

# AQUATICA™

## Digital



# Keri Wilk

Nikon D7000 and Aquatica AD7000 Review

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### INTRO

Aquatica phoned me here at ReefNet at the end of December 2010, and asked me if I'd be willing to field test and publicly review a prototype of their AD7000 housing for the newly-released Nikon D7000. The review was to be honest, candid, and to include all positive and negative aspects of the system. It was clear to me that Aquatica was more interested in honest user feedback and constructive criticism than an overly positive advertorial.

I accepted their offer and booked a trip to Dominica to put the system through its paces. Aquatica generously covered my trip expenses, and I (reluctantly) sent back the prototype upon my return.

The newest Aquatica housing that I had used before this review was my father's AD300 (for the Nikon D300) which was released in 2008. Since then, I've watched from the sidelines at dive shows across the US, as their line of housings has grown, in both quantity and quality. Many advances and innovations had been made by Aquatica since the AD300, which made me all the more eager to get in the water with the AD7000.

### Nikon D7000

When the D7000 box arrived at my house, I put the battery to charge immediately, and starting paging through the user manual. The 1200 USD price tag became more and more shocking to me as I read on, considering the long list of newly-developed and pro features packed into this consumer-level body. Nikon has set the bar incredibly high with this new release, which makes you wonder what the next pro body is going to have under its hood (D800? D400?).

**FEATURES:** 16.2MP APS-C (DX) sensor

The D7000's new 16 megapixel sensor is capable of capturing more details than any other DX body from Nikon.



Nikon D7000 in Aquatica AD7000 housing, Tokina 10-17mm lens @ 10mm behind Aquatica's 9.25" Megadome, 2 x Ikelite DS160 strobes - 1/60th, f/10, ISO 100.



The D7000's new sensor has roughly 30% more pixels than the 12MP D90, D300/s, D700, and D3, and is only topped in resolution by one body in the Nikon range - the professional D3X, at 24MP. With those extra 4 million pixels, you can print an image 15% taller and wider, for a given DPI. This may not seem like much, and is probably a moot point to many of you, but I certainly appreciate the extra resolution compared to my D300. This pixel dense sensor, combined with a 14 bit A/D converter (discussed below) and a new EXPEED 2 processing engine are capable of reproducing beautifully rich colors, incredibly sharp details, and buttery smooth tonal gradients.

### Dual SD slots (SDXC compatible)

The D7000's 14-bit RAW and JPEG images sometimes tip the scales at over 25MB and 9MB, respectively, and its 1080p HD videos average around 2MB per second, so storage space can be eaten up very quickly. Thankfully, the D7000 has two SD card slots, so single-card capacity issues can be avoided.

I used a pair of SanDisk 16GB Extreme Pro cards, which was more than enough to let me shoot worry-free for a full day of 3 or 4 dives. I probably could've managed with just a single 16GB (or pair of 8GB), but the last thing I want to do is waste time underwater deleting photos.



Several hundred exposures were taken to achieve this shot. The second card slot came in handy in this case, since I greatly exceeded the 16GB capacity of the first memory card. Volcanic gas bubbles at "Champanagne". Nikon D7000 in Aquatica AD7000 housing with tripod, Tokina 10-17mm lens @ 17mm with Magic Filter behind Aquatica's 9.25" Megadome, no strobes - 1/6th, f/29, ISO 100.

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The second slot can be used as extra storage, or as an automatic backup destination, on the off chance that data from one of the cards is lost (I've had a couple of no-name cards go completely belly up before). Videos can be directed to either card slot, but once that card is full, you need to manually switch destinations (SHOOTING MENU>Movie settings>Destination). You can also send RAW images to one card, and JPEGs to the other, but I find this feature useless.



A self-portrait shot from the inside of a large barrel sponge. The camera was set to shoot every second using the interval timer shooting mode (SHOOTING MENU>Interval timer shooting). I let the camera take over 100 shots before manually stopping it – this spilled me over into my second 16GB card. Nikon D7000 in Aquatica AD7000 housing, Tokina 10-17mm @ 10mm behind Aquatica's 9.25" Megadome, 2 x Ikelite DS160 strobes - 1/60th, f/14, ISO 200.

### 100% viewfinder

Usually a pro-body feature, a 100% coverage viewfinder allows precise in-camera framing, potentially eliminating the need for future cropping. Underwater, this feature is relevant only when using an external viewfinder, like Aquatica's Aqua View (discussed below), since it's nearly impossible to see the entire frame through any housing manufacturer's stock viewfinders.



### 1/320s flash sync speed

A disappointing aspect of digital sensors is their inability to capture highlights in the same way that film does.

Sensors are comprised of an array of pixels, which collect and record photons. These pixels and photons can be thought of as buckets and water droplets, respectively. Nothing prevents water from entering the buckets, so they can get filled as fast as water is poured into them.

Precisely framing divers in wide angle shots is much easier with 100% coverage viewfinders. Nikon D7000 in Aquatica AD7000 housing, Tokina 10-17mm @ 10mm behind Aquatica's 9.25" Megadome, 2 x Ikelite DS160 strobes - 1/200th, f/13, ISO 200.

Now, consider slide film, which is comprised of a plastic substrate coated with grains of light-sensitive silver-halide. Each grain can still be thought of as a bucket, but with a small funnel attached that the water must first travel through. Average quantities of water can pass through the funnel without restriction, but, when faced with large amounts, the funnel will overflow, only letting a portion of the water into the bucket.

In other words, digital sensors are much more sensitive to high-intensity light than film.

What this means for underwater photographers is that shooting into the sun will often result in an unsightly stark-white ball in your images, usually encircled by an equally unattractive cyan ring.

To expose the sun more pleasingly, a very high shutter speed, small aperture, and low ISO are typically required, but this usually results in extreme underexposure of the foreground, which isn't always desirable (unless shooting silhouettes). Ideally, you'd just turn on your strobes, crank up their power and illuminate the underexposed area, but DSLRs are limited by something called the "maximum flash synchronization speed" which prevents strobes from being used past a particular shutter speed. The higher this limiting shutter speed, the more these sun balls can be kept under control, so having a camera with a high sync speed is very desirable. The D7000 can sync up to 1/320s, which is the fastest in Nikon's DSLR range, other than the lower grade D70/s and D50 which sync up to 1/500s.



This is an example of a completely blown out sun ball surrounded by a ring of cyan. Taken with a Nikon D90, which has a slower maximum sync speed (1/200 vs. 1/320) and shallower bit-depth (12-bit vs. 14-bit) than the D7000. This image illustrates the highlight rendering problems that digital sensors face. Nikon D90, Tokina 10-17mm lens @ 12mm, 2 x Ikelite DS160 strobes - 1/200th (max sync speed), f/25, ISO 100.

