INTERNATIONAL STANDARD

ISO 21600

First edition
2019-02

Technical product documentation (TPD) — General requirements of mechanical product digital manuals

Documentation technique de produits (TPD) — Exigences générales pour manuels numériques des produits mécaniques

Reference number
ISO 21600:2019(E)

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Published in Switzerland

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Foreword

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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.

Technical product documentation (TPD) — General requirements of mechanical product digital manuals

1 Scope

This document specifies the composition, basic principles, preparation process, general requirements, detailed requirements, publication and application requirements, and management requirements of mechanical product digital manuals.

This document is intended to be used for guidance in the preparation of digital manuals, which provide guidance in the use, repair and maintenance of products. It is also intended to be used for reference in production and manufacturing.

This document does not specify function or data structure of any specific software.

This document applies to the preparation of mechanical product digital manuals based on service bills of material and modularized technical information.

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 16792:2015, *Technical product documentation — Digital product definition data practices*

ISO 17599:2015, *Technical product documentation (TPD) — General requirements of digital mock-up for mechanical products*

IEC 82079-1:2012, *Preparation of instructions for use — Structuring, content and presentation — Part 1: General principles and detailed requirements*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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
digital manual
document that describes product information, whose contents are organized in a structured way, mainly expressed by three-dimensional models, published in either electronic or paper form and used to guide the use, repair and maintenance of products

3.2
engineering bill of materials
list of part numbers and assemblies that make up the design engineering configuration that contains the raw stock size and the material specification

[SOURCE: ISO 10303-240:2005, 3.4.3, modified — the article “the” is deleted.]

3.3
service bill of materials
bill about the items and quantities of the complete machine, components, parts and their service attributes, which is listed based on demands of after-sale service

3.4
data element
basic unit of data, of which the definition, identification, expression or allowable value may be stipulated by a set of properties known as metadata

3.5
data module
independent and complete data unit that describes the structure, performance and operational steps of mechanical products using models, text, pictures, audio and video

3.6
template
electronic document with a fixed format for preparing digital manuals

3.7
service bill of materials for product type
bill for product type about the items and quantities of the complete machine, components, parts and their service attributes, which is listed based on demands of after-sale service

3.8
configuration information
requirements for product or service design, realization, verification, operation and support

[SOURCE: ISO 10007:2017, 3.5]

3.9
service bill of materials for product instance
bill for product instance about the items and quantities of the complete machine, components, parts and their service attributes, which is listed based on demands of after-sale service

4 Abbreviations

BOM	bill of materials
DE	data element
DM	data module
EBOM	engineering bill of materials
ERP	enterprise resource planning
MES	manufacturing execution system
PDM	product data management
PT-SBOM	service bill of materials for product type
PI-SBOM	service bill of materials for product instance
SBOM	service bill of materials

5 Composition of digital manuals

Digital manuals usually include:

a) parts manual, which includes:
   - chapters and directories;
   - models or pictures;
   - material lists;
   - tool lists;
   - parts lists.

b) operation, repair and maintenance manual, which includes:
   - chapters and directories;
   - operation information;
   - repair and maintenance information.

c) safety manual, which includes:
   - chapters and directories;
   - warning levels;
   - warning labels;
   - warning text.

d) others, for example, an accompanying list.

6 Basic principles

Preparation of digital manuals shall meet the following basic principles:

a) Descriptions of products in digital manuals shall be consistent with the actual states of the corresponding products.

b) Expression and style of information in digital manuals shall be suitable for displaying, viewing, understanding and expanding.

c) The digital manual shall be easily maintained.

d) Information in digital manuals shall be kept safe by using access authority right limits.

e) Digital manuals shall be able to be installed and run in a network environment.

7 Preparation process

7.1 Relationship of data

Use the engineering bill of materials (EBOM), models and other data (e.g. production date) to create a service bill of materials (SBOM), data elements (DEs), data modules (DMs) and a template; from these a digital manual can be generated and released. This usually includes a parts manual, an operation, repair and maintenance manual, a safety manual and an accompanying list. See Annex A, Figure A.1 for the relationship between data at each preparation stage of a digital manual.

