

# Effective PDF Testing Strategy

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## 1. About the Author

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The author, Steve Kang, is currently General Manager of the Testing Products Group at QualityLogic, Inc. and oversees all of the tools and test suites products for the imaging and telecom industries. Before QualityLogic, Mr. Kang served as VP of Engineering at controller/RIP development companies, Advanced Hi-Tech and ColorBus, Inc. His technical background includes development of high speed controllers and RIPs using customized PostScript, PCL and PDF interpreters from Adobe, Global Graphics, Zoran and other vendors. Mr. Kang holds a Masters degree in Computer Science from University of Southern California and an MBA from the UCLA Anderson School. He can be contacted at [skang@qualitylogic.com](mailto:skang@qualitylogic.com) or by calling (805)531-9030.

## 2. References

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List of helpful documents for these PDF related tests are provided below as hyperlinks. Please click on the individual link below to access the PDF documents.

- [PDF 1.7 Functional Test Suite](#)
- [PDF 1.7 Application Test Suite](#)
- [PDF Compatibility Test Suite](#)
- [PDF 1.7 InteropAnalyzer](#)
- [ISO 32000 PDF Reference](#)

### 3. Introduction

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Portable Document Format (or simply PDF) was created by Adobe Systems in 1993 as a document exchange format. Adobe's first page description language, PostScript, was created as a page description language for printers. Although PostScript was a rich 2D page description language, it also included typical programming constructs such as loops, if conditions and others that can also cause unpredictable states across different pages. PostScript in essence was a page dependent language where states and conditions that occurred in previous pages can directly affect the output for subsequent pages.

PDF was in part created to solve some of the deficiencies behind the PostScript language. Since 1993, thanks largely to the popularity of the Internet, PDF has become the ideal format for exchanging rich documents between users. The initial version of PDF was essentially a simplified object based page independent language leveraging all of the graphics primitives supported in PostScript. In fact, Adobe's PDF interpreters were developed by leveraging its PostScript core engine through use of PostScript prologues to implement the PDF features. PDF has evolved into a very rich document format capable of supporting annotations, 3D objects, audio, and other interactive elements. It is the most dominant document exchange format that is used today.

QualityLogic has been committed to providing test suites for all major PDLs including PDF. The **PDF InteropAnalyzer** product was QualityLogic's 1<sup>st</sup> PDF testing product. In 2008, the **PDF 1.7 Functional Test Suite** was introduced to provide a strict conformance test suite for the PDF language. Recently, the **PDF Compatibility Test Suite** was introduced to provide a basic PDF test suite for PDF applications and printers and the PDF Application Test Suite (ATS) provides real world PDF files. This paper will explain how all of these products can each play a role in an effective PDF testing strategy for your implementation.

### 4. Interoperability Testing

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The PDF InteropAnalyzer was created to provide our customers with a large collection of PDF files created by various applications and producers gathered from the Internet and generated by QualityLogic. This product includes a searchable database application and a large collection of PDF files. The PDF files that are included in the PDF InteropAnalyzer are meant to provide an excellent representation of what users may actually try to produce using popular applications and PDF creators. This type of testing is called interoperability testing where coverage testing of typical combinations of PDF operators produced by applications is tested against the target PDF implementation.

In 2009, we introduced two new PDF interoperability test suites:

- **PDF Compatibility Test Suite** – This test suite contains 127 basic compatibility test files for PDF versions 1.1 through 1.7. This product is designed as an entry-level test for companies who need to validate basic PDF interoperability.
- **PDF 1.7 Application Test Suite** – This test suite evolves the interoperability testing that was provided by PDF InteropAnalyzer product further – over 1000 PDF files using the most current PDF creation methods and applications including PDF/A, PDF/X, Adobe Creative Suite 4, Macintosh and other creation methods.