### ASIDE:

For those interested, here is a brief explanation of why this limitation exists:



The Nikon D7000's high sync speed (1/320th) helps suppress sun balls. Furthermore, its 14-bit RAW images provide 4 times more highlight tones than 12-bit images, so monotone cyan rings can more easily be avoided. Taken in 20 feet of water, at 9:30am on a cloudless day. Nikon D7000 in Aquatica AD7000 housing, Tokina 10-17mm lens @ 10mm behind Aquatica's 9.25" Megadome, 2 x Ikelite DS160 strobes - 1/320th, f/20, ISO 100.

Focal plane shutters in DSLRs consist of 2 "curtains" – front and rear. The front curtain blocks the sensor until the shutter release is triggered, and then moves fully out of the way. The sensor remains exposed for the selected duration (i.e. the shutter speed), then the rear curtain quickly springs- *Continued next page*

into place, ending the exposure. At a high enough shutter speed the second curtain cannot move quickly enough to provide the correct exposure. This mechanical limitation of independently moving curtains is overcome by having the curtains move together in the form of a slit that pans across the sensor. The shutter speed is now determined by the slit's fixed travel time and its width ---the narrower the slit, the faster the effective shutter speed. This mode of shutter operation presents a problem for flash photography. If a short strobe burst (typically 1/1000-1/50000s) occurs while the slit is passing over the sensor, only that part of the image under the slit will "see" the flash, and the rest of the frame will be dark. The flash must therefore be triggered while the shutter curtains are moving independently. The maximum shutter speed at which this occurs is the camera's sync speed. [Note: Some newer cameras extend the sync speed to higher values by rapid pulsing of the dedicated flash while the slit is travelling, but this significantly diminishes the flash power].

In addition to being essential for suppressing sun balls, high sync speeds are also a key element in creating jet-black backgrounds. When shooting against bright backgrounds, like sand, sea grass, or coral, it can be difficult to eliminate all of the ambient light, so the higher the camera's sync speed, the better.

### 2016 pixel RGB sensor for metering

After 14 years of using their 1005 segment RGB meter (first seen in the F5), Nikon released a newly developed 2016 segment metering system in the D7000. Since the new metering module has more than twice the number of RGB segments of its predecessor, and because it's combined with the new (presumably more powerful) EXPEED 2 processor, it certainly seems like Nikon's new metering system is a step forward. I never took the camera out of manual (M) mode, and used manually controlled Ikelite DS160 strobes (no TTL), so I didn't actually test this system underwater.

### 100-6400 ISO range (expandable to 25600 equivalents)

The first thing I did when I turned on the D7000 was shoot at high ISOs to compare with my D300. To say that I was shocked is an understatement – flabbergasted is more like it. Even though the D7000's sensor has 25% more pixels than the D300 over the same area, it exhibits significantly less noise at high ISOs. Equally surprising is how well this sensor compares to the D700's FX sensor. I don't have a D700 to test against, but if merit is given to the DXO Mark tests, then the noise levels of the D7000 are only one stop behind it... with a sensor having 50% less area AND 25% more pixels!

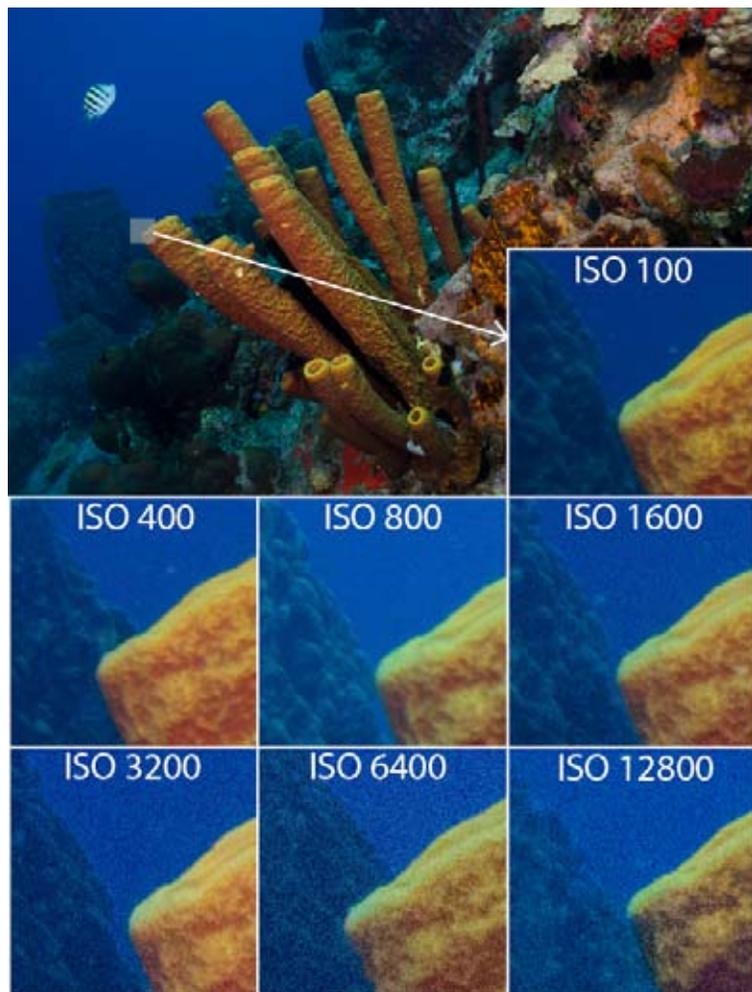


Eliminating ambient light from a scene is made much easier with cameras having a high sync speed. Once eliminated, artificial light can be applied (in this case using a snoot) to illuminate only what you want. Nikon D7000 in Aquatica AD7000 housing, Nikon 105VR behind Aquatica's manual focus flat port, 1 hardwired Ikelite DS160 strobe, and 1 Ikelite DS160 mounted on a Gorilla pod with an Ikelite remote trigger and a ReefNet Fiber Optic Micro Snoot - 1/320th, f/16, ISO 100.

This is an incredible step forward in sensor technology. It's certainly going to be interesting to see the noise levels that the next generation FX sensors produce using this same technology – I'm sure we'll see soon enough!

I arrived in Dominica on schedule, but my bags didn't make it with me. All of my strobes were in those bags, but I did have the D7000 housing, Aquatica's 9.25" Megadome, and my trusty Magic Filters, so I was stuck shooting with ambient light day after day until my bags arrived. This gave me a chance to play with the camera's low light capabilities, and I was very pleasantly surprised time and time again. Finally, a Nikon DX camera with a usable ISO range!

Taken in 40 feet of water on an overcast day. The D7000's impressive high ISO performance opens doors that were previously been locked to DX shooters. 100% crop displayed in the corner. Nikon D7000 in Aquatica AD7000 housing, Tokina 10-17mm lens @ 17mm with Magic Filter behind Aquatica's 9.25" Megadome, no strobes - 1/30th, f/8, ISO 1600.



