



SLOVENSKI STANDARD
SIST EN 1011-5:2003

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Varjenje - Priporočila za varjenje kovinskih materialov - 5. del: Varjenje platiranega jekla

Welding - Recommendations for welding of metallic materials - Part 5: Welding of clad steel

Schweißen - Empfehlungen zum Schweißen metallischer Werkstoffe - Teil 5: Schweißen von plattierten Stählen

Soudage - Recommendations pour le soudage des matériaux métalliques - Partie 5: Soudage des aciers plaqués

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25.160.10	Varilni postopki in varjenje	Welding processes
77.080.20	Jekla	Steels

SIST EN 1011-5:2003

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EUROPEAN STANDARD
NORME EUROPÉENNE
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EN 1011-5

April 2003

ICS 25.160.10

English version

Welding - Recommendations for welding of metallic materials - Part 5: Welding of clad steel

Soudage - Recommendations pour le soudage des
matériaux métalliques - Partie 5: Soudage des aciers
plaqués

Schweißen - Empfehlungen zum Schweißen metallischer
Werkstoffe - Teil 5: Schweißen von plattierten Stählen

This European Standard was approved by CEN on 28 February 2003.

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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 Management Centre 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, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and United Kingdom.

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

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Foreword

This document (EN 1011-5:2003) 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of an identical text or by endorsement, at the latest by October 2003, and conflicting national standards shall be withdrawn at the latest by October 2003.

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, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

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EN 1011-5:2003 (E)**1 Scope**

This European Standard gives general recommendations for welding of clad steels by means of appropriate arc welding processes and electroslag strip cladding.

It is generally applicable to all clad steels and is appropriate regardless of the type of fabrication involved, although the application standard may have additional requirements. Non-ferrous claddings, such as titanium, tantalum, zirconium and their alloys are not covered by this standard.

Examples for joint preparation are given in EN ISO 9692-4.

This standard covers welding of cladding deposits as well as welding of the transition zone(s), when existing, between parent metal and cladding. These transition zones are metal combinations of non-alloyed ferrous parent metal with high alloyed stainless steels, nickel alloys or other non-ferrous metals.

The mechanical and physical design of the joints is not covered by this standard. 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.

The corrosion resistance of the cladding depends on many factors and is not a part of this standard.

For general guidelines see EN 1011-1.

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 1011-3, *Welding — Recommendations for welding of metallic materials — Part 3: Arc welding of stainless steels.*

EN 10088-1, *Stainless steels — Part 1: List of stainless steels.*

prEN ISO 5817, *Welding — Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) — Quality levels for imperfections (ISO/DIS 5817:2002).*

EN ISO 9692-4, *Welding and allied processes — Recommendations for joint preparation — Part 4: Clad steels (ISO 9692-4:2003).*

EN ISO 13916, *Welding — Guidance on the measurement of preheating temperature, interpass temperature and preheat maintenance temperature (ISO 13916:1996).*

prEN ISO 15607, *Specification and approval of welding procedures for metallic materials — General rules (ISO/DIS 15607:2000).*

prEN ISO 15609-1, *Specification and approval of welding procedures for metallic materials — Welding procedure specification — Part 1: Arc welding (ISO/DIS 15609-1:2000).*

prEN ISO 15614-1, *Specification and approval of welding procedures for metallic materials — Welding procedure test — Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys (ISO/DIS 15614-1:2000).*

3 Terms and definitions

For the purposes of this European Standard, the following term and definition apply.

3.1

clad steel

combination of two or more dissimilar metals bonded inseparably together by different cladding processes

4 Materials

4.1 Clad steels

Clad steels can be produced by several cladding processes such as:

- hot roll cladding;
- explosive welding;
- surfacing by welding;
- combined weld / hot roll cladding.

The inseparable cladding (commonly $t_2 \geq 2$ mm wall thickness), which will be in contact with the adjacent medium, is designed to meet requirements such as corrosion resistance, abrasion and/or heat resistance at different working temperatures.

4.2 Parent metal

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The parent metal is a weldable steel, commonly according to CR ISO 15608:2000 (group 1 to 6). The parent metal has to provide the required strength and toughness to maintain mechanical integrity.

4.3 Cladding

Cladding includes:

- Stainless steels according to EN 10088-1;
- Nickel and nickel alloys;
- Copper and copper alloys;
- Cobalt alloys (stellites).

Cladding shall be capable of being joined by arc welding processes to the parent metals.

The finished surface conditions of cladding particularly used in components for the chemical industry should guarantee an adequate corrosion resistance and other specified characteristics. For information on corrosion resistance of cladding see relevant application standards.

5 Welding consumables for cladding deposits

The cladding deposit, including dilution with the cladding, shall be compatible with the cladding. Therefore, consumables should be selected with regard to the parent metal, to the cladding and the particular application. The consumables shall comply with the relevant standards and/or specifications.

