

DOMES

by Pete Atkinson

The advent of digital has raised the spectre of fuzzy corners again, after being largely banished with film. I spent years trying to get the best results with my home-made housings until I finally thought I knew what I was doing. And then I bought a commercial housing...

It seems a lot of people are having trouble correcting the Nikon 12-24mm zoom, partly because the manufacturers recommendations are wrong.

Seacam recommended a 35mm port extension with the Superdome so this is what I bought. The corners were the worst I had ever seen, on anything, anywhere.

In general you want the centre of curvature of the dome in the same place as the apparent front entrance pupil of the lens. And then maybe a + diopetre.

DOME CENTRE OF CURVATURE

If the housing manufacturer doesn't provide this data, you can measure it. I draw part of a half-circle on light card about the right internal radius of the dome. I cut it out with scissors and see if it fits perfectly, flush with the interior of the dome. It's easy to see if it's too big or too small, so just keep adjusting the radius until you get a perfect fit. When you do, the centre of curvature is this radius distance from the inside of the front of the dome.

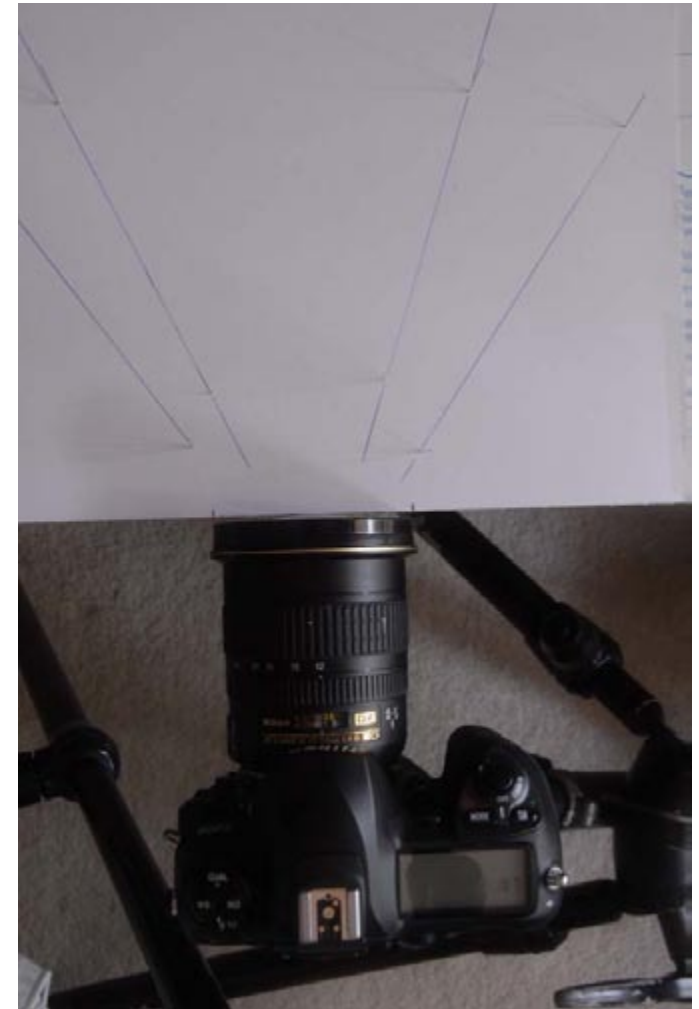


Darryl Torckler and Pete Atkinson calculate what dome extension Darryl needs for his Aquatica dome.

