INTERNATIONAL STANDARD

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Optics and photonics — Electronic exchange of optical data —

Part 1: NODIF information model

Optique et photonique — Transfert électronique des données optiques —

Partie 1: Modèle de données NODIF

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 25297-1 was prepared by Technical Committee ISO/TC 172, *Optics and photonics*, Subcommittee SC 1, *Fundamental standards*.

This second edition cancels and replaces the first edition (ISO 25297-1:2010), which has undergone a minor revision to correctly identify the status of Annex A as being normative rather than informative and to apply corrections to Figures 1, 2, A.8, A.14, A.18 and A.23.

ISO 25297 consists of the following parts, under the general title *Optics and photonics — Electronic exchange of optical data*:

— *Part 1: NODIF information model*

— *Part 2: Mapping to the classes and properties defined in ISO 23584*

Introduction

This part of ISO 25297, dealing with the Neutral Optical Data Interchange Format (NODIF), is the International Standard that describes the way optical information is transferred from one computer-aided-design program (CAD, CAE, CAM) to another, in a machine-independent and language-independent format.

ISO 10303 (all parts) is the International Standard for Exchange of Product model data (STEP) that describes the computer-interpretable representation and exchange of product data. Its objective is to provide a neutral mechanism capable of describing any product data throughout the life cycle of the product, independent of any particular system. This description makes it suitable not only for neutral file exchange, but also as a basis for implementing and sharing product databases and for archiving. ISO 10303 (all parts) has been designed to support an extensive domain of product data-communication requirements, i.e. all product data necessary to completely define any product for all applications over the product's life cycle.

STEP is organized in a series of parts, each published separately. Each part falls into one of the following categories: descriptive methods, integrated resources, application integrated constructs, application protocols, abstract test suites, implementation methods and conformance testing. The series is described in ISO 10303-1.

A fundamental concept is the definition of the application protocol (AP), which is the mechanism for specifying information requirements and for ensuring reliable communication. An application protocol defines the context, scope and information requirements for a particular product and specifies the resource constructs required to satisfy these requirements. Application protocols employ three types of information models:

a) an application activity model (AAM), which describes the activities and processes that use and produce the product data in a specific application context;

b) an application reference model (ARM), which defines the terminology within the application context and specifies the conceptual structures and constraints that are used to describe the information requirements for an application;

c) an application interpreted model (AIM), which is a model of selected integrated resources that are constrained, specialized or completed to satisfy the information requirements of the ARM.

This part of ISO 25297 for NODIF is intended to conform to the requirements of ISO 10303 (all parts) as a member of the application protocol series.

Optics and photonics — Electronic exchange of optical data —

Part 1:
NODIF information model

1 Scope

This part of ISO 25297 specifies the information requirements for optical systems and parts, and provides an information model to support the processes of optical design, optical evaluation and analysis for these optical systems and parts when using computers with CAD and CAE.

NOTE Generally, an optical system means an optical unit as an optical product, which performs optical functions, and is composed of optical elements and the barrels in which these elements are mounted. In this part of ISO 25297, an optical system is a collection of optical parts and optical assemblies, e.g. the viewfinder system or the taking lens system of a leaf shutter camera.

This information model adds the data peculiar to optical design specification based on STEP to ISO 10303 (all parts). The additional information is product specification information, optical design information, optical evaluation information and analysis information.

This part of ISO 25297 is generically called the Neutral Optical Data Interchange Format (NODIF).

The following are within the scope:

— information on product specification, optical design, optical evaluation and analysis;

— optical systems and parts in imaging systems, such as cameras and copiers, viewing systems for telescopes and microscopes and the other optical systems, such as projectors and pick-up lenses;

— multiple-configuration optical systems, including zoom lenses and inner focusing systems;

— optical path definition, including ray-path sequence and optical surface arrangement;

— optical assemblies, including cemented parts and dynamic parts;

— mathematical description of the optical surface form;

— description of diffractive surfaces;

— machining process designation, such as polishing, moulding or replicating;

— optical material specifications, such as material names, lot numbers and measured refractive indices;

— optical tolerances for the shape and material property of each optical part;

— assembly tolerances, such as separation, parallelism, displacement and tilt;

— effective diameters, coatings and protective surface treatment;

— paraxial evaluation, such as focal length, back focal length, principal points and f-number;

— ray-tracing evaluation, such as geometrical ray-tracing results (i.e. ray directions and intersection points on each surface and optical path lengths), aberrations and wavefront aberration;

— OTF evaluation based on geometrical and/or physical optics;

— illuminance distribution on a detection surface or a projection surface;

— spectral characteristics;

— ghost image evaluation;

— thermal analysis accompanying optical surface deformation and material property value change;

— stress analysis accompanying optical surface deformation and material property value change;

— veiling glare and surface imperfections.

