
**Technical product documentation —
Requirements for digital mock-up
virtual assembly test for mechanical
products**

*Documentation technique de produits — Exigences sur les essais
d'assemblage virtuel des produits mécaniques*

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

[ISO 21143:2020](https://standards.iteh.ai/catalog/standards/iso/2b92c261-7adf-4a61-b8d7-b3a5df541345/iso-21143-2020)

<https://standards.iteh.ai/catalog/standards/iso/2b92c261-7adf-4a61-b8d7-b3a5df541345/iso-21143-2020>



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

ISO 21143:2020

<https://standards.iteh.ai/catalog/standards/iso/2b92c261-7adf-4a61-b8d7-b3a5df541345/iso-21143-2020>



COPYRIGHT PROTECTED DOCUMENT

© ISO 2020

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
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 VAT process	3
4.1 General principles.....	3
4.2 Workflow process.....	3
5 VAT preparation requirements	4
5.1 General.....	4
5.2 Test plan.....	4
5.3 Model preparation.....	4
5.3.1 Product modelling.....	4
5.3.2 Environment modelling.....	4
5.3.3 Virtual operator modelling.....	5
5.3.4 Model qualification.....	5
5.4 Configuration and initialization.....	5
6 VAT implementation requirements	5
6.1 General.....	5
6.2 Interference inspection.....	6
6.2.1 Inspection tasks.....	6
6.2.2 Static interference inspection.....	6
6.2.3 Dynamic interference inspection.....	8
6.3 Assembly feasibility analysis.....	9
6.3.1 Analysis tasks.....	9
6.3.2 Assembly process analysis.....	10
6.3.3 Ergonomics evaluation.....	11
7 VAT review requirements	12
7.1 General.....	12
7.2 Preparation.....	13
7.3 Plan.....	13
7.4 Process.....	13
7.5 Report.....	13
Annex A (informative) A VAT aeroplane workflow process	15

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 documents 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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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 was prepared by Technical Committee ISO/TC 10, *Technical product documentation*, Subcommittee SC 6, *Mechanical engineering documentation*.

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.

<https://standards.iteh.ai/catalog/standards/iso/2b92e261-7adf-4a61-b8d7-b3a5df541345/iso-21143-2020>

Introduction

The digital mock-up virtual assembly test (VAT) is a computer simulation procedure in lieu of performing a physical prototype test for a product to verify the compatibility of the mechanical interface and the feasibility of assembly. This test can be used to explore and resolve interface and/or assembly problems before physical product assembly. VAT activities typically include virtual interference inspection, assembly process analysis and ergonomic evaluation based on 3D nominal models in the design phase. It can be helpful to consider the results of a VAT to predict and provide early warnings regarding the risk of interference or assembly problems, although the VAT cannot completely replace all the tests in on-site assembly testing.

The objectives of the VAT are as follows:

- a) verify the mechanical interface compatibility of units, sub-systems and products;
- b) ensure that the design output is interference-free and that all contacts or clearances are acceptable;
- c) validate layout design at every assembly level;
- d) verify assembly feasibility in the manufacturing and operational environments;
- e) evaluate the assembly process to optimize the assembly plan.

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

[ISO 21143:2020](https://standards.iteh.ai/catalog/standards/iso/2b92c261-7adf-4a61-b8d7-b3a5df541345/iso-21143-2020)

<https://standards.iteh.ai/catalog/standards/iso/2b92c261-7adf-4a61-b8d7-b3a5df541345/iso-21143-2020>

Technical product documentation — Requirements for digital mock-up virtual assembly test for mechanical products

1 Scope

This document specifies the requirements for a digital mock-up virtual assembly test (VAT) for mechanical products, which is suitable for guiding virtual assembly testing before physical production. The application of this document is intended to result in an effective VAT and efficient on-site assembly. This test is applicable to 3D nominal models with theoretically exact dimensions.

