

# THE CASE FOR A STANDARD THAT'S OLD NEWS

## RECOMMENDATION OF PDF/A FOR DIGITIZED NEWSPAPER PRESERVATION

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**Abstract** – Since 2004, the Library of Congress, a beholden stakeholder in the risk assessment of and consideration for file formats, has supported the preservation of and access to digitized historic newspapers through the National Digital Newspaper Program (NDNP), a distributed, mass digitization program. This paper evaluates the implementation and validation of PDF as specified for NDNP, explores the benefits of PDF/A, and analyzes the adverse effects for digital preservation as realized in current digitization workflows.

**Keywords** – file formats, file validation, newspaper digitization, PDF, PDF/A

**Conference Topics** – The Cutting Edge: Technical Infrastructure and Implementation

### I. INTRODUCTION

The Portable Document Format (PDF) plays a vital role in the continued access of digitized newspaper. This is particularly true under the aegis of the National Digital Newspaper Program (NDNP), a collaboration between the National Endowment for the Humanities (NEH) and the Library of Congress (LC), which enables access to and preservation of digitized historic newspapers. The NDNP specification includes recommendations for PDF profiles, which, since the introduction of Version 2.1 in 2006, recommends PDF/A-1 where no conflict exists with the NDNP PDF Profile.<sup>1</sup> In addition to the recom-

[1] The most recent version of NDNP technical specifications removes specific PDF/A requirements, replacing them with general PDF/A recommendations with the goal to minimize any conflicts with the current NDNP PDF specification (NDNP PDF Profile (Version 2.4))

mendation for PDF/A, the standard requires Type1 encoding of embedded fonts, Flate compression for text streams, PDF linearization for optimized load performance, embedded XMP metadata, and 13 other requirements for conformance to the NDNP PDF technical specifications (Version 2.4) [1]. This paper explores what features of existing PDFs in the NDNP collection do not conform to PDF/A, identifies challenges effacing PDF validation, and offers recommendations for investigating alternative validation workflows for NDNP PDF Profiles.

### II. BACKGROUND

#### A. National Digital Newspaper Program

In 2003, NDNP originated from a formal agreement between the NEH and the LC with the stated goal to provide permanent digital access to historic newspapers published in the United States. The project began in 2004 with NEH funding multiple state-level institutions ranging from public universities to state historical societies, and LC supporting awardees throughout the digitization process and hosting *Chronicling America*,<sup>2</sup> a website dedicated to providing free and open access to newspapers digitized through the NDNP. NDNP builds upon the success of the 29-year NEH and LC collaboration, the United States Newspaper Program (1982-2011), which saw all fifty U.S. states, the District of Columbia, Puerto Rico, and the U.S. Virgin Islands contribute bibliographic data for over 140,000 newspaper titles, and preserve approximately 65 million newspaper pages on microfilm [2]. Through NDNP, grant awardees from 46 states, the District

[2] *Chronicling America*: <https://chroniclingamerica.loc.gov/>

of Columbia, and one U.S. territory (Puerto Rico) have contributed over 14.8 million newspaper pages representing 24 languages published between 1789 and 1963. As the content steward for NDNP, the LC works to establish and maintain imaging and bibliographic standards to manage the large-scale preservation of newspapers. When selecting titles, awardees must meet the “Technical Guidelines for Applicants” specification.<sup>[1]</sup> These technical specifications describe an “extendable, scalable, and sustainable workflow” for awardee institutions [3]. As part of the project deliverables under the current specification, awardees provide an information package that includes a TIFF, JPEG2000, ALTO XML, and PDF file for each newspaper page. Since 2016, the Federal Agencies Digital Guidelines Initiative (FADGI) Still Images Working Group has explored the possibility to use JPEG2000 and PDF/A as master file formats [4]. LC contributes to FADGI and in turn uses FADGI to inform best practices for digitization. The current recommendations in the guideline demonstrates an increasing emphasis on PDF/A as a format of importance for newspaper digitization.

