

Long Term Archiving with 3D PDF

3D PDF Consortium

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GLOBAL PRODUCT DATA INTEROPERABILITY **SUMMIT** 2015



ELYSIUM

Parker Aerospace

NORTHROP GRUMMAN

BOEING



3D PDF Consortium

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A community dedicated to driving adoption of 3D PDF enabled solutions through:

- Defining industry needs and priorities
- Creating reference implementations and other resources
- Providing input to the standards process
- Raising awareness

A worldwide, non-profit, member organization

Open to all companies

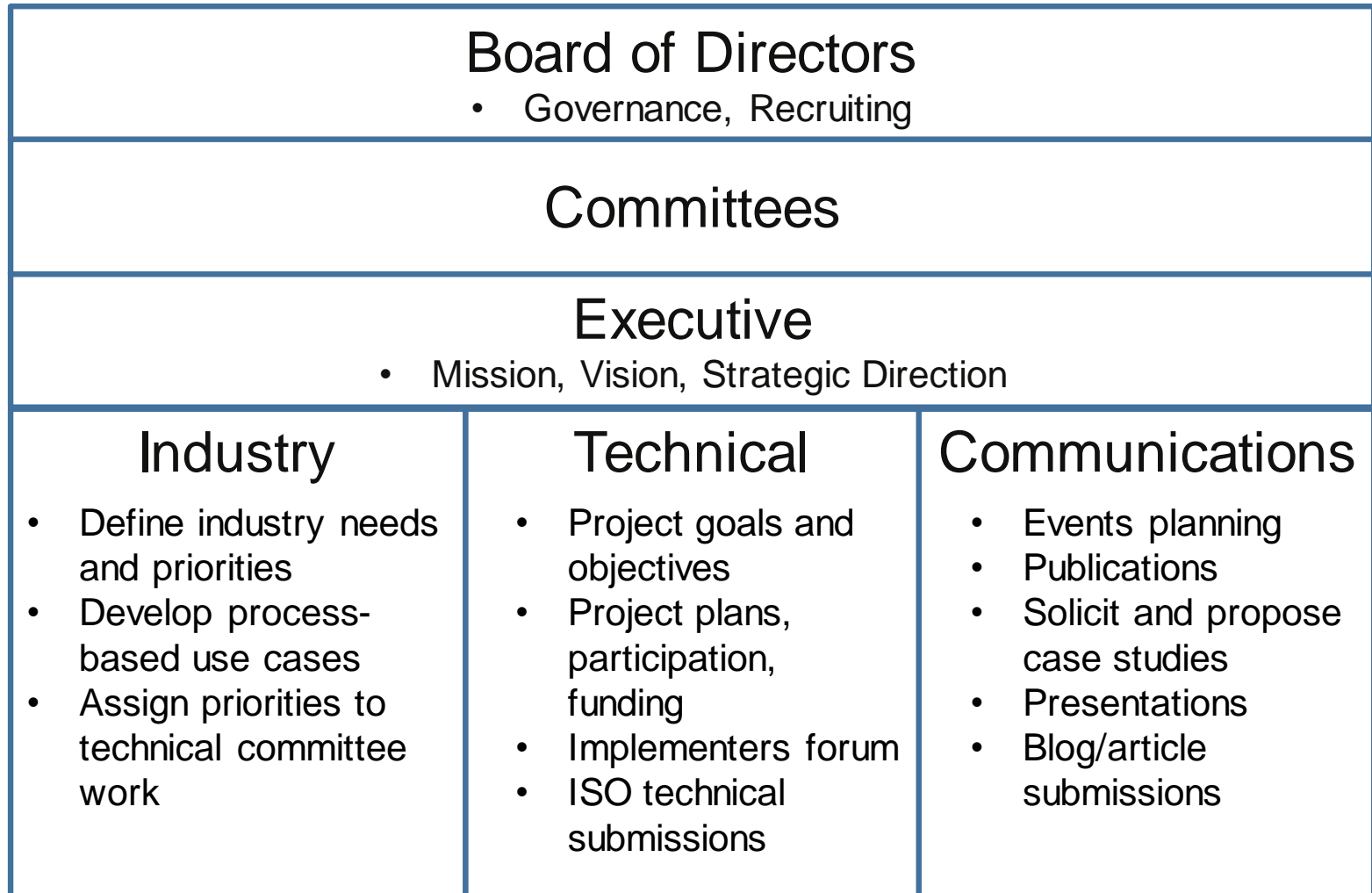
3D PDF Consortium - Members

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3D PDF Consortium - Organization