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 17599, *Technical product documentation (TPD) — General requirements of digital mock-up for mechanical products*

ISO 29845, *Technical product documentation — Document types*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 17599 and ISO 29845 and the following apply.

<https://standards.iteh.ai>
<https://standards.iteh.ai>
Document Preview
ISO 21143:2020

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

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

3.1

design model

portion of the data set that contains models and supplemental geometry

[SOURCE: ISO 29845:2011, 3.1.8]

3.2

3D nominal model

type of design model that contains three-dimensional geometry with theoretically exact dimensions

3.3

virtual assembly test

VAT

test for examining an assembly process in a virtual environment

**3.4
simplification**

method which allows some features built without modelling or some parts (or components) without assembling during the modelling process

Note 1 to entry: Through simplification, the geometric detailed representation can be simplified and the model loading efficiency can be improved provided that the simplification does not incur ambiguous understanding or bring about inconvenience to the use of a model.

[SOURCE: ISO 17599:2015, 3.12]

**3.5
lightweight**

method to extract patches from the product geometry model

Note 1 to entry: It reduces resource expenditure in model loading, and it is suitable for large assembly, assembly simulation, advertising, technical training and so on.

[SOURCE: ISO 17599:2015, 3.13]

**3.6
environment model**

type of model containing, for example, shop floor or tools and fixtures

**3.7
ideal human model**

computer-based dummy model in accordance with the actual statistical data set of human body features, typically as a whole-body model or local feature model, inclusive of citizenship or country of residence, gender, height and weight, fatigue and other characteristics

**3.8
process model**

type of model containing an assembly sequence, path and procedure

**3.9
assembly process simulation**

simulation of an assembly process in a virtual environment for the purposes of planning, analysis and optimization

**3.10
assembly path**

movement path of parts or components in an assembly process

**3.11
interference**

parts of two or more 3D nominal models occupying the same space at the same time

**3.12
clearance**

two or more adjacent surfaces in the nominal model not touching one another

**3.13
contact**

two or more surfaces in the nominal model touching one another

4 VAT process

4.1 General principles

A VAT shall be conducted at the design or manufacture start-up phase and shall take into account product peculiarities and complexity; developer and supplier divisions; software and hardware selection; basic library development; test and analysis methodologies; legal restrictions; risk management; cost; schedule; allowable deviations and other constraints. From the unit level through to the integrated product level, the VAT shall be implemented utilizing appropriate technical methods and suitable test tasks shall be performed at each assembly level.

4.2 Workflow process

Generally, the VAT process includes the following preparation, implementation and review phases:

- a) In the preparation phase, to certify the interface and assembly designs of the product, a VAT plan shall be developed that includes at minimum the test objectives, test tasks, test methodologies, test process, test bill of material (BOM) and test schedule. Test models shall be prepared, including product models, environment models and virtual operator models, and all models shall be certified. A virtual test environment shall be configured and initialized before moving on to the next phase.
- b) In the implementation phase, an interference inspection and assembly feasibility analysis shall be conducted in a virtual assembly environment. The VAT process and all relevant issues shall be documented, and the results verified in a closed-loop check.
- c) In the review phase, to validate the test results, a review shall be conducted to establish that the requirements of each of the different phases in the VAT process – preparation, plan, process and report – have been met.

Figure 1 shows a diagram of the VAT workflow process, and Annex A, Figure A.1, shows a VAT aeroplane workflow process.