7.2 Information preparation

Information needed before preparation of digital manuals shall include but not be limited to:

— early-stage summaries of maintenance;

— EBOM and models;

— maintenance requirements.

7.3 Preparation of digital manuals

7.3.1 Preparation of SBOM

SBOM shall include but not be limited to:

a) structure, which shall include but not be limited to:

— layer of structure, which indicates the layered state of components and parts;

— node, which indicates all components and parts;

— quantity, which indicates the quantity of components and parts;

b) content, which shall include but not be limited to:

— material number, which indicates the serial number of components and parts;

— version, which indicates the version of components and parts;

— name, which indicates the name of components and parts;

— archived information, which includes product ID, production order information;

— service attributes, which indicates the defined service attributes of components and parts.

NOTE Service attributes not only extract some attributes from EBOM, but can also add other attributes according to actual needs, such as replacement cycles.

See Annex B, Figure B.1 for the preparation process of SBOM.

7.3.2 Preparation of DE

As the basic element in a digital manual, DE mainly includes:

— models, which shall be able to be linked to corresponding nodes of SBOM and vice versa;

— text;

— pictures, which shall support link functionality;

— audio, which includes non-verbal sounds, warning sounds and an interpreter's voice;

— video, which shall support link functionality.

See Annex C, Figure C.1 for the preparation process of models. See Annex D, Figure D.1 for the preparation process of DE.

7.3.3 Preparation of DM

DM is the smallest presentation unit of digital manuals. It shall contain a complete set of technical information, may be composed of one or more (kinds of) DEs and may be managed by codes. It mainly includes:

— DM of description, which shall describe the product information such as structures, functions, principles and purposes;

— DM of operation, which shall describe the necessary information for product installation and operation;

— DM of maintenance planning, which shall describe product maintenance planning information, including information needed by preventive maintenance;

— DM of faults, which shall describe fault phenomena and methods to diagnose and exclude faults;

— DM of procedures, which shall describe all kinds of procedure information, for example product maintenance or repair procedure;

— DM of processes, which shall describe the logic to organize other DMs;

— DM of illustrated parts, which shall describe parts lists and legend information.

See Annex E, Figure E.1 for the preparation process of DM.

7.3.4 Preparation of templates

Templates shall include but not be limited to:

— template of parts manual;

— template of operation, repair and maintenance manual;

— template of safety manual;

— template of accompanying list.

See Annex F, Figure F.1 for the preparation process of templates.

7.4 Release of digital manuals

Digital manuals may be released in various forms, such as HTML or Microsoft® Word[1)]. After release, output information may include:

— parts manual;

— operation, repair and maintenance manual;

— safety manual;

— other, for example, packing list.

1) Microsoft® Word is an example of a suitable product available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product.

8 General requirements

8.1 Compiling requirements

The compiling of digital manuals shall meet the following requirements:

a) Different parts of a digital manual may be separately prepared according to the maintenance characteristics of products.

b) The structure tree of digital manuals shall be formed from SBOM, so that users can quickly browse the technical information.

c) Technical information of digital manuals shall be organized using the form of DMs. If necessary a database of safety information may be built as well.

d) Design parameters, such as length, width, height, weight of mechanical products, shall be derived from the models and inserted into the specified location in digital manuals.

e) Service lists for typical repair parts (e.g. engines, pumps and motors), typical materials (e.g oils, fats and sandpaper) and tools shall be provided.

f) When the structure or performance of the mechanical products changes, the digital manual shall be updated in accordance with 11.2.4.

8.2 Data requirements

Digital manual data shall meet the following requirements:

a) Data source for the same data shall be unique.

b) Once SBOM, DEs and DMs have been built, they shall be used repeatedly.

c) Product model information and component parameters and attribute information shall be accurately associated with service bill of materials for product type (PT-SBOM) from the design system.

d) Configuration information of the product shall be accurately associated with service bill of materials for product instance (PI-SBOM) from product data management (PDM) or enterprise resource planning (ERP) system.

e) Production date, batch, ID and important parts information of mechanical products shall be accurately associated with PI-SBOM from the production order.