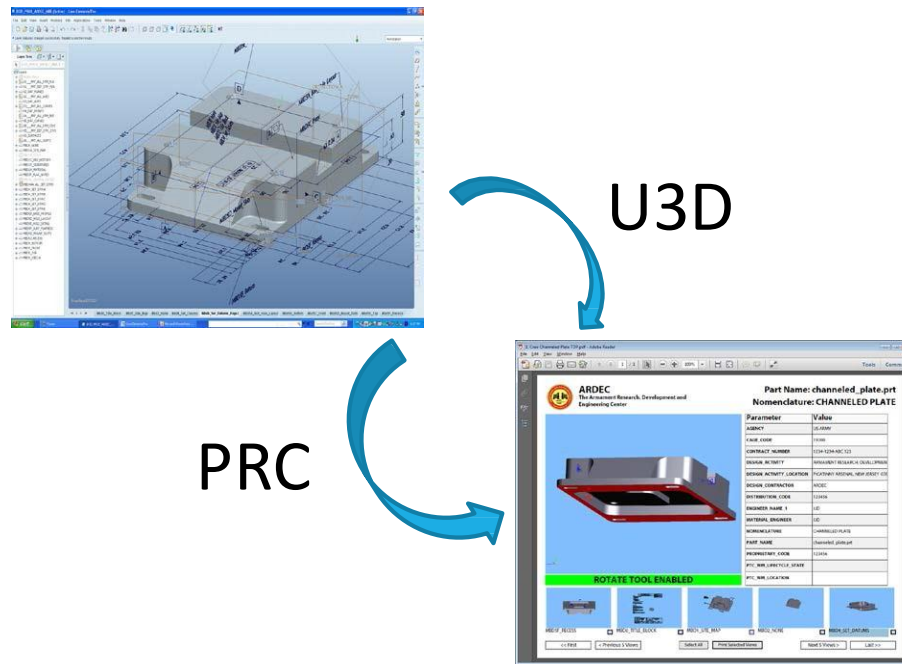
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What is 3D PDF?

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Any PDF file containing data defined in either Universal 3D (U3D), or Product Representation Compact (PRC) formats



PDF – 3D Content

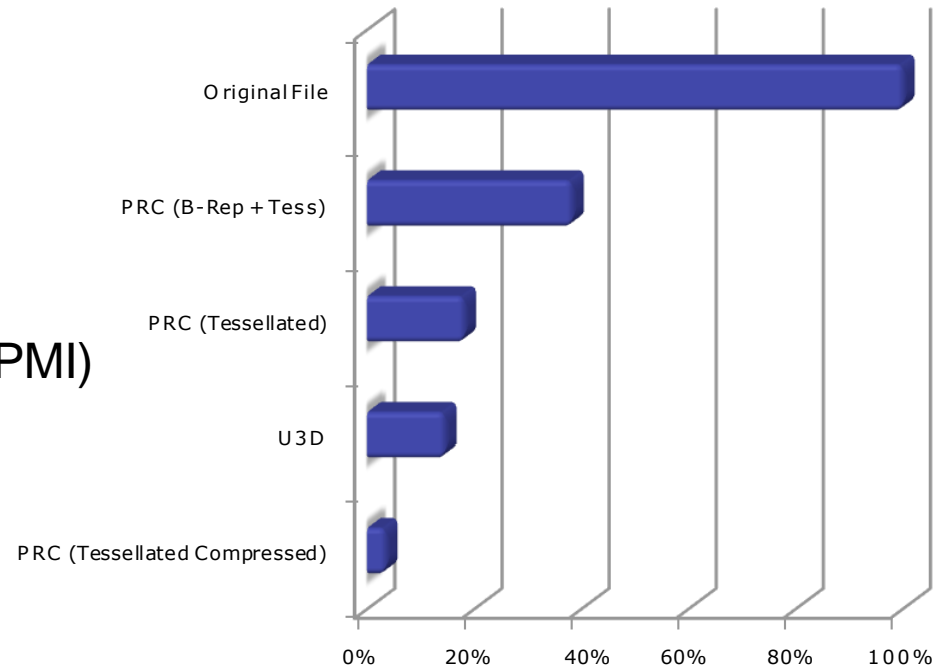
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PRC

