Making an Aquatica

by Jean Bruneau, Aquatica Technical Adviser

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Every once in a while people ask me how housings are made, so to dispel any myths I have decided to take you on a tour of our company and show you the process from the ground up. No folks, it's nothing like the machinery seen in Charlie Chaplin movies. Underwater housings do not come out of an oven and we certainly don't have a large steam whistle calling the breaks like in the cartoons. In order for you to have fun creating images underwater, we need to be serious about our work (that does not mean we are unpleasant people, we love our fun as much as any of you)!

The first step in creating a housing is not really taken by us, but by the camera manufacturer. The camera that they decide to create obviously has a major influence on whether or not it will catch on with underwater photographers. As a specialized community, underwater photographers are looking for things in a camera that are quite often over-looked by topside photographers. Therefore, not all cameras are suitable for underwater use. When we decide to make housings for a camera, we look for a model that will match the specific needs of underwater photographers.

Once a candidate is selected, the next step is getting the camera. The large camera companies do not give housing manufacturers any special treatment and the best way to get a model ahead of time is by keeping a good relationship with the local Canon or Nikon rep. Usually we can get access to their sample model quite a bit ahead of the official

camera launch. We can then take this opportunity to set it up on a laser scan bench and grab a 3D virtual model of the camera that we can load up on the computer and get going on the design work in earnest.

The 3D model is then integrated in the Computer Aided Design software (CAD). The rather complex software allows placement of the housing component in a virtual environment, which allows the engineers to then rotate the virtually created housing around and look at it from every conceivable angle.

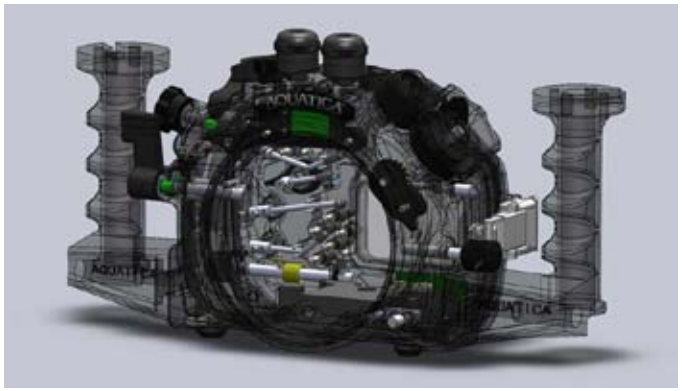
Once satisfied with the design, it's time to layout where the controls and buttons will be spread out and how they will access the camera's controls. This part is critical and quite a few factors need to be considered:

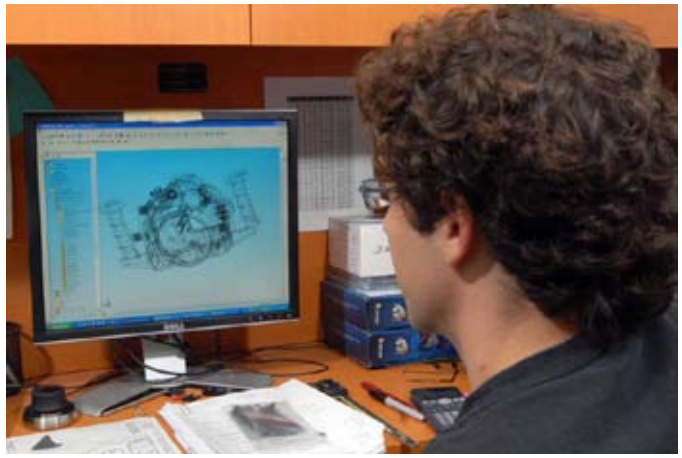
How vital is this control's location?

How complex is the mechanism to locate when placed in the housing?

Is this going to conflict with other controls, and if yes, which one is the priority?

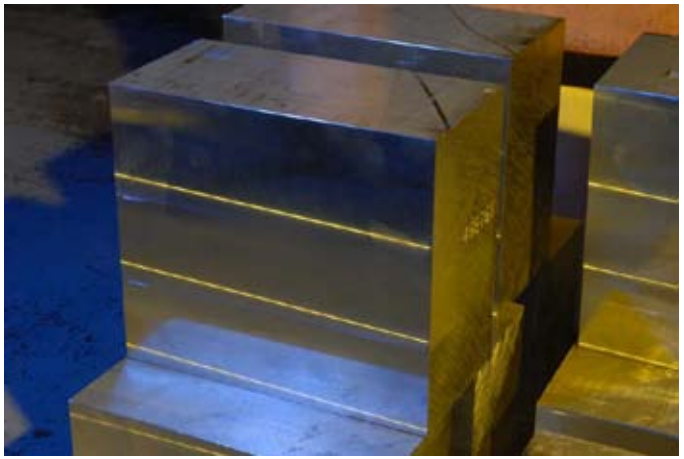
Are there any specific needs to address such as space for the built in flash to pop up.