The following are outside the scope of this part of ISO 25297:

— mechanical design, electronic design and embedded software design;

— optical systems in which the optical path is changeable, e.g. beam splitters or variable magnification converters;

— tolerances for mechanical parts;

— parts with a diameter less than 10 times the wavelength of light;

— parts made from materials whose dielectric constant, σ, electric permittivity, ε, and magnetic permittivity, μ, are uninfluenced by interaction between the materials and the light;

— graphical documents resulting from design, evaluation and analysis of products;

— optical wave guide for optical communications;

— product planning information concerning market research and customer analysis;

— product definition and configuration control information irrelevant to design, evaluation and analysis;

— analysis information, except thermal and stress analysis, e.g. vibration analysis;

— information on trial production, production process including production planning and production control, and processes after production, such as shipment and repair;

— ophthalmic optics.

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 10110-1, *Optics and photonics — Preparation of drawings for optical elements and systems — Part 1: General*

ISO 10110-2:1996, *Optics and optical instruments — Preparation of drawings for optical elements and systems — Part 2: Material imperfections — Stress birefringence*

ISO 10110-3:1996, *Optics and optical instruments — Preparation of drawings for optical elements and systems — Part 3: Material imperfections — Bubbles and inclusions*

ISO 10110-4:1997, *Optics and optical instruments — Preparation of drawings for optical elements and systems — Part 4: Material imperfections — Inhomogeneity and striae*

ISO 10110-5:2007, *Optics and photonics — Preparation of drawings for optical elements and systems — Part 5: Surface form tolerances*

ISO 10110-6:1996, *Optics and optical instruments — Preparation of drawings for optical elements and systems — Part 6: Centring tolerances*

ISO 10110-7:2008, *Optics and photonics — Preparation of drawings for optical elements and systems — Part 7: Surface imperfection tolerances*

ISO 10110-8, *Optics and photonics — Preparation of drawings for optical elements and systems — Part 8: Surface texture; roughness and waviness*

ISO 10110-12:2007, *Optics and photonics — Preparation of drawings for optical elements and systems — Part 12: Aspheric surfaces*

ISO 10110-17:2004, *Optics and photonics — Preparation of drawings for optical elements and systems — Part 17: Laser irradiation damage threshold*

ISO 10303-1:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 1: Overview and fundamental principles*

ISO 10303-203, *Industrial automation systems and integration — Product data representation and exchange — Part 203: Application protocol: Configuration controlled 3D design of mechanical parts and assemblies (modular version)*

ISO 23584-2, *Optics and photonics — Specification of reference dictionary — Part 2: Classes' and properties' definitions*[1)]

ISO 25297-2, *Optics and photonics — Electronic exchange of optical data — Part 2: Mapping to the classes and properties defined in ISO 23584*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

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

3.1.1
application
group of one or more processes creating or using product data

[ISO 10303-1:1994, 3.2.2]

3.1.2
application activity model
AAM
model that describes an application in terms of its processes and information flows

[ISO 10303-1:1994, 3.2.3]

3.1.3
application object
atomic element of an application reference model that defines a unique concept of the application and contains attributes specifying the data elements of the object

[ISO 10303-1:1994, 3.2.6]

3.1.4
application protocol
AP
one of the parts of ISO 10303-1 that specifies an application-interpreted model satisfying the scope and information requirements for a specific application

NOTE This definition differs from the definition used in open system interconnection (OSI) standards. However, since ISO 10303-1 is not intended to be used directly with OSI communications, no confusion should arise.

[ISO 10303-1:1994, 3.2.7]

1) To be published.

3.1.5
application reference model
ARM
information model that describes the information requirements and constraints of a specific application context

[ISO 10303-1:1994, 3.2.8]

NOTE See Annex B for diagrams of example application activity models.

3.1.6
assembly
product that is decomposable into a set of components or other assemblies from the perspective of a specific application

[ISO 10303-1:1994, 3.2.10]

3.1.7
component
product that is not subject to decomposition from the perspective of a specific application

[ISO 10303-1:1994, 3.2.11]

3.1.8
data
representation of information in a formal manner suitable for communication, interpretation or processing by human beings or computers

[ISO 10303-1:1994, 3.2.14]

3.1.9
data exchange
storing, accessing, transferring and archiving of data

[ISO 10303-1:1994, 3.2.15]

3.1.10
design_discipline_product_definition
one of the organizational definitions or views of a part in accordance with ISO 10303-203:2005, 4.2.8

NOTE A part version is the identification of the representation of a part after its design has undergone a formal release or change.