APPARENT FRONT ENTRANCE PUPIL

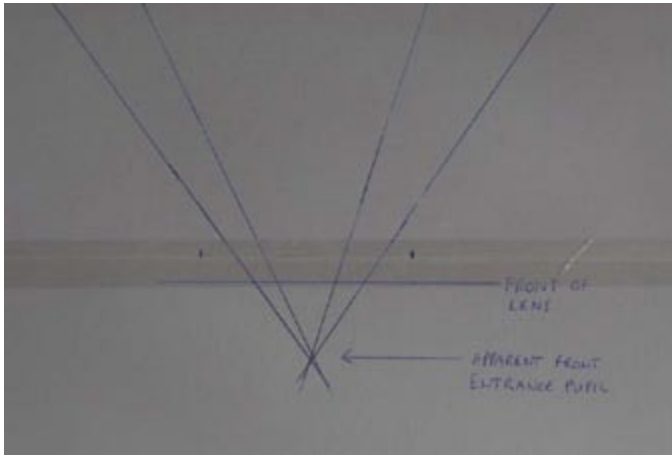
I used to call this the front node, but the above term is more accurate. In effect, it's the apparent position of the aperture diaphragm when you look through the front of the lens. Hold the camera backwards towards a window. Look into the lens. The position of the white dot is the apparent front entrance pupil. It's not the actual position of the diaphragm. There are several ways to measure this. The best is to Google it. (See the link later.) The panoramic photography people need to know this so they can rotate their camera around the apparent front entrance pupil when they shoot frames they want to stitch together. And they have done the calculations for the lenses we use.

If you want to check this the hard way, set the camera and lens up on a tripod with the lens almost touching and bisected by the edge of a table. Put



Line up pins looking through the viewfinder and draw lines along the aligned pins.

a sheet of A4 paper in front of the lens, touching the filter thread. Stick a pin vertically in the paper about 20cm away from the lens, about 45 degrees from the lens axis. Look through the viewfinder and stick another pin in about 10cm away so it appears to be lined up with the other. Draw a line



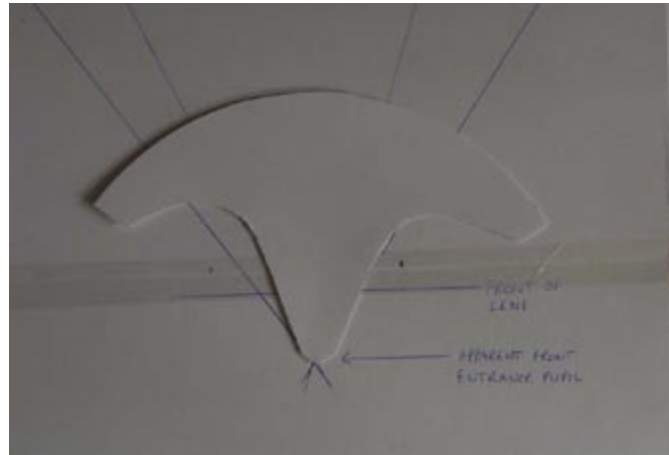
Project the lines on another piece of paper till they cross at the apparent front entrance pupil. This is where the centre of curvature of the dome should be.

through these two points. Do this about 45 degrees the other side and for good measure, at a few other angles, right to the edge of the field of view. Move the camera somewhere else and project these lines so they meet, on another piece of paper taped to the first. This is the position of the apparent front node. Apparently.

Now you have the information you need to calculate what dome extension is required to make the apparent entrance pupil and the centre of curvature coincide.

DIOPTRIS

The dome in water acts as a negative lens, creating a virtual image about four times the radius of the dome in front of the camera on which the lens must focus. Some lenses can do this without a dioptr, but in my opinion all wide lenses except fisheyes should be used with a dioptr.



The centre of curvature of the dome and the apparent front entrance pupil should be in the same place.

When I built my own housings, I would have plano-convex dioptr (flat on the back) made in obscure powers, like +3.3 for a 6" dome and +2.4 for an 8" dome.

