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# How do you know it works as intended?

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# Why are you talking to me?

- **Why examiners shouldn't rely on tools to 'just work'**
  - True of both hardware and software
- **Processes to validate tools**
  - Example for file carving tools
- **When to validate tools**
- **Resources to help**



## But why?!

- Tools can get things wrong:
  - Existing artifact not fully understood / parsed
  - New artifact not understood
  - Artifact format changes so no longer parsed
  - Artifact moves location so no longer found
- Can result in:
  - Omission of data
  - Incorrect output
  - Invalid output





So... when?!

- Upon receipt, before first use
- After every major software/firmware update
  - Or, selected updates
  - Only use versions that have been validated on casework
- For hardware, also periodically
  - Once a year is a good guide
  - Remember: all hardware will fail eventually



# How?!

- Draw up known test data set(s)
- Document 'correct' expected result based on each data set
- Tool validation process:
  - Document the test data set(s) used
  - Document the tool and version you are validating
  - Use the test data set(s) with the tool and document all features tested
  - Document the actual results output from the tool for each data set
  - Document the comparison between actual and expected results
  - Document any limitations of the test



# Example – validating file carving tools

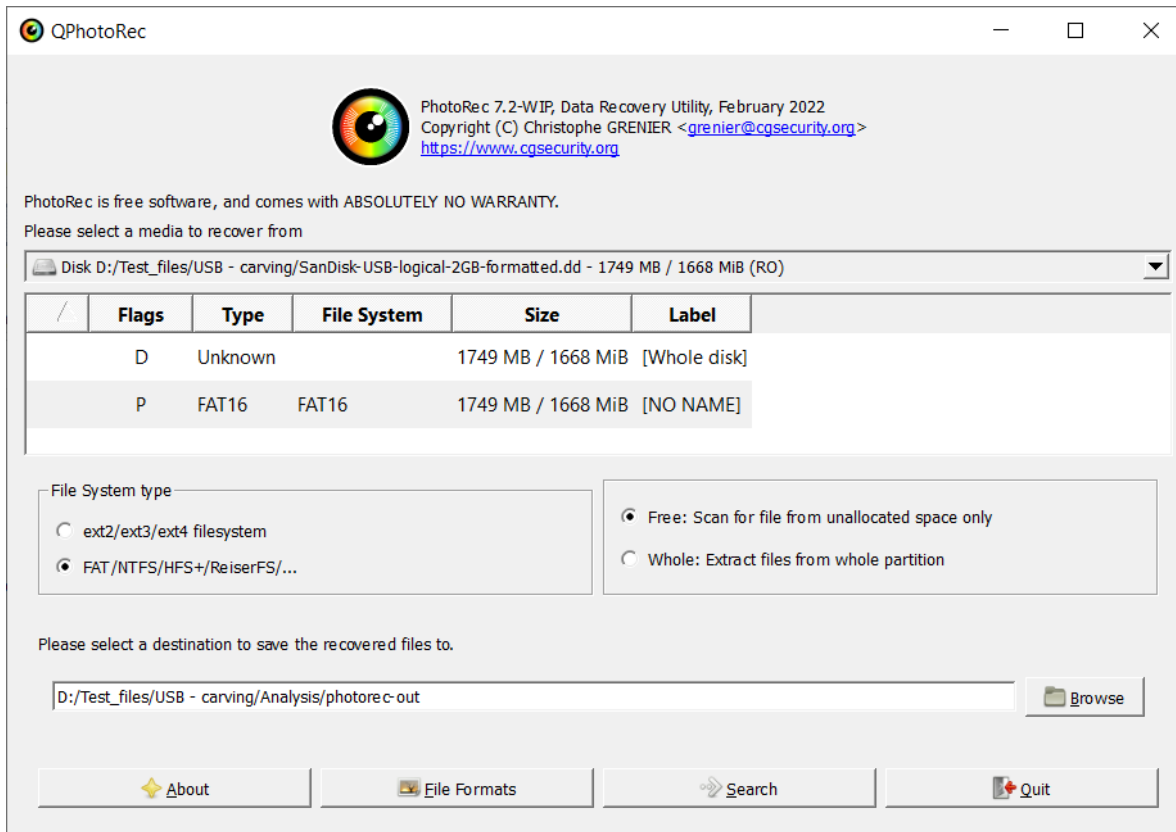
File Type	Filename	Origin	Size (KB)	MDS	SHA1
7z	AVI-7z	Created from AVI folder containing files above	20,393	a75e46686d2b69377db8bb6ee409	8461249e04d9c9701d35889f9d10437b0c616
7z	BMP-7z	Created from BMP folder containing files above	35,524	80135a9d318a61c397e6d2736e0759e	e16911a0d5c2c1e1a0e055739e60d297940c
7z	DOC-7z	Created from DOC folder containing files above	6,933	79a621143853204839783d0a86b61d	ed319a15589a71690803099403832218799
7z	GIF-7z	Created from GIF folder containing files above	10,674	a37961d92c7d1438ab6e047b6d0254e	a70ca17e703a54586ac07654d628746aa54
7z	JPEG-7z	Created from JPEG folder containing files above	10,790	49fd12894540a7e1310216511791a008	4c0e650963365685108319925dc5e8f410a2a
AVI	1280.avi	https://www.applovesto.com/avi-video-clips-free-download/	11,006	47462021761c3eeebdf82197364f1b	8351a1b0081e419007714e6dfcb00a0e46e
AVI	Bubble Turning Into Iok.avi	https://www.applovesto.com/avi-video-clips-free-download/	8,850	3e4e6542e5614e4703b794d2716180	85bd54f3cc6d119681a0e160330a08321d7