: Noise increases gradually with ISO, but only gets out of hand past the ISO 6400 mark (in my opinion). Keep in mind that this is meant strictly as a noise comparison – pay no attention to the differences in exposure, sharpness, or color, since many variables were not kept constant (aperture, shutter speed, focus point, ambient light, the camera’s position, etc.). Nikon D7000 in Aquatica AD7000 housing, Tokina 10-17mm lens @ 17mm behind Aquatica’s 9.25” Megadome, 2 x Ikelite DS160 strobes at various powers – ISO 100: 1/80th, f/10; ISO 400: 1/160th, f/10; ISO 800: 1/320th, f/10; ISO 1600: 1/320th, f/14; ISO 3200: 1/320th, f/18; ISO 6400: 1/320th, f/22; ISO 12800: 1/320th, f/22. Yes, I accidentally skipped ISO 200.

As you can see from the above comparison, noise increases incrementally with ISO. The level of noise that one considers “too much” is a highly subjective matter, depending mainly on personal preference and an image’s intended use.

I enter a lot of photo contests, and print 12” x 18” images for friends and family regularly, and I’d feel comfortable doing both with images shot at up to ISO 3200-6400. If you’re only publishing images online, then the entire range is very usable... when viewed at screen resolution, the full ISO 100 shot above is only marginally cleaner than the ISO 12800 shot!



When viewed at lower resolution, images taken at ISO 12800 are surprisingly comparable to those taken at ISO 100. 50% crops of both images shown. Nikon D7000 in Aquatica AD7000 housing, Tokina 10-17mm lens @ 17mm behind Aquatica’s 9.25” Megadome, 2 x Ikelite DS160 strobes at various powers – ISO 100: 1/80th, f/10; ISO 12800: 1/320th, f/22.

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### Multi-cam 4800DX autofocus sensor

Another new feature being debuted in the D7000 is Nikon's Multi-CAM 4800DX autofocus module. It has 39 focus points (9 of which are the more accurate cross-type sensors), and is capable of more accurate 3D tracking than previous models, when combined with the 2016-segment RGB metering module and EX-PEED 2 processor. I've done a number of very unscientific focus tests between the D300 and D7000, and it seems to me that the D7000 wins every time in terms of speed and low contrast performance. The edge that the D300's Multi-CAM 3500DX autofocus system has is 12 more focus points (6 more cross-type) spread over a larger portion of the frame.

An autofocus mode on the D300 that I hadn't given a chance until now was its AF-C 3D-tracking system. This mode is also present on the D7000, but is now backed by a more powerful RGB metering system, so is presumably more accurate. The system recognizes the color of the subject of focus, and will track it through the focus area. This simplifies the composing of images, since it eliminates the need to manually position the focus point – it just follows your subject, provided that it's distinct enough relative to its background.

I usually only use the AF-S servo with a single focus point placed where I want it, but I now found myself using a combination of the AF-C servo with this 3D-tracking mode for shooting mid-range zoom, and macro/super macro shots. When I wanted to fix the plane of focus, I simply held down the AF-L button and then rocked the camera back and forth for fine-tuning.

Less notable is the camera's AF-A (Auto-autofocus) mode, which decides, based on the subject's movement (or lack of it), whether AF-S or AF-C is to be used, and sticks with that servo mode until the shutter is fully-depressed or released. This seems good - in theory - but after using it for less than 5 minutes, I got frustrated and switched out of it and never re-visited that mode. Equally useless to me is the "Auto Area AF" focus mode, which lets the camera decide which focus point should be used. This gives you no control whatsoever over what is in focus

### 14-bit RAW images

Like the D300s, D700, D3 and other high-end bodies, the D7000 can record RAW files in either 12- or 14-bit format – file sizes of the latter being 20% larger than the former. Here's a little background info that will help you understand what these formats really mean.

A sensor's photosites actually record grayscale data, rather than RGB as you might expect. Each photosite has a color filter that allows either red, blue, or green light to pass through, and the intensity of this light is converted from an analog signal to a simple numerical value. Once data from the entire sensor is collected, the camera's image processor uses data from adjacent photosites to interpolate a full color RGB image – a process known as "demosaicing".



The 3D tracking system was able to keep the eye of this trumpet fish in focus as I re-framed the image. These shots were taken in a 2 second time span. Nikon D7000 in Aquatica AD7000 housing, Nikon 60mm behind Aquatica's manual focus flat port, 2 x Ikelite DS160 strobes - 1/80th, f/11, ISO 200. AF-C servo mode with 3D-tracking activated.



14-bit RAW images can produce more pleasing tonal gradients than their 12-bit predecessors, since they're capable of identifying 4 times the number of light intensity levels. Nikon D7000 in Aquatica AD7000 housing, Tokina 10-17mm lens @ 17mm behind Aquatica's 9.25" Megadome, no strobes - 1/320th, f/22, ISO 100.

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The “bit-depth” of a sensor indicates the range of possible values for the recorded intensity at every photosite. 12-bit sensors have a range of 4096 values (that’s 2 to the 12th power), and 14-bit sensors have a range of 16384 values (2 to the 14th power) – that’s 4 times the range of values. This means that tonal gradients can be recorded more smoothly, fine details can be recorded more accurately, and highlight/shadow areas will contain more information for potent restoration. However, contrary to what some believe, dynamic range is not affected by bit depth, since it is related to the light sensitivity of the sensor, rather than how many levels each pixel is divided into.

### **Full HD Video capability**

This camera can record full HD 1080p videos at 24 fps or 720p videos at 24 or 30 fps. It compresses them using H.264/MPEG-4 coding – which is the most commonly used format for dealing with HD videos. Video clips max out at 20 minutes, and in camera trimming and frame-grabbing can be performed by pausing a video clip, pressing the WB button, and then selecting the action you’d like to take (Choose start point/Choose end point/Save selected frame).

ISO and shutter speed (minimum 1/30) can be manually adjusted while shooting, but, frustratingly, you have to leave live view to both adjust the aperture and to reset the custom white balance. There are two focus modes to choose from when in live view – single-servo (AF-S) and full-time-servo (AF-F). Each of these modes can be used with any one of the four focus areas (face priority, wide area, normal area, or subject-tracking).

In AF-S mode, autofocus is activated when the shutter is half depressed, and stays put when released. When in AF-F mode, the camera makes focus adjustments continuously to keep the subject sharp, until the shutter is half-depressed, which momentarily switches it into AF-S mode. On paper, this sounds like an ideal setting for shooting video, but in reality, it’s a little disappointing. The contrast-based autofocus system used in live view mode is not nearly as quick or accurate as the Multi-CAM 4800DX sensor, and left the camera hunting for focus, and getting confused when switching between a close foreground and a distant subject. Sometimes the system seemed to give up altogether, requiring a quick tap of the shutter to jolt it back to life.

I always used either the normal focus area, or the subject tracking function when shooting videos, since the wide focus area covers too much of the frame, and the face priority function is useless underwater. The subject tracking function is an interesting feature, which is similar to the 3D tracking mode in the camera’s primary autofocus system – simply place the focus box over the subject, press OK, and watch the little focus square follow the subject around. However, again, this is much better in concept than in practice. During my stay in Dominica, I tried to use this feature to track a number of different subjects, but could only get it to work reliably on stationary subjects that stood out from their surroundings.

