



**International
Standard**

ISO 18166

**Numerical welding simulation —
Execution and documentation**

Simulation numérique de soudage — Exécution et documentation

**First edition
2026-01**

iTeh Standards
(<https://standards.itih.ai>)
Document Preview

ISO 18166:2026

<https://standards.itih.ai/catalog/standards/iso/66503741-58e3-454d-a4a1-b3ab504b226a/iso-18166-2026>

iTeh Standards
(<https://standards.iteh.ai>)
Document Preview

ISO 18166:2026

<https://standards.iteh.ai/catalog/standards/iso/66503741-58e3-454d-a4a1-b3ab504b226a/iso-18166-2026>



COPYRIGHT PROTECTED DOCUMENT

© ISO 2026

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

	Page
Foreword	v
Introduction	vi
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Abbreviated terms	3
5 Principle	4
6 Scientific Computation Tools (SCTs)	4
7 Required data for simulation	5
8 Formulation of the problem and establishment of the simulation strategy	5
9 Establishment of the input parameters	8
9.1 Input data	8
9.2 Simulation template	8
10 Geometry and mesh	8
10.1 Geometry and mesh of welded joint	8
10.2 Mesh size	8
10.3 Type of elements	8
10.4 Modelling of the filler material	9
11 Performing the simulation	9
11.1 Code verification	9
11.2 Thermal and metallurgical computations	10
11.2.1 General	10
11.2.2 Focus on metallurgical transformations	10
11.2.3 Modelling of heat source	10
11.2.4 Boundary and initial thermal conditions	11
11.3 Thermomechanical computation for residual stresses prediction	11
11.3.1 General	11
11.3.2 Model parameters adjustments	11
11.3.3 Materials with phase transformations	11
11.3.4 Boundary and initial thermomechanical conditions	11
11.4 Monitoring the solution during computation	12
12 Simulation post-processing	12
12.1 General	12
12.2 Cross-section of fusion zone	12
12.3 Transient evolution of temperatures	12
12.4 Phases and residual stresses and strains distributions	12
13 Comparing/challenging the results	13
13.1 General	13
13.2 Calculation verification	13
13.3 Validation	14
13.3.1 General	14
13.3.2 Validation process	14
13.3.3 Lack of knowledge	14
13.3.4 Validation experiment guidelines	15
13.3.5 Additional validation and verification activities	15
14 Uncertainty quantification	15
15 Reporting/display of results	16
15.1 General	16

ISO 18166:2026(en)

15.2	Objective of welding simulation.....	16
15.3	Material properties and input data.....	16
15.4	Geometry and mesh.....	16
15.5	Numerical model parameters	17
15.6	Analysis of results	17
Annex A	(informative) Technical specification of scientific computation tools for numerical welding simulation/computational weld mechanics.....	18
Annex B	(informative) Documentation template.....	20
Annex C	(informative) Heat source modelling and calibration	26
Annex D	(informative) Guidelines for validation experiment.....	35
Annex E	(informative) Characterizing, tracing, and managing uncertainty in computational weld mechanics and real-world systems.....	37
Annex F	(informative) Mechanical properties of materials.....	39
Bibliography	46

iTeh Standards (<https://standards.iteh.ai>) Document Preview

ISO 18166:2026

<https://standards.iteh.ai/catalog/standards/iso/66503741-58e3-454d-a4a1-b3ab504b226a/iso-18166-2026>

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document has been prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 121, *Welding and allied processes*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This first edition of ISO 18166 cancels and replaces ISO/TS 18166:2016, which has been technically revised.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html. Official interpretations of TC 44 documents, where they exist, are available from this page: <https://committee.iso.org/sites/tc44/home/interpretation.html>.

Introduction

This document is not intended for use in a specific industry or with a specific software. Commercial tools are not excluded. This document is beneficial for the design, manufacturing and assessment of a wide range of components if the physical phenomena, software and numerical methods meet the specifications of the scientific computational tools (SCTs) defined in [Annex A](#).

This document can be used by industrial entities to define their requirements for specific applications of computational welding mechanics (CWM).

iTeh Standards
(<https://standards.iteh.ai>)
Document Preview

[ISO 18166:2026](#)

<https://standards.iteh.ai/catalog/standards/iso/66503741-58e3-454d-a4a1-b3ab504b226a/iso-18166-2026>

Numerical welding simulation — Execution and documentation

1 Scope

This document specifies the execution, validation, verification and documentation of a numerical welding simulation within the field of computational welding mechanics (CWM) and performed with a scientific computational tool (SCT).

This document is applicable to the thermal and mechanical finite element analysis (FEA) of arc, laser and electron beam welding processes for the purpose of calculating the effects of welding processes, and in particular, residual stresses and distortion, in support of structural integrity assessment.

2 Normative references

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.

ISO/TR 25901-1, *Welding and allied processes — Vocabulary — Part 1: General terms*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/TR 25901-1 and the following apply.

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

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

3.1

accuracy

closeness of agreement between a measured quantity value and a true quantity value of a measurand

Note 1 to entry: The term measurand is defined by the VIM (ISO/IEC Guide 99:2007, 2.3) as a “quantity intended to be measured”.

[SOURCE: ISO/IEC Guide 99 :2007, 2.13, modified — Note 1 to entry has been added.]

3.2

calculation strategy

set of modelling (and simulation) choices to perform a numerical simulation

Note 1 to entry: A calculation strategy defines the choice of physical models and of the coupling physics between models, the correlations, the discretization both spatial (mesh) and temporal (time step), the calculation options.

3.3

calibration

process of adjusting modelling parameter values of the scientific computing tool

Note 1 to entry: Calibration improves agreement between the calculated values and the reference values.