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Standards

Irish Standard
I.S. EN IEC 63078:2020

Installations for electroheating and electromagnetic processing - Test methods for induction through-heating installations

I.S. EN IEC 63078:2020

Incorporating amendments/corrigenda/National Annexes issued since publication:

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NSAI
1 Swift Square,
Northwood, Santry
Dublin 9

T +353 1 807 3800
F +353 1 807 3838
E standards@nsai.ie
W NSAI.ie

Sales:
T +353 1 857 6730
F +353 1 857 6729
W standards.ie

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National Foreword

I.S. EN IEC 63078:2020 is the adopted Irish version of the European Document EN IEC 63078:2020, Installations for electroheating and electromagnetic processing - Test methods for induction through-heating installations

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EUROPEAN STANDARD

EN IEC 63078

NORME EUROPÉENNE

EUROPÄISCHE NORM

February 2020

ICS 25.180.10

English Version

**Installations for electroheating and electromagnetic processing -
Test methods for induction through-heating installations
(IEC 63078:2019)**

Installations pour traitement électrothermique et
électromagnétique - Méthodes d'essai pour les installations
de chauffage par induction
(IEC 63078:2019)

Elektrowärmeanlagen und Anlagen für elektromagnetische
Bearbeitungsprozesse - Prüfverfahren für induktive
Durcherwärmungsanlagen
(IEC 63078:2019)

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

EN IEC 63078:2020 (E)

European foreword

The text of document 27/1118/FDIS, future edition 1 of IEC 63078, prepared by IEC/TC 27 "Industrial electroheating and electromagnetic processing" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 63078:2020.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2020-09-27
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In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 62076:2006	NOTE	Harmonized as EN 62076:2006 (not modified)
IEC 60683:2011	NOTE	Harmonized as EN 60683:2012 (not modified)

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

Clause 2 of IEC 60398:2015 is applicable with the following additions:

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60398	2015	Installations for electroheating and electromagnetic processing - General performance test methods	EN 60398	2015
IEC 60519-1	— ¹	Safety in installations for electroheating and electromagnetic processing - Part 1: General requirements	EN IEC 60519-1	— ²
IEC 60519-3	2005	Safety in electroheat installations - Part 3: Particular requirements for induction and conduction heating and induction melting installations	EN 60519-3	2005

¹ Under preparation. Stage at time of publication: IEC BPUB 60519-1:2020.

² Under preparation. Stage at time of publication: FprEN IEC 60519-1:2019.

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IEC 63078

Edition 1.0 2019-11

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Installations for electroheating and electromagnetic processing – Test methods
for induction through-heating installations**

**Installations pour traitement électrothermique et électromagnétique – Méthodes
d'essai pour les installations de chauffage par induction**





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IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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IEC 63078

Edition 1.0 2019-11

INTERNATIONAL STANDARD

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**Installations for electroheating and electromagnetic processing – Test methods
for induction through-heating installations**

**Installations pour traitement électrothermique et électromagnétique – Méthodes
d'essai pour les installations de chauffage par induction**

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**INSTALLATIONS FOR ELECTROHEATING AND ELECTROMAGNETIC
PROCESSING – TEST METHODS FOR INDUCTION
THROUGH-HEATING INSTALLATIONS**
FOREWORD

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International Standard IEC 63078 has been prepared by IEC technical committee 27: Industrial electroheating and electromagnetic processing.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
27/1118/FDIS	27/1119/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

This International Standard is to be used in conjunction with IEC 60398:2015.

The clauses of this document supplement, modify or replace clauses of IEC 60398. When this document states “addition”, “modification” or “replacement”, the relevant text in IEC 60398 is to be adapted accordingly.

Subclauses which are additional to those in IEC 60398 are numbered starting from 101. Additional annexes are numbered AA, BB, etc.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

Induction through-heating and induction melting are very important applications of induction heating. However, an induction through-heating installation is more complex than an induction melting furnace, as it includes more heating manners, varieties and sizes. In addition, some performance tests which are very useful to users, for example the determination of temperature homogeneity of billets and energy efficiency of the installation, are not easy to carry out.

Induction through-heating installations are widely used in many industries for example machine building and metallurgy, for heating billets or workpieces of alloy steel, copper, aluminum, etc. before their subsequent hot forming (e.g. forging, extruding and rolling), with clean and fast heating, easy temperature control and automation as well as a high degree of energy-saving.

This document was prepared on the basis of IEC 60398:2015, with some references made to IEC 62076:2006 and “Induction Heating – Industrial Applications” published by UIE in 1992.