#### B. Portable Document Format—Archival

Since 2006, the NDNP technical specifications have asserted that, “Except where conflicting with any of the other requirements of [the NDNP PDF] profile, conforming to PDF/A (ISO 19005-1) is recommended” [1]. In 2005, the International Organization for Standardization introduced ISO 19005, a standard supporting the long-term preservation of electronic documents. The sustainability is ensured by excluding or requiring document aspects, such as prohibiting embedding of Javascript or requiring font embedding, respectively. Based upon PDF 1.4, ISO 19005- 1:2005 specifies the use of PDF 1.4 for long-term preservation as the Portable Document Format—Archival. Since the first publication, two additional specifications have been released as ISO 19005-2:2011 and ISO 19005- 3:2012, which specify how to implement PDF 1.7, standardized as ISO 32000, as PDF/A. Despite chronological ordering, the later releases of the standard do not indicate a “better or more advanced” format [5]. They are simply different approaches to creating a sustainable PDF. The implementation of ISO 19005 as PDF/A

permits three levels of conformance: Level A (accessible); Level B (basic), and Level U (unicode). Table I. provides an overview of the conformance levels relevant to each ISO 19005 publication. Each conformance level enables the use or disuse of requirements in the specifications “to prevent the onerous requirements for full conformance presenting a barrier to software developers” [6].

TABLE I

|         | ISO 19005-1:2005 | ISO 19005-2:2011 | ISO 19005-3:2012 |
|---------|------------------|------------------|------------------|
| Level A | PDF/A-1a         | PDF/A-2a         | PDF/A-3a         |
| Level B | PDF/A-1b         | PDF/A2b          | PDF/A-3b         |
| Level U | NA               | PDF/A-2u         | PDF/A-3u         |

Among the features introduced with ISO 19005-2:2011, PDF/A-2 permits embedding of JPEG2000 images. Since its release, JPEG2000 has been subject to scrutiny for long-term preservation [7]. Despite its criticism, JPEG2000 is ubiquitous to digitization projects and is included as a required format for the NDNP file package. ISO 19005- 3:2012 differs from ISO 19005-2:2011 in that the specification permits embedding of any file type, a provision which, in response to widespread criticism, resulted in a report from the National Digital Stewardship Alliance on the risks and benefits of the format [8].

#### C. Validation

##### 1. Digital Viewer and Validator

Before the LC accepts a submission package, the content creator must validate the submission package through the Digital Viewer and Validator (DVV), Version 2.2.1 [9]. Developed by the Library of Congress for NDNP, DVV “wraps’ JHOVE [(J)STOR/Harvard Object Validation Environment), Version 1.0] and extends JHOVE’s existing TIFF, PDF, and JPEG2000 modules with the NDNP-specific validation rules” [10]. For example, JHOVE validates whether a PDF is well-formed, and the NDNP extension validates that the PDF is “grayscale, downsampled to 150dpi and encoded using JPEG, using a medium (or 40) quality setting” [1]. The NDNP extension for DVV only validates the NDNP file requirements, which means that PDF/A compliance is not included in the validation process. In addition to validating the file image and

[1] Both current and previous guidelines are located here:

<https://www.loc.gov/ndnp/guidelines/>

container formats against JHOVE and additional rules implemented in the NDNP specification, DVV validates METS and ALTO records using Schematron [10].

As part of validation, DVV generates and embeds in the METS file a SHA-1 value as the digital signature, or fixity. Successful appendage of the original object's fixity indicates that a file is valid, and "proves that the technical metadata . . . was created by the NDNP Validation Library" (i.e., DVV) [10]. With multiple stakeholders of the content, including the LC, the awardee, and in many cases, a digitization vendor, frequent fixity checks are essential. In an effort to ensure that no changes occurred during file transfer, DVV's verification function enables users to verify the file fixity by checking the digital signature values generated during validation [10].