## 5. Conformance Testing

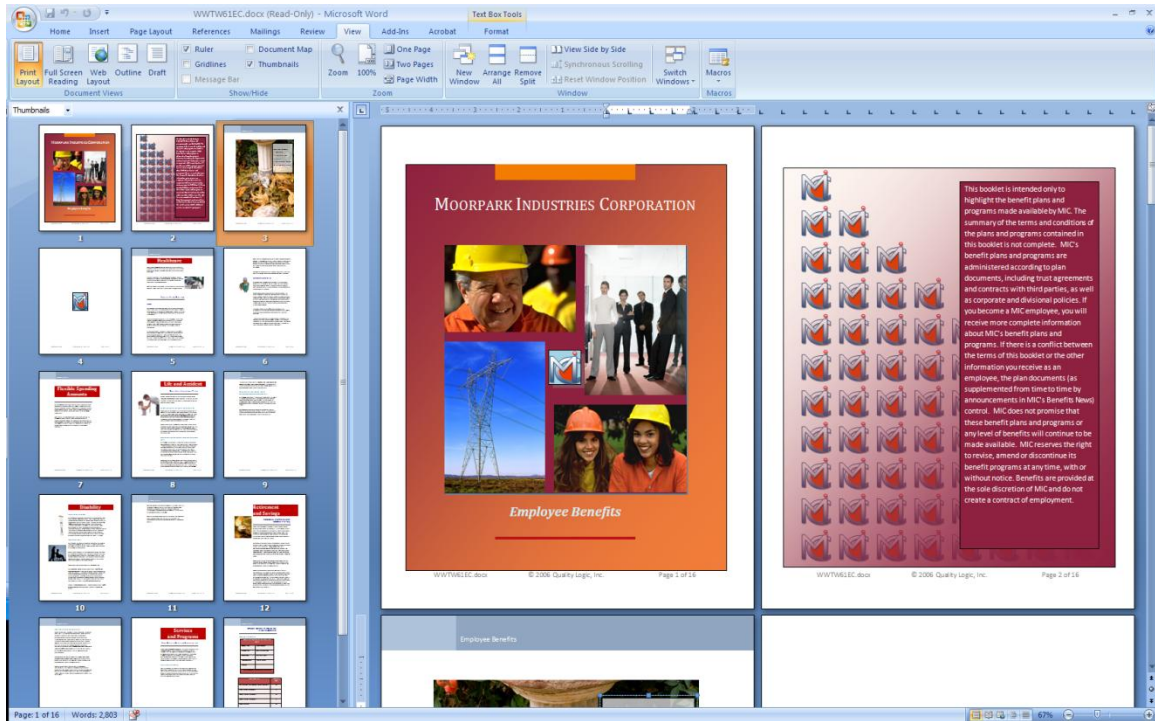
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Application based interoperability testing is certainly required and effective for testing the typical usage scenarios that are likely to be encountered. However, the PDF (or any other PDL) language specification is over 1000 pages and there are hundreds of different PDF operators and attributes can be included in a perfectly valid PDF file. Nearly all of PDF creators and applications that exist today output only a subset of the full PDF language specification. Therefore, no matter how many different files one may produce using various applications, the resulting PDF output files would not cover the full breadth of the PDF language specification. Conformance to the PDF language specification cannot be achieved by using just application produced PDF files leaving the PDF vendor with potentially significant risk and exposure.

***With so many PDF implementations out in the marketplace, leaving this type of exposure can result in a significant competitive disadvantage for your product – it is certain that new versions will make use of PDF functionality that have not been used before. PDF conformance testing is critical to producing robust PDF implementations.***

### 5.1. PDF Coverage from a Typical Application

Here is a typical Microsoft Word 2007 document that consists of text, images, graphics and even transparency. This example would be a typical example of what a user may produce.



The PDF file was created from this Word 2007 file by using Microsoft’s export PDF feature. When we examine the PDF file that was created, it is clear that the PDF features that are being tested by this test file are very minimal (similar results were found using Adobe’s PDF plugin for Word 2007).

PDF Version	Version 1.5
ColorSpace	Has 8 Bits Per Component
	Is Device Color Space
	Has Device Gray Color Space
	Has Device RGB Color Space
	Pattern color space
Compression	Compressed object streams used
	Image Compression: DCTDecode
	Image Compression: FlateDecode
	Page Description Compressed
	Uses Lossy Compression

Document	Page Count
	Orientation equal all pages
	Size equal all pages
	6-20 Page Document
	Is Portrait
	Is Letter Portrait
Font	Has Compact Font
	Font is embedded
	Font is TrueType
Image	Has Images
	Image 1-200 dpp Resolution
	Image 201-400 dpp Resolution
	Set to Interpolate
Misc	/XRefStm - Key search outside compressed data
	Has Smooth Shading
	Has Text Knockout
	/MarkInfo - Key search outside compressed data
Rendering	Image Rendering Intent: RelativeColorimetric
	Graphic State Rendering Intent: RelativeColorimetric
Transparency	Has Transparency
	Has Null Transparency
	Transparency Blend Mode: Normal
	/Group - Key search outside compressed data
	/Matte - Key search outside compressed data