INSTALLATIONS FOR ELECTROHEATING AND ELECTROMAGNETIC PROCESSING – TEST METHODS FOR INDUCTION THROUGH-HEATING INSTALLATIONS

1 Scope

This clause of IEC 60398:2015 is replaced by the following.

This document specifies the test procedures, conditions and methods for determining the main performance parameters and operational characteristics of induction through-heating installations.

Measurements and tests that are solely used for the verification of safety requirements of the installations are outside the scope of this document and are covered by IEC 60519-1 and IEC 60519-3.

This document is applicable to the induction heating installations which through-heat the whole or part of metal billet or workpiece for its subsequent hot forming (e.g. forging, extruding and rolling), using low, mains or medium frequencies. It is possible to use it as a reference for other induction heating installations for heat-treatment and other purposes as well as superconducting DC induction through-heating installations.

This document includes the concept and material on energy efficiency dealing with the electrical and processing parts of the installations, as well as the overall performance.

2 Normative references

This clause of IEC 60398:2015 is applicable except as follows.

Replacement:

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Modification:

Delete footnotes

Additions:

IEC 60398:2015, *Installations for electroheating and electromagnetic processing – General performance test methods*

IEC 60519-1:—1, *Safety in installations for electroheating and electromagnetic processing – Part 1: General requirements*

¹ Sixth edition under preparation. Stage at the time of publication: IEC PRVC 60519-1:2019.

IEC 60519-3:2005, *Safety in electroheat installations – Part 3: Particular requirements for induction and conduction heating and induction melting installations*

3 Terms and definitions

This clause of IEC 60398:2015 is applicable except as follows.

Replacement:

For the purposes of this document, the terms and definitions given in IEC 60398:2015 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

Additions:

NOTE 101 For the following definitions of terms related to some parts and electrical parameters of power circuit of induction through-heating equipment, see also the explanatory diagrams in Annex AA. The symbols are also listed in Annex BB.

3.101

induction through-heating installation

installation comprising induction through-heating equipment and the electrical and mechanical auxiliaries necessary for the operation and utilization of the equipment

Note 1 to entry: The electrical auxiliaries comprise all electrical components in the power circuit of induction through-heating equipment, power supply for mechanical auxiliaries and control system; and the mechanical auxiliaries comprise billet handling mechanism and its mechanical power as well as water cooling system, etc.

3.102

induction through-heating equipment

equipment consisting of one or more heating inductors, supporting frames (cabinets) and the connections for cooling water and electricity, etc., for induction heating and holding of billet

3.103

batch heating

repetitive static heating manner, which involves placing an individual billet into a heating inductor for heating and holding, and then extracting it

[SOURCE: IEC 62076:2006, 3.39, modified – The differences between induction through-heating and induction melting in workload name and technological process have been considered.]

3.104

stage heating

heating manner having two or more heating inductors, in which, for a two heating inductor equipment for example, the billet is firstly placed into a heating inductor for heating, secondly moved to another heating inductor for holding and then extracted

3.105

continuous heating

heating manner, in which the billets progress continuously or rhythmically through one or more heating inductors for heating and holding

[SOURCE: IEC 62076:2006, 3.40, modified – The differences between induction through-heating and induction melting in workload name and technological process have been considered.]

3.106

lining

<heating inductor> part of inductor, which is placed between the induction coil and heated billet as a thermal insulation, and usually consists of a refractory layer and a temperature holding layer or is directly formed by ramming or pouring refractory materials

3.107

power circuit of induction through-heating equipment

circuit consisting of the power source(s) and compensated circuit(s) of the induction through-heating equipment, including the conductors connecting both

3.108

power source

equipment for the supply of power to the compensated circuit of induction through-heating equipment, being mains frequency single phase or three phases power supply or semiconductor frequency converter and having the following main specified characteristics:

- frequency f_2 or frequency band $f_{21} \dots f_{22}$
- voltage U_2 (RMS value)
- current I_2 (RMS value)
- active power P_2

[SOURCE: IEC 62076:2006, 3.13, modified – The types of power source used have been specified and supplemented, see Annex AA.]

3.109

compensated circuit of induction through-heating equipment

electric circuit comprising one or more inductors, a compensating capacitor bank and a load-matching transformer (if applicable)

Note 1 to entry: See Annex AA.