## 2. Validation Challenges

With myriad PDF versions, substandards, and versions of substandards, PDF validation is challenging. As found in Lindlar, Tunnat, and Wilson's paper on "A PDF Test-Set for Well-Formedness Validation in JHOVE - The Good, the Bad and the Ugly," JHOVE fails to meet a ground truth requirement for PDF validation [11]. Thus, while DVV includes an extension of the JHOVE PDF module, a validation module specific to the validation of the NDNP PDF Profile may be better suited for accurate assessment and to avoid constraints imposed by the capacity of JHOVE's PDF module.

Given that the DVV's validation profile is not testing for compliance with the ISO 19005-1 specification for PDF/A, awardees who wish to submit PDF files which conform to the NDNP PDF Profile in addition to ISO 19005-1 must rely upon workflows outside of the formal NDNP validation process to ensure PDA/A compliance.

In evaluating PDF/A converter software<sup>4</sup>[1] for the Florida Virtual Campus digital repository workflow, Jamin Koo and Carol Chou identified that the pdfaPilot, 3-Heights, and PDF/A Manager occasionally

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[1] here are two methods of converting or generating a PDF/A: create or conform. To "create" a PDF/A file, a user begins with a source file (e.g., Microsoft Word Document or LaTeX). To "conform" to PDF/A, a user begins with another PDF.

failed to identify non-conformance, resulting in 90%, 74%, and 91.30% accuracy rates, respectively [12]. As with the PDFlib "Bavaria Report on PDF/A Validation Accuracy," Koo and Chou limited their evaluation of tools against the PDF/A-1b (ISO 19005, conformance Level B) profile [13]. With an imperfect accuracy rate for PDF/A conversion across tools, PDF/A-specific validation is requisite.

## 3. veraPDF

As a result of the EU PREFORMA (PREservation FORMats) project, the veraPDF consortium released a validation tool dedicated to validation of PDF/A: veraPDF [14].<sup>5</sup>[2] In addition to validating against each PDF/A profile (PDF/A-1a, PDF/A-1b, PDF/A-2a, PDF/A-2b, PDF/A-2u, PDF/A-3a, PDF/A-3b, PDF/A-3u), veraPDF allows users to create a profile unique to their institutional needs. For example, NDNP might extend the validation to validate the NDNP PDF Profile specification that, "The PDF will open to single page layout," a rule not required for a valid PDF/A [1].

## III. METHOD

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In this section, the authors introduce the approach for selecting a testing corpus, define testing processes, and outline a metric for analysis of results.

### A. File Selection and Retrieval

The pages from 69 newspaper issues were identified and downloaded from the Chronicling America website, totaling to 382 unique PDFs (i.e., pages). In an effort to establish a diverse testing corpus, one issue was selected from each contributing awardee, totaling to 45 issues.<sup>6</sup>[3] From the awardees' corporea, the authors selected the first issue from the most voluminous English-language

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[2] See also the homepage for veraPDF for further information and resources: <https://verapdf.org/>

[3] As noted in the background section above, NDNP has 46 participating awardees, of which only 45 have contributed content to dat

newspaper.<sup>[1]</sup> Following the same selection process, one issue representing each non-English language was selected, totaling to 24 newspaper issues.

### B. File Validation

The authors tested against all PDF/A versions (PDF/A-1, PDF/A-2, and PDF/A-3) for a more comprehensive assessment of possible compliance to ISO 19005 across the corpora, and they limited the scope to conformance Level B for its suitability for digitized documents.<sup>8[2]</sup> While NDNP PDFs contain embedded OCR, the logical structural requirements for PDF/A are difficult to achieve. Using the veraPDF (Version 1.12.1) GUI on a Windows 10 OS, the authors batch processed the 382 PDF files against the PDF/A-1, PDF/A-2, and PDF/A-3 modules. Results were saved as XML for ease of data manipulation. The authors then parsed the veraPDF XML output to a CSV for increased ease of analysis.