At this point, the design will gradually go from a simple wire frame shape to a photo realistic rendering, such those you see from time to time from the various manufacturers when they announce future projects.

The final price of the housing is also a consideration. Complex mechanisms tend to be more expensive to manufacture and this needs to be accounted for at some point. Entry-level housings do not benefit from the same in-depth complexity as high-end housings at a substantially higher price bracket. Still, it is understood that every innovation that can be possibly implemented in a new housing



design will be included. The next step is to enter the data of the preproduction prototype into the Computer Numerical Control (CNC) program. The information being entered is really nothing more than a set of directions, sort of like numerical instructions, that tell the machines computer what work needs to be done. Once the programmer has uploaded the data, it will instruct the CNC machine, in this case a sophisticated one working on 5-axes, where and how deep to shave and drill out excess material from the provided block of aluminum.

Machining

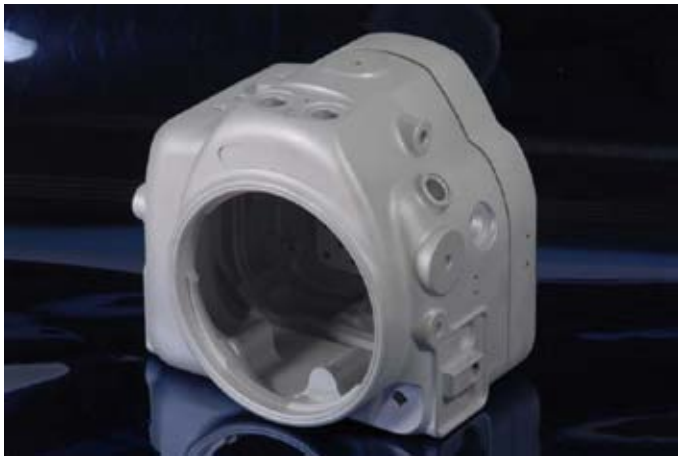
A modern machine shop will have various machining tools at hand to fulfill the multiple tasks associated with such complex shapes. The top of the line machine has got to be the 5-axis CNC machine. While the more traditional 3-axis machine will work on only (you guessed it) 3 axes (up/down, left/right and front/back) the 5 axes one can actually pivot its mechanical head to follow much more sophisticated shapes and contours. That allows us to have a much smoother looking housing in the end, and very importantly, to shave of as much excess material in order to lighten up the final housing shell. This whole machining process is so visually intriguing that I am sometimes caught gawking at the window for minutes, just like some poor sap staring at a washing machine at the local Laundromat. But hey, bite me, I like my job!

In order to have a complete housing we will need two aluminum blocks—one for the front portion, and the other for the back. To start off, the machinist will insert a block of raw aluminum of a specific alloy into the machine.

Then cutting tools will be loaded on to the dispenser and the process will begin. From this first procedure will emerge the internal hollowed side of the housing. The block will then be flipped over, the proper program will be loaded, and the necessary cutting tools will be installed. From there, it's a just simple "press enter" and the exterior details will be fashioned out. The housing now starts to resemble what it will look like when completed.

From this process comes a shiny, and in my opinion, stunningly beautiful piece that captures and reflects light in a way only a grease monkey like me can appreciate. Alas, this piece of art also

has razor sharp edges that will rival some of those sharp objects found underwater. This sharpness will need to be addressed and this brings us to the next chapter, the treatment stage, in which the housing shells are prepared for painting and assembling.



Treating

When the machining is finished we get to the less fun part of the job – the part I like to call "deburring." This is where we use fine-gritted sand paper to go over the sharp edges and dull them into civilized ones. Various types of fine gritted sand paper are used for this chore, which aside from making the housing friendlier to handle, ensures that O-rings will not get cut on sharp edges.

This is a manual process that requires one's full concentration. Forgetting one small edge will most likely mean scrapping the housing shell down the line, so attention to detail at this stage is of the utmost importance. Pity the individual who does not pay attention to their work, as a bloodied knuckle in a bandage is the likely consequence After manual deburring there are still some external sharp edges that need to be addressed, so the shell is put in a tumbler. The tumbler is a donut shaped machine loaded with pellets of different sizes. In the machine, the shell will be subjected to a lengthy period of vibration, which will cause the pellets to rub against it and dull out all sharp edges. This machine is horrendously noisy and any conversation between people is put to a standstill during this process.

Once out of the tumbler, the shell is off to the sandblasting where it is bombarded with a silica particle until it gets a dull and smooth finish. This process will give it a pleasant sculptural look, and it is almost as if the housing is shedding its hard metallic look for a softer organic one.

A good cleaning is then done and the shells are packed and off to be dunked into anodizing chemicals. Anodizing is a process where the shell is dunked in a chemical solution so that it is protected from salt water corrosion.