8.3 Content and presentation requirements

The content and presentation requirements shall be in accordance with the requirements of IEC 82079-1:2012, Clause 5 and Clause 6.

9 Detailed requirements

9.1 SBOM requirements

9.1.1 Preparation principles

Preparation of SBOM shall meet the following principles:

a) SBOM shall remain consistent with the product state in the whole product life cycle.

b) Attributes and structures of SBOM shall meet the preparation requirements of digital manuals.

c) SBOM shall contain attribute information of components and parts, such as material code and manufacturing type.

d) SBOM shall be associated with corresponding models.

e) SBOM shall contain version information.

9.1.2 Structure transformation requirements

PT-SBOM may be prepared by the transformation from EBOM. The transformation shall meet the following requirements:

a) The components and parts defined as minimum service units shall not be split up further.

b) New service node information may be added to PT-SBOM if needed.

c) The purchased components and parts shall be split into minimum service units based on needs of service.

d) Production information shall be added to PT-SBOM.

See Annex G, Figure G.1 for the transformation rules from EBOM to PT-SBOM.

9.1.3 Preparation requirements

9.1.3.1 Preparation of PT-SBOM

Preparation of PT-SBOM shall meet the following requirements:

a) Structure information of PT-SBOM may be obtained from EBOM or models.

b) When preparing PT-SBOM, parameter definitions of special attributes shall not affect EBOM.

c) PT-SBOM shall define service attributes of materials based on needs of service.

d) Newly increased service components in PT-SBOM shall be defined based on the feature of product.

e) PT-SBOM shall accurately and completely contain all materials of corresponding types of product, including multi-configuration materials.

9.1.3.2 Preparation of PI-SBOM

Preparation of PI-SBOM shall meet the following requirements:

a) PI-SBOM shall be generated based on PT-SBOM.

b) PI-SBOM shall extract production information, such as ID, production date and orders information, from information systems such as ERP and manufacturing execution system (MES), and make accurate descriptions.

c) PI-SBOM shall be consistent with the product state.

9.2 DE requirements

9.2.1 Model requirements

9.2.1.1 General requirements

Models shall meet the following general requirements:

a) Models shall contain complete configuration information of the product, and there shall be no redundant element.

b) Lightweight models shall be used.

c) Model integrity shall meet the requirements of ISO 16792:2015, Clause 6.

d) Component models shall be unique.

9.2.1.2 Detailed requirements

Models shall meet the following detailed requirements:

a) The lightweight model shall

- reflect the geometric characteristics and the constraint relationships of the design model;
- correctly reflect parameter information of the design model;
- meet the preparation requirements of exploded views, assembly and disassembly animations, and mechanism motions and simulations;
- be updated when the design model changes;
- contain effective version information;
- link to the corresponding SBOM;
- contain the best view of components and parts needed for the digital manual.

b) If necessary, the component model shall be decomposed as follows:

- the decomposition levels shall be determined according to certain principles;
- a component that cannot be disassembled, for example welding assembly, shall no longer be further exploded;
- exploding shall be in accordance with the actual assembly and disassembly motion of parts, and shall create offset lines in order to explain the motion path of exploded parts;
- standard parts shall be exploded by group units, for example bolts, washers and nuts;
- array installed standard parts may only explode one group among them;
- ball marks of components and parts shall be established based on the exploded view and put in suitable positions to avoid overlap or cross;
- the best views of exploded view, which may not be unique, shall be prepared.

c) Models shall be able to be used to prepare animations of the assembly and disassembly process. The animation of assembly and disassembly shall

- be prepared based on lightweight models;
- show the gravity centre and lifting position of the components and parts, and the tools used;

— provide necessary instructions for different assembly and disassembly states and, especially when describing actions of hydraulic and electrical components, provide specific operation steps;

— highlight safety warning labels such as danger, warning and notice;

— highlight components that are being assembled or disassembled and their labelling information;

— prepare the best views of key states during the assembly and disassembly process for needs of printing digital manuals;

— be able to be output as video.

d) Models shall be able to be used to prepare mechanism motion and simulation. The mechanism motion and simulation shall

— be prepared based on lightweight models;

— define constraints between different components and parts according to the actual situation of mechanical products;

— accurately reflect functions and actions of mechanical products;

— prepare the best views of key states during the mechanism motion and simulation process in order to compile pictures in digital manuals.

e) Models shall be able to be linked with all other media, for example text, pictures and video.

f) ISO 17599:2015, Clause 8 shall apply.

