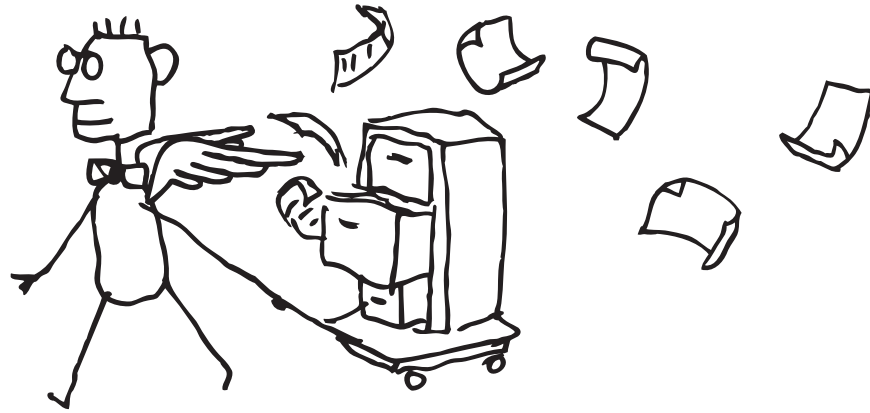


A Technical Introduction to PDF/A



 PDFlib® Whitepaper

The PDF/A Family of Archiving Standards

PDF/A is targeted at reliable long-time preservation of digital documents with text, raster images and vector graphics as well as associated metadata. The PDF/A format specified in the ISO 19005 standard strives to provide a consistent and robust subset of PDF which can faithfully be reproduced even after a long archiving period, or used for reliable data exchange in enterprise and government environments. This whitepaper discusses important technical aspects of PDF/A-1, PDF/A-2 and PDF/A-3.

- PDF/A-1** PDF/A-1, the first standard within a series of multiple parts, has been published in 2005 as ISO 19005-1. It is based on PDF 1.4 (the file format of Acrobat 5) and imposes some restrictions regarding the use of color, fonts, annotations, and other elements. There are two flavors of PDF/A-1:
- ▶ Level B conformance (PDF/A-1b; »b« as in »basic«) ensures that the visual appearance of a document is preservable in the long term. PDF/A-1b ensures that the document will look the same when it is viewed or printed some time in the future.
 - ▶ Level A conformance (PDF/A-1a; »a« as in »accessible«) is based on level B, but adds crucial properties of Tagged PDF: it requires structure information and reliable Unicode text semantics in order to preserve the document's logical structure and natural reading order. Simply put, PDF/A-1a not only ensures that the document will look the same when it is used in the future, but also that its contents (semantics) can be reliably interpreted and will be accessible to physically impaired users. As an important example, screenreader programs can read Tagged PDF documents to blind users.

- PDF/A-2** The PDF world advanced a lot since the publication of PDF/A-1. Among many other milestones, PDF 1.7 (the file format of Acrobat 8) has been standardized as ISO 32000-1 in 2008. In order to make numerous new PDF features available in PDF/A workflows, a new part of the standard called PDF/A-2 has been published in 2011 as ISO 19005-2.

PDF/A-2 is based on PDF 1.7 and includes many useful additions which are not available in PDF/A-1. These include important file format aspects such as JPEG 2000 compression, optional content (layers), PDF packages and others. PDF/A-2 documents may contain file attachments provided the attached documents themselves conform to PDF/A-1 or PDF/A-2.

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PDF/A-2 does not make PDF/A-1 obsolete or force users to migrate to the newer version – after all, this would be absurd for a standard which is targeted at long-time preservation!

- PDF/A-3** Another part of the standard called PDF/A-3 has been published in 2012 as ISO 19005-3. PDF/A-3 also supports conformance levels A, B, and U. It differs from PDF/A-2 in the following aspects:
- ▶ While PDF/A-2 allows only file attachments which conform to PDF/A, PDF/A-3 allows arbitrary file types as attachments to meet the requirements of various user groups.
 - ▶ File attachments are associated with the whole document, a page, or some other part of the document. The relationship between the attached file and the corresponding part of the document must be specified explicitly, e.g. source, alternative, or supplemental data.

Typical PDF/A-3 scenarios include embedding of word processor or spreadsheet source files in a final-form PDF/A document, or the inclusion of machine-readable XML data in a PDF intended for human consumption, e.g. an invoice.

PDF/A viewers are not required to do anything specific with attached non-PDF/A files except for extracting them. The PDF/A standard does not guarantee that attachments can be viewed or otherwise used in the future – it simply allows their presence in an archivable document.

In the same spirit as PDF/A-2 which does not replace PDF/A-2, PDF/A-3 does not replace PDF/A-2. Any part of the PDF/A standard can be used for long term archival as appropriate.

Technical Concepts in PDF/A

Fundamental PDF/A requirements

PDF/A requires certain PDF features and prohibits others:

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- ▶ To guarantee exact color reproduction all colors must be specified in a device-independent way.
- ▶ Metadata must be embedded using the XMP format. The PDF/A conformance level must be recorded with specific XMP properties.
- ▶ Encryption must not be used to make sure that the documents contents can always be accessed without any restriction.
- ▶ Certain requirements for annotations and form fields ensure that the visualization is fixed and that screen and print representation are identical.