- **Engineering Format**
 - Product Structure
 - Tessellation
 - Precise B-Rep
 - Product and Manufacturing Information (PMI)
 - Highly compact

U3D

- **Presentation Format**
 - ECMA standard (ECMA 363-3)
 - Only supports tessellated data
 - No longer actively developed



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PRC Content - Physical

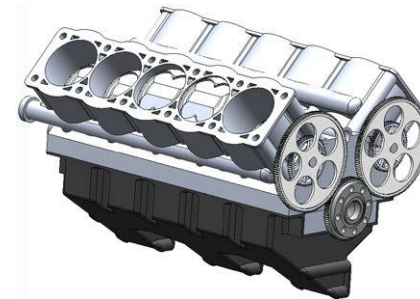
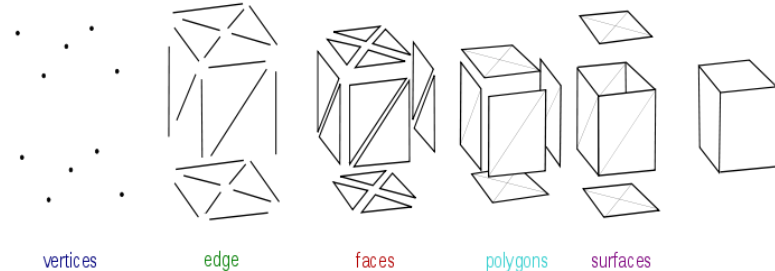
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Topology

- Complete topological description

Geometry

- Designed to represent geometry from ALL CAD systems
- Points, coordinate systems, polyhedra, curves, surfaces
- Maintains period and parametric definitions of curves and surfaces

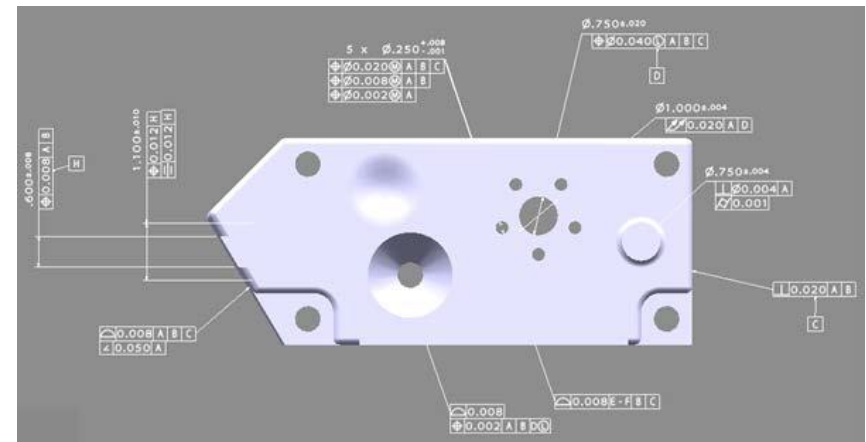


PRC Content - PMI

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Full visual PMI

- **Annotations and symbols**
- **Can be associated to 3D elements**



PRC Content - Metadata

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Name

- Key value pairs representing attributes (i.e. author, creation date, release date)