### C. Validation Evaluation

Upon identifying the rules failed between the PDF/A-1, PDF/A-2, and PDF/A-3 validation profiles, rules were categorized by type. Four overarching types were identified as encompassing considerations fundamental to newspaper digitization: XMP Metadata, Embedded Images, Embedded Fonts, and Object Streams (in order of importance). The authors have identified and ranked categories in accordance to their salience for access and preservation of digitized newspapers within the NDNP framework.

## IV. DISCUSSION

As expected, all files conformed to the NDNP PDF specification, in that the files are PDF version 1.4, the PDF base required by both PDF/A-1 and the NDNP

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[1] Puerto Rico has contributed only Spanish-language newspapers. An issue from the most voluminous newspaper was selected to represent their awardship; an issue from the second most voluminous newspaper was selected as the overall most voluminous Spanish-language newspaper.

[2] As cited in "Preservation with PDF/A (2nd Edition)", minimal compliance with ISO 19005 in Level B conformance is suitable for digitized documents to "[render] visual appearance" [6]

PDF specification. Also as anticipated, all files failed validation against the PDF/A-1b,<sup>9[3]</sup> PDF/A-2b, and PDF/A-3b veraPDF modules.

### A. XMP Metadata

Perhaps the most ubiquitous element of access and preservation, metadata supports robust contextualization of a digital object. The XMP header metadata embedded in PDFs and other image and container files supports descriptive and administrative elements. ISO 19005-1 requires that, if metadata properties are contained in the document information dictionary, XMP "analogous properties . . . shall also be embedded . . . with equivalent values" [15]. The document information dictionary "contains the creation and modification dates of the file, together with some simple . . . metadata," which are not included in the XMP serialization but may be embedded in XMP extensions [16]. While non-conformance to this rule does not impact the NDNP workflow, it does suggest poor metadata practices. (See CosDocument, Appendix 1.) Poor metadata practice is further exemplified in the content objects' failure to meet the XMP Package and XMP Property requirements for ISO 19005, which require valid XMP serialization, stating that "XMP form shall use predefined schemas defined in XMP Specification, or extension schemas that comply with XMP Specification" [15, 17]. An essential feature included in the NDNP Technical Specification, best practice suggests that XMP metadata should conform to the XMP Specification.

### B. Embedded Images

Validation failure for images included undefined OutputIntents of color profiles and use of interpolation, both which introduce potential harm of long-term sustainability. The NDNP Technical Specification requires that images be digitized at grayscale but does not impose requirements upon the color-space. As seen in Appendix 1, results indicate that content creators fulfilled the grayscale requirement but did not define the colorspace (e.g., DeviceRGB, DeviceCYMK, DeviceGray) in the OutputIntent. The inclusion of image interpolation suggests that artifacts were generated through the image conversion process. The interpolation algorithm is specific to rendering software and thus cannot be embedded

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[3] 9 PDF/A-1b profile defaulted for all files in the auto-detect module

in a file. Use of interpolation impacts access by imposing an appearance which may not be rendered in every implementation.

### C. *Embedded Fonts*

While font object streams render underneath the image object stream, fonts are captured during the OCR process and therein are embedded in the PDF. Thus, while it may seem that the visual appearance of a font is unnecessary, font information is captured in the OCR. All validation profiles indicated 137 failures to PDF/A-1 Rule 6.3.4-1, and PDF/A-2–PDF/A-3 Rule 6.2.11.4-1, which suggests that awardees are using Type 3 fonts. This further suggests that the DVV did not identify when PDF files contained Type 3 fonts, despite the requirements of the NDNP specification, which states that, “Only the 14 standard Type 1 fonts [may] be used. These fonts will not be embedded” [1]. This suggests that there are inconsistencies between the NDNP Specification and the digitization output. Increased validation not supported in the DVV’s current validation profile, Version 2.1.1, may enable content creators and stewards to adhere to the NDNP Specification, as well as general recommendations for long-term preservation as identified in ISO 19005.