3.110

mass of test billets

G_{test}

out of the through-heated billets, total mass of those qualified used for the determination of specific energy consumption and productivity

3.111

dimensions of billet

maximum dimensions of the overall billets with any transport or protection means, which the induction through-heating equipment is designed for and is marked on the rating plate, expressed in diameter × length or width × thickness × length

3.112

billet temperature

θ_b

temperature of the billet at a given time of the through-heating cycle

3.113

starting temperature of billet

θ_{bs}

temperature of the billet at the beginning of the through-heating cycle

3.114**final temperature of billet** θ_{bf}

temperature of the billet attained at the end of the holding period of the through-heating cycle

3.115**rated temperature of billet** θ_{br}

temperature to be requested by through-heating technology for the billet of a given material, which the induction through-heating equipment is designed for and which is marked on the rating plate

3.116**temperature homogeneity of billet** $\Delta\theta_b$

homogeneous degree of billet temperature when it is extracted after heating and holding, which is expressed as the maximum and minimum deviations of the temperatures measured at the temperature measuring points with the rated temperature of the billet (they may be positive or negative), or expressed as the transverse (radial) temperature difference and the longitudinal temperature difference of the billet for the long billets with a circular or rectangular, etc. uniform cross section

Note 1 to entry: Requirements and measuring conditions for the determination of billet temperature homogeneity are specified in Annex CC.

3.117**transverse temperature difference of billet****radial temperature difference of billet** $\Delta\theta_{bt(r)}$

maximum and minimum temperature differences which may be positive or negative, between periphery and centre on the cross section of a long billet with a uniform cross section when it is extracted after its heating and holding

Note 1 to entry: Usually, the temperature at the centre of a billet cross section is lower.

Note 2 to entry: The radial temperature difference $\Delta\theta_{br}$ applies for a billet with a circular cross section.

3.118**longitudinal temperature difference of billet** $\Delta\theta_{bl}$

difference between the maximum temperature and the minimum temperature along the longitudinal direction of a long billet with a uniform cross section when it is extracted after its heating and holding

Note 1 to entry: Usually, the temperature at two ends of a billet is lower.

3.119**inlet temperature of cooling water** θ_{wi}

temperature of the cooling water when entering the cooling water circuit of the heating inductor

[SOURCE: IEC 62076:2006, 3.33, modified – The term and its symbol have been changed, the words “coolant” and “inductor assembly” have been replaced by “cooling water” and “heating inductor”.]

3.120**outlet temperature of cooling water** θ_{wo}

temperature of the cooling water when leaving the cooling water circuit of the heating inductor, with the induction through-heating equipment operating at rated conditions

[SOURCE: IEC 62076:2006, 3.34, modified – The term and its symbol have been changed, the words “coolant”, “inductor assembly” and “furnace” have been replaced respectively by “cooling water”, “heating inductor” and “induction through-heating equipment”.]

3.121

equipment duty at rated conditions

rated equipment duty

induction through-heating equipment operation with specified dimensions of lining and billet, specified billet quantity, rated power and rated frequency range without exceeding the maximum voltage and current defined by the supplier

3.122

thermal steady state

<equipment> thermal state in which the whole energy input into the induction through-heating equipment is used for the compensation of its thermal losses

Note 1 to entry: In thermal steady state, the temperatures of all constructional components of induction through-heating equipment and all the outlet temperatures of the cooling water are relatively stable and do not rise.

[SOURCE: IEC 62076:2006, 3.36, modified – The “furnace” has been replaced by “induction through-heating equipment” and the note added.]

3.123

hot state

<equipment> thermal steady state of the induction through-heating equipment when the billet is at its final temperature

[SOURCE: IEC 60683:2011, 3.13, modified – The definition suitable for induction through-heating equipment has been given with the ambiguous term “thermal condition” replaced by “thermal steady state” and “furnace” by “induction through-heating equipment”.]

3.124

cold state

<equipment> thermal state in which the induction through-heating equipment is not energized and the temperature of the whole equipment is at ambient temperature

[SOURCE: IEC 60683:2011, 3.4, modified – The definition suitable for induction through-heating equipment has been given.]

3.125

holding power

P_h

<equipment> active power supplied to the power circuit of induction through-heating equipment, in order to maintain the specified billet at a specified temperature for its temperature homogeneity

[SOURCE: IEC 60398:2015, 3.3.2, modified – The original definition including its two notes, has been simplified according to induction through-heating equipment.]

3.126

electrical energy consumption of the equipment

electrical energy supplied to the power circuit of induction through-heating equipment during the defined time period

Note 1 to entry: E_{ae} is the active electrical energy consumption.

Note 2 to entry: E_{re} is the reactive electrical energy consumption.

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