Persistent ID

- Two types of unique identification

Style

- Transparency, rendering mode, materials

Layer

- Logical grouping of elements

Show/hide

- Enables visibility

Coordinate systems

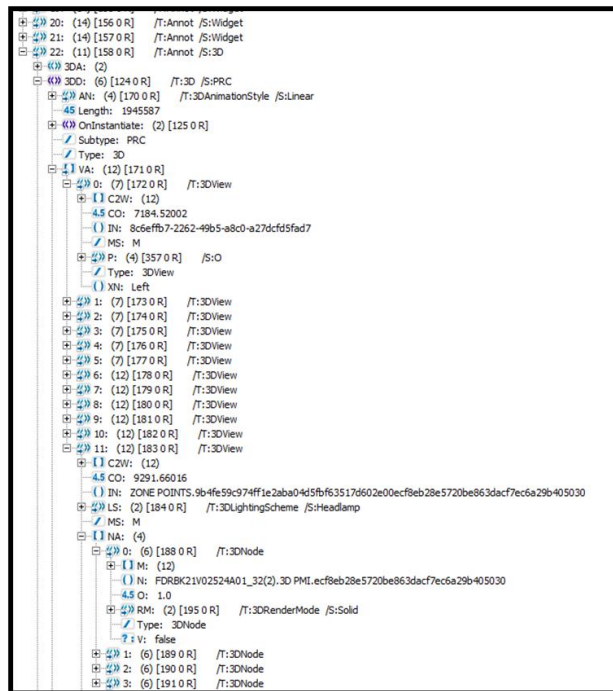
- Part based or local based

Stored as XML

- Ease of access

PDF Structure with 3D

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3D data is a stream within the PDF

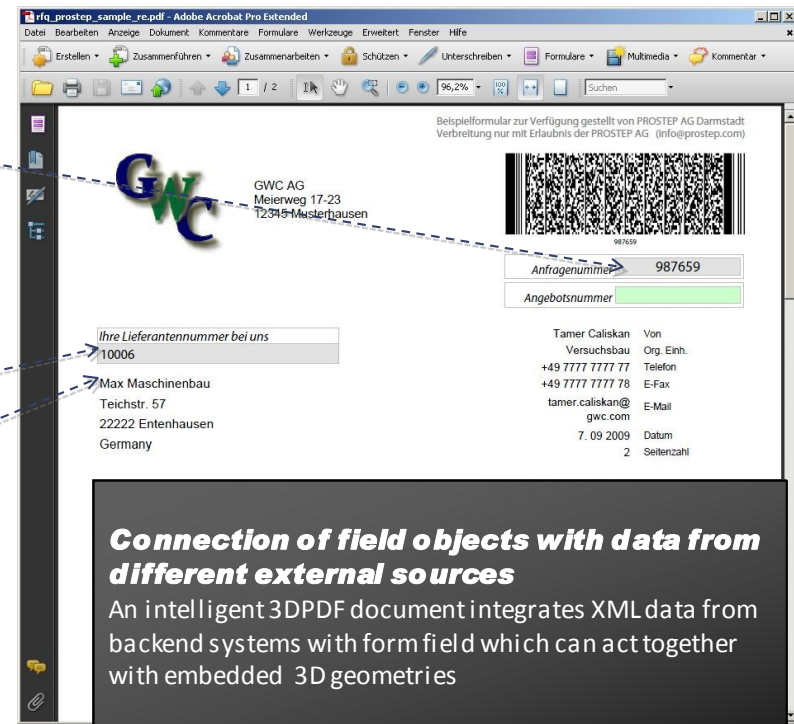
Geometry data is sequential binary; other data is XML and accessible