Perhaps the most notable difference between the PDF/A-1b and PDF/A-2b–PDF/A-3b validation profiles as seen in the results of this test is the relationship between Rule 6.3.5-2 (PDF/A-1b) and 6.2.11.4-4 (PDF/A-2b–PDF/A-3). The validation output for PDF/A-1b and PDF/A-2b–PDF/A-3b differed in that PDF/A-1b validation identified 28 failed instances of Rule 6.3.5-2, which requires that, “For all Type 1 font subsets referenced within a conforming file, the font descriptor dictionary shall include a CharSet string listing the character names defined in the font subset” [18]. PDF/A-3b validation identified 34 failed instances of Rule 6.2.11.4-4, which requires that CID fonts be completely identified, whether or not all fonts are referenced. While no correlation has been identified between the rules, the fact that the PDF/A-1b validation profile did not detect failure for CID fonts in Rule 6.3.3-2 and vice versa such that the PDF/A-2b and PDF/A-3b validation profiles did not detect failure for CharSet with Rule 6.2.11.4-3 is of note.

Although evaluation of files which contained

errors was not added to the methodology for this preliminary research, the authors are interested in the validation of fonts for non-English newspaper content. In skimming the results, it was found that Fraktur, a prominent glyph set used in many early 20th century German-language texts, did not return any font errors.

### D. *Object Streams*

Object streams are necessary to long-term sustainability of content by exacting, for example, the beginning and end of an indirect object. However, the logical structure requirements for PDF have not been included in the NDNP PDF Profile, and as such has been considered out of scope for evaluation of PDF in the context of newspaper digitization under the current aegis of NDNP.

## V. FUTURE RESEARCH

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As digital collections experience exponential growth, repository managers seek alternatives to economize file storage space. Excluding TIFF from the newspaper archival information package reduces storage requirements, supporting long-term preservation of content produced at scale. The authors recommend additional investigation of PDF/A as a master file format for both preservation and access to minimize potential risks.<sup>10</sup>[1]

## VI. CONCLUSION

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The authors posit that, for institutions digitizing newspapers using a framework that places emphasis on PDF, the validation tool employed for quality assurance must ensure that the requirements for PDF are actually met. The discussion demonstrates that, without adequate validation software, non-conforming files may be approved unnoticed. Additional research is necessary to provide recommendations for implementation of veraPDF validation within newspaper digitization workflows, to remediate existing errors in PDFs as found in the non-conformance of fonts to the NDNP PDF Profile.

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[1] Yan Han recommends PDF/A for its suitability as any information package throughout the preservation cycle—submission, archiving, dissemination—rendering the requirement of an archival TIFF redundant [19]

## ACKNOWLEDGMENT

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The authors thank the Library of Congress for making newspaper content freely accessible for all scholarly purposes, including validation of PDFs.

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## APPENDICES

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### A. Appendix 1: PDF/A Failed Validation Rules<sup>[1]</sup>

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[1] Not all tests were equivalent between the PDF/A-1 and PDF/A-2–PDF/A-3 validation profiles. In particular, the PDF/A-2–PDF/A-3 validation profile does not contain rules for testing the CosDocument and PDXGState objects. Furthermore, the PDCIDFont and PDType1Font objects, which failed against

See Appendix 2 for relevant veraPDF validation rules.

