possible detrimental effects, which can occur as a result of welding, is given in annex A. The list is not exhaustive but features those metallurgical and technological influences that are specific to, or more prevalent with, aluminium. Potential causes and counter measures are also listed.

Consideration shall be given, e.g. in the design of welded structures, to the mechanical properties of the heat affected zone (HAZ) and the weld deposit which can be influenced by the welding procedure. For instance, the weld deposit and the HAZ can have lower mechanical properties than the parent material.

Care shall be taken to avoid the creation of any HAZ that has not been considered in the design, e.g. the welding of a temporary attachment.

7 Fusion welding processes

This standard applies to the following processes according to EN ISO 4063 which may be used singly or in combination:

- 131 Metal arc inert gas welding (MIG);
- 141 Tungsten inert gas arc welding (TIG);
- 15 Plasma arc welding.

Other fusion welding processes by agreement.

8 Welding consumables

8.1 Filler metal

Filler metal shall be compatible with the parent metal, see annex B.

Filler metals shall be stored in their original packaging in a dry place adequately protected from the effects of the weather and in accordance with relevant standards and/or the supplier's recommendation.

Particular attention shall be paid to the storage and identification of partly used reels of wire and packages of rods located in fabricating shops or on site. This is necessary to ensure that they do not become moist or contaminated, e.g. by dust or oil.

8.2 Shielding gases and gas backing

Argon is most commonly used for MIG, TIG and plasma arc welding of aluminium, but some advantage can be obtained by the use of helium and helium/argon mixtures. They produce improved penetration and/or an increase in the welding speed. They can also reduce imperfections. Shielding gases and gas backing of the following categories according to EN 439 shall normally be used:

- I1 (argon);

- I2 (helium);

- I3 (argon/helium mixtures).

Other gas mixtures shall only be used in accordance with the design specification (see annex B).

9 Equipment

Further information is given in EN 729-2 and EN 729-3. Return cables shall be of the same or greater cross-sectional area as the welding leads. When quality assurance in accordance with EN 729-2 is required, monitoring systems shall be calibrated and welding equipment shall be validated.

10 Joint types

10.1 General

General guidance is given in prEN ISO 9692-3:1998. Gaps between fusion faces can cause problems, e.g. burn through, distortion, and imperfections. Attempts should therefore be made to minimize them.

10.2 Butt joints

10.2.1 *General*

Butt joints shall include all joints between plates, pipes or combinations, and includes "T" butt joints.