3.1.11
external definition
definition of product information defined outside NODIF

3.1.12
external file reference
locator of an external file to identify a collection of information whose contents are excluded from the data structure of NODIF

3.1.13
information
facts, concepts or instructions

[ISO 10303-1:1994, 3.2.20]

3.1.14
product
thing or substance produced by a natural or artificial process

[ISO 10303-1:1994, 3.2.26]

3.1.15
product data
representation of information about a product in a formal manner suitable for communication, interpretation or processing by human beings or by computers

[ISO 10303-1:1994, 3.2.27]

3.1.16
unit of functionality
collection of application objects and their relationships that defines one or more concepts within the application context such that removal of any component would render the concepts incomplete or ambiguous

[ISO 10303-1:1994, 3.2.33]

3.2 Abbreviated terms

AAM	application activity model
AP	application protocol
ARM	application reference model
BOM	bill of material
CAD	computer-aided design
CAE	computer-aided engineering
ICAM	integrated computer-aided manufacturing
ID	identification
IDEF0	ICAM definition language 0
LEW	line equivalent width
MTF	modulation transfer function
OTF	optical transfer function
PDM	product data management
SED	spot equivalent diameter
STEP	standard for the exchange of product model data (generic term for ISO 10303)
UoF	units of functionality
VGI	veiling glare index