| Object Type                                | PDF/A-1b Files Failed | PDF/A-2b Files Failed | PDF/A-3b Files Failed |
|--|-----------------------|-----------------------|-----------------------|
| CosDocument<br>Appendix 2: 16              | 235                   |                       |                       |
| CosIndirect<br>Appendix 2: 3,4             | 100                   | 100                   | 100                   |
| CosStream<br>Appendix 2:1                  | 40                    | 40                    | 40                    |
| CosStream<br>Appendix 2:2                  | 16                    | 16                    | 16                    |
| MainXMP<br>Package<br>Appendix 2:19        | 382                   | 382                   | 382                   |
| PDCIDFont<br>Appendix 2:9                  | -                     | 34                    | 34                    |
| PDDeviceGray<br>Appendix 2:6               | 344                   | 344                   | 344                   |
| PDDeviceRGB<br>Appendix 2:                 | 19                    | 19                    | 19                    |
| PDExtGState<br>Appendix 2:14               | 120                   | -                     | -                     |
| PDExtGState<br>Appendix 2:15               | 120                   | -                     | -                     |
| PDFont<br>Appendix 2:8,<br>11              | 137                   | 137                   | 137                   |
| PDTrueType<br>Font<br>Appendix 2:10,<br>13 | 16                    | 16                    | 16                    |
| PDType1Font<br>Appendix 2:12               | 16                    |                       |                       |
| PDXImage<br>Appendix 2:7                   | 105                   | 105                   | 105                   |
| XMPPackage<br>Appendix 2:17                | 12                    | 12                    | 12                    |

## B. Appendix 2: Relevant veraPDF Validation Rules

- Rule 6.1.7-1** (ISO 19005-1:2005, ISO 19005-2:2011, ISO 19005-3:2012) "The value of the Length key specified in the stream dictionary shall match the number of bytes in

the file following the LINE FEED character after the stream keyword and preceding the EOL marker before the endstream keyword."

- Rule 6.1.7-2** (ISO 19005-1:2005, ISO 19005-2:2011, ISO 19005-3:2012) "The stream keyword shall be followed either by a CARRIAGE RETURN (0Dh) and LINE FEED (0Ah) character sequence or by a single LINE FEED character. The endstream keyword shall be preceded by an EOL marker."
- Rule 6.1.8-1** (ISO 19005-1:2005) "The object number and generation number shall be separated by a single white-space character. The generation number and obj keyword shall be separated by a single white-space character. The object number and endobj keyword shall each be preceded by an EOL marker. The obj and endobj keywords shall each be followed by an EOL marker."
- Rule 6.1.9-1** (ISO 19005-2:2011, ISO 19005-3:2012) "The object number and generation number shall be separated by a single white-space character. The generation number and obj keyword shall be separated by a single white-space character. The object number and endobj keyword shall each be preceded by an EOL marker. The obj and endobj keywords shall each be followed by an EOL marker."
- Rule 6.2.3-2** (ISO 19005-1:2005) "DeviceRGB may be used only if the file has a PDF/A-1 OutputIntent that uses an RGB colour space." Same test condition as **Rule 6.2.4.3-2** (ISO 19005-2:2011, ISO 19005-3:2012) "DeviceRGB shall only be used if a device independent DefaultRGB colour space has been set when the DeviceRGB colour space is used, or if the file has a PDF/A OutputIntent that contains an RGB destination profile."
- Rule 6.2.3-4** (ISO 19005-1:2005) "If an uncalibrated colour space is used in a file then that file shall contain a PDF/A-1 OutputIntent, as defined in 6.2.2."<sup>[1]</sup> PDF/A-2-PDF/A-3 and PDF/A-1b, respectively, contain different

[1] 12 Rule 6.2.2-2 (ISO 19005-1:2005) "If a file's

OutputIntents array contains more than one entry, then all entries that contain a DestOutputProfile key shall have as the value of that key the same indirect object, which shall be a valid ICC profile stream."

rules in the validation profile, thus resulting in inconsistent validation output. Same test condition as Rule **6.2.4.3-4** (ISO 19005-2:2011, ISO 19005-3:2012) “DeviceGray shall only be used if a device independent DefaultGray colour space has been set when the DeviceGray colour space is used, or if a PDF/A OutputIntent is present.”