In addition to these straight-forward requirements, however, PDF/A requires various other PDF features which are more subtle (e.g. certain entries in font data structures), and prohibits some critical structures (e.g. certain combinations of TrueType fonts and encodings). There are many aspects which must be implemented and checked by software developers before they arrive at fully standard-conforming PDF/A products. PDF/A is much more than simply »PDF with embedded fonts and no encryption«!

Additional restrictions in PDF/A-1

PDF/A-1 somehow suffers from the fact that it was the first in the PDF/A family: the standard was created at a time when important PDF concepts were not yet ready for prime time. As a result, the following features are prohibited in PDF/A-1, but are allowed in the newer parts PDF/A-2 and PDF/A-3:

- ▶ All features which require PDF 1.5 or above, e.g. JPEG 2000 compression and layers (optional content).
- ▶ Transparency: although transparency is possible in PDF 1.4, it was not considered suitable for archiving purposes at the time because there was no consistent description and implementation of transparency support available. Since identical behavior in all PDF viewers could not be guaranteed, it was decided to completely ban transparency from PDF/A-1. After the publication of PDF/A-1 the exact semantics of PDF transparency have been clarified and standardized in ISO 32000-1; later standards therefore very well allow the use of transparency.
- ▶ File attachments were banned from PDF/A-1 to make sure that all document contents are fully archivable. While PDF/A-2 allows file attachments, it restricts them to PDF/A-1 or PDF/A-2 files to make sure that attached files can also faithfully be reproduced. PDF/A-3 further relaxes this rule to allow arbitrary file types as attachments.

Device-independent color specification

In order to ensure consistent color reproduction across output devices and time, PDF/A requires the use of device-independent color, usually achieved via ICC profiles or CIE Lab color specifications. The optional output intent describes the color characteristics of the document. While these concepts are widely used in the graphic arts industry, enterprise PDF developers are not necessarily familiar with color management and must familiarize themselves with ICC profiles and related concepts.

Raster images, e.g. TIFF and JPEG, play a vital role in document creation. Scanned paper documents and photographs from digital cameras are common examples of raster image data in document workflows.

In many cases raster image data in modern workflows is already device-independent, usually by means of an embedded ICC color profile or standardized color spaces such as sRGB. Such images are ready for use in PDF/A. However, legacy image data is in many cases device-dependent, such as black-and-white or RGB scans without any associated ICC profile.

XMP metadata and extension schemas

Extensible Metadata Platform (XMP) is an XML-based format modeled after W3C's RDF (*Resource Description Framework*) which forms the foundation of the semantic Web initiative. In 2012 XMP has been standardized as ISO 16684-1. PDF/A mandates the use of XMP metadata for storing information about a document inside the PDF itself. XMP provides a powerful and flexible framework for storing standard and custom metadata properties (see our separate Whitepaper on XMP).

The XMP specification includes more than a dozen predefined schemas with hundreds of properties for common document and image characteristics. The most widely used predefined XMP schema is called the Dublin Core. It includes properties such as Title, Creator, Subject, and Description.

XMP is extensible by its very nature, i.e. company- or industry-specific metadata requirements can be met by constructing custom schemas. PDF/A supports this concept. However, in order to ensure automated retrieval PDF/A mandates that a machine-readable description of the custom metadata must be embedded in the document. This is achieved with an »XMP extension schema description«: a standardized part of the XMP metadata describes the structure of custom XMP metadata properties.

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Level A conformance also requires that all text in the document has Unicode semantics available (see below) and that logical words are separated by space characters.

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PDF/A-2 and PDF/A-3 offer level U conformance in addition to levels A and B. Level U requires proper Unicode semantics for all text in the document, but does not mandate Tagged PDF. This requirement is rooted in the fact that PDF supports a variety of font and encoding techniques, not all of which support Unicode. For example, PDF supports PostScript Type 1 fonts which have been introduced in the 1980's, while the Unicode consortium started its work in 1991. PDF/A conformance levels A and U require that supplementary Unicode mapping information must be present for fonts which do not contain it internally. But not all Unicode values are acceptable: values in the Private Use Area (PUA) are not allowed since they do not carry any common interpretation (semantics).

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As an example, code 0x1A in the common WingDings font contains an image of a computer keyboard with the glyph name *keyboard* and the PUA Unicode value U+F037. For lack of better substitute text the glyph name could be used to construct suitable ActualText, e.g. »symbol for keyboard«. It should be noted that programmatically constructing ActualText must be considered a makeshift solution; human-selected text is always preferable to machine-generated ActualText.

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Special care must be taken when processing PDF/A documents in order to maintain standard conformance. Even simple operations may spoil a document's conformance status. It is therefore crucial to deploy only tools which are PDF/A-aware to guard against the risk that PDF/A documents are modified in a way which violates the standard.

Splitting and Merging

Even simple operations may result in non-conforming documents. For example, inserting a page in a PDF/A document poses some immediate dangers:

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- ▶ Even if the imported page stems from a PDF/A document dangers lurk in multiple areas. For example, the color characteristics (e.g. output intent) of both documents don't necessarily match, which again could result in non-conforming output.
- ▶ A small operation such as adding a metadata field may violate the standard unless the software properly implements the rules for XMP metadata as mandated by PDF/A.

Any kind of content or metadata processing applied to PDF/A documents must be applied with PDF/A-aware software to avoid jeopardizing PDF/A conformance.

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