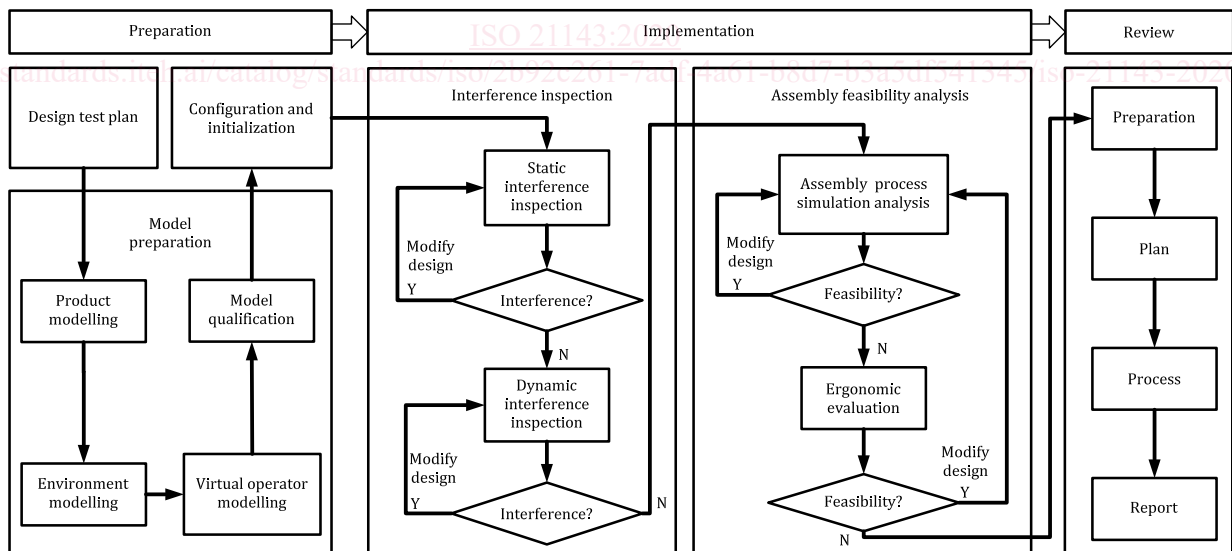


Figure 1 — VAT workflow process

5 VAT preparation requirements

5.1 General

Preparation of a VAT shall comprise the development of a test plan, the preparation of models and the configuration and initialization of a virtual assembly environment. The test plan, models and configuration and initialization statuses shall be documented.

5.2 Test plan

The test plan shall include but not be limited to the following:

- a) Test objectives: specification of test objectives to verify that the design meets the interface and assembly requirements when exposed to applicable environments;
- b) Test tasks: inspection and analysis tasks developed to meet the test objectives, which shall be incrementally performed at different assembly levels from the unit level to the integrated product level;
- c) Test methodologies: a suitable combination of inspection and analysis methods, hardware and software tools and a test process shall be selected or developed to identify latent design defects;
- d) Test process: a detailed flow chart of the VAT steps shall be developed to ensure the validity of the test results;
- e) Test BOM: a complete BOM for the VAT shall be provided according to the test tasks, test methodologies and test process;
- f) Test schedule: a time schedule shall be established to ensure the implementation of the VAT in the appropriate sequence from the unit level to the integrated product level, and the lower-level assembly testing shall be conducted before initiating upper-level testing.

5.3 Model preparation

ISO 21143:2020

<https://standards.iteh.ai/catalog/standards/iso/2b92e261-7adf-4a61-b8d7-b3a5df541345/iso-21143-2020>

5.3.1 Product modelling

A product model shall be developed, which may be simplified and/or lightweighted to improve test efficiency without affecting the established test objectives, the details of which are as follows:

- a) The general modelling requirements for mechanical products shall be followed according to ISO 17599.
- b) The simplified and/or lightweighted models at the unit level for the VAT shall keep their external geometric representation and may contain an empty internal chamber.
- c) The simplified and/or lightweighted models at the sub-system level for the VAT shall maintain uniformity of geometry, coordinate information, assembly constraints and other information that serves the test objectives.
- d) The integrated product model shall be partially simplified and/or lightweighted according to the speciality of the test task, without affecting the correct function of the movement mechanism.

5.3.2 Environment modelling

Environment modelling shall be used to hierarchically construct a digital workspace and support facilities that reflect the requirements of the desired assembly activities, as follows:

- a) The shop floor model shall be consistent with the actual workspace, and an activity boundary and operational space shall be established that provide enough assembly space.