AVI	file_example_AVI_1920_2_3MG.avi	https://file-examples.com/index.php/sample-video-files/sample-avi-files-download/	2,227	c527593dc4b2673b60146339d4b89c2	573400d5d49ed0e0e0272570618477dd31f1
AVI	file_example_AVI_480_750KB.avi	https://file-examples.com/index.php/sample-video-files/sample-avi-files-download/	726	9d22d2b1e44127263ca0f9e09649d	a188e06e60f7729b8dc02319437a6bb1677
AVI	sample-avi-file.avi	https://www.learningcentral.net.com/sample-avi-video-file-download/	8,130	b0358ab72c4d50612929202780c2d194e	246ee40354074e1914510393e3000d4793d5
BMP	GRN.BMP	https://www.FileFormat.info/Format/bmp/sample/indoe.htm	85	64986d3586321b3d9c9711709e8e6d7	b367a7cc095467d39f09939bd5e7e7046bb0b2
BMP	MADELS.BMP	https://www.FileFormat.info/Format/bmp/sample/indoe.htm			
BMP	RAT.BMP	https://www.FileFormat.info/Format/bmp/sample/indoe.htm			
BMP	sample_5184-1456.bmp	https://fileexamples.com/formats/bmp			
BMP	Small Sample BMP Image File Download.bmp	https://www.learningcentral.net.com/sample-bmp-file-for-testing			
BMP	Yellow_star.bmp	Created by khedley			
DOC	file-sample_1MB.doc	https://file-examples.com/index.php/sample-documents-download/			
DOC	SampleDOCfile_200kb.doc	https://sample-video.com/download-sample-doo-file.php			
DOC	SampleDOCfile_500kb.doc	https://sample-video.com/download-sample-doo-file.php			
DOC	USB connection artifacts.doc	Created by khedley			
DOCX	15-MB-docx-file-download.docx	https://www.learningcentral.net.com/sample-docx-file-for-testing			
DOCX	file-sample_500kB.docx	https://file-examples.com/index.php/sample-documents-download/			
DOCX	sample-docx-file-for-testing.docx	https://www.learningcentral.net.com/sample-docx-file-for-testing			
DOCX	Using WSL.docx	Created by khedley			
GIF	giphy (1).gif	https://giphy.com/gifs/hatuh-seams-erney-ypers-Gd4fgi			
GIF	giphy (2).gif	https://giphy.com/gifs/blyde-beta-howtomob-07YLIFFCOE8			
GIF	giphy.gif	https://giphy.com/gifs/Internet-plze-computer-D5o2G0AB8			
GIF	How do I connect my computer to a TV or projector?	https://imgur.com/gallery/vj0tym/How-do-I-connect-my-computer-to-a-TV-or-projector			
GIF	undefined - imgur.gif	https://imgur.com/gallery/NVof3D			
JPEG	file_example_JPG_500KB.jpg	https://file-examples.com.github.io/uploads/2017/10/file-example			
JPEG	IMG_2375.JPG	Created by khedley			
JPEG	IMG_3385_cropped.jpg	Created by khedley			
JPEG	IMG_3973.JPG	Created by khedley			
JPEG	IMG_3977.JPG	Created by khedley			
JPEG	ltsdphoto-1304263738-170667a.jpg	https://unsplash.com/photos/ltsd			