While the autofocus system was rather disappointing, the quality of the videos was impressive. I didn’t have any video lights, so chose to shoot with ambient light and a magic filter whenever possible. Not only are colors rendered vibrantly, the sensor produced usable videos in even the dimmest conditions, because of its low noise levels at high ISOs.

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### **AESTHETICS**

Prior to the release of its Nikon D90 model, Aquatica manufactured its housings primarily by using an aluminum casting process, followed by 3-axis CNC machining. This imposed a number of design restrictions, giving the housings a hard-edged and relatively “boxy” look.

Now, however, they use an in-house state-of-the-art 5-axis CNC machine that can produce very smoothly-contoured surfaces, overhanging internal features, and can eliminate more excess material than ever before, creating lighter housings without compromising strength. There are hardly any straight lines on the D7000 housing, making it look far more sleek and stylish than my father’s D300 housing.

The CNC machined aluminum bodies are anodized black, and then all of the critically-dimensioned areas are masked before baking on a hard powder-coating for increased durability, scratch-resistance, and corrosion prevention.

All of this is great for those interested in aesthetics, but what is (or should be) more important is the housing’s functionality – in particular its ergonomics. In the following, I discuss all of the D7000 housing controls, pointing out their strengths and weaknesses.

### **BASICS**

The redesigned camera saddle (first seen in the AN-5 for the Sony NEX 5) slides smoothly along two guide-rods into the housing, and locks firmly in place, providing a consistent camera position every time it is installed. It screws into the base of the camera, and can be tightened with most coins. To remove the camera/saddle assembly from the housing, you need to press down on a flat lip extending out from under the camera, then pull on the body, making sure that it is free of obstructions.

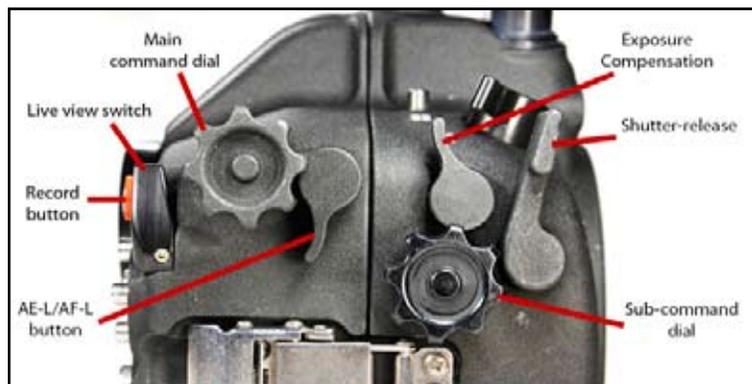
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The memory cards are easily accessible with the back plate of the housing removed, but the battery compartment is blocked by the bottom of the housing, so the camera needs to be slid out a few inches (not all the way) to access it.

I never took the tightly-fitting back plate o-ring from its groove – I just wiped it and its mating surface with a t-shirt, and sealed it back up every day. However, I was a bit more careful with the port o-rings. Whenever I changed ports, I'd clean the o-ring, groove, and mating surface before attaching it to the housing using their standard bayonet mounting system.

## CONTROLS

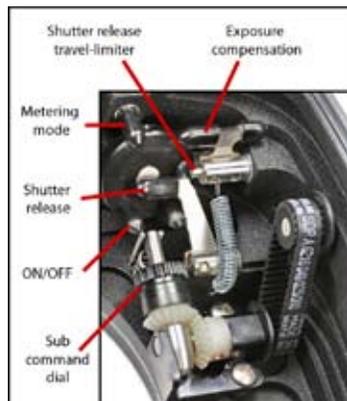
### RIGHT HAND SIDE



*Right side view of the AD7000, with all major control positions indicated*

### Shutter release lever

The correct amount of pressure needed to trigger the shutter is subjective. Some prefer a spongy feel, requiring significant travel to operate, thus making it easy to differentiate between half- and fully-depressed states. Others prefer a hair-trigger, to minimize the time it takes to click off a shot. The AD7000 shutter-release lever is somewhere close to the hair-trigger end of the spectrum. When in “Ch” mode (continuous high-speed shooting, 6 FPS), I would occasionally squeeze out an extra couple of exposures accidentally, so I opted to use the “Cl” mode (continuous low-speed shooting) set to 3FPS instead, and my problem was eliminated.



*A shutter release travel-limiter prevents the mechanism from damaging the camera or return spring*

### Main command and sub-command dial knobs

The shutter speed and aperture controls are two of the most frequently used camera functions, so the design and position of the housing's access knobs are very important.

Their deep ridges, knurled edges, and textured powder-coating



*Both my middle and index fingers could access this vital lever while solidly gripping the right handle.*

more than happy to make, since one-finger control is far more important to me.

A toothed pulley connects the housing's sub-command dial knob to a spring-loaded gear assembly which presses firmly against the camera. It gripped the dial very well, and never missed a beat. This design does its job very well, but on one occasion the pulley shifted so that it was partially hanging off one of the gears. This was more of a head-scratcher than a “problem”, since I couldn't recreate it, it didn't affect the knob's function, and it corrected itself after I rotated the knob a few times. I pointed this out to Aquatica, and they immediately solved the problem by adding a stopper on the problematic gear, preventing slippage from occurring.



*The spring-loaded sub and main command dial gear assembly*

The main command dial gear assembly is also spring-loaded along a track, ensuring that the dial is properly engaged every time the camera is installed. It uses a more traditional gear/shaft transmission system to relocate the housing's knob closer to the user's thumb, and to make space for the D-PAD, REC, and Live View buttons.

With my index finger on the shutter release, my thumb and middle finger had no difficulty reaching and rotating these knobs, allowing me to quickly adjust exposure settings when shooting moving subjects.



*The AD7000's large knurled knobs allowed me to very quickly increase the shutter speed as this turtle swam overhead. Nikon D7000 in Aquatica AD7000 housing, Tokina 10-17mm lens @ 17mm with behind Aquatica's 9.25" Megadome, no strobes – LEFT: 1/60th, f/20, ISO 100; RIGHT: 1/320th, f/20, ISO 100.*

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### +/- EV control lever

This spring-loaded lever is positioned just behind the shutter-release, and can be held down with either the middle or index finger. While it's depressed, your thumb can easily rotate the main command dial knob to set the EV compensation. This information is displayed in the viewfinder, so immediately after reviewing an image's exposure, you can return to framing the subject and make the necessary EV adjustments. I seldom use this camera function underwater, but it's good to have it available nonetheless.

### AE-L/AF-L button lever

Located just in front of the main command dial knob, it can be triggered with your right thumb to lock focus and exposure settings. The function of this button can be re-assigned through the menu (CUSTOM SETTINGS MENU>Controls>Assign AE-L/AF-L button). I usually kept it assigned as an AF-ON button (which simultaneously de-activates the shutter-release's AF function) for shooting super macro. It can also be assigned as an AF-L button only (without locking exposure), or to lock flash exposure when using optically triggered strobes.



