

## Keep 'Em Alive!

### Live Hauling Fish

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Aquaneering has been manufacturing Aluminum Insulated Live Haul Tanks since 1981. Over the years I have had various questions from many fish farmers about tank design. In this article I have compiled the answers to some of the most common questions I have received, in order to further educate the buying public and to establish guidelines for a Live Haul Tank that best suits your particular needs.

“**What are you hauling?**” is always the first question I ask when a customer calls Aquaneering about a new Live Haul Tank. Firstly, it is necessary to define the type, quantity, and size of fish that you are hauling. The accompanying chart provides estimated densities for hauling fish based on the experience of my customers.

Fish Type	Stocking Densities	Hauling Temperatures
Catfish	3 to 3.5 lbs/gal	50° to 65° C
Tilapia	2 to 2.5 lbs/gal	65° to 70° C
Striped Bass	1.5 to 1.8 lbs/gal	55° to 60° C
Trout/Salmon	2.2 lbs/gal (Max)	45° to 55° C

**Note:** Like any other venture, experience is a key component in success. I suggest that if you are just starting out in live fish hauling to reduce these capacities up to 30 to 50% of the maximum listed. There is nothing more nerve-racking then driving down the road in a new rig, the truck loaded to its maximum weight, and wondering whether the fish are still alive! After you have a few deliveries to your credit you can begin to increase the amount of fish in 100 lb. increments until you feel comfortable hauling at the maximum capacities shown.

The type of fish you are hauling is an integral factor in the design of the tank. Trout and Salmon tend to do better in deeper tanks, since the level of O<sub>2</sub> transfer increases with water depth. Most trout tanks we

build range from 32" to 48" tall. Catfish and Tilapia do not have to conform to the same criteria. Since they are packed at much higher densities, it is necessary to over-aerate. These tanks are usually 30" to 36" tall, making them much easier to load and unload.

Besides dissolved oxygen content, other environmental parameters for hauling fish include CO<sub>2</sub> gas content and water temperature. These requirements also vary with species. Trout and Salmon require vent pipes and a large freeboard to allow cross-ventilation between each compartment. This, in addition to heavy aeration, removes CO<sub>2</sub> gas. Most Catfish and Tilapia haulers do not regard CO<sub>2</sub> gas as a problem. (CO<sub>2</sub> is produced as a byproduct of respiration in a highly oxygenated water environment, in conjunction with the pre-existing condition of digestion of excess food in the fish gut.) As CO<sub>2</sub> levels escalate, the pH drops, which decreases the toxicity of the ammonia in the water. This allows for high densities of fish to be hauled without any artificial means of ammonia removal. However, if you plan to place the fish in a live sales tank upon arrival, it must be equipped with an efficient filtration system

Most operators use well insulated tanks to maintain the water temperature. For most areas of the country, 2" of foam insulation is more than enough. If operating in very extreme climates, it would be wise to opt for an extra inch of foam, which will be able to handle **ANY** temperature range. Typically, we like to haul fish in as cool water as practically allowable, since it reduces the respiration and activity of the fish. In warm areas this can be done with ice or a water chiller to pre-cool the water before filling the tank.

### **How many pounds of fish do you want to haul?**

To properly determine the quantity of fish you can load on a truck, I normally start out by asking how many pounds of fish you want to haul, calculate the number of gallons required, and then add the weight of the tank to that of the water.

A typical example of a truck type we frequently set up for is as follows:

- **Capacity: 12,000 lbs of Trout**
- 12,000 lbs ÷ 2.2 lbs Trout per Gallon

- Requires 5,500 Gallons of Water

Next we divide by the number of compartments:

- $5,500 \div 6$  compartments = 900
- Each compartment houses 900 gallons

Based on some of our standard dimensions, we figure out the capacity:

### Insert Image HERE

1. Use all inside dimensions or outside dimensions (deduct insulation and thickness).
2. Deduct the freeboard from the height (for sloped bottoms, I usually take the amount of slope and divide it by two for an average depth).

**Capacity** = (Overall Height – Freeboard –  $\frac{1}{2}$  Slope) x Width x Length. This gives you the cubic inch carrying capacity of the tank.

**Gallons of Water** = Capacity  $\div$  231.

**Weight** = (Gallons x 8.3) + Tank Weight

To continue with our example above:

- 48" tall x 70" wide x 90" long Single Compartment tank w/ 2" insulation and 5" freeboard for CO<sub>2</sub> removal.
- **Inside Width** =  $70 - 4 = 66"$  (for 2" insulation)
- **Inside Length** =  $90 - 4 = 86"$  (for 2" insulation)
- **Inside Height** =  $48 - 4 = 44"$  (for 2" insulation)  
                           =  $44 - 1.5 = 42.5"$  (for 3" Sloped Bottom)  
                           =  $42.5 - 6 = 37.5"$  (for 5" freeboard)

**Capacity** = H x W x L  
 =  $37.5" \times 66" \times 86"$   
 = 212,850 cubic inches

**Gallons** = 920 Gallons

**Weight** = Gallons x 8.3 + Tank Weight

$$= 920 \times 8.6 + 955^*$$

$$= 8,590 \text{ lbs}$$

For our standard Aquaneering Tank the total weight of fish and tank is 8,590 lbs. We multiply this by the number of compartments and calculate a total payload of 51,550 lbs. In addition to this, we need to account for the O<sub>2</sub> system, aerators, and trailer.