***Interoperability testing using application generated test files is important but not sufficient to provide an effective testing coverage for the target PDF printer or application. An effective testing strategy must include conformance testing against what the target PDL language allows.***

## 5.2. PDF Functional Test Suite Design Goals

QualityLogic has developed conformance test suites for over 25 years for all of the major PDL's – PostScript, PCL, PDF, XPS, OpenXPS and PPML among others. The goal of these conformance test suites is to test each major feature that is allowed in the PDL specification (and not any particular application). There are typically two conformance test suites for a PDL: Functional Test Suite (FTS) and Comprehensive Evaluation Test (CET) suite.

The PDF 1.7 Functional Test Suite was designed by PDF experts for the PDF developers and QA teams. These test files are designed to be easily understood with minimum number of operators to test the target feature. The tests are developed by QualityLogic's custom software in order to accurately control what operator gets inserted into the target test file. The collection of test files in the PDF 1.7 FTS product is ideal for testing conformance to the PDF language specification. Design goals for the PDF 1.7 FTS product are:

- Test each imaging PDF feature as described in the Adobe PDF 1.7 Reference Manual and ISO 32000 PDF standard.
- Use minimal number of operators and attributes to test the target PDF operator or attribute. This feature behind PDF FTS test cases provides the user with an easy way of understanding our test case structure and the ability to modify or expand the test.
- Contains 599 individual conformance test cases (in USLetter and A4 sizes) to exercise the PDF language in a concise yet very effective drill down testing. Because we include minimal number of operators to test the target feature for each test, users can concentrate on testing and debugging each particular feature sequentially and thoroughly.
- Tests PDF operators and attributes from PDF v1.1 through v1.7 including basic testing of interactive and security PDF features. Please refer to the **PDF FTS Summary** section for further details.



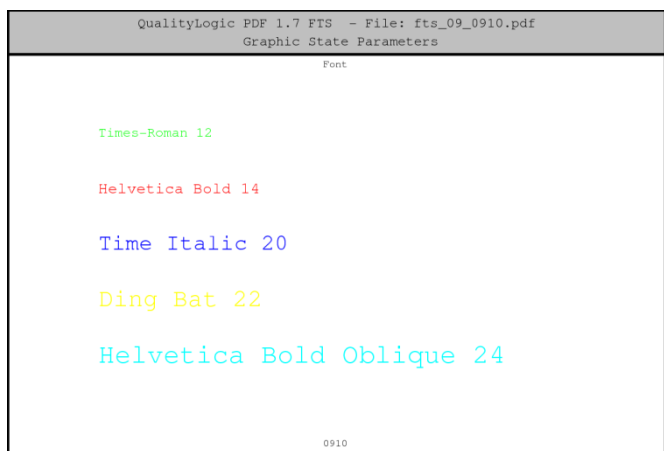
### 5.3. PDF FTS Summary

The following table summarizes each section in the PDF FTS product and contains the number of test cases that are included for that particular test section. All of these tests are provided in both USLetter and A4 paper sizes for the convenience of the customer.