This complex and multi-stage operation requires the shells to be immersed in several vats of chemicals, which follows military specifications to ensure that this vital step in the protection of the housing is successful. Poor quality anodizing would leave the housing open to salt water corosion, something that is unacceptable for both the manufacturer and the end user.

Once this anodizing process is complete, the housing will come in the front assembly room for the first time to be prepared for the paint process.

Painting and Labeling

It's now time to prepare the housing for powder coating. The first step is to mask all areas that are to remain free of paint. Of particular importance are the surfaces that will be in contact with an O-ring and need to remain smooth and free of any textured paint or chips, which could let water leak in. Custom made reusable masks are used for the standard holes such as push buttons, bulkhead connectors and control shafts. For surfaces such as the various window ports and the rear main sealing surface, which are different on every housing, a

specialized masking tape is used and precisely trimmed with a sharp blade. The masking material is a unique material made to resist the brutal heat that it will be confronted later on in the painting oven.

Masking requires patience and the attention to detail that is beyond the scope of yours truly and it is one part of the job I am gladly exempt from. Since we are a small company, every staff member is called upon to lend a hand in most tasks, whether it's for deburring, assembling or packing and shipping—that is unless one sucks at a specific task, and I unfortunately do at masking.

Once prepped up the housings are transferred to the paint shop. For a layer of protection we use a powder-coated treatment. This coating is a highly resistant finish that is applied through an electrostatic process and then baked.

Essentially, this method uses a powder that does not require a solvent, as standard paint does, to keep the binder and filler working together. Instead it is applied by spraying on the parts to be treated, which are charged with electrical current and then cured in a high temperature oven that creates a tough resilient skin.

This skin has a much harder finish than the conventional method of painting and is exactly what the salt water environment requires. Ok, so now you got me, in the beginning I stated that housings did not come out of an oven; well they do at some point!

Once the housings have cooled down, they are brought back to the assembly room. The masking material is removed in preparation for the attaching and painting of the different logos and operational labels. Aside from the company logo that is attached with a waterproof bonding material, all other symbols or text on the housing are pad printed with a highly resistant paint. It was found that applying stick-on labels just did not last long enough in the harsh underwater environment.

We are now down to the wire. While all the previous steps were being taken care of, the multiple shafts, lever and miscellaneous parts involved were machined and finally migrated to the assembly room.

Up to this point, everything else could be done with the virtual 3D camera rendering, but for the next stage, the fine-tuning, an actual camera body needs to be installed in the housing.

Assembly and Testing

The painting and labeling process completed, assembly is now ready to start and all shafts buttons and levers are set in place. This is also when the housing will become personalized to the eventual owner's requirement. If they requested a depth rating upgrade to 130m/ 425ft, it would be installed at this point. Same goes for the strobe connectors which are configured to the preferred configuration – wired bulkheads or fiber optics.

Every single control is tested, adjusted and re-tested. Wired bulkhead strobe connectors are tested for continuity prior to installation with a multi meter and again with actual strobes after they are installed on the housing.

Once every o-ring is in place, every fastener screwed down, every eyepiece element secured, it's time to pressure test the housing. The pressure test tank actually looks like some low-tech giant pressure cooker. In our case, since Aquatica is not in the culinary business, we will built up the hydraulic

pressure to the equivalent of 90m /300ft to make sure the housing can stand up to the ruthless rigors of diving.

Needless to say, a close and thorough inspection of all the internal parts is done afterward in order to detect any signs of water entry. If even so much as one small drop or residual humidity is found, the housing will be torn apart and closely inspected. Once the source of entry is determined, it will be either rebuilt from the ground up if it was a minor issue or sent to the recycling bin if the source could not be pin pointed accurately.

Once the housing has successfully completed the hydrostatic test, the strobe connectors are again subjected to yet another continuity test. Finally the preproduction prototype, and eventually the productions models, will be ready to enter the real world. There are still a few steps before green lighting the final production of housings. The inhouse technical staff and some trusted outside field advisers will evaluate the completed preproduction prototype housing underwater to determine if any minor changes need to be done to the final production models. When I say "trusted field advisers," it means we trust them to be straight to the point and not be afraid to express their opinions. Once out there and put through the tests, it might be that minor changes or modifications need to be made, for example, a control placement might be shifted for better access.

Once a consensus is attained on what the final production version ought to be like, we go back to reprogramming the updated data instruction (if required) into the CNC machine and the cycle starts again, but this time instead of an individual unit, the machine shop will allocate a time window in order to process batches of this new housing.

Only after all of these operations are repeated again, and the owner manual printed, is the packaging procedure finalized, making it available for purchase.

So there you go—that's my work environment. I certainly hope you enjoyed the visit and that the next time you see an underwater housing, no matter who made it, you'll see more than just a fancy camera container.

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Jean is the Technical Adviser for Aquatica and has been associated with them as far back as 1990. Aside from being an active underwater photographer, Jean as been writing technical and nautical articles on the subject of photography since the mid 80's.

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