Holding the AE-L/AF-L lever depressed while keeping a finger firmly on the shutter release lever was easy.

On the prototype that I used, there was nothing to prevent this lever from being rotated indefinitely, so there was no indication of when my thumb had pressed it far enough. Within a few days of hearing this, Aquatica sent me 3D renders of a modified internal component, which restricts rotation to a 30 degree arc (approximately). This revised design will be incorporated in production models.



### On/Off lever

This lever is on the top right surface of the housing. Its two-pronged internal mechanism must be properly oriented before installing the camera. Otherwise, the ON/OFF switch might not be engaged enough to function.

### Record button and Live View lever

Above the 5-button D-pad and behind the main command dial, this button/lever combo is located on one of the corners of the housing.

These housing controls have been moved a significant distance from their location on the camera body, making them much more easily accessible than if they were directly transposed from the body to the housing. The Live View lever on this prototype was missing its return-spring, so I had to manually swing it back and forth to switch between modes - production models will not have this issue. Switching in and out of live view was easy to do with my thumb on the lever, without releasing my grip on the handle.



The record button was a little further away than I would've preferred. To reach it, I had to slightly uncurl my grip, which always added a bit of wobble to the end of video. Pressing this button to stop recording also added a little shake, since it's relatively stiff. I would've preferred that this button be controlled by a lever instead, since they require less force to operate. However, the inner workings of this corner of the housing are so complicated and tightly packed already, that implementing a lever would probably have been impossible without re-designing all of the other buttons as well.

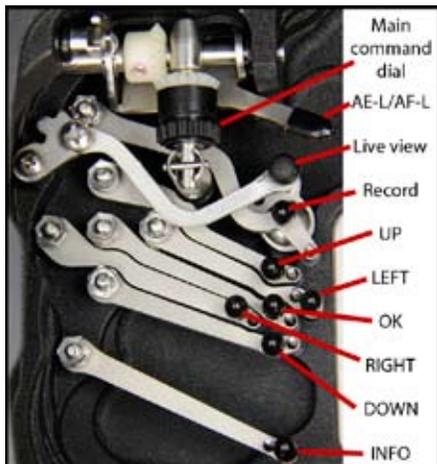
Occasionally, at moderate depths (50-90ft), the record button wouldn't spring back up after being depressed. I pointed out this flaw to Aquatica, and once I returned the housing, they were able to pinpoint the problem to the walls of the button-hole not being masked properly before powder-coating. This caused the walls to be slightly thicker and textured (rather than being smooth), resulting in the button being held down from the extra frictional force. They've designed new masking plugs for these button holes to prevent this from occurring in production models.

### D-Pad/OK buttons

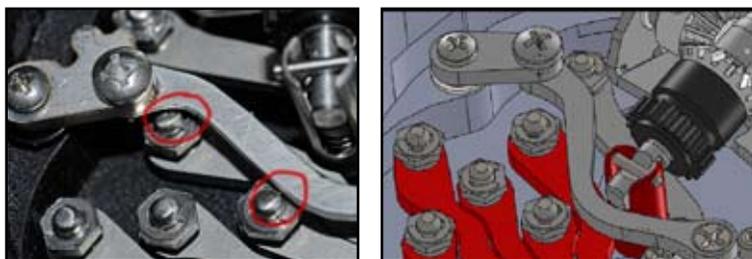
Just below the record button on the back plate are 5 buttons organized in a circle, corresponding to the UP, DOWN, LEFT, and RIGHT arrows, and a central OK button on the camera body. These buttons have been moved as far to the right of the housing as possible using a combination of laser-cut metal linkages and guide-pins. *Continued next page-*



That said, it was a bit of a stretch for me to reach the leftmost button without uncurling my fingers from the handle. I noticed this only when I needed to move the focus point around in the viewfinder, but once I started using the 3D tracking mode, I rarely had to use these buttons with my eye to the camera anymore. The other two uses of these buttons (reviewing images and accessing menu items) are exclusively performed before or after shooting, so having to take your hand away from the shutter release and command dials is not an issue.



and accessing menu items) are exclusively performed before or after shooting, so having to take your hand away from the shutter release and command dials is not an issue.



This prototype had a slight clearance issue with the live view lever. When at rest, it prevented the UP button from being depressed, and partially restricted the LEFT button. Aquatica already had this problem solved, as seen in the computer rendering above even before this prototype hit the water.

### INFO button

Just under the D-pad is the INFO button. Pressing it once brings up all relevant shooting information on the LCD screen, allowing adjustments to be made without looking at the top LCD panel (which there is no window for) or through the viewfinder. Pressing it a second time brings up a second shooting menu, where movie quality, noise reduction, color space, picture control, and active D-lighting can be set. The 3 customizable camera buttons (AE-L/AF-L, Fn, and Preview) can be quickly assigned through this screen as well. I used this button very frequently. With your hand on the grip, it also requires a bit of a stretch to get to, but this wasn't an issue since you'd never need to press it while shooting. The same masking problem caused this button to stick down occasionally, and Aquatica has implemented the same solution as for the record button.



A pet peeve of mine with the camera, is that this very useful INFO screen disappears when you touch the shutter release. So, every time you adjust exposure, and take another shot, you need to press the INFO button again to re-display the informa-



Diver with yellow tube sponges. Nikon D7000 in Aquatica AD7000 housing, Tokina 10-17mm @ 10mm behind Aquatica's 9.25" Megadome, 2 x Ikelite DS160 strobes – 1/200th, f/22, ISO 100.

tion. Alternatively, the ON/OFF switch can be configured to activate the INFO screen as well, and is more accessible than the INFO button. However, while it may be easier to use the ON/OFF lever than the INFO button, the INFO screen still annoyingly disappears when the shutter release is touched.

### Metering method button

This is on top of the housing, just behind the ON/OFF button. I left the camera in matrix metering mode for the whole trip, so I never had to use this button. A little dexterity is needed for this one, since the main command dial has to be rotated while the button is held down. You can either remove your right hand from the grip to perform both tasks at once, or you can reach over to press the button with your left hand, while rotating the command dial with your right. A little awkward, but I wouldn't have complained if this button wasn't even included in the housing.

**UPDATE:** This useful piece of information was brought to my attention by Jean Bruneau (Aquatica’s technical advisor) when I sent him my list of issues with the housing. Normally, the WB, ISO, +/- EV, QUAL, AF servo, and metering method buttons must be held down while adjustments are made with the main or sub-command dials. However, “hidden” in the custom settings menu is a function that changes how these buttons operate (Custom Settings Menu>Controls>Release button to use dial). When this menu item is in its ON state, these buttons no longer need to be held down to be adjusted. Instead, you can remove your finger from them once they’ve been pressed, then the command dials can be used separately. This way, all of these buttons can essentially be operated with one hand (at a time).

### LEFT HAND SIDE

#### Zoom/focus knob



The zoom/focus knob in its normal (left) and retracted (right) positions.