### **What aeration system is best?**

Unfortunately, what is best for a Catfish farmer in California is not necessarily the best for a guy hauling Trout in Minnesota. The first thing that needs to be discussed when selecting an aeration system is what type and how many pounds of fish are being hauled, and how often you plan to be on the road. For a larger truck hauling 4000 to 5000 lbs of fish two to three times a week, Liquid O<sub>2</sub> in large stainless steel Dewar bottles is the best way to go. Not only is liquid O<sub>2</sub> one-third to one-quarter the price of gaseous O<sub>2</sub>, but liquid is held at a much higher density, meaning one Dewar liquid bottle contains the equivalent content of 18 gaseous bottles. Additionally, the Dewar bottles can be filled while on the truck. This saves substantial time by eliminating the need for changing bottles while on the road. Large semi trailers that we set up commonly operate with two Dewar bottles and typically, the bottles can be hooked in series by plumbing the secondary bottle's liquid outlet to the vent of the first bottle.

For smaller operators, liquid O<sub>2</sub> does not make much sense, since the liquid O<sub>2</sub> Dewar bottles have a nasty habit of venting. If the interior bottle temperature rises above -183°C (O<sub>2</sub>'s boiling point), the liquid will boil into a gaseous state and vent to the atmosphere. An unused bottle would be completely vented in two to three weeks (in a warm climate), which means that if you are only hauling 1,000 lbs per week it would be much more cost effective to use gas bottles. Gas bottles can be rented from local welding supply houses (medical grade O<sub>2</sub> is not required for fish) and should always be setup with at least two bottles, so that you leave with 1 bottle full every time.

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\* Tank weight based on Aquaneering Single Compartment Double Wall Aluminum Construction with 2" Thick Foamed in place Polyurethane insulation.

The best setup for a small truck is the combination of bottled O<sub>2</sub> and electrical aeration. With this setup you take advantage of the 12 volt automotive electrical system to provide “free air” to the tank and have the O<sub>2</sub> bottle as a backup in case the truck breaks down. I always like to tweak the fish with a little bit (1 to 3 lpm) of O<sub>2</sub> in this configuration because they look better upon arrival.

### **Aerators?**

Another inexpensive setup for a pick-up is using a gas motor with an old smog pump off an early 80's automobile. Some people are still using Roots-style blowers operated by gas motors for larger trucks. However, we have not installed any such systems in recent years. There are basically two types of 12 volt aerators on the market currently: the Basket-style made by Boatcycle and Commerce Welding which are very effective in shallow tanks with small fish, and the Fresh-Flows which use a propeller and suction tube to pump water from the bottom of the tank to the surface. These work well in deep tanks that I described for hauling Trout and Salmon. Whatever setup you choose, you need to consider both the cost and backup capabilities in an emergency situation.

### **Diffusers?**

Several different types of diffusers are commonly used today. Many farmers that have been in the business for years still use carbon stones; however, finding high quality stones is becoming increasingly difficult. Additionally, they are prone to breakage if ice is dropped on them or if they are handled for maintenance. Soaker hose and heavy duty variants of the recycled extruded rubber “leaky” hose work well and are inexpensive. They are normally fashioned into grids, with 8” to 10” between them and clamped to manifolds that can be homemade from copper pipe or commercially purchased from stainless steel. They do consume a lot of O<sub>2</sub>; however they are ideal for heavily stocked Catfish or Tilapia tanks. The most efficient and popular stones are micro diffusers made by Point-4 Systems. They create very fine bubbles, which uses your supply of O<sub>2</sub> more efficiently, since large merely float to surface and do not oxygenate the water as well. You need to exercise caution in selecting a diffuser in cold climates where freezing can occur, and could crack the diffuser if not properly drained.

## **Design Details**

After we have worked through the basic capacity of the tank and aeration needs, the discussion usually turns over to design details.

Dump gates and caps all depend on the size of fish you are carrying. For big fish, the rectangular dumps work very well since more than one fish can exit at once without bumping its nose. Or, if you are stocking in a location where access is limited, the 6" or 8" Cam-Lock round dumps are great, since you can add length to the hose easily and reach even the most secluded spots.

Tanks are available, from different manufacturers, in Aluminum, Fiberglass, and Stainless Steel. One must weigh the advantages of price, weight, and longevity when making a selection. Quality control and standing behind the product are also what defines a good tank. It is not uncommon for quality tanks to outlast two or even three trucks over the years, and I often see some of the first ones I build still on the road!

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