9.2.2 Text requirements

Text shall meet the following requirements:

a) Descriptions shall be accurate, concise and easy to understand.

b) Each paragraph shall have only one central theme.

c) Unified unit system of measurement shall be used.

9.2.3 Picture requirements

Pictures shall meet the following requirements:

a) Pictures shall be clear and easy to understand.

b) Symbols shall conform with relevant graphical symbols and standards.

c) Picture formats shall be consistent in the digital manual.

d) The best views of models shall be used and, if necessary, pictures of physical products may be used.

9.2.4 Audio requirements

Audio shall meet the following requirements:

a) Audio formats shall be consistent in the digital manual.

b) Necessary visual information shall be synchronously displayed with the audio information.

c) Non-verbal sounds, including background sound, shall not affect personal safety.

d) Warning sounds may be used in conjunction with safety information and shall not cause confusion.

e) Interpreters shall speak clearly and accurately at a moderate speed.

9.2.5 Video requirements

Video shall meet the following requirements:

a) Video shall be vivid and easy to understand.

b) Necessary text information shall be delivered as subtext or audio.

c) Video formats shall be consistent in the digital manual.

d) When multiple video is associated with the same node, video shall be sequenced.

9.3 DM requirements

DMs shall meet the following requirements:

a) DMs shall be applicable to the exchange of information.

b) Each DM shall consist of common information and technical information. Common information shall include identification information, such as code, name, version and date, and status information, such as security level (e.g. public, internal, secret), creator and alteration information. Technical information shall include one or more (kinds of) relevant DEs and necessary safety information.

9.4 Template requirements

9.4.1 Basic requirements

Digital manual templates shall meet the following basic requirements:

a) The interface of the template shall be clear and concise.

b) The directory tree of the template shall be editable.

c) The directory tree of the template shall be associated with corresponding DMs.

d) Templates shall be able to set formats for pictures, tables and texts.

e) Fonts of titles and highlighted texts, such as warnings, shall be prescribed.

f) The display areas of DEs and DMs in templates shall be editable.

9.4.2 Requirements of the online template

9.4.2.1 Directory tree requirements

The directory tree of the online template shall meet the following requirements:

a) Catalogues of online templates shall be displayed in the manner of a directory tree.

b) The directory tree shall be edited based on the characteristics of products.

c) Nodes of the directory tree may be generated by the names of corresponding DMs.

9.4.2.2 Picture requirements

Pictures in the online template shall meet the following requirements:

a) Each picture shall have a title associated with it to ensure that they are always displayed together.

b) Pictures shall automatically generate their serial numbers, which shall be associated with the picture numbers referenced in the text.

9.4.2.3 Table requirements

Tables in the online template shall meet the following requirements:

a) Each table shall have a title associated with it to ensure that they are always displayed together.

b) Tables shall automatically generate serial numbers, which shall be associated with the table numbers referenced in the text.

c) Each table shall include a header, row headline, column heading and content.

9.4.2.4 Scroll bar requirements

The scroll bar of the online template shall specify the area sizes of DEs and DMs in the online template. When contents displayed exceed the specified area, all the information in the area shall be displayed by using the scroll bar.

See Annex H for an example of the online template.

9.4.3 Requirements of the printed template

The printed template shall meet the following requirements:

a) The chapter directory of the printed template shall be generated by the directory tree of the online template.

b) The printed template shall include all information in the corresponding online template.

c) Each type of printed template shall generate a corresponding manual, such as a parts manual, or an operation, repair and maintenance manual.

d) Pictures based on models in the printed template shall show the best views.

e) Headers and footers may be added to the printed template.

f) Pictures and tables shall be associated with their titles to avoid separation.