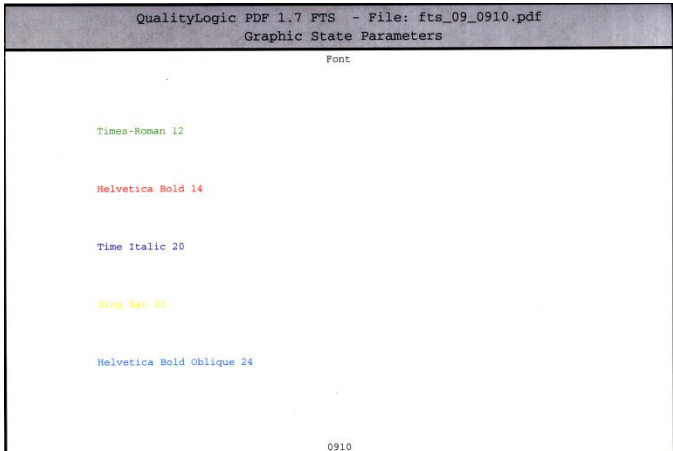
<b>TEST SECTION DESCRIPTION</b>	<b>NUMBER OF TESTS</b>
01 – File Header	8
02 – Catalog	26
03 – Trailer	4
04 – Cross-Reference	16
05 – Object Stream	3
06 – Page Object	28
07 – Name Dictionary	10
08 – Graphic State Operators	34
09 – Graphic State Parameters	25
10 – Path Construction Operators	8
11 – Path Painting Operators	12
12 – Clipping Path Operators	8
13 – Color Spaces	12
14 – Color Operators	22
15 – Patterns	26
16 – External Projects	3
17 – Images	26
18 – Form XObjects	17
19 – Optional Content	25
20 – Text State Operators	13
21 – Text-Positioning Operators	5
22 – Text-Showing Operators	4
23 – Fonts	9
24 – Rendering	32
25 – Transparency	27
26 – Soft-Mask	6
27 – Viewer Preferences (PDF 1.2)	17
28 – Destinations	10
29 – Document Outline	6
30 – Collections (PDF 1.7)	4
31 – Page Level Navigation	27
32 – Annotations	42
33 – Actions	19
34 – Additional Actions	21
35 – Interactive Forms	26
36 – Digital Signatures	2
37 – Measurement Properties	2
38 – Document Requirements	2
39 – Multimedia Features	7
40 – Document Interchange	5
<b>Total</b>	<b>599</b>

### 5.4. Problems uncovered by PDF FTS in leading PDF products

Here is one example of a real set of problems uncovered by a PDF FTS test case. This test case is a PDF graphic state parameter test which uses different fonts/sizes. One would expect this test to be a very simple test case but please note all of the different bugs that was uncovered by this PDF FTS test case including Adobe’s Acrobat 8 Professional product. This problem is one of many other issues we have observed using the PDF FTS product on leading PDF products.



**Incorrect (PDF Viewer Vendor A – wrong fonts)**



**Incorrect (PDF printer Vendor B – wrong size/fonts)**



**Incorrect (Acrobat 8 – missing text/fonts)**



**Correct Rendering**

## 6. Use of TestJob Builder in Testing

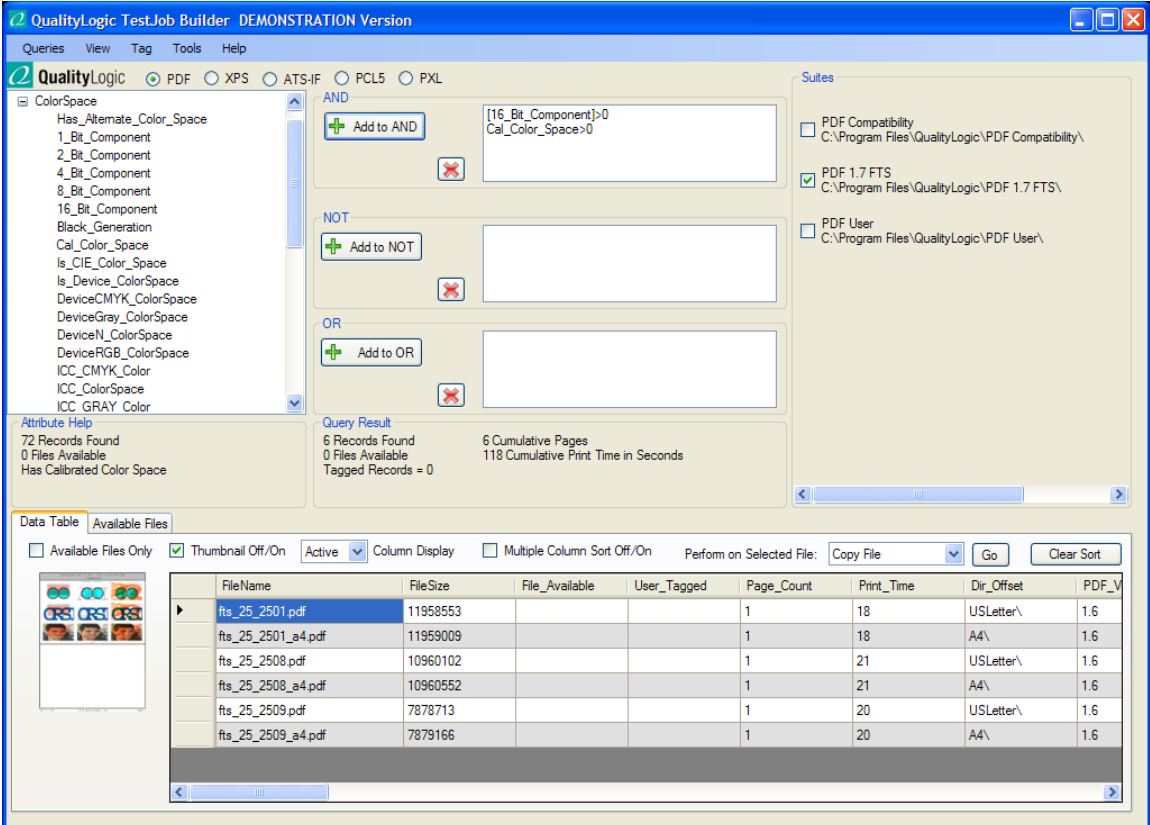
PDF FTS provides a systematic conformance testing of the PDF language for the PDF device under test. Complementary to the PDF FTS product is the TestJob Builder v2.0 application that provides a convenient way for user to search specific PDF test cases using easy to understand PDF feature search terms. In addition, users can add their own PDF, XPS or PCL test files “on the fly” to the TestJob Builder database instantly and easily. Here is a sample session using PDF FTS and TestJob Builder application.