JPEG	photo-1534450718292-294656355k9d.jpg	https://unsplash.com/photos/ltsd			
MOV	720.mov	https://www.applovesto.com/sample-mov-file-download/			
MOV	Cloud Formation Video.mov	https://www.applovesto.com/sample-mov-file-download/			
MOV	file_example_MOV_480_700kB.mov	https://file-examples.com/index.php/sample-video-files/sample-mov-file-download/			
MOV	sample_960x400_codec_with_audio.mov	https://fileexamples.com/formats/mov			
MOV	sample-mov-file.mov	https://www.learningcentral.net.com/mp4-sample-video-files-download/			
MP3	file_example_MP3_700KB.mp3	https://file-examples.com/index.php/sample-audio-files/sample-mp3-file-download/			
MP3	Kalimba.mp3	https://www.learningcentral.net.com/sample-audio-file/			
MP3	sample3.mp3	https://fileexamples.com/formats/mp3			
MP3	sample4.mp3	https://fileexamples.com/formats/mp3			
MP3	Symphony No.6 (1st movement).mp3	https://fileexamples.com/formats/mp3			
MP4	file_example_MP4_1920_18MG.mp4	https://file-examples.com/index.php/sample-video-files/sample-mp4-file-download/			
MP4	giphy360p (1).mp4	https://giphy.com/explore/download			
MP4	giphy360p.mp4	https://giphy.com/explore/download			
MP4	sample_1280x720_surfing_with_audio.mp4	https://fileexamples.com/formats/mp4			
MP4	sample_960x400.mp4	https://fileexamples.com/formats/mp4			
MP4	sample-mp4-file.mp4	https://www.learningcentral.net.com/mp4-sample-video-files-download/			
PDF	file-sample_PDF_1MB.pdf	https://file-examples.com/index.php/sample-documents-download/			
PDF	file-sample_150KB.pdf	https://file-examples.com/index.php/sample-documents-download/			
PDF	pdf.pdf	https://www.pdf995.com/samples/pdf.pdf			
PDF	PhoneData_Location_Cheatsheet_khedley.pdf	Created by khedley			
PDF	PhoneData_Postar_khedley.pdf	Created by khedley			
PDF	sample.pdf	http://www.aftrkx.edu/images/default/sample.pdf			
PNG	2cd43b_1649260a2774e6fb87d101c321ec17.png	https://www.freepng.com/dragon-png-4-images			
PNG	2cd43b_1649260a2774e6fb87d101c321ec17.png	https://www.freepng.com/dragon-png-4-images			
PNG	pngwing.com (1).png	https://www.pngwing.com/en/free-png-cwuf			
PNG	pngwing.com.png	https://www.pngwing.com/en/free-png-cwuf			
PNG	transparent-image-leaf-5f8e1cd1d911e41579e61.png	https://www.subpng.com/png-dwqdf			
PNG	transparent-cow-lan-adum-lan-60b8ed5257.png	https://www.subpng.com/png-dwqdf			
PPT	file_example_PPT_1MB.ppt	https://file-examples.com/index.php/sample-documents-download/			
PPT	file_example_PPT_250KB.ppt	https://file-examples.com/index.php/sample-documents-download/			
PPT	PhoneData_Forensics.ppt	Created by khedley			
PPTX	160930-artifical-intelligence-template-16d.pptx	https://www.free-power-point-templates.com/free-machine-learning-pptx-templates/			
PPTX	ppb1.pptx	https://www.applovesto.com/sample-ppts-file/			
PPTX	ppb2.pptx	https://www.applovesto.com/sample-ppts-file/			
TIFF	C01T1_1.TIF	https://www.FileFormat.info/Format/tif/sample/			
TIFF	file_example_TIFF_10MB.tiff	https://file-examples.com/index.php/sample-images-download/			
TIFF	FLAG_T3A.TIF	https://www.FileFormat.info/Format/tif/sample/			
TIFF	Sample-TIF-file-download-for-testing.tiff	https://www.learningcentral.net.com/sample-tif-file-for-testing			
TIFF	TIF-image-file-download.tiff	https://www.learningcentral.net.com/sample-tif-file-for-testing			
WAV	BabyElephantWalk50.wav	https://www2.cu.uic.edu/~t101/3sound/files/			
WAV	bird_0aw2.wav	https://www.wwsurok.com/animals/animals.htm			
WAV	crickets.wav	https://www.wwsurok.com/animals/animals.htm			
WAV	Fanfare50.wav	https://www2.cu.uic.edu/~t101/3sound/files/			
WAV	file_example_WAV_5MG.wav	https://file-examples.com/index.php/sample-audio-files/sample-audio-file-download/			
WAV	taunt.wav	https://www2.cu.uic.edu/~t101/3sound/files/			
WMV	1280.wmv	https://www.applovesto.com/sample-wmv-video-file-free-download/			
WMV	file_example_WMV_480_1_2MB.wmv	https://file-examples.com/index.php/sample-video-files/sample-wmv-file-download/			
WMV	sample_3840x2160.wmv	https://fileexamples.com/formats/wmv			
WMV	sample-wmv-file.wmv	https://www.learningcentral.net.com/sample-wmv-video-file-download/			
WMV	Video2.WMV	https://www.lehman.edu/faculty/hoffmann/t7/techsach/Video2/sample.html			
XLS	file_example_XLS_10.xls	https://file-examples.com/index.php/sample-documents-download/sample-xls-download/			
XLS	file_example_XLS_5000.xls	https://file-examples.com/index.php/sample-documents-download/sample-xls-download/			
XLS	USB_artifacts.xls	Created by khedley			
XLSX	file_example_XLSX_1000.xlsx	https://file-examples.com/index.php/sample-documents-download/sample-xls-download/			
XLSX	file_example_XLSX_50.xlsx	https://file-examples.com/index.php/sample-documents-download/sample-xls-download/			
XLSX	sample3.xlsx	https://fileexamples.com/formats/xlsx			
ZIP	DOCX-XLSX-PPTX.zip	Created from DOCX-XLSX-PPTX folder containing files above			
ZIP	MOV.zip	Created from MOV folder containing files above			
ZIP	MP3.zip	Created from MP3 folder containing files above			
ZIP	PDF.zip	Created from PDF folder containing files above			
ZIP	PNG.zip	Created from PNG folder containing files above			

Row Labels	Count of Filename
7z	5
AVI	5
BMP	6
DOC	4
DOCX	4
GIF	5
JPEG	7
MOV	5
MP3	5
MP4	6
PDF	6
PNG	6
PPT	3
PPTX	3
TIFF	5
WAV	6
WMV	5
XLS	3
XLSX	3
ZIP	5
<b>Grand Total</b>	<b>97</b>



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# PhotoRec 7.2



- Add a raw disk image...
- Select destination folder
- Search

[https://www.cgsecurity.org/wiki/TestDisk\\_download](https://www.cgsecurity.org/wiki/TestDisk_download)



## Executive Summary

PhotoRec version 7.2 was run in its default configuration against the test image [Khyrenz-FileCarvingImage-USB-logical-2GB-formatted.dd](#)<sup>[1]</sup>.

The below table is a summary of the test files that PhotoRec carved from this image.

File Type	Number of Test Files	Exact match	Usable match	Not found	False positive	Invalid file
7z	5	5				
AVI	5	5				
BMP	6	5	1			
DOC	4	4				
DOCX	4	4				
GIF	5	5				
JPEG	7	2		5		
MOV	5	5				
MP3	5	4		1		1
MP4	6	6				
PDF	6	6				
PNG	6	6				
PPT	3	3				
PPTX	3	3				
TIFF	5		5			
WAV	6	6				
WMV	5	2		3		
XLS	3	3				
XLSX	3	3				
ZIP	5	5				
<b>Total</b>	<b>97</b>	<b>82</b>	<b>6</b>	<b>9</b>	<b>0</b>	<b>1</b>
Percentage		<b>84.54%</b>	<b>6.19%</b>	<b>9.28%</b>		

As this table shows, 84.54% of the test files were recovered exactly; the SHA1 file hashes were a match to the original files. In total, 90.73% of the original files were recovered in a usable state and could be successfully viewed, with the remaining 9.28% of the original files not carved.

Eight of the original test files were not found within the image by PhotoRec. These were all JPEG or WMV file formats.

- Full validation report at:

<https://www.khyrenz.com/resources/>

Categories:

- 1. Exact match:** SHA1 match to an original test file
- 2. Usable match:** Carved file can be successfully opened and viewed, and appears similar to an original test file
- 3. Not found:** No output resembling original file
- 4. False positive:** Carved file is valid and can be opened/viewed, but is not similar to an original file
- 5. Invalid file:** Carved file cannot be opened or viewed







**MAGNET AXIOM™**



**X-Ways**



Example –  
comparing file  
carving tools

```
foremost version 1.5.7 by Jesse Kornblum, Kris Kendall, and Nick Mikus.  
$ foremost [-v|-V|-h|-T|-Q|-q|-a|-w|-d] [-t <type>] [-s <blocks>] [-k <size>]  
[-b <size>] [-c <file>] [-o <dir>] [-i <file>]
```



## AXIOM 5.10.0.30634

- **PROCESSING DETAILS (enable):**
  - Calculate hash values
  - Find more artifacts
- **ARTIFACT DETAILS (enable):**
  - **CUSTOM ARTIFACTS:** Carved Archives
  - **DOCUMENTS:** Excel, Microsoft Office, PDF, PowerPoint, Word
  - **MEDIA (all)**
- Ignored carved embedded JPEG & PNG files

## X-Ways Forensic 20.4

- F10 → File header signature search & Compute hash (MD5 and SHA1) → OK → <select all> → OK

## Foremost 1.5.7

- `foremost -i SanDisk-USB-logical-2GB-formatted.001 -o foremost-out`
- `md5deep foremost-out/*/* > foremost_md5.txt`



# Supported File Types By Default

## BUILTIN FORMATS

Recover files from a disk image based on file types specified by the user using the -t switch.

jpg Support for the JFIF and Exif formats including implementations used in modern digital cameras.

gif

png

bmp Support for windows bmp format.

avi

exe Support for Windows PE binaries, will extract DLL and EXE files along with their compile times.

mpg Support for most MPEG files (must begin with 0x000001BA)

wav

riff This will extract AVI and RIFF since they use the same file format (RIFF). note faster than running each separately.

wmv Note may also extract wma files as they have similar format.

mov

pdf

ole This will grab any file using the OLE file structure. This includes PowerPoint, Word, Excel, Access, and StarWriter

doc Note it is more efficient to run OLE as you get more bang for your buck. If you wish to ignore all other ole files then use this.

zip Note it will extract .jar files as well because they use a similar format. Open Office docs are just zip'd XML files so they are extracted as well. These include SXW, SXC, SXI, and SX? for undetermined OpenOffice files. Office 2007 files are also XML based (PPTX,DOCX,XLSX)

rar

htm

cpp C source code detection, note this is primitive and may generate documents other than C code.

mp4 Support for MP4 files.

all Run all pre-defined extraction methods. [Default if no -t is specified]

# MAGNET AXIOM™

Name	Description	Extensions
This field is required.	This field is optional.	This field is optional.
WordPerfect Files	WordPerfect Files	WP;WPD;WPG;WPP;WP5;WP6;WPF
Google WebP Images	WebP files - Header WEBPVP8	webp
Carved Audio	Carving for mp3 files with ID3 v2 header	
Carved Audio	Carving for mp3 files with ID3 v3 header	
Carved Audio	Carving for mp3 files with ID3 v4 header	
Carved Audio	Carving for WAV files - HEADER WAVEfmt	
Carved Audio	Carving for WAV files - HEADER WAVEJUNK	
Carved Archives	Zip header 1. Contents of Carved Archive files are not opened and searched.	
Carved Archives	Zip header 2. Contents of Carved Archive files are not opened and searched.	
Carved Archives	7zip. Contents of Carved Archive files are not opened and searched.	
Carved Archives	rar and rar5. Contents of Carved Archive files are not opened and searched.	

- Some file types not carved by default
- Others can be added



foremost version 1.5.7

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# Tool Comparison Against 'Known' Data

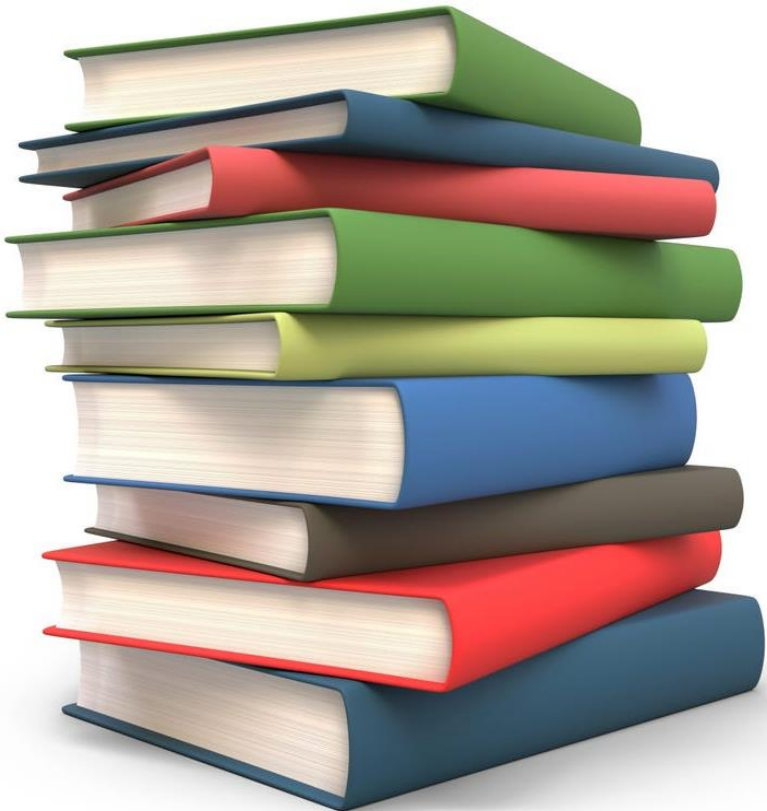
Tool	Version	Hash match	Usable	Not Found	False Positive	Invalid	Found	Not Found
AXIOM	5.10.0.30634	55	12	30	0	22	<b>69.07%</b>	<b>30.93%</b>
Foremost	1.5.7	35	22	40	79	995	<b>58.76%</b>	<b>41.24%</b>
PhotoRec	7.2	82	6	9	0	1	<b>90.72%</b>	<b>9.28%</b>
X-Ways Forensic	20.4	81	16	0	1	2	<b>100.00%</b>	<b>0.00%</b>

\*Caveat: This is ONE test against ONE dataset & ONE tool version



## Other Resources

- NIST Computer Forensics Tool Testing (CFTT) program
  - <https://www.nist.gov/itl/ssd/software-quality-group/computer-forensics-tool-testing-program-cftt>
- SWGDE Guidelines for Validation Testing
  - <https://drive.google.com/file/d/1vakqb14EJzq3eNkww5ui40WYGP7IGCsD/view>
- Sample carving test images (Brian Carrier):
  - <http://dftt.sourceforge.net/>





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