10 Releasing and application requirements

10.1 Releasing requirements

When releasing a digital manual, it shall meet the following requirements:

a) Released information shall be consistent with product information.

b) Released digital manuals shall be suitable for users to view, browse and print.

c) Views of models shall be able to be converted to pictures when printing.

d) New digital manuals may be prepared by editing released digital manuals.

10.2 Application requirements

10.2.1 Advertisement requirements

In released digital manuals, models can be shaded or rendered for the purposes of advertisement.

10.2.2 Sales requirements

Digital manuals shall include structures, configurations, important performance parameters, working conditions, suitable working environments and other key information about products to help salespersons to understand, advertise and promote products.

10.2.3 Training requirements

To meet training needs, digital manuals shall meet the following requirements:

a) If necessary, digital manuals shall provide demonstration information on models to show how to disassemble, assemble, transport and store the product to help to train users.

b) The demonstration information on service models shall guide users on how to maintain the product, including, but not limited to:

   — providing tools and their methods of use for every maintenance procedure;

   — suggesting quantities of consumables such as lubricants and greases.

10.2.4 Service requirements

Digital manuals shall provide accurate maintenance information to help servicepersons to provide after-sale service for customers.

10.2.5 Browsing requirements

When browsing digital manuals, users shall be able to:

a) open the digital manual in different places independently, for example online or via CD-ROM;

b) index other parameters, preferably based on material codes;

c) be provided with suitable access authorities to protect their privacy;

d) add, store, display and hide text notes;

e) use keywords to search for relevant information quickly;

f) move, zoom in, zoom out and rotate models.

11 Management requirements

11.1 General requirements

Digital manual management includes, but is not limited to, life cycle management and data management. It shall meet the following general requirements:

a) In the same enterprise, the software and its version used to prepare and manage the digital manual in the life cycle of products shall be harmonized.

b) All data and alteration processes of the digital manual generated from the different life cycle stages of products shall be managed by standard procedures.

11.2 Life cycle management requirements

11.2.1 General requirements

Life cycle management of digital manuals mainly includes preparation stage management, releasing stage management and maintenance stage management. It shall be managed based on the life cycle of SBOM.

11.2.2 Preparation stage management requirements

Preparation stage management shall meet the following requirements:

a) Management practices for every life cycle stage of the digital manual shall be established during the preparation stage of the digital manual, which shall include but not be limited to

   — management practices of DE preparation;

   — management practices of DM preparation;

   — management practices of SBOM preparation;

   — management practices of template preparation;

   — management practices of digital manual preparation;

   — management practices of digital manual evaluation;

   — management practices of digital manual update.

b) The DEs, DMs, SBOM, template and digital manual shall be evaluated. Release them only after passing the evaluation.

11.2.3 Releasing stage management requirements

Releasing stage management shall meet the following requirements:

a) The accuracy of released information shall be confirmed.

b) The access authority of the recipient of released information shall be confirmed.

11.2.4 Maintenance stage management requirements

Maintenance stage management shall meet the following requirements:

a) Digital manuals shall be updated when the need for error correction, design changes or product maintenance arises.

b) Updates to the digital manual shall be in accordance with update procedures. Alteration can happen only after the application for the alteration is approved.

c) Updates to the digital manual shall not damage the quality of the digital manual.

d) Digital manuals shall be managed by version information.

11.3 Data management requirements

Data management of digital manuals shall meet the following requirements:

a) A management platform shall be used to manage digital manual data.

b) Digital manual data generated from each stage of the life cycle of products shall be uniformly managed, including:

   — hierarchical management of data according to the product structure;

   — management of data according to the properties and characteristics of the data;

   — version status management of data, for example mandatory baseline with stage information can be created on SBOM, according to which data shall be archived;

   — establishment of effective data index and relevance regulations.

c) The safety, integrity and validity of the digital manual data shall be regularly checked.

d) A data safety management mechanism shall be established for digital manuals and data backup shall be carried out regularly to avoid data loss or damage caused by nature or human factors.