### Test Example #1: Find all tests in PDF FTS that contains “16 bits per component images and “Calibrated Color Space”.

Step 1: Click on the “16\_bit\_Component” search attribute and select the “Add to AND” button.

Step 2: Click on the “Cal\_Color\_Space” search attribute and select the “Add to AND” button.

Final Result: *We’ve now found the 6 test files in PDF FTS that contains both 16 bits per component images and Calibrated color space.*



The screenshot shows the QualityLogic TestJob Builder interface. The search criteria are defined as:

- AND: [16\_Bit\_Component]>0, Cal\_Color\_Space>0
- NOT: (empty)
- OR: (empty)

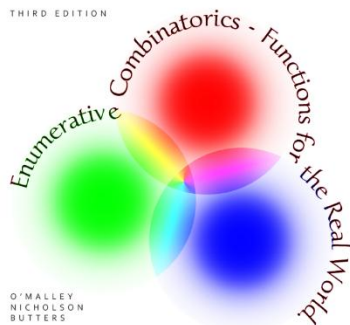
The Query Result shows:

- 6 Records Found
- 0 Files Available
- 6 Cumulative Pages
- 118 Cumulative Print Time in Seconds
- Tagged Records = 0

The Data Table shows the following results:

FileName	FileSize	File_Available	User_Tagged	Page_Count	Print_Time	Dir_Offset	PDF_V
fts_25_2501.pdf	11958553			1	18	USLetter\	1.6
fts_25_2501_a4.pdf	11959009			1	18	A4\	1.6
fts_25_2508.pdf	10960102			1	21	USLetter\	1.6
fts_25_2508_a4.pdf	10960552			1	21	A4\	1.6
fts_25_2509.pdf	7878713			1	20	USLetter\	1.6
fts_25_2509_a4.pdf	7879166			1	20	A4\	1.6

**Test Example #2: Analyze a customer PDF file to understand what PDF features are being tested.**



Customer File

Step 1: Click on "Add files" and select the customer PDF file. *TestJob Builder will dynamically analyze the selected PDF file(s).*

Step 2: Select "File Statistics" and click on "Go" button to view the analysis report of that specific PDF file.

Final Result: *Now, TestJob Builder has finished analysis of the selected PDF file and generated an analysis report as shown below.*

**PDF Individual File Analysis Report**  
2/23/2009

**PDF Analysis Report**

[Analysis Report](#) [Unique Producers](#) [Unique Creators](#)

