

# SLOVENSKI STANDARD

## SIST-TP CEN ISO/TR 16060:2014

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### Porušitvene preiskave zvarov na kovinskih materialih - Jedkala za makroskopsko in mikroskopsko preiskavo (ISO/TR 16060:2003)

Destructive tests on welds in metallic materials - Etchants for macroscopic and microscopic examination (ISO/TR 16060:2003)

**iTeh STANDARD PREVIEW**

Zerstörende Prüfung von Schweißverbindungen an metallischen Werkstoffen - Ätzungen für die makroskopische und mikroskopische Untersuchung (ISO/TR 16060:2003)

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Essais destructifs des soudures sur matériaux métalliques - Réactifs pour examens macroscopique et microscopique (ISO/TR 16060:2003)

**Ta slovenski standard je istoveten z: CEN ISO/TR 16060:2014**

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#### **ICS:**

25.160.40      Varjeni spoji in vari      Welded joints

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RAPPORT TECHNIQUE  
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**CEN ISO/TR 16060**

August 2014

ICS 25.160.40

Supersedes CR 12361:1996

English Version

**Destructive tests on welds in metallic materials - Etchants for  
macroscopic and microscopic examination (ISO/TR 16060:2003)**

Essais destructifs des soudures sur matériaux métalliques -  
Réactifs pour examens macroscopique et microscopique  
(ISO/TR 16060:2003)

Zerstörende Prüfung von Schweißverbindungen an  
metallischen Werkstoffen - Ätzungen für die  
makroskopische und mikroskopische Untersuchung  
(ISO/TR 16060:2003)

This Technical Report was approved by CEN on 18 August 2014. It has been drawn up by the Technical Committee CEN/TC 121.

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

**CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels**

**Contents**

Page

Foreword.....3

**iTeh STANDARD PREVIEW**  
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[SIST-TP CEN ISO/TR 16060:2014](https://standards.iteh.ai/catalog/standards/sist/98c1e23d-32fd-443a-b418-1bc7f3e24f49/sist-tp-cen-iso-tr-16060-2014)  
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## Foreword

The text of ISO/TR 16060:2003 has been prepared by Technical Committee ISO/TC 44 "Welding and allied processes" of the International Organization for Standardization (ISO) and has been taken over as CEN ISO/TR 16060:2014 by Technical Committee CEN/TC 121 "Welding and allied processes" the secretariat of which is held by DIN.

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This document supersedes CR 12361:1996.

### Endorsement notice

The text of ISO/TR 16060:2003 has been approved by CEN as CEN ISO/TR 16060:2014 without any modification.

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<https://standards.iteh.ai/catalog/standards/sist/98c1e23d-32fd-443a-b418-1bc7f3e24f49/sist-tp-cen-iso-tr-16060-2014>

# TECHNICAL REPORT

# ISO/TR 16060

First edition  
2003-10-15

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## Destructive tests on welds in metallic materials — Etchants for macroscopic and microscopic examination

*Essais destructifs des soudures sur matériaux métalliques — Réactifs  
pour examens macroscopique et microscopique*

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## Contents

Page

<b>Foreword</b> .....	<b>iv</b>
<b>1 Scope</b> .....	<b>1</b>
<b>2 Normative references</b> .....	<b>1</b>
<b>3 General</b> .....	<b>1</b>
<b>4 Etchants for carbon steels and low-alloy steels</b> .....	<b>1</b>
<b>5 Etchants for stainless steels</b> .....	<b>1</b>
<b>6 Etchants for nickel and nickel alloys</b> .....	<b>2</b>
<b>7 Etchants for titanium and titanium alloys</b> .....	<b>2</b>
<b>8 Etchants for copper and copper alloys</b> .....	<b>2</b>
<b>9 Etchants for aluminium and aluminium alloys</b> .....	<b>2</b>
<b>10 Designation</b> .....	<b>2</b>
<b>Annex A (informative) Etchants for carbon steels and low-alloy steels</b> .....	<b>3</b>
<b>Annex B (informative) Etchants for stainless steels</b> .....	<b>10</b>
<b>Annex C (informative) Etchants for nickel and nickel alloys</b> .....	<b>16</b>
<b>Annex D (informative) Etchants for titanium and titanium alloys</b> .....	<b>18</b>
<b>Annex E (informative) Etchants for copper and copper alloys</b> .....	<b>20</b>
<b>Annex F (informative) Etchants for aluminium and aluminium alloys</b> .....	<b>22</b>
<b>Annex G (informative) List of etchants</b> .....	<b>27</b>

**ISO/TR 16060:2003(E)****Foreword**

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In exceptional circumstances, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide by a simple majority vote of its participating members to publish a Technical Report. A Technical Report is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO/TR 16060 was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 5, *Testing and inspection of welds*.