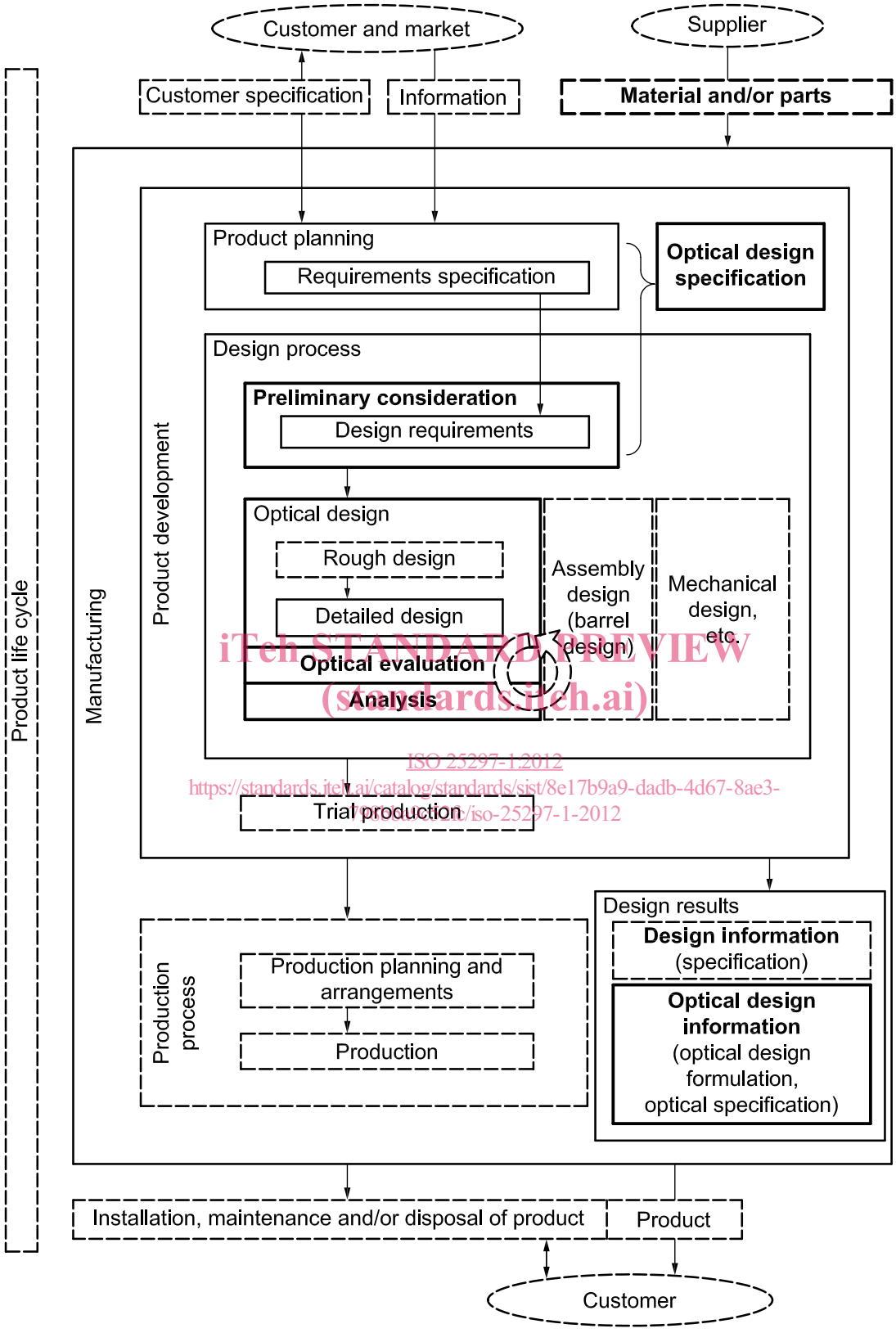
4 Information requirements

4.1 General

In 4.2 and 4.3 the information requirements for NODIF are specified. The information requirements are specified as a set of units of functionality and application objects.

A mapping of these information requirements to the classes and properties defined in ISO 23584-2 is specified in ISO 25297-2.

A diagram of the manufacturing process for optical products is given in Figure 1.



NOTE The dotted line means “out of scope”.

Figure 1 — Manufacturing process of optical products

4.2 Units of functionality

4.2.1 General

4.2.1.1 Subclause 4.2.1 specifies the units of functionality (UoF) for optical design, optical evaluation and analysis in the application protocol of optical systems, parts, and assemblies.

This part of NODIF specifies the following units of functionality:

— optical_part_identification;

— optical_design_specification;

— optical_design_information;

— optical_evaluation_information;

— analysis_information.

4.2.1.2 The following units of functionality make use of UoFs defined in accordance with ISO 10303-203:

— end_item_identification;

— part_identification;

— authorization;

— design_activity_control;

— bill_of_material;

— shape;

— design_information;

— effectivity;

— source_control.

The UoFs and application objects, and the relations between them, are illustrated in the simple ARM diagram shown in Figure 2.