Where consumable inserts are used, they shall correspond with the relevant filler metal composition.

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In some cases, the filler metals used for the buttering may also be used for filling and capping runs, if appropriate for the application.

The service conditions of a clad steel component, such as working temperature or possible post weld heat treatment (PWHT) shall be considered when selecting appropriate consumables.

It is necessary to pay attention to the effects of dilution when depositing one layer on another, especially the first layer on the parent metal. The welding process, the welding conditions and the consumables have a significant influence on the chemical compositions and the ferrite numbers (FN) of a stainless cladding deposit. Gains or losses of alloying elements, for example the metallurgical reactions between wire/strip and fluxes or gases, have to be taken into account.

If the ferrite number is a requirement in the specification, the methods for measurement according to EN ISO 8249, e. g. the magnetic determination with calibrated instruments, should be in accordance with the design specification. In case of dispute, the WRC-92 constitution diagram shall be used.

6 Welding procedures

Different arc welding processes may be used to produce cladding deposits matching specified requirements. Deposits in one, two or more layers can be realized in order to achieve the required characteristic. The number of the layers depends on several factors and should be confirmed by a welding procedure specification.

Commonly the selection of any welding procedure depends on:

- welding position;
- access conditions;
- alloy type;
- specified requirements, such as dilution rate (which should generally be kept as low as possible, provided that penetration is adequate).

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7 Fabrication

When storing, handling or fabricating clad steels, measures shall be taken to protect the cladding from contamination and surface damage. In case of damage impairs the service performance, reconditioning shall be undertaken according to EN 1011-3 or other relevant standards.

Repairing/restoring of damaged cladding shall be such as to avoid the formation of brittle phases.

Joint preparation shall be in accordance with EN ISO 9692-4.

Clad steels can be cut using normal methods; shearing (for thin plates) and plasma cutting should be started from the cladding side. When preparing joint faces, oxidation, hardening and general contamination from thermal cutting processes shall be eliminated by mechanical machining (grinding) to a sufficient depth from the cut face. During shearing, cracking and work hardening can occur; if any, this shall be removed prior to welding.

Mechanical joint preparation is preferable.

Cold or hot forming operations can be carried out on clad steels by the manufacture as appropriate. The processing treatment and instructions are supplied by the manufacturer or fabricator as appropriate.

Hard stamping on the cladding causes highly stressed and/or corrosion sensitive areas and shall be avoided.

All operations leading to the formation of brittle phases in the transition zones, for example when grinding, shall be avoided.

8 Welding

8.1 Welding from both sides

8.1.1 Parent metal

The parent metal shall first be welded according to an qualified welding procedure.

The root run should not penetrate into the cladding.

8.1.2 Single-layer cladding deposits

The cladding deposit shall be welded by a qualified welding procedure. All requirements concerning the arc welding of dissimilar metals shall be observed.

A single layer cladding deposit may be applied when the welding procedure has been shown to achieve the specified requirements, especially the chemical composition. The consumables used for this application shall be sufficiently alloyed to compensate the dilution with the parent metal and to match the specified characteristics. The welding consumables shall be verified by a qualified procedure and they shall be appropriate for the application. Welding processes with low penetration characteristics are recommended.

8.1.3 Multi-layer cladding deposits

The cladding deposit shall be welded by a qualified procedure. All requirements concerning the arc welding of dissimilar metals shall be observed.

For the buttering (first layer), the same procedure as mentioned in 8.1.2 may be valid.

The subsequent runs should be welded using consumables with a higher or equal alloy content to that of the cladding, or be adequate for the requirements.

8.1.4 Non-ferrous cladding deposits

For non-ferrous metals and high-temperature ($\geq 300^{\circ}\text{C}$) applications, special agreement in the design specifications shall be provided.

8.2 Single side welding

In the case of single side welding, the joint preparation according to EN 22553 is generally an "HU"– or a "U"– preparation for the parent metal with the root face entirely within the cladding (see EN ISO 9692–4, reference numbers: 8 and 9). The root run shall be welded using a process and consumables appropriate for the application. The welding consumables shall be verified by a qualified procedure and they shall be appropriate for the application.

The filling run(s) shall be welded with consumables and procedures as commonly used for the buttering (see 8.1.2). All requirements concerning the arc welding of dissimilar metals shall be observed.

To prevent oxidation or contamination during arc welding of the root run and the filling runs, a back shielding gas according to EN 439 should be applied.

8.3 General welding conditions

8.3.1 Preparation of joint faces

Any large notches or any other imperfections in joint geometry which might impair welding, shall be corrected by applying a weld deposit according to a qualified welding procedure. Subsequently, it shall be ground smooth and flush with the adjacent surface to produce an acceptable finish.

When preparing joint faces for stainless steels and non–ferrous cladding, dedicated tools shall be used. This particularly applies to grinding wheels and wire brushes.