Tools exist to do the conversion from authoring system and placement in PDF file

Data binding

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```
<?xml version="1.0" encoding="UTF-8" ?>
- <tns:Request xmlns:tns="http://www.example.org/VW_EGVZ">
  <tns:requestNumber>987659</tns:requestNumber>
  <tns:description />
  <tns:dateOfRFQ>18.03.2009</tns:dateOfRFQ>
  <tns:closingDate>31.03.2009</tns:closingDate>
  <tns:dateOfReceipt />
  <tns:packagingTerms />
  <tns:deliveryTerms />
  <tns:paymentTerms />
  <tns:currency />
  <tns:reasonOfRefusal />
  <tns:noOfferPlanned />
  <tns:isFormFilled>0</tns:isFormFilled>
  <tns:pageCount>1</tns:pageCount>
- <tns:masterData>
  <tns:company>Global World Company</tns:company>
  <tns:unit>Versuchsbau</tns:unit>
  <tns:project>GWC001</tns:project>
- <tns:address>
  <tns:street>Industriepark</tns:street>
  <tns:no>1</tns:no>
  <tns:zip>11111</tns:zip>
  <tns:city>Globus</tns:city>
  <tns:country>Germany</tns:country>
</tns:address>
+ <tns:disponent>
+ <tns:technicalContact>
+ <tns:financialContact>
</tns:masterData>
- <tns:vendor>
  <tns:vendorId>10006</tns:vendorId>
  <tns:company>Max Maschinenbau</tns:company>
- <tns:address>
  <tns:street>Teichstr.</tns:street>
  <tns:no>57</tns:no>
  <tns:zip>22222</tns:zip>
  <tns:city>Entenhausen</tns:city>
  <tns:country>Germany</tns:country>
</tns:address>
- <tns:contact>
  <tns:forename>Max</tns:forename>
  <tns:surname>Mustermann</tns:surname>
  <tns:email>max.musterman@mm.max</tns:email>
```



Templates

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Predetermines layout

- Where objects are placed
- How data binding is realized
- How objects behave

Visible content

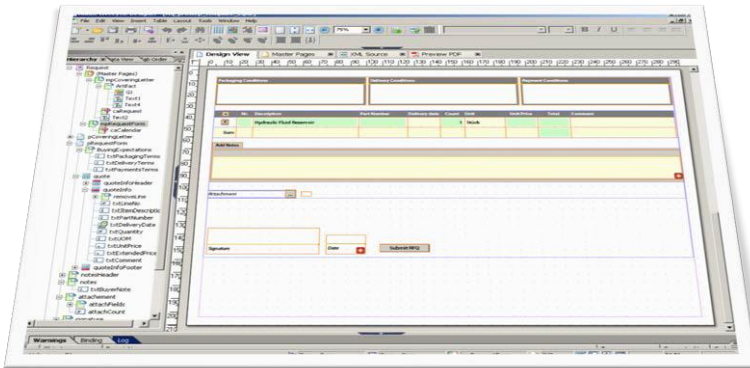
- Text
- 2D and 3D
- Form objects (editable)
- Control elements (buttons, lists)

Data content

- XML data

Control logic

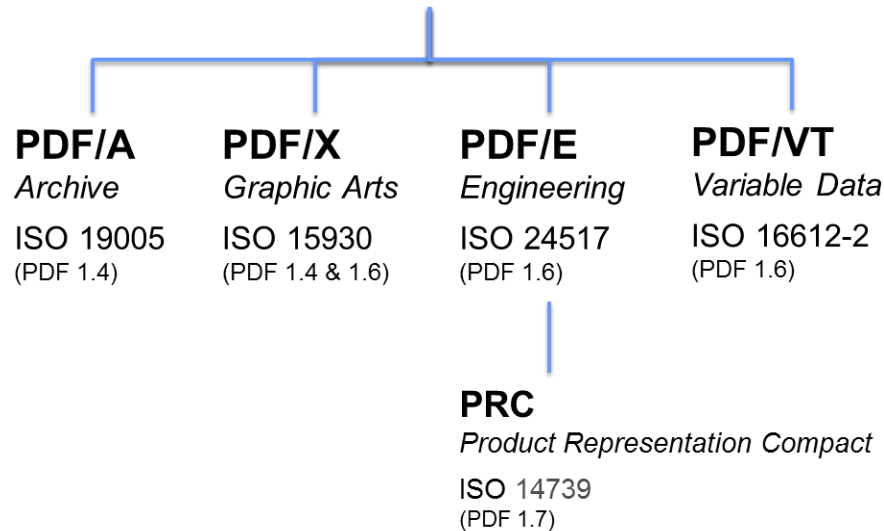
- JavaScript
- FormCalc
- Flash apps



PDF standards

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PDF 1.7 (ISO-32000)



What is PDF/E?

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The engineering document format

The screenshot displays a PDF/E viewer window titled "Parts+Catalogs-1.pdf". The interface includes a toolbar at the top with various icons for navigation and editing. Below the toolbar, there's a "Model Tree" on the left side, showing a hierarchical structure of the assembly. The main content area is divided into several sections:

- Supplier Name:** Dura
- Address:** 1434 Spruce Street, Boulder, CO 80302, USA
- Phone:** 800-555-1212
- Plant:** Boulder