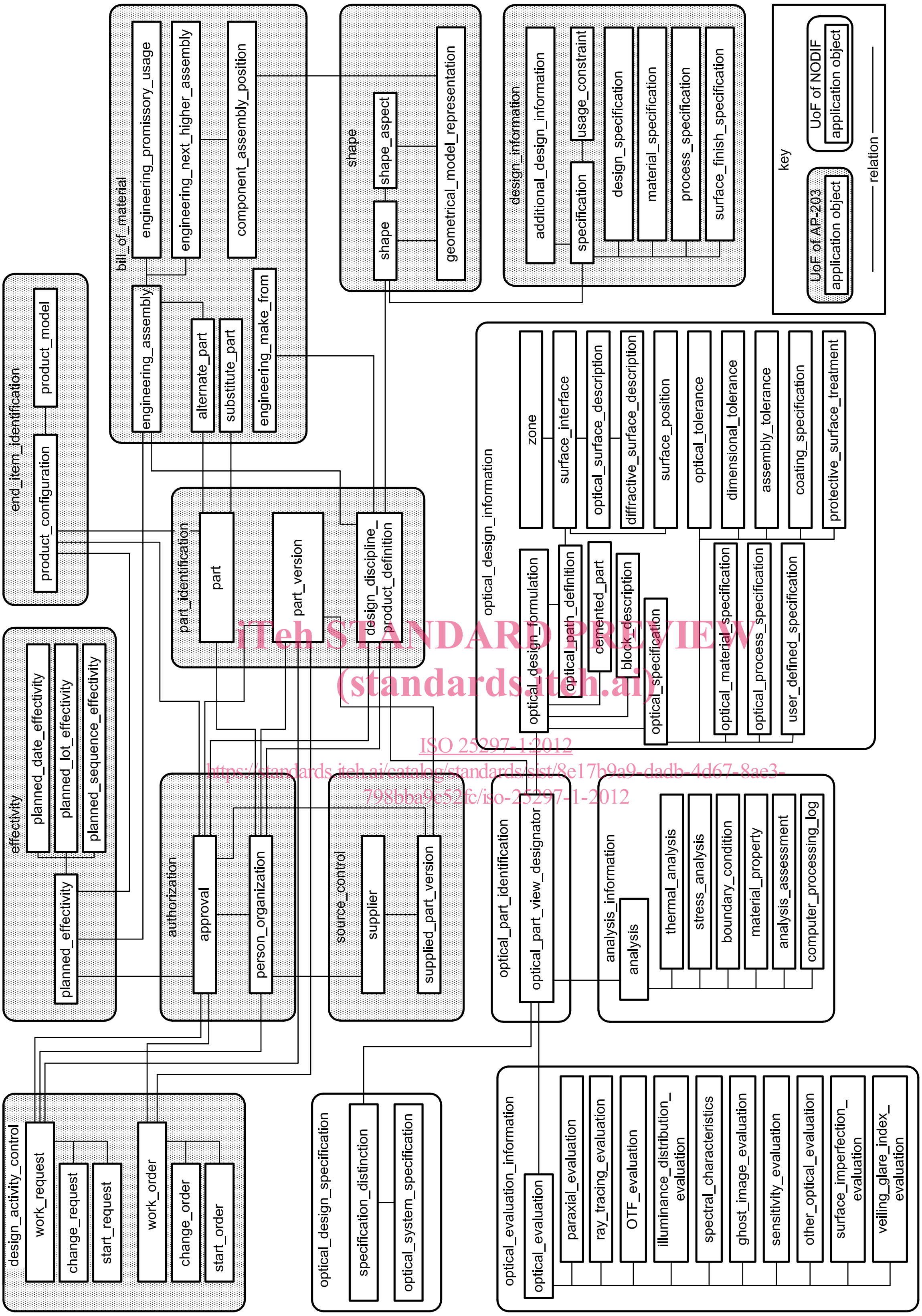

end_item_identification
product_configuration
product_model
bill_of_material
engineering_promissory_usage
engineering_next_higher_assembly
component_assembly_position
engineering_assembly
alternate_part
substitute_part
engineering_make_from
shape
shape
shape_aspect
geometrical_model_representation
design_information
additional_design_information
specification
usage_constraint
design_specification
material_specification
process_specification
surface_finish_specification
key
UoF of AP-203
application object
UoF of NODIF
application object
relation
effectivity
planned_effectivity
planned_date_effectivity
planned_lot_effectivity
planned_sequence_effectivity
part_identification
part
part_version
design_discipline_
product_definition
optical_design_information
zone
surface_interface
optical_surface_description
diffractive_surface_description
surface_position
optical_tolerance
dimensional_tolerance
assembly_tolerance
coating_specification
protective_surface_treatment
optical_design_formulation
optical_path_definition
cemented_part
block_description
optical_specification
optical_material_specification
optical_process_specification
user_defined_specification
authorization
approval
person_organization
source_control
supplier
supplied_part_version
optical_part_identification
optical_part_view_designator
analysis_information
analysis
thermal_analysis
stress_analysis
boundary_condition
material_property
analysis_assessment
computer_processing_log
design_activity_control
work_request
change_request
start_request
work_order
change_order
start_order
optical_design_specification
specification_distinction
optical_system_specification
optical_evaluation_information
optical_evaluation
paraxial_evaluation
ray_tracing_evaluation
OTF_evaluation
illuminance_distribution_
evaluation
spectral_characteristics
ghost_image_evaluation
sensitivity_evaluation
other_optical_evaluation
surface_imperfection_
evaluation
veiling_glare_index_
evaluation

Figure 2 — NODIF simple ARM diagram

4.2.2 optical_part_identification

The optical_part_identification UoF contains the linkage between the information on optical systems and parts described in NODIF and the information on assemblies and parts described in other APs in ISO 10303, especially AP 203. The application object, optical_part_view_designator, is used in the optical_part_identification UoF.

4.2.3 optical_design_specification

The optical_design_specification UoF contains optical design specifications, such as optical performance, accuracy, quality, operating environment, dimensions and mass for an optical system. The following application objects are used in the optical_design_specification UoF:

— specification_distinction;

— optical_system_specification.

4.2.4 optical_design_information

The optical_design_information UoF contains a collection of information on optical design. The following application objects are used in the optical_design_information UoF:

— optical_design_formulation;

— block_description;

— cemented_part;

— optical_path_definition;

— surface_interface;

— surface_position;

— optical_surface_description;

— diffractive_surface_description;

— optical_specification;

— optical_material_specification;

— optical_process_specification;

— optical_tolerance;

— dimensional_tolerance;

— assembly_tolerance;

— zone;

— coating_specification;

— protective_surface_treatment;

— user-defined_specification.