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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)

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

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

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25.160.40 Varjeni spoji in vari Welded joints

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

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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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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Endorsement notice

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

TECHNICAL REPORT

ISO/TR 16060

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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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Foreword

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

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.

2 Normative references

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.

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

Components	Characteristics			
	Specific gravity g/cm^3	Concentration %	Hydrate	Remarks
HCl	1,18 1,16	35 to 38 31,5 to 33	—	
HF	1,13	40	—	
HNO_3	1,42	69	—	
H_2SO_4	1,84	98	—	
H_2O_2	—	6 % W/V [a]	—	Usually 20 volumes (i.e. 20 volume available O_2)
H_3PO_4	1,70	85	—	
CH_3COOH	1,05	99,1	—	glacial
HBF_4	1,23	35	—	
$C_2H_2O_4$	—	—	2	
$FeCl_3$	—	—	6	
$CuCl_2$	—	—	2	
$MgCl_2$	—	—	6	
$Fe(NO_3)_3$	—	—	9	

[a] 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

Type of etchant: Macroscopic and microscopic etchant
Composition in volume and in order of mixing: 99 ml to 95 ml industrial methylated spirits* 1 ml to 5 ml nitric acid (HNO_3) *Ethyl alcohol (C_2H_5OH), denatured with methyl alcohol (CH_3OH) Also methyl alcohol or isoamyl alcohol [$(CH_3)_2CH(CH_2)_2OH$]
Safe shelf life: Indefinite
Surface preparation: 600 grit or finer (macroetching ≈ 5 % of nitric acid) 3 µm diamond or finer (microetching ≈ 2 % of nitric acid)
Etching temperature: Ambient
Etching time: A few seconds — check by eye
Additional precautions/requirements: Usual precautions for handling and disposal of acids.
Comments: 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.