**Analysis Report - 2/23/2009**

Group	Search Term	Occurrences	File Count	%
Query	AC9Z81EC.pdf			
	Records Analyzed: 1			
	PDF 1.7 FTS			
PDF Version	Version 1.7	1	1	100.0%
ColorSpace	Has 8 Bits Per Component	8	1	100.0%
	Is CIE Color Space	8	1	100.0%
	Has ICC Color Space	8	1	100.0%
	Has ICC RGB Color Space	8	1	100.0%
Compression	Page Description Compressed	2	1	100.0%
Document	Orientation equal all pages	1	1	100.0%
	Size equal all pages	1	1	100.0%
	Page Count	2	1	100.0%
	2-5 Page Document	1	1	100.0%
Font	Has Compact Font	6	1	100.0%
	Font is embedded	6	1	100.0%
Image	Has Images	8	1	100.0%
	Image 201-400 dpp Resolution	8	1	100.0%
Misc	Has Text Knockout	14	1	100.0%
	Has Thumbnails	1	1	100.0%
Rendering	Image Rendering Intent: RelativeColorimetric	8	1	100.0%
	Graphic State Rendering Intent: RelativeColorimetric	14	1	100.0%
Transparency	Has Transparency	4	1	100.0%
	/Group - Key search outside compressed data	2	1	100.0%
	/Matte - Key search outside compressed data	4	1	100.0%

**Unique Producers**

Producer Name	Count	%
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The analysis report indicates that this particular PDF file contains not only CIE and ICC RGB color space objects but also 8 bits per pixel images, text knockout objects, thumbnails, transparency and RelativeColorimetric rendering intents.

## 7. Testimonials

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### **Mike Mazilli**

*The PDF Functional Test Suite has instantly become an essential test tool in validating our product's PDF conformance. The simplified layout of one test per file allows our quality assurance team the ability to efficiently verify that functionality of our product is operating as expected. The layout also contributes to easier problem categorization resulting in quicker turnaround time in initial test cycles. The PDF Functional Test Suite contains content that touches on all PDF functionality and serves as a perfect starting point in testing with the results of the suite providing a solid indicator of the quality of our PDF implementation.*

### **Mabry**

*Our development team has relied heavily on Quality Logic's Test Suites for our PDL validation for many years. The PDF Functional Test Suite is an excellent addition to the suites that Quality Logic offers. The PDF Functional Test Suite tests specific PDF functionality over the entire PDF specification. Since the tests are separated by functionality, our development team can more efficiently focus on specific areas, and be more confident in our overall testing coverage.*

### **Takashi Hashizume**

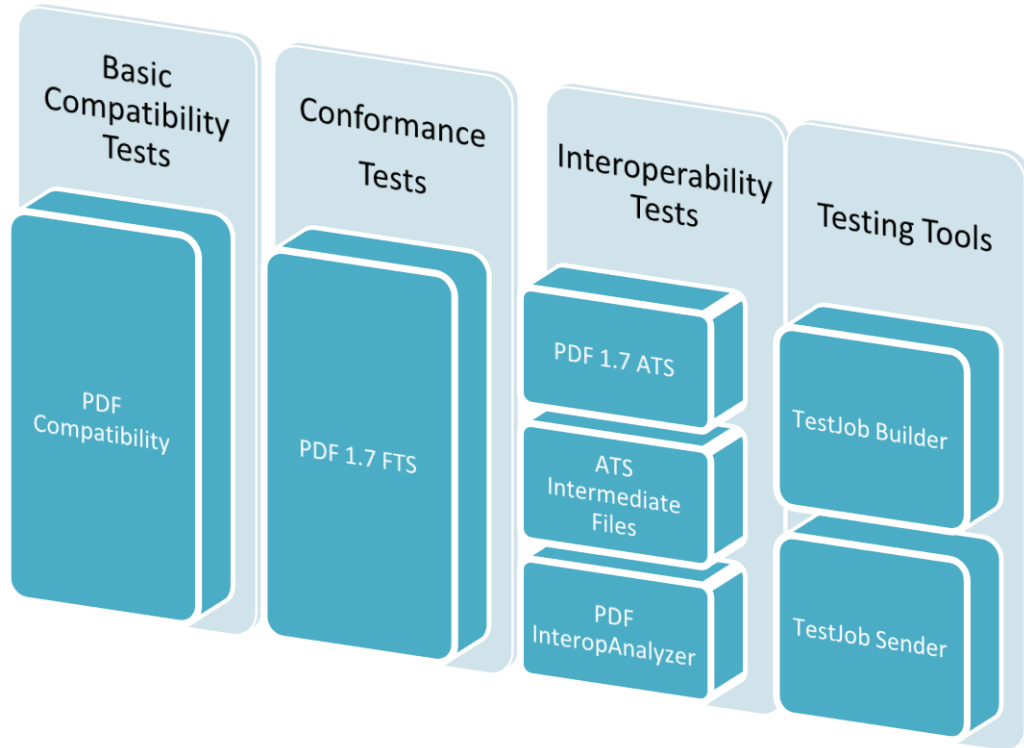
*PDF FTS は PDF conformance を確認する目的に対して非常に有効なテストツールです。短時間に PDF の仕様全体を網羅したテストを実施することができ、製品毎の品質チェックの基本ツールとしても有効です。アプリケーションから生成した PDF ファイルだけでは発見できない、未知の問題を早期に解決することにも役立ちます。*