- Platform:** Truck Heavy
- Program:** F-350
- Year:** 2009

The **Manufacturing Bill of Materials** section lists various components with their IDs and descriptions:

ID	Part Description	Qty
1001	1001-0001-0001-0001-0001	1
1002	1002-0002-0002-0002-0002	1
1003	1003-0003-0003-0003-0003	1
1004	1004-0004-0004-0004-0004	1
1005	1005-0005-0005-0005-0005	1
1006	1006-0006-0006-0006-0006	1
1007	1007-0007-0007-0007-0007	1
1008	1008-0008-0008-0008-0008	1
1009	1009-0009-0009-0009-0009	1
1010	1010-0010-0010-0010-0010	1
1011	1011-0011-0011-0011-0011	1
1012	1012-0012-0012-0012-0012	1
1013	1013-0013-0013-0013-0013	1
1014	1014-0014-0014-0014-0014	1
1015	1015-0015-0015-0015-0015	1
1016	1016-0016-0016-0016-0016	1
1017	1017-0017-0017-0017-0017	1
1018	1018-0018-0018-0018-0018	1
1019	1019-0019-0019-0019-0019	1
1020	1020-0020-0020-0020-0020	1
1021	1021-0021-0021-0021-0021	1
1022	1022-0022-0022-0022-0022	1
1023	1023-0023-0023-0023-0023	1
1024	1024-0024-0024-0024-0024	1
1025	1025-0025-0025-0025-0025	1
1026	1026-0026-0026-0026-0026	1
1027	1027-0027-0027-0027-0027	1
1028	1028-0028-0028-0028-0028	1
1029	1029-0029-0029-0029-0029	1
1030	1030-0030-0030-0030-0030	1
1031	1031-0031-0031-0031-0031	1
1032	1032-0032-0032-0032-0032	1
1033	1033-0033-0033-0033-0033	1
1034	1034-0034-0034-0034-0034	1
1035	1035-0035-0035-0035-0035	1
1036	1036-0036-0036-0036-0036	1
1037	1037-0037-0037-0037-0037	1
1038	1038-0038-0038-0038-0038	1
1039	1039-0039-0039-0039-0039	1
1040	1040-0040-0040-0040-0040	1
1041	1041-0041-0041-0041-0041	1
1042	1042-0042-0042-0042-0042	1
1043	1043-0043-0043-0043-0043	1
1044	1044-0044-0044-0044-0044	1
1045	1045-0045-0045-0045-0045	1
1046	1046-0046-0046-0046-0046	1
1047	1047-0047-0047-0047-0047	1
1048	1048-0048-0048-0048-0048	1
1049	1049-0049-0049-0049-0049	1
1050	1050-0050-0050-0050-0050	1

The **Shipping Instructions** section provides details on shipping requirements:

- Assembly Plant:** Louisville
- Weight (lbs):** 19.3
- Cost/MSRP:** 357.63
- Shipping Weight (lbs):** 25.5
- Availability Date:** 7/29/2009
- Shipping Dimensions:** 12.5 x 7.3 x 7.9
- Effectivity Date:** 7/25/2009
- Effectivity Rev:** 5
- PPAP Date:** 5/22/2009 12:00:00
- Volume:** 100000
- Inventory:** 1000

The **Omega Automotive** logo is visible in the bottom right corner of the document.

Why develop an engineering version of PDF?

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Engineering today is mostly done in 3D

Multiple proprietary CAD data formats exist

- AutoCAD, CATIA, Siemens NX, PTC Creo, etc.

Tools for proprietary formats are expensive