I could easily reach and rotate the zoom/focus knob with my index finger alone, but I preferred a two-finger approach, using my thumb to pinch it. It rotates very smoothly, and is large and textured enough to grip it very well when, for example, taking slow shutter speed zoom shots.

The knob is made of two parts – a knurled section that is connected to the internal gear assembly, and a smooth section that, when rotated, disengages the internal gearing assembly from the lens’ zoom/focus gear. This is a helpful feature for safely installing geared lenses, since it eliminates the possibility of gear interference.

#### Mode dial knob and release mode dial knob

The mode dial knob is the same as the main and sub-command dial knobs – deep-ridged with a knurled perimeter. There isn’t a viewing window on the housing to see which mode you’re in, but pressing the INFO button will display this information in the top-left corner of the rear LCD. I could reach and rotate it with my left thumb with my hand still on the handle.



The U1 and U2 modes can store and instantly recall user-saved camera settings. I set U1 as a starting point for macro photography (ISO 100, 1/320, f/11, WB @ 4760K, AF-S, single-point focus), and set U2 as a starting point for shooting video (ISO 400, 1/30, f/8, WB @ PRE, AF-S, subject tracking mode).

The release mode dial knob is slightly smaller than the mode dial knob, and requires two hands to operate – one is needed to hold down the lock release, while another is needed to rotate the knob. There’s no easy way of doing this accurately with one hand but, fortunately, this is a dial that is rarely used (at least for me). I primarily shoot in low-speed continuous mode (set at 3 or 4 FPS), which can easily take single exposures as well as relatively quick sequences. For split shots, I switch over to the high-speed continuous mode (6 FPS) in order to maximize my chances of capturing a pleasing waterline

#### Pop-up flash opener/closer

This is a two-way lever. Pressing it down or up will open or close the camera’s pop-up flash, respectively. It is located on the top-left corner of the housing, well within reach of your left thumb. Shooting with electronic sync cords renders this lever useless, but when using fiber optics to trigger strobes, this can be very useful. Instead of manually turning off your strobes to shoot solely with ambient light, the pop-up flash can be closed instead.



The two-way lever which controls the pop-up flash.



The inner-workings of the two-way flash lever



#### M/AF switch lever and AF-servo/focus area button

The M/AF switch lever and concentric AF-servo/focus-area button are cleverly combined into a single unit, just below the zoom knob. Rotating the M/AF lever is smooth and easy, but it always took me a few moments to blindly locate the camera’s switch with this 2-prong mechanism. Once it was in place, I had no problems, and could switch back and forth freely (which I rarely did). This assembly should be retracted (pulled away from the camera) before removing the camera from the housing, since it can snag pretty easily on the lens or lens gear on the way out.



Pressing the AF-servo/focus area button was a little awkward. With my hand on the grip, it is directly in line with my ring finger, but was too stiff for me to press down comfortably with it. If I wanted to use my (stronger) middle finger, it required me to bend it somewhat unnaturally, and was still uncomfortable to use. Instead, I found that removing my hand from the handle, and depressing it with my thumb was the best option. The focus area (single, 9-point, 21-point, 39-point, AUTO, or 3D) could then be adjusted with the sub-command dial knob, and the AF-servo mode (AF-A, AF-S, or AF-C) could be adjusted with the main command dial knob.

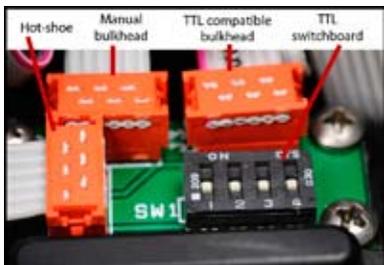
### Menu, WB, ISO/ZOOM IN, QUAL/ZOOM OUT, Playback, Delete

These buttons are located just left of the LCD screen in a vertical line, and are all within reach of my thumb (the delete button took a little stretching though). I never had to fiddle around to adjust WB or ISO settings - I was able to easily locate and use them with my eye to the viewfinder.



### Bulkhead

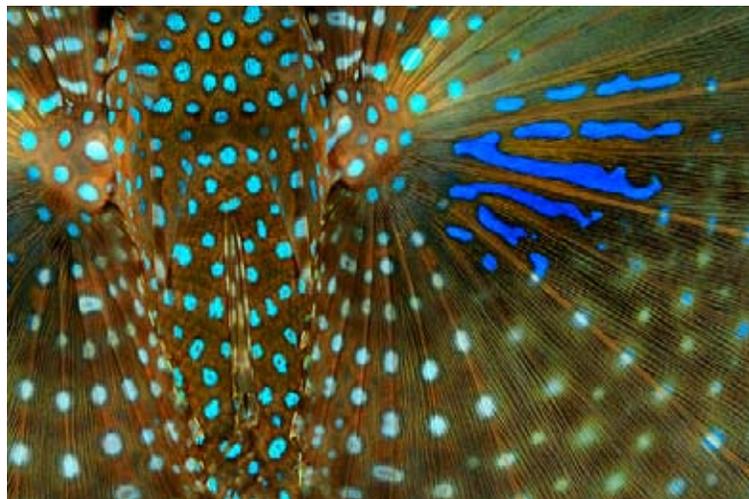
A pair of optical bulkheads comes standard on the AD7000, but, if you prefer, a pair of traditional electronic bulkheads can be installed instead (Ikelite, Nikonos, or a combination of the two). The benefits of optically synced strobes are hard to ignore – full TTL compatibility with S-TTL strobes, lightweight fiber optic cables as opposed to bulky electrical cords, modest price tags, and safe, idiot-proof housing connections.



I was using a pair of Ikelite DS160s, without a TTL converter, and without the optical converter that they showed off at DEMA, so was forced to use the strobes manually with electrical sync cords. Their new bulkhead system consists of a central circuit board with 3 female outlets – 2 for bulkheads, and 1 for the hot-shoe.

In one corner of the circuit board is a small switchboard which governs TTL functionality. When all of the switches are in the “ON” or “UP” position, the TTL contacts in the right bulkhead are activated, making automatic flash exposure possible when used with compatible strobes or TTL converters. The left bulkhead is strictly for manual strobes.

In the rush to get this test equipment assembled and shipped to me before leaving for Dominica (it arrived the day before I left!), some excess soldering flux was left behind on the hot-shoe, which made my strobes go bananas. Wiping the contacts clean and letting them dry overnight fixed the problem. Nonetheless, I told Aquatica about this issue, and they’ve assured me that instead of using solder to connect hot-shoe pins to the bulkhead wires, they’re using a crimping process, which mechanically combines them instead, eliminating the possibility of short circuits due to



Flying gurnard wing detail. Nikon D7000 in Aquatica AD7000 housing, Nikon 60mm behind Aquatica’s manual focus flat port, 2 x Ikelite DS160 strobes - 1/160th, f/13, ISO 200. AF-C servo mode with 3D-tracking activated.

flux. Just another great example of Aquatica’s commitment to improving their designs based on photographers’ experiences.

