

Voyager's Fuel Tank

December, 2005

Goals:

- At least 50 *useable* gallons, about the same as now with the two tanks.
- Minimal unusable fuel
- A low sump for these reasons:
 - Minimize fuel made unusable by rolling-induced sloshing
 - A collection point for *all* water and most crud
 - A built-in, always easily available, pump-out of the sump using small diameter (1/4") hose. Every time we fill the tank we'll draw off any water and crud. The hose is a small diameter so there's little good fuel pumped out. Also used to get fuel for filling filters, etc.
- No low spots (except at sump); all fuel drains naturally to the sump despite imperfect tank construction, heeling and pitching.
- Good fuel gauge with a rolling-resistant sender
- Cleanout hatch with reasonable access to the entire tank
- Fill pipe that goes to (nearly) the bottom of the tank to reduce foaming
- 2" deck fill for those fast pumps

Current tank dimensions

- 9" x 30"w x 36" long
- But there's 2" clearance at top
- Removing 2x4 supports lets me lengthen it by 3.5"
- There's a good 3" or so available forward of the tank
- I think the biggest width to get down the hatch is 29" so make it 28" to be safe.

Notes on new tank

- Tanks walls are 0.25" fiberglass
- Baffles:
 - Tabbed in place. Where they intersect they're tabbed together.
 - 3/16" thick panels purchased from McMaster
 - Holes are provided in main transverse baffle where it meets longitudinal one for the two pickup lines from the sump.
 - Fuel lines are tabbed to the longitudinal baffle.
- Fill pipe is 1.75" stainless pipe, inserted into a 2" fiberglass sleeve (a standard exhaust part) which is glassed to the top of the tank..
- Access to prop shaft coupling has been improved: The tank is 11" tall which, since there's no 1" thick shelf, essentially lifts it by an inch. It's 28" wide giving essentially another inch of athwartship access.
- Tank support: This is a fully self-supporting tank with no shelf. The 0.25" thick FRP is strong enough that no other support is needed. On the port and starboard sides there's a 4" wide 40" long piece of wood 5200'd to the tank. (That gives 32,000 pounds of load-carrying ability). The current plywood that's glassed to the

- cockpit sides to support the tank will be cut down to hang just 6" below the cockpit. 20 screws staggered on 2" centers connect the tank to the plywood (so, each screw supports about 12 pounds with a full tank). The vent line (and maybe the stove propane line) will run forward over the port mounting ear, so that ear doesn't stretch all the way to the top of the tank; it starts about 2" down.
- The fuel pickup, pumpout, return and vent lines are all near the aft end of the tank. They go through the top through a ½ inch thickened layer of glass; they're bonded to that with 5200.
 - Pump-out arrangement:
 - A manual fuel pump pulls from the clean-out line. The input to this pump has a shut-off valve; the output has a 90 degree bend to discharge downwards. It's mounted vertically in the port cockpit locker.
 - We pump into a 500ml graduated cylinder stored (somehow) conveniently. We look at the fuel to check for water and crud on each tank fill.
 - A 1 gallon jerry jug lives in that locker to collect waste fuel from this and filter changes.
 - Layup schedule:
 - Mat, mat, roving, mat, mat. The mat is 1.5 oz and the roving 24 oz. (Total 0.232" thick). If I were doing it again I'd change this to mat, mat, mat, mat, roving. The roving is just a strengthening layer, but is rough, so it's hard to get mat over it without having air bubbles.
 - It's impossible to layup over the sump, so the glass gets a hole cut into it so it just surrounds the sump. Then for each layer a bunch of strips are laid up over the sump.
 - Male mold:
 - Built 0.25" smaller than the tank in all dimensions, to account for the laminate thickness.
 - Made of 0.5" MDF with pine supports glued inside of it to attach the bottom to.
 - Since there's an odd twist in the bottom I cut 1" long strips and screwed those down to the pine, twisting them as required.
 - Routed all edges for 0.5" radius
 - Glassed over to account for the gaps in the bottom and all. One layer of 1.5 oz mat, with one layer of cloth over that. Then a final layer of resin heavily painted on. This last resin layer is finishing resin (i.e., with wax) so it sets up hard). To save on resin bucks I mixed surfacing agent into laminating resin to turn it into finishing resin.
 - If I were doing it again I'd make the four sides of the mold much longer than the required dimensions. Then the glass wouldn't bang into the workbench/sawhorses when doing the laminating.
 - The sump is made from a stainless mixing bowl from Wal-Mart, cut to size. Glued onto the mold and then a bead is formed around it using resin and micro-balloons.
 - Total resin used: 8 gallons.

Tank size & notes

- The fuel pickup is mounted 2.75" above the bottom of the sump
- Total capacity, based on actual measured volume of the complex bottom shape, taking the baffles, etc into account: 62.5 gallons not including the sump. Because the top is a bit above the tank itself, there's probably another one to two gallons available as well.
- Unusable fuel with no heel: 0.29 gallons (this is the unusable part of the sump)
- 15 degree heel unusable capacity: 0.45 gallons (entire sump and nothing else)
- No heel, number of gallons to put 1" of fuel over the sump (note there's 0.16 usable gallons available in the sump as well): 0.3 gallon
- If the tank doesn't get completely filled for some reason (heels, foam, etc) amount lost if there's 1" of empty space at top: 4.9 gallons
- Amount of fuel in pump-out line wasted when checking for water: 0.01 gallon
- Measured amount of fuel in the pump: 150 ml

Parts List

- Vent 5/8" – Panel coupling 50785K273, plus pipe 4512K16
- Three 1/4" copper fittings on tank (cleanout, return, pickup) - 50785K273 (bulkhead fitting), 5272K191 (1/4 NPT to 1/4" flared pipe), 44555K151 (90 degree 1/4 NPT male to 1/4" barbed end.
- Pump: cork to plug top end: McM 6448K65
- 2" hose to deck fill – McM 5282K15
- Graduated cylinder <http://www.indigo.com/glass/gphglass/graduated-cylinder.html>
- Hatch – Beckson Marine 8" screw out deckplate, part number DP-80B
- Pump – Tempo UPK10
- Sender - http://www.wemausa.com/tank_sensors/tank_level_sensors.htm
- 2" deck fill
(<http://www.eangler