Annex A
(informative)

Relationship of data at each preparation stage of a digital manual

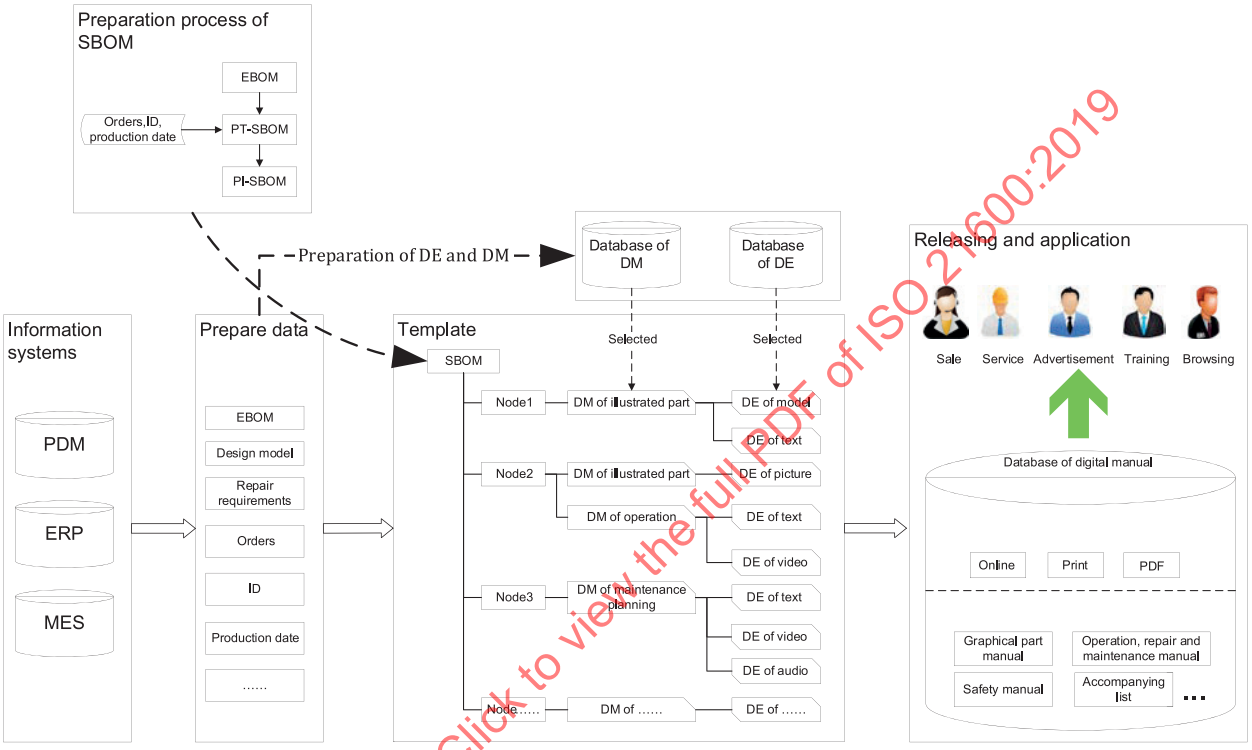

Figure A.1 — Relationship of data at each preparation stage of a digital manual

Annex B
(informative)