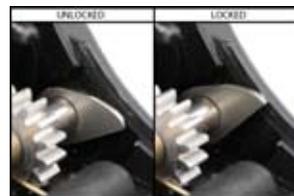
### Port lock and lens-release mechanism

If you’ve used a housing without a locking port for long enough, you’ve probably had it unknowingly rotate dangerously close to its “release” position at some point (especially with large dome ports). To prevent this from happening, housing manufacturers have come up with various designs to lock the port in place.



The port lock lever

Aquatica’s solution is elaborate and complicated on the inside, but all of the gears, springs, shafts, and cams are controlled by a single lever located to the left of the port. When the lever is rotated far enough, the locking cam mechanism moves out of the way, allowing a port to be installed. Then, to lock the port, you simply press the lever like you would a button, and it springs into place.



close-up shot of the port lock mechanism in the unlocked (left) and locked (right) positions.



port lock and lens-release internal mechanism.

The primary function of this assembly is to lock the port, but Aquatica has also incorporated a lens-release lever. When the mechanism is in its “locked” state, pressing the lever like a button depresses the camera’s lens-release button, eliminating the need to squeeze your fingers (or Allen keys) between the port opening and lens, as has been required in the past. This also means that the camera body doesn’t need to be removed from the housing to change lenses. When the mechanism is in its “unlocked” state, the camera can be removed from the housing with the lens still attached.

## Moisture alarm

Solid machined-aluminum housings are great because of their tight tolerances, strength, durability, and aesthetics, but blindly trusting your camera to be safely sealed inside their dark cavities can make the first few minutes of every dive a bit nerve-racking. However, much of this stress can be alleviated by installing a moisture alarm in the housing, which Aquatica is including as a standard feature.

Basically consisting of a battery, a bright LED, a speaker, and a few wires, moisture alarms are very simple and effective tools that, in my opinion, are essential to any underwater camera system.

## Hydrophone

First, a little background info:

All materials (air, water, wood, etc.) have an attribute known as “acoustic impedance”, which is proportional to that material’s density, and to the frequency of sound trying to travel through it. When sound is travelling between 2 materials, the more similar their impedances, the more easily sound is transmitted. Microphones present in DSLRs have acoustic impedance close to that of air, so they perform at their best when used in it (on land?). When that same microphone tries to record sound in an aluminum underwater housing, the results are usually inferior. Metal has much higher acoustic impedance (because it is much more dense) than air and water, so only a fraction of incoming sound pressure reaches the camera’s microphone after traveling through the walls of the housing. Hydrophones are specifically-designed microphones with acoustic impedances very close to that of water, so they’re (theoretically) able to record sound underwater much more accurately.

### Now, onto Aquatica’s hydrophone.

Aquatica is the only DSLR housing manufacturer to provide a hydrophone as a housing option – let alone as a standard feature. Located just above the zoom knob on the top-left side of the housing, it is installed through an extra hole, which can also accept their remote triggers (or potentially an HDMI bulkhead for using an external video monitor...). The cable



**When the hydrophone is connected to the camera, the back plate o-ring is obstructed, so extra care must be taken when sealing the housing.**

coming from the hydrophone has a stereo microphone jack (despite providing only mono audio recording) and connects to the camera through an access panel on its left side. Unfortunately, when the access panel is open, it interferes with the housing’s main o-ring, so extra care must be taken when closing the housing with the hydrophone connected.

Around Dominica, there are 2 main underwater acoustic attractions that I’m aware of – the communicating cetaceans that po-

pulate the waters, and a dive site called “Champagne”. The latter has dozens of streams of volcanic gas bubbles fizzing from the seafloor, sounding like an open can of carbonated pop.

Getting into the water with their resident sperm whales requires a costly permit from authorities, so that got moved from my to-do list to my bucket list. However, I was able to dive at Champagne a few times, so I did some hydrophone testing there.

Audio captured with and without the hydrophone is very different – but not in the way that I expected.

When the camera’s internal microphone is in a very quiet environment (i.e. an underwater housing), its sensitivity is, by default, automatically increased to bring out faint noises. Then, when the relative silence is interrupted by the crashing sounds of exhaled bubbles, the hiss from inhaling through a regulator, or the whirr of an autofocus motor, the camera cannot re-adjust the sensitivity rapidly enough to prevent a sharp spike in the volume. This creates very harsh sounds with a hard-edged feeling.

I didn’t realize until after the trip that the sensitivity of the microphone can be locked at one of three levels (low, medium, or high), but I suspect any one of them will not deal adequately with the range of underwater sounds typically encountered.

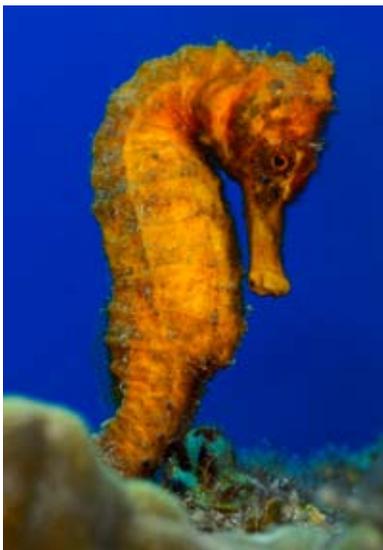
On the other hand, when the hydrophone is connected, the sensitivity level remains constant, and a broad range of underwater sounds is recorded without any abrupt spikes in volume. The sound of exhaled bubbles is reduced to a faint gurgle, inhalations become a whisper, and the autofocus motor becomes almost inaudible, but the crackling sounds of the reef can still be heard. It was even sensitive enough to pick up the hiss of my leaky first-stage. Although sound levels are much more balanced and smooth with the hydrophone, they are also slightly less intense.

The difference between the microphone and hydrophone is somewhat analogous to a pair of sensors having different dynamic ranges. At a given ISO (gain), one sensor might be able record brighter highlights (high frequency sounds) and darker shadows (low frequency sounds) in a single frame (unit of time) than the other sensor.

## Aqua View Finder

If you’ve never used an external viewfinder on your underwater camera housing, then you really don’t know what you’re missing. I used standard housing viewfinders for a dozen years before finally getting a taste of the good life in 2008 - and now I can’t (won’t) go back. Standard viewfinders don’t allow the entire frame to be seen at once, so it can be difficult getting precisely framed images. I often had to resort to what I call the “Ray Charles Technique” for framing with standard viewfinders – that is, moving my head side-to-side to piece together the full image in my mind. While external viewfinders are often viewed as a luxury item, they are regarded as a necessity by most serious underwater photographers. Who wants to spend thousands of dollars getting to a tropical (or sub-Antarctic) destination, only to waste time and miss opportunities underwater?

The 8-element, black anodized and powder-coated Aqua View Finder eliminates guesswork when framing an image, providing a bright, clear view of the entire frame, even with your mask slightly away from it. Just like the camera's eyepiece, you can fine-tune the dioptic strength of the Aqua View Finder using a special tool provided with the viewfinder kit. It doesn't obstruct the rear LCD at all, so you can review images and access menus without restriction.