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# Destructive tests on welds in metallic materials — Etchants for macroscopic and microscopic examination

## 1 Scope

This Technical Report gives a non-exhaustive list of etchants that can be used for the macroscopic and microscopic examination of welds in accordance with ISO 17639 for the following groups of materials:

- carbon steels and low-alloy steels;
- stainless steels;
- nickel and nickel alloys;
- titanium and titanium alloys;
- copper and copper alloys;
- aluminium and aluminium alloys.

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## 2 Normative references

[SIST-TP CEN ISO/TR 16060:2014](#)

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The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 17639, *Destructive tests on welds in metallic materials — Macroscopic and microscopic examination of welds*

## 3 General

Where details of concentration or waters of crystallization of reagents are not defined in the annexes, Table 1 is applicable. These values should be confirmed by the suppliers of each etchant.

## 4 Etchants for carbon steels and low-alloy steels

The etchants for carbon and low alloyed steels are given in Annex A.

## 5 Etchants for stainless steels

The etchants for stainless steels are given in Annex B.

## ISO/TR 16060:2003(E)

**6 Etchants for nickel and nickel alloys**

The etchants for nickel and nickel alloys are given in Annex C.

**7 Etchants for titanium and titanium alloys**

The etchants for titanium and titanium alloys are given in Annex D.

**8 Etchants for copper and copper alloys**

The etchants for copper and copper alloys are given in Annex E.

**9 Etchants for aluminium and aluminium alloys**

The etchants for aluminium and aluminium alloys are given in Annex F.

**10 Designation**

Etchants should be designated either by names or by numbers of tables in accordance with Annex G.

**Table 1 — Characteristics of components**  
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Components	Characteristics			Remarks
	Specific gravity g/cm <sup>3</sup>	Concentration %	Hydrate	
HCl	1,18 1,16	35 to 38 31,5 to 33	—	
HF	1,13	40	—	
HNO <sub>3</sub>	1,42	69	—	
H <sub>2</sub> SO <sub>4</sub>	1,84	98	—	
H <sub>2</sub> O <sub>2</sub>	—	6 % W/V <sup>a</sup>	—	Usually 20 volumes (i.e. 20 volume available O <sub>2</sub> )
H <sub>3</sub> PO <sub>4</sub>	1,70	85	—	
CH <sub>3</sub> COOH	1,05	99,1	—	glacial
HBF <sub>4</sub>	1,23	35	—	
C <sub>2</sub> H <sub>2</sub> O <sub>4</sub>	—	—	2	
FeCl <sub>3</sub>	—	—	6	
CuCl <sub>2</sub>	—	—	2	
MgCl <sub>2</sub>	—	—	6	
Fe(NO <sub>3</sub> ) <sub>3</sub>	—	—	9	

<sup>a</sup> W/V means weight by volume.

## Annex A (informative)

### Etchants for carbon steels and low-alloy steels

See Tables A.1 to A.13.

Table A.1 — Nital

<b>Type of etchant:</b> Macroscopic and microscopic etchant
<b>Composition in volume and in order of mixing:</b> 99 ml to 95 ml industrial methylated spirits* 1 ml to 5 ml nitric acid (HNO <sub>3</sub> )  *Ethyl alcohol (C <sub>2</sub> H <sub>5</sub> OH), denatured with methyl alcohol (CH <sub>3</sub> OH) Also methyl alcohol or isoamyl alcohol [(CH <sub>3</sub> ) <sub>2</sub> CH(CH <sub>2</sub> ) <sub>2</sub> OH]
<b>Safe shelf life:</b> Indefinite
<b>Surface preparation:</b> 600 grit or finer (macroetching ≈ 5 % of nitric acid) 3 μm diamond or finer (microetching ≈ 2 % of nitric acid)
<b>Etching temperature:</b> Ambient
<b>Etching time:</b> A few seconds — check by eye
<b>Additional precautions/requirements:</b> Usual precautions for handling and disposal of acids.
<b>Comments:</b>  Can increase strength to 15 % for macroetching on ground surface — reveals ferrite boundaries — differentiates ferrite from martensite. Good general purpose etchant.  Amyl alcohol is preferable for galvanized steel.