Preparation process of SBOM

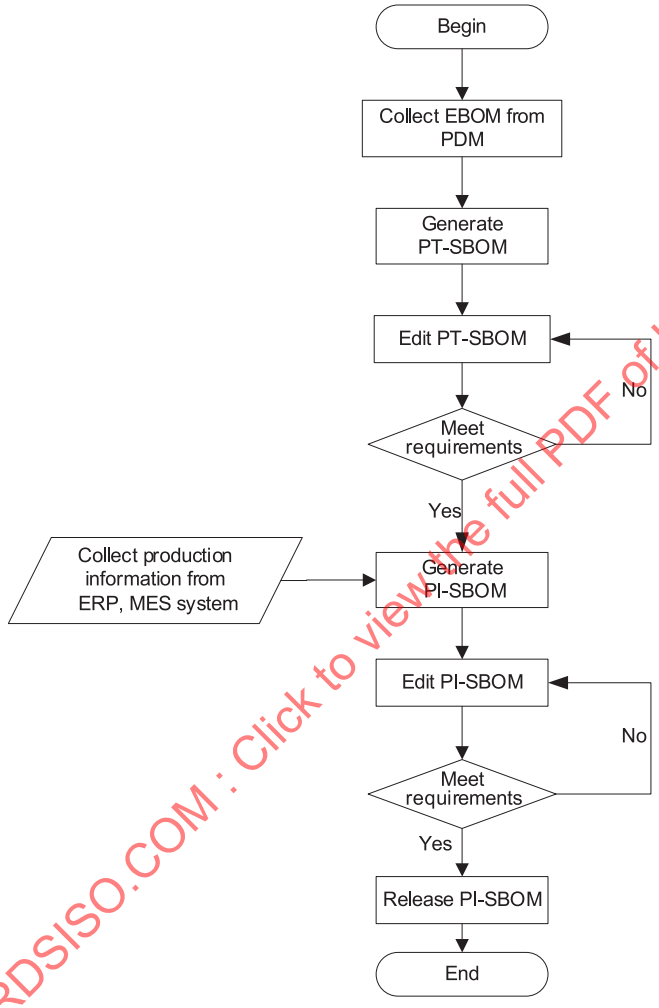

Figure B.1 — Preparation process of SBOM

Annex C
(informative)

Preparation process of a model

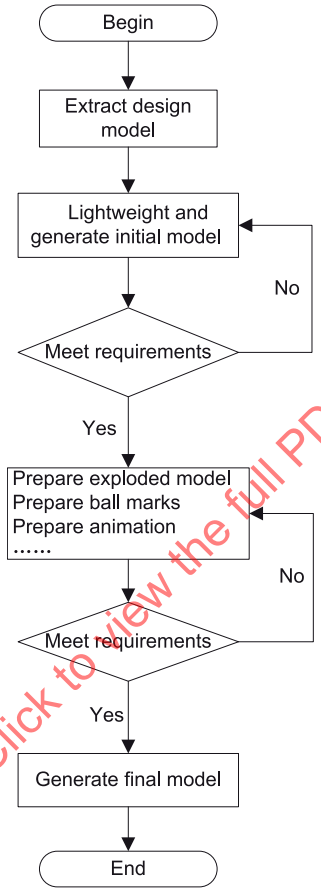

Figure C.1 — Preparation process of a model

Annex D
(informative)

Preparation process of DE

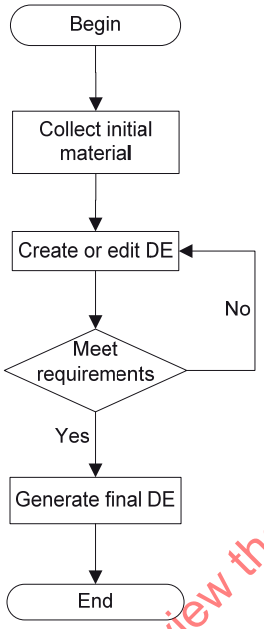

Figure D.1 — Preparation process of DE

Annex E
(informative)

Preparation process of DM

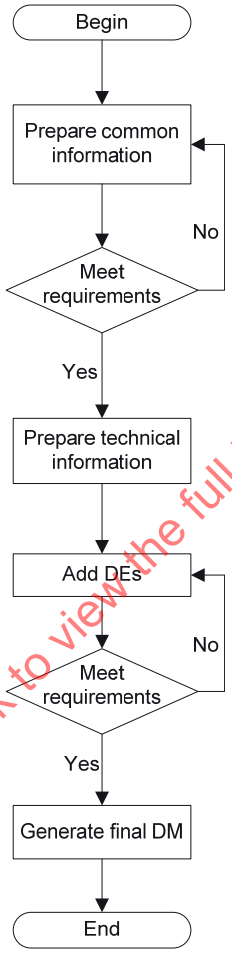

Figure E.1 — Preparation process of DM