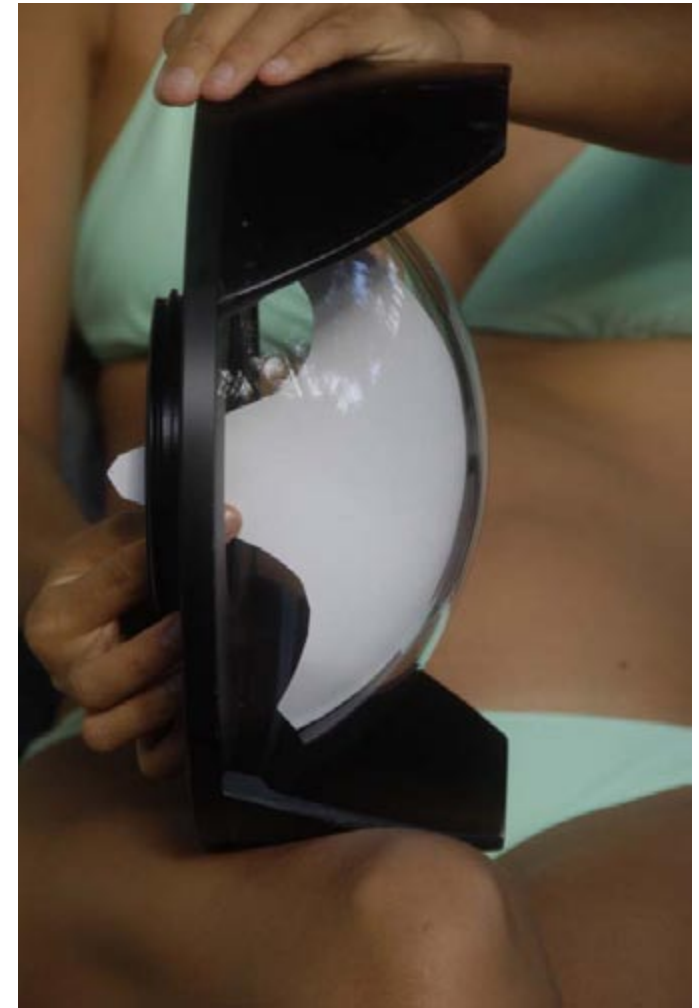
For the 12-24 I had a plano-convex dioptr made here in Cairns, but although in theory it has some benefits for lens correction, it didn't give as good results as a B&W dioptr. (Which is not made anywhere near Cairns...).

By matching the dioptr to the dome, the lens will then focus where it says it's focusing, so at 2m when something is 2m away. This maximises the focusing range of the lens.

In theory, I thought a +2 would be a closer match to the Seacam Superdome (about 111.5mm radius) but in fact the +3 gives me better corners.

CURVATURE OF FIELD

One reason corners are blurred is that they are



Measuring the internal radius of a dome by trial and error with paper cut-outs.

not in focus. The plane of focus in a dome system is curved, so when you focus on the middle of the picture, unless the depth of focus encompasses the distance to the corners of the curved field of view, they will be blurred. The smaller the dome, the more tightly curved the curvature of field and the more difficult it is to include them in the depth

of focus. So big domes and small apertures are the best ingredients to reduce this problem.

HOW DIOPTRES AND DOME POSITION AFFECT ANGLE OF VIEW.

If the dome extension is too short, you will lose angle of view. Also, when you add a dioptre, you lose some angle of view too. Don't ask me why.

FISHEYES

The Nikon 10.5 fisheye seems very forgiving. In theory, it should be behind a hemispherical dome. However it gives acceptable results behind some section domes and no one seems to have trouble getting good results with this. Equally, fisheye lenses designed for film cameras seem to work well on digital cameras (Nikon ones, at least) behind section domes. The apparent front pupil of the 10.5 fisheye is said to be 39.5mm in front of the lens mount. If you can, mount a hemispherical dome with its centre of curvature 39.5mm in front of the lens mount for this lens.

NIKON 12-24mm ZOOM

If you correct this lens at the 12mm end, the 24mm end will work

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fine. A great resource for getting front entrance pupil data is Joseph Wisniewski's site, http://www.swissarmyfork.com/lens_table_1.htm

He puts the front entrance pupil for this lens at 12mm at 112.5mm in front of the film plane, or about 66.5mm in front of the mount. This is a couple of mm in front of the rubber zoom grip. My measurements with a +3 on the lens puts the front entrance pupil about 110mm from the film plane, or about 28mm behind the filter thread of the 12-24. I use 55mm extension with the Superdome and a B&W +3 dioptre and the corners seem acceptable to me.

None of the major manufacturers recommend a dioptre for this lens. I wonder what tests they have done?

Hopefully by now, you are as paranoid as I am about corner sharpness and will spend hours in the nearest pool fretting over lens tests.

Let me know how you get on. Let the housing manufacturers know too!

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