Existing open standards for CAD data are too old (IGES) or do not have a standard viewer available (STEP, JT)

Estimated that there is up to 4 times the demand for CAD data outside the engineering department – RFI/RFQ, assembly instructions, maintenance manuals, marketing, etc.

PDF/E (ISO 24517-1:2008)

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Based on PDF (ISO 32000-1)

Covers 3 primary areas:

- Incorporation of complex engineering data into compact PDF (3D, object-level data, etc.)
- Accurate printing of engineering drawings
- Support for secure exchange/management of annotation and markup data

Constrained to provide predictability

- All fonts **MUST** be embedded
- No external resources; self contained
- 3D, Layers, Multimedia

The need to archive PDF/E

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Long life cycle products

- Airplanes
- Ships
- Automobiles
- Buildings
- Nuclear Power Plants
- Off Shore Platforms
- Etc.

**Need to maintain / repair /
operate these designs
throughout their lifecycle**



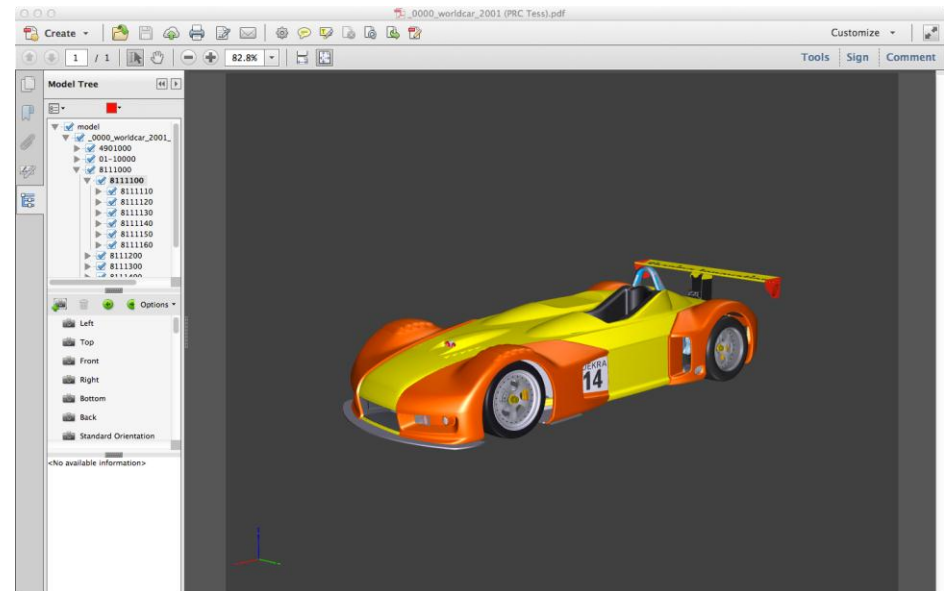
Engineering archival requirements

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Model has to maintain it's original form

Relationships between multiple objects must be preserved

- **Assemblies / Subassemblies / Parts**



Engineering archival requirements

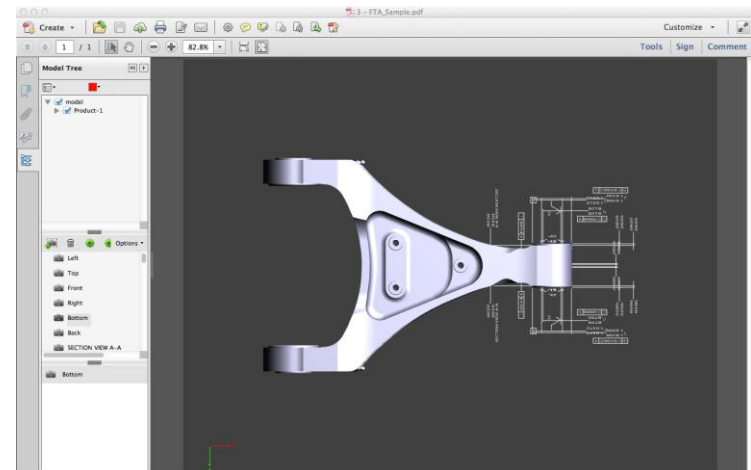
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Preserve attribute data that is associated to the model

- Properties – materials
- Manufacturing Information - PMI

Preserve views of the model

- Camera, Hide/Show, Sections, etc.

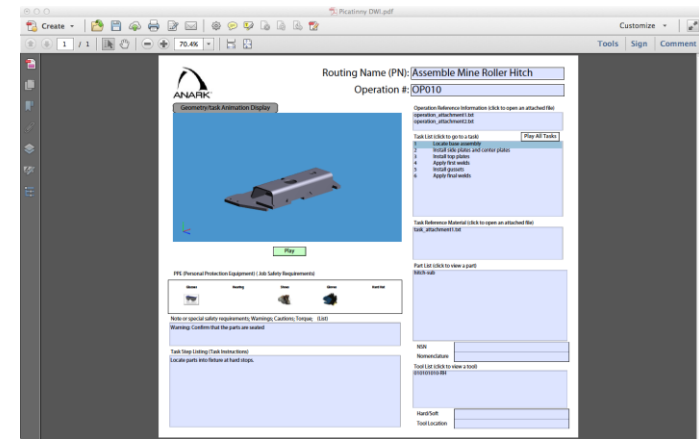


Engineering archival requirements

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Preserve relationships between the model and associated data

- Inspection data
- Bill of Materials (BOM)
- Animations
- Visual Response



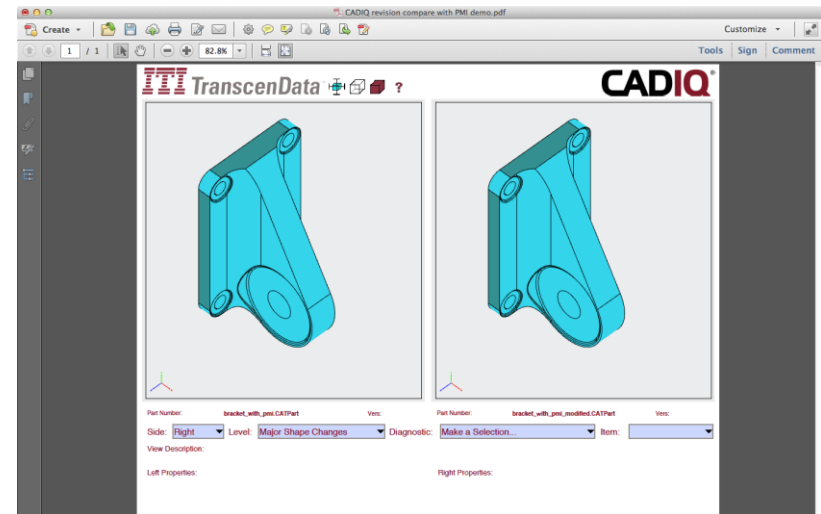
Engineering archival requirements

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**Preserve validation
information**

**Preserve Digital Rights
(DRM)**

**Preserve associated
business information
(attachments)**



PDF/E-2 (ISO 24517-2)

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The Engineering Archival Format

- Aligned with ISO 32000-2 (PDF 2.0) for engineering features
- PRC (ISO 14739-1)
 - Compact, precise engineering data
- Geospatial (GIS)
- 2D & 3D Measurements
- 3D JavaScript

Currently under development

Benefits of the PDF Platform

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Access

- through Acrobat Reader

Multi-type

- 3D, 2D, image, text, audio, video, enterprise data

Fit for purpose

- JavaScript support, templates, forms, portfolios

Infrastructure

- existing systems and resources already support PDF

Neutrality

- Investment protection

Value

- Low investment threshold with high payback

PDF/A vs PDF/E:2

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PDF/A

- Multiple versions (1 – 4)
- Each version less restrictive
- Developed for archivist community
- No 3D

PDF/E:2

- Developed as archival standard for engineering PDF
- Confusing name

ISO Standards

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Portable Document Format - Engineering

PDF/E

ISO 24517:2 Started in 2002

• Content

- 3D (precise and tessellated)
- Product Structure
- PMI

• Use Cases

- MBD
- 3D Visualization
- Archiving

• Increasing usage in Model Based Enterprise

Jupiter Technology
JT

ISO Started in 1990

• Content

- 3D (precise and tessellated)
- Product Structure
- PMI

• Use Cases

- 3D Visualization
- DMU
- Archiving

• Increasing usage in Engineering

Standard for the Exchange of Product data

STEP

ISO 10303 Started in 1984

• Content

- 2D/3D (precise)
- Product Structure
- PMI
- Additional life cycle data

• Use Cases

- CAD/PLM Data Exchange
- Various AP
- LOTAR

• High usage and wide dissemination

STEP - Strengths / Weaknesses

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Strengths

- **LOTAR**
- **Designed to be the “digital thread” for engineering**
 - Process automation
- **Wide adoption by engineering applications**

Weaknesses

- **No visualization data**
- **Few viewers available**
- **File size**
- **No document capabilities**

JT- Strengths / Weaknesses

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Strengths

- **Siemens / Teamcenter**
- **Visualization**
- **Compressable**

Weaknesses

- **No adoption by some major engineering software developers**
- **No standardized geometry representation**
- **Weak document capabilities**

PDF:E - Strengths / Weaknesses

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Strengths

- Designed to archive documents, not just data
- Forms / Templates
- Scripting
- Audio / Video
- Drawings
- Highly Compressed

Weaknesses

- Geometry not read by engineering applications
- Weak process automation capabilities

Complementary Archiving Standards

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Use strengths of one format to offset weaknesses of another

STEP + PDF

- **PDF used as containing document**
 - Visualization
 - Documentation
- **STEP file attachment**
 - Geometry
 - Process automation