*(The PDF FTS is a very efficient test tool for the purpose of verifying PDF conformance. This test suite covers full PDF specification and can be executed within a short time. It is also an efficient tool to qualify each product for "fundamental" test. The PDF FTS has helped to find out unknown anomalies in early stage, which cannot be found by using the PDF files produced by applications alone.)*

## 8. Recommendations

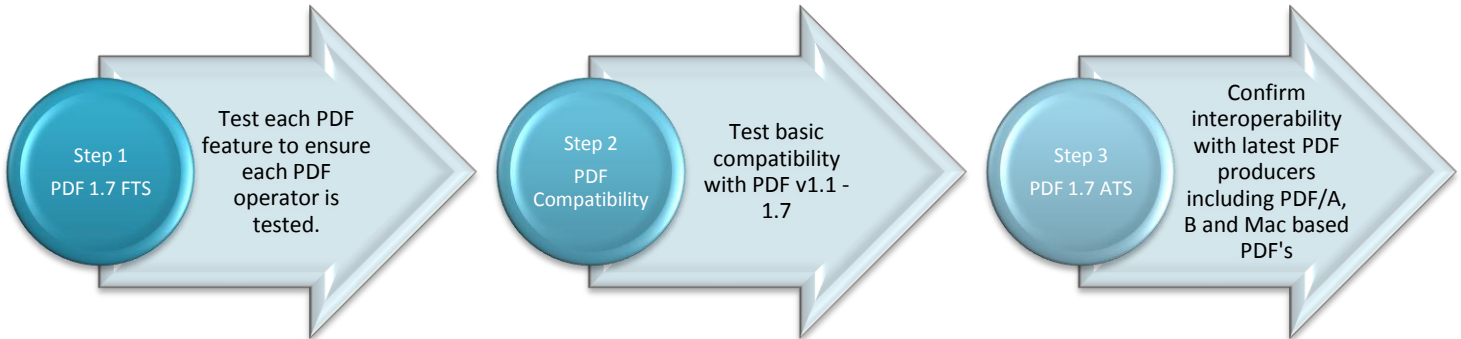
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A robust and competitive PDF implementation must be tested in both conformance to the PDF language and interoperability with various PDF producers. Both aspects are critical in the development of quality PDF implementation. An overview of all of the test products related to PDF testing from QualityLogic is shown below.



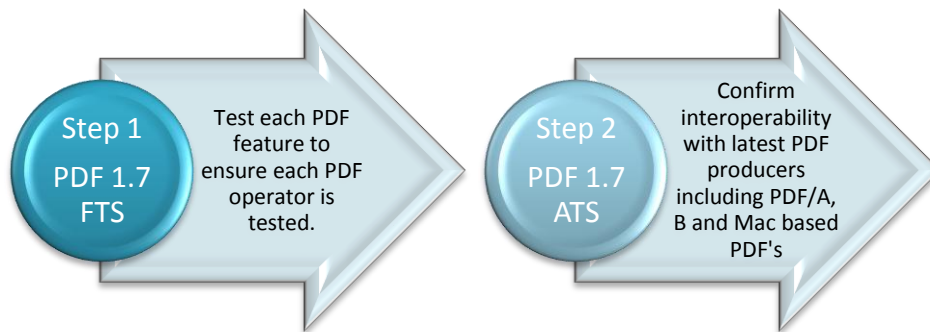
### 8.1. Testing Strategy for New Users

For new users who do not currently use any PDF tests from QualityLogic, we recommend the following test model:



### 8.2. Testing Strategy for PDF InteropAnalyzer Users

For users who do own PDF InteropAnalyzer products from QualityLogic, we recommend the following test model:



### 8.3. Testing Strategy for PDF 1.7 FTS Users

For users who do own PDF 1.7 FTS product from QualityLogic, we recommend the following test model:

