

Image File Formats- Descriptions and Discussions

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JPG Basics

[JPGs](#) (same as [JPEGs](#)) are normal digital camera images. Cameras create JPG images from raw image sensor data based on your settings like Sharpness and White Balance. The camera makes the JPG and then the raw data evaporates as soon as the JPG is recorded.

Beware [JPEG 2000](#) which you only find in some advanced software. It was a newer proposed version of JPG that has been forgotten today for still photography. It is COMPLETELY INCOMPATIBLE WITH the current JPG systems. JPEG 2000 has found application in the [Digital Cinema Initiative](#) and will be used as their standard for the movies many or most of us will be seeing in theaters today and in the near future.

Raw Basics

Raw files are just the raw sensor data. It isn't a picture until it is processed further. Most fancy digital cameras allow you to save the raw data instead of the actual JPG picture. If you do, you still have to do the processing in your computer to make an image (JPG or otherwise) that you actually can see. Cameras do this processing in hardware much faster than your computer can do it in software.

Some cameras have a handy raw + JPG mode which saves both the raw data and the JPG picture.

Raw files are just like raw olives: you need to cook or otherwise process them before you can use them. They also go bad fast if left in the raw state and can keep forever once processed to something like olive oil or JPGs.

Horror of horrors, I've heard that the latest Nikon software can't even read the NEFs from older cameras and that you need to load older software to read them. Just like raw eggs, unless you process it into something like an egg-albumen print or a JPG, the raw files may go bad if left unprocessed.

It's not the file that goes bad, silly, it's the potential ability of future software to read it. Since raw data is entirely unique to each camera, and different even for different firmware revisions for the same camera, raw isn't even a format, even though the different files have the same suffix like .CRW or .NEF.

Raw files themselves don't go bad. What goes bad is that in 10 or 20 years, whatever software we're running on whatever sort of computer we'll be using may not be able to open a long-forgotten 20-year old proprietary file.

JPGs are universal. Raw is proprietary to camera make and model and even camera firmware version. Without solid manufacturer support you won't be able to use your raw files again.

Can you find a computer to open word processing files from 10 or 20 years ago today in Lotus Notes or PFS Write or Brother Style Writer? I can't; that's why I converted my files from these programs to the universal .TXT format back when I could. Do you trust Canon, Nikon and Adobe to support 10 or 20 year old cameras? How about 30 or 40 year old cameras? If you do, go ahead and leave your raw files as raw. I convert all my raw files to JPGs or TIFFs for archiving.

The JPG processing in the camera can be better than what you may be able to do later in software from raw. In the September 2004 issue of "Outdoor Photographer" magazine, page 25, Rob Shepard says "...the high quality JPEG images looked far superior to the raw files when both were opened directly."

Cameras create their JPGs from the 12 bit or more raw data as it comes off the sensor. Your contrast, white balance, sharpening and everything are applied to the raw data in-camera, and only afterwards is the file compressed and stored as a JPG. You'll see no additional artifacts since that's all done before the JPG conversion.

Using raw files obviously takes a lot more time and patience, like [refrying beans](#), since you could have had all that processing done right in the camera for free. You only want to go through this trouble if for some reason you're unsure of what settings to use. The raw data, since it includes everything, also takes up a whole lot more space and takes more time to move around. It's sort of like either having a complete car that runs (JPG), or a science project in a million pieces that still needs assembly before you can drive it (raw). You can't really change exposure after a raw file is shot, although the software that opens this data gives one the option to rescale the data and give the impression of changing exposure. You can get this same synthetic lightening from JPGs, too, although only raw allows some ability to correct overexposure.

I take a lot of heat from tweakers because I, like other photographers, prefer to make my adjustments in-camera and use the JPGs directly. Others prefer to spend even more time later twiddling in raw, but that's not for me. I get the look I need with JPGs and prefer to spend my time making more photos. If you're the sort of person who likes to twiddle and redo than by all means raw is for you.

Everyone's needs vary. For many hobbyists tweaking is part of the fun and I don't want to spoil that. Please just don't take it personally that I prefer to get my shots right the first time instead of having to tweak them later. If I need to correct a goof I just do it from the JPGs.

JPG Details

[JPG](#) (same as [JPEG](#)) is the standard used by prolific shooters. It gives great quality and offers the fastest speed for everything. It is the most popular and compatible image format on the planet. It is especially popular for the things for which digital cameras are best suited in the first place, like news, sports and events. With JPG you can shoot hundreds or thousands of images at a time and the files are ready for release with no further processing. JPGs done properly, as digital cameras do when set to NORMAL or FINE, give great results you can use immediately. Of course you need a professional digital camera that provides the exact in-camera adjustments, like subtle white balance control and immediate, easy access to them, to be able to do this. Pros skip many of the cameras that excite amateurs if those cameras require adjustments to be made through menus or have limited WB capabilities.

Professional journalists like [Karl Grobl](#) who need to produce results shoot JPG. Karl just returned from a two month series of assignments in Asia. He brought back 20 Gigabytes of JPGs, and those were just the keepers. Karl no longer has the time to piddle with anything in Photoshop: if the image isn't perfect as shot it gets deleted. Life is too short to piddle with sloppy images if making images is what you do for a living. Of course if photography is your hobby and you find the piddling enjoyable or if you're in a studio with time to burn then that's another story. Karl has a ton of images he needs to get to a ton of clients, and then he's off on the next assignment. There is just no time to wait for things like raw file processing. I've seen Karl's 20 x 30" prints from his JPGs and they are spectacular.

Sometimes raw will look different from JPG depending on the differences between sharpening algorithms used in-camera (JPG) and in different versions of software (raw.) I find every raw opener (Adobe Photoshop CS, Adobe Camera raw, the camera maker's version, iView, etc.) processes the image a little bit differently in terms of sharpness, curves and colors, so you never really have a definitive look until after you've opened and saved the file as a standard JPG, PSD or TIFF.

You may prefer one or the other. If you don't like the in-camera options, shoot unsharpened JPGs and sharpen elsewhere. Likewise, if you set the wrong white balance or underexposed you can always correct it later using, for instance, Photoshop's Levels, Curves and/or Color Balance features, among others. I have no problem adding two stops of exposure to a dark JPG in Photoshop's Levels or Curves command.

Many people who shoot raw, which I consider to be a big waste of time, don't realize that white balance can be adjusted in Photoshop even from JPGs. No, Photoshop doesn't yet have a "dummies" panel actually marked with common white balance monikers, but skilled photographers have always been able to do it. I prefer using the "Set White Point" and "Set Neutral Gray" eyedroppers in the Levels command. See [here](#) for how to do it.

Some cameras, like the [Casio EX-Z750](#), allow correction of JPGs for White Balance and exposure after they've been shot as well.

I've made deliberate comparisons on my D1H (and so can you) by shooting a scene in both JPG and raw at ISO 200, ISO 800 and then underexposing two stops (set exposure compensation to -2) at ISO 200. There now are six shots. Open the underexposed raw by adding +2 stops while opening and apply correction to the dark JPG with Levels or Curves. Now look at these two vs. the shots made at ISO 800. They look pretty much the same, which if you really get into the camera's signal processing and external math you'll realize that you're doing the same thing to the same data; just the different processes are doing these identical algorithms in different places. Of course how you lighten the dark JPG will probably alter the look of the image; I forget what curves I used best to simulate adding two stops. Hee hee, I only made the normal ISO 200 shots to show that pushing two stops from ISO 200 gives the same grain as shooting directly at ISO 800. Actually it's better to shoot at ISO 800 in the first place since the camera does a better job by increasing the analog gain of the CCD amplifiers. Also the very best image of that indoor/outdoor contrasty scene was made by using the underexposed image (which retained the outdoor part) and using a filter to lighten the dark indoors. I got the same result from the JPG and raw files.

If you're a tweaker you'd be interested to learn raw and JPG also have the same effective bit precision. JPG has 8 bits per color per pixel and raw may have 12 bits, but here's the big catch: raw is 12 bit linear, and JPG is 8 bit [log, gamma corrected or some other non-linear transform](#) derived from the 12 bit linear data. Thus in the shadows where this might matter the two are the same, since the full 12 bit resolution in the dark areas is preserved by the non-linear coding. Even if the two formats differed in dark resolution the sensor noise is still greater than one [LSB](#) anyway making it a moot point.

Raw Details

Raw is designed for people who intend to spend a lot of time twiddling with one image at a time. For these applications I use large format 4x5" film instead for much better quality, thus you see why I don't use raw. Raw is very popular for people shooting landscapes with digital cameras, which is not what digital cameras are for. Unfortunately this is becoming popular among amateurs, but remember that for amateurs the fun is in making the photo, and for fun digital is king. Personally I focus on the final image, for which big film excels. This goes to explain all the heat I get from hobbyists, who of course love raw and shoot Yosemite on their digital SLRs which is very different from what I do. Raw is also for people who don't yet get perfect exposure right when they make the image, although of course JPEGs also allow these adjustments.

Raw is needlessly tedious if you can get the right image to begin with. Raw always requires extra steps to process from the camera into a usable format, the files can only be opened with very special software, requires far more time for everything and therefore slows workflows. In fact, raw is not any sort of a standard format: .CRW or .NEF or whatever files are actually very different from each model of camera, and you

constantly need to be updating your conversion software just to be able to read files from whatever camera you just got. I had NEF files from an advance sample of a Nikon D70 I couldn't open since the software had not been released. In the professional arena workflow efficiency is the difference between waiting for a batch convert to complete and working on a new paying project. Raw looks the same anyway as a good JPG. I will admit that on the D70 the differences in default sharpening are such that the raw images do look sharper than the JPGs if you're looking zoomed in to 100% on a computer, but were still invisible to me in 12 x 18" prints.

Don't pay too much attention to sales demos showing how you can restore details in highlights for a shot that was overexposed by a critical half stop. First off, no one really is so bad a studio photographer that they'd actually overexpose a series of studio shots by a half a stop and not know it on a digital camera. That reminds me of comedian [George Carlin's](#) line about he thinks that the stupidest thing a human being can do is to run out of gas in a car with a working gas gauge. You can see overexposure on the LCD of the digicam. Yes, raw is great to catch this last half a stop if you goofed, but that's about as far as it can correct depending on your camera. Today I find that unlike earlier cameras the Nikon D70 seems to offer a good deal more ability to catch lost highlights, which again I have yet to see that the efforts involved with raw justified any improvement in the final image. Even though I could see the improvement, my girlfriend still preferred the 12 x 18" print of the BASIC JPG image to the 12 x 18" print made from the raw file on which I spent an hour correcting all the levels and lens distortion and chromatic issues. Such is art!

If you intend to spend hours twiddling with individual shots or have enough time to waste piddling in chat rooms like [this](#) then go ahead and shoot raw, just remember to save them as something standardized so you can read them later. If you need loads of great images *now* then shoot straight to standard JPGs.

Raw looks no better than JPG for real photos. It just takes up space, wastes your time and runs the risk of not being able to be opened now and in the future. Raw is OK if you only shoot a few dozen images and you want to play around with each of them in Photoshop; JPG is best if you need hundreds or thousands of images each day and get them right in the camera to begin with. The latest trick of making dual-exposure composites from single raw files actually can be done just the same from a JPG; just open the JPG (exposed for the highlights) in Photoshop and apply the LEVELS or CURVES command to the layer representing your shadows.

Example 1 : a friend of mine on his first day out with his D1X shot a foot race. He had no idea he would shoot so much and his single 256MB card was filling up quickly. He had to set the camera down to SMALL resolution (1,312 x 2,000) and BASIC JPG (256kB) so he could keep shooting. He then licensed one of those image files to a shoe company for use on a poster. It looked great in print and he got \$1,200 for the temporary use of the file. (No, he did not sell the image outright for such a low price.) Sure, he could have shot raw, but if he did he would have missed the shot completely

since he would have been out of memory giving him *no* image at all instead of a great looking one.

Example 2: While everyone was in chat rooms yesterday I spent the day consulting on a shoot of a \$7,000,000 home. We shot raw + JPG on a Canon 1Ds so my client would have both kinds of files from which to learn afterwards. It took a half hour to download the images from the 1 Gig flash card, and we never even used the raw files. The JPGS were all we used, and we had the files prepped, profiled and ready to go to press that night at 355DPI for use in a very high-end publication. None of the raw files were used, but they did waste our time. There also is some weirdness in how the 1Ds records these in the raw + JPG mode, see [here](#).

JPG - More

Prolific shooters shoot JPG because time is money and we are able to get things right the first time. JPGs, especially the larger JPGs, offer the same image quality as raw or TIFF, with much less time and effort if you can set your camera correctly to begin with.

JPGs work the fastest in file transfers, CD backups, reprocessing for automated web galleries, ability to drop off for printing at a lab, file opening, ability to send files to clients and everything really. Therefore, since time is money in every profession, JPG is the format of choice for photography.

JPG is the world's most popular format for digital images. It is the format most likely to be legible to any piece of equipment, in fact, even many DVD players can read JPGs from a CD.

The ability to get a shot right the first time is one of the things good shooters get from practice. One needs a camera that can be adjusted instantly for ISO, White Balance (WB), exposure compensation and sharpening. This is why I complain if a camera requires menus to make adjustments. Good cameras like the Nikon [D1H](#) allow one to make most of these adjustments instantly with dedicated buttons, no menus required. **The best delineator between a pro camera and a tyro's toy is whether or not you need menus to adjust it from shot to shot.** In any shoot I am constantly adjusting all these things as my light and subject change, so there is no time to wait around for menus.

More pedestrian cameras, like my point-and-shoot digital [A70](#), require me to stop and twiddle through menus to adjust any of these things. This makes it much harder to get a perfect image immediately.

A well-done JPG is all I ever need.

If I didn't have a camera that allowed me to get the right results the first time I might be tempted by the tedious raw format. Oddly, the simpler cameras that might need raw don't offer it, and the better cameras that do usually don't need it!

Some people worry that JPG implies poor quality. This is because JPEG files can be made at any quality level, high or low, and we've all seen bad JPGs.

Photoshop users know that you have a huge range of quality settings when you "SAVE AS" or SAVE FOR WEB." Smaller JPGs, especially what you see formatted for the internet on my and other websites for easy download over telephone lines, will have artifacts often visible as slight noise around a sharp line against a flat background, or potential blockiness of a smooth area like the sky, or slight muddling of textured areas. This is not a problem with the JPG format, it's just that those JPGs were deliberately made to be have small file sizes and thus unfortunately look crummy.

The JPG format is adjustable for quality vs. file size. Larger JPGs, which is what cameras record, record enough data, especially at the milder compression settings (FINE on Nikon and Canon) so that these artifacts don't occur. JPGs at the correct quality settings have no visible artifacts. Play with this yourself as I have: make a bunch of photos at the different settings (including raw) and put them all up on your screen at 100%. You'll see for yourself.

Thus there is no quality disadvantage to using JPGs correctly, and many logistical advantages.

Raw - More

Raw are proprietary nonstandard formats just for getting images to your computer before saving or processing. They always require a special step just to open them after which you can save them in a useable format. Each camera maker has its own incompatible format.

Even worse, some camera makers want to ensure you have to buy special software from them and only them in order to read your files. See [here](#) about how Nikon is encrypting the raw files from the D2X to ensure that only their software will work properly. This means that if Japanese industrial giant Mitsubishi, parent of Nikon, wanted to raise profits they may already have set the current software to time-out your ability to read today's raw files in a few years, and then the only way you could see your photos is to buy new software.

If you have time to burn and don't mind the incompatibility aspect by all means go raw. If you are only shooting a few images at a time don't worry too much and use raw if you want.

Raw formats, like Nikon's NEF and Canon's CRW, are aimed at people who have the time to piddle around after a shoot to make up for what was not set correctly in the first place. Theses folks are the ones who also have the time to spend in chat rooms like [this](#) instead of actually photographing.

The biggest quality advantage of raw is the ability to correct for some of your mistakes after the fact, so if you can get it right the first time most of the raw advantage evaporates, but all the disadvantages remain.

Raw is free from visible compression artifacts, just like JPG at the milder compression levels. It also can record with a couple of more bits of z-axis precision (12 bits instead of 8 bits) , which is invisible unless you have a very poorly lit image and need to do horrendous curve adjustments. In this case your problem is not file format; it's your lighting.

But no! Raw records usually with 12 bits, but a linear 12 bits. JPG uses only 8 bits, but these are after the log and gamma conversion, and thus preserves the 12 bit precision at the shadow levels where it's important!

Raw is NOT a digital negative. Unlike a real negative, it still has restricted resolution and dynamic range, and most importantly, cannot be read or seen except with very special software. JPGs are far more universally read, and closer to a negative in terms of being visible to everyone over time. Raw is like a color negative since each piece of software you might use to open it yields different colors!

Disadvantages of Raw:

1.) Time is money to people who need to make money from photography. We simply don't have the time to waste for all the files to download and then especially to wait while hundreds of raw files open up the hard way before we can see them, much less do anything with them.

Raw takes too long: too long to record to the card, especially with compressed versions, takes up too much space on the card so more cards are required, takes longer to transfer to a computer, longer to back up to CDs and takes more CDs, etc. Not only is there a big disadvantage due to the bigger file sizes, but also:

2.) The formats are not standardized. With Nikon and Canon at least the latest version Photoshop CS can open the raw formats, but otherwise you have to revert to using each manufacturer's proprietary software. This may be something you are willing to flog through today, but what if a fringe manufacturer like Sigma, that as far as I know is not supported in Photoshop CS and certainly not likely supported in Breeze Browser or iView as far as I know, decides *not* to supply upgraded software in the coming years that can run on the computers of the future if Sigma is no longer choosing to make or support digital cameras? **If you can't run today's reader software in the future then you won't be able to read your image files and they are lost forever.** Thus you see why raw files are not at all like a negative that you can read in 50 or 100 years.

3.) Because it's not standardized, you can't send these files to clients or anyone and expect them to open. Also if you do, and they can read them, then you have lost control over how your file looks, since they may choose to open it differently. (Of course

if your client asks for raw give it to them.) If you shoot raw you have to open each file and convert it to something like JPG or TIFF before you can send it out. This costs time you simply don't have to spend if you had shot JPG to begin with. This is one thing for just a few shots, especially if you are going to play with them in Photoshop anyway, but if you are doing this for money you are probably dealing with hundreds and hundreds of files everyday and there just is not enough time. Personally I try to create hundreds of JPGs I can send directly to my client so I can get onto the next project immediately. I only open things in Photoshop if I goofed the first time.

4.) Each camera maker has its own incompatible format. One cannot save files in raw format either, thank goodness.

5.) Different software opens up the files differently. The same files look different! I see one thing with Photoshop's Camera raw plug in, one thing with Nikon's plug in, and different things on different versions of iView even in different screens! In this way raw is like a digital negative: the colors and sharpness look different every time you try to print it! Pros need images that always look the right color; the color we captured in the first place, which is why slide film is far more popular than negative film professionally.

6.) Did I say it takes a long time? I had one camera maker's plug in take 30 seconds to open a raw file, and that's after you manually chose all the settings with which you want the file to open. The preview was crummy, so that you might have to try a few times until you get it right, just to open a file. Multiply this by 500 shots made at a wedding and you can see why it's just not happening.

7.) Today's versions of software may not be able to open older raw files, losing your images forever. My prognostication of this photographic apocalypse is nigh: as of July 2005 a reader writes that he couldn't get Nikon Capture 4.3 or Photoshop to open older NEF files, getting "unexpected end of file" errors. While waiting for Nikon support to tell him what historical combination of Nikon Capture and Nikon View versions would enable to see his images he tried Bibble Pro, which worked. I always make TIF archive copies of anything about which I care shot in raw. Raw means raw, which means it's not cooked and very perishable. Just like raw meat, raw files become worthless as time progresses unless they are processed into something with a long life, like a standard TIF or JPG image.

So by all means shoot raw if you want, just don't expect any visible quality difference, and do be prepared for a lot of time spent twiddling and the possibility of not being able to open files occasionally now or ever in the future. I gave up on raw since every program I use opens them differently, and every different version of a program, like iView, deals with them differently in every release.

Personally, when I want quality and have the time to mess with things I shoot on film and scan it. This way I also have a color standard, the transparency, against which to compare the files and prints.

If you shoot raw I prefer the built-in plugin with Photoshop CS for opening all these files. [Here's](#) a great article on how to calibrate color if you insist.

Others speak very highly of Nikon's extra-cost Capture program. I've never tried it. If I shot raw I would certainly try it out. I think there are free demos available, too. If you do shoot raw of course you can go get the program in the future if you're unhappy with other openers.

Raw + JPG Modes

As of 2004 many cameras allow you to record both. This is great, since you

- 1.) Have the JPGs for immediate use
- 2.) Have the raw files if you need or want them, and most importantly,
- 3.) Have a back-up file in case either is corrupted.

The disadvantages are that you wind up recording even more data that you probably don't need. Data transfer and storage and archiving and backup takes time, which is money to a professional or anyone else who values their finite time on this planet.

TIFF

TIFFs (also called .TIF) are very large files used for saving processed images.

TIFFs are used only in tethered studio applications, if ever, for camera capture. Tiffs don't have any of the post-processing advantages of raw and have enormous file sizes that will completely clog up any workflow if you are shooting many images on cards.

TIFF (or PSD, the format native to Photoshop) is perfectly fine for archiving files after you've played around with them or for sending to a client on CD. Just don't set your camera to this format for recording on cards since it's so cumbersome.

ARCHIVING

If you shoot JPG, just archive the camera original JPG files.

If you shoot raw you should also archive everything in a standard JPG or TIFF format so you'll be assured of having the best chance of being able to open and use the files in the future.