7. **Rule 6.2.4-3** (ISO 19005-1:2005) / **6.2.8-3** (ISO 19005-2:2011, ISO 19005-3:2012) “If an Image dictionary contains the Interpolate key, its value shall be false.”
8. **Rule 6.2.11.4-1** (ISO 19005-2:2011, ISO 19005-3:2012) “The font programs for all fonts used for rendering within a conforming file shall be embedded within that file, as defined in ISO 32000-1:2008, 9.9.”
9. **Rule 6.2.11.4-4** (ISO 19005-2:2011, ISO 19005-3:2012) “If the FontDescriptor dictionary of an embedded CID font contains a CIDSet stream, then it shall identify all CIDs which are present in the font program, regardless of whether a CID in the font is referenced or used by the PDF or not.”
10. **Rule 6.2.11.6-2** (ISO 19005-2:2011, ISO 19005-3:2012) “No non-symbolic TrueType font shall define a Differences array unless all of the glyph names in the Differences array are listed in the Adobe Glyph List and the embedded font program contains at least the Microsoft Unicode (3,1 - Platform ID=3, Encoding ID=1) encoding in the ‘cmap’ table.”
11. **Rule 6.3.4-1** (ISO 19005-1:2005) “The font programs for all fonts used within a conforming file shall be embedded within that file, as defined in PDF Reference 5.8, except when the fonts are used exclusively with text rendering mode 3.”
12. **Rule 6.3.5-2** (ISO 19005-1:2005) “For all Type 1 font subsets referenced within a conforming file, the font descriptor dictionary shall include a CharSet string listing the character names defined in the font subset, as described in PDF Reference Table 5.18.”
13. **Rule 6.3.7-1** (ISO 19005-1:2005) “All non-symbolic TrueType fonts shall specify MacRomanEncoding or WinAnsiEncoding, either as the value of the Encoding entry in the font dictionary or as the value of the BaseEncoding entry in the dictionary that is the value of the Encoding entry in the font dictionary. If the value of the Encoding entry is a dictionary, it shall not contain a Differences entry.”
14. **Rule 6.4-4** (ISO 19005-1:2005) “The following keys, if present in an ExtGState object, shall have the values shown: BM - Normal or Compatible.”
15. **Rule 6.4-5** (ISO 19005-1:2005) “The following keys, if present in an ExtGState object, shall have the values shown: CA - 1.0.”
16. **Rule 6.7.3-1** (ISO 19005-1:2005) “If [a document information dictionary appears in a document], then all of its entries that have analogous properties in predefined XMP schemas ...shall also be embedded in the file in XMP form with equivalent values.”
17. **Rule 6.7.9-1** (ISO 19005-1:2005) “The metadata stream shall conform to XMP Specification and well formed PDFExtension Schema for all extensions.” Same test condition as Rule **6.6.2.1-4** (ISO 19005-2:2011, ISO 19005-3:2012) “All metadata streams present in the PDF shall conform to the XMP Specification. All content of all XMP packets shall be well-formed, as defined by Extensible Markup Language (XML) 1.0 (Third Edition), 2.1, and the RDF/XML Syntax Specification (Revised).”
18. **Rule 6.7.9-2** (ISO 19005-1:2005) “Properties specified in XMP form shall use either the predefined schemas defined in XMP Specification, or extension schemas that comply with XMP Specification.” Same test condition as **Rule 6.6.2.3-7** (ISO 19005-2:2011, ISO 19005-3:2012) “All properties specified in XMP form shall use either the predefined schemas defined in the XMP Specification, ISO 19005-1 or this part of ISO 19005, or any extension schemas that comply with 6.6.2.3.2.”
19. **Rule 6.7.11-1** (ISO 19005-1:2005) / **6.6.4-1** (ISO 19005-2:2011, ISO 19005-3:2012) “The PDF/A version and conformance level of a file shall be specified using the PDF/A Identification extension schema.”