### Standard mounting holes

Shooting videos with a rock-steady camera is vital to producing professional-looking material. So, Aquatica included 3 threaded (1/4"-20) holes in the base of the AD7000 to allow the attachment of any standard tripod (or TLC's new tripod, released at DEMA 2010). Tripods are useful for videos, but are also helpful for keeping the camera still enough to take long exposures underwater.

Precisely framing this seahorse would've been much more difficult without the Aqua View Finder. Nikon D7000 in Aquatica AD7000 housing, Nikon 105mm VR behind Aquatica's manual focus flat port, 2 x Ikelite DS160 strobes - 1/40th, f/11, ISO 100.



### Missing controls

There are 3 camera buttons that have been excluded from the AD7000.

First is the bracketing button, located just under the pop-up flash button. I can't remember the last time I used this function on land, let alone underwater, so not having access to it didn't bother me at all.

Second is the programmable function button ("Fn"). Its location on the camera (the nook between the camera grip and the lens mount) is likely what prevented this button from being incorporated in the housing design. There are already so many gears/levers/pulleys/springs/shafts in that corner of the housing, that I can't imagine how another would've been included. I rarely use any of the functions that it can be programmed to operate, so I didn't miss this one either.

A barrel sponge and moonball, shot during a night dive at 11pm. Nikon D7000 in Aquatica AD7000 housing mounted on a tripod, Tokina 10-17mm lens @ 10mm behind Aquatica's 9.25" Megadome, 1 x DS160 strobe - 4 seconds, f/7.1, ISO 800.

Last is the preview button ("Pv"), which, by default, is used to check the depth of field of an image before taking a shot. Tucked underneath the lens, this button is in an equally awkward location, making a housing control difficult to incorporate. It can be programmed to operate all of the same function as the Fn button, so also belongs to the "unmissed" category.

## CONCLUSION



Boasting a new autofocus module, new metering system, new image processor, and new sensor (amongst other things), this consumer-level camera probably would have been regarded as a pro-level camera if it had a full frame sensor and a pro-style body.

The recording of HD videos isn't my cup of tea, but it seems like this capability could be a very productive when placed in skilled hands. The Nikon D7000 is easily the best DX format camera that I have ever used (but don't tell my D300 I said that...).

With regard to the AD7000, there is only so much that 3D modeling programs can simulate and predict, so prototypes are never perfect. That's why it is so important to thoroughly test a prototype before production begins, especially for an expensive piece of equipment like underwater camera housing.

The design problems that I encountered with the prototype AD7000 were immediately addressed and rectified by Aquatica's design team, which demonstrated the kind of dedication to quality that is essential for a company's survival in this highly competitive industry. Of the few minor inconveniences that I mentioned, related to button placement, stiffness, and type, they were all based on my personal preferences, and were rather insignificant. Overall, I was very happy with the AD7000's performance.



Including a moisture alarm and a hydrophone as standard housing features was a very generous gesture, which I'm sure users will appreciate. And if the multifunctional port-lock/lens-release is any indication of the capability of Aquatica's engineering team, they have a bright and innovative future ahead of them.

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## ACKNOWLEDGEMENTS

### EQUIPMENT:

This review would not have been possible without Aquatica loaning me their AD7000 prototype. But they didn't just box it up and ship it over to me... Aquatica's president, Norma Alonzo, hand-delivered the package, and made sure that I had everything I needed. I communicated by phone and email with several other members of Aquatica's staff, who were very helpful when troubleshooting in the field. These members include Blake Stoughton (co-owner), Joe Bendahan (marketing director), Luc Beauregard (engineer) and Jean Bruneau (technical advisor, who also loaned me some of his personal camera gear).



One of Dominica's many beautiful waterfalls – Emerald pool. Nikon D7000, Tokina 10-17mm @13mm, tripod – 4 seconds, f/25, ISO 200.

For more information about Aquatica gear, visit: <http://aquatica.ca>

### ACCOMMODATIONS:

Located in a quiet area just south of Dominica's capital, Roseau, and minutes away from the popular Soufriere Scott's Head Marine Reserve, Castle Comfort Lodge is a very homey oceanfront facility with only 14 rooms that, once again, made my stay with them a great pleasure (this was my 5th stay). Their comfortable air-conditioned rooms, dipping pool, seaside bar, and spectacular sunsets made off-gassing relaxing and enjoyable. Dining at their on-site restaurant was delightful, with delicious nightly specials served by friendly staff. I am grateful for their assistance with my lost luggage – they tracked and delivered them to me all the way from St. Lucia – as well as for finding and supplying me with tools that I required. My thanks go to all staff, especially Arienne Perryman (manager).



The sunset view from one of the rooms at Castle Comfort

### DIVING:

Operated from Castle Comfort Lodge's dock, Dive Dominica is a very professional dive facility capable of efficiently servicing both small and large groups of divers. They have 3 dedicated dive boats ranging in maximum capacity from 10-24 divers, as well as 2 boats for whale watching and/or snorkeling trips.



One of Dive Dominica's 3 dive boats

Dive briefings were consistent and thorough, and either 1 or 2 dive masters would accompany the divers, depending on the size of the group. Whenever possible (almost every day), dive staff went out of their way to accommodate my shooting needs – modeling for me, carrying my second camera rig, and letting me go as slowly as I needed. Doing 2 boat dives a day was enough to almost fill my memory cards, but if I still had space, or energy, I took full advantage of Castle Comfort's great house reef. Tanks for these shore dives are complimentary.

Dominica's reefs are some of the healthiest I've seen in the Caribbean – table-sized barrel sponges, colonies of long yellow tube sponges, and countless varieties of soft and hard corals blanket the walls, pinnacles, and slopes of the marine reserve. Fish life was abundant, currents were uncommon, visibility was great, and every dive left me wanting more.

Special thanks to Gus, Stinger, Reggie, Thomas, Brad, Odelle, Kevin, Imran, and especially Daniel Perryman (manager) for helping me with extra effort and patience.

For more information about Castle Comfort and Dive Dominica, visit: For more information, visit: <http://www.castlecomfortdivelodge.com>

### GENERAL

Another big thanks goes out to two of Dominica's most well-known photographers - Simon Walsh and Arun «Izzy» Madisetti. They generously drove me around the island to photograph some of Dominica's waterfalls when I wasn't able to dive. Check out their site: [www.imagesdominica.com](http://www.imagesdominica.com)

### ABOUT THE AUTHOR:

Although only 26 years old, Keri has already accumulated close to 16 years of underwater photography experience. Educated as a mechanical engineer, he currently designs and develops products for ReefNet and is part of DivePhotoGuide.com's editorial team. Over the years, his work has appeared in countless magazines, scientific journals, field guides, books, and museums, and he's won over 70 awards in major international underwater photography competitions. For more of Keri's work, visit [www.reefnet.ca](http://www.reefnet.ca), or [www.divephotoguide.com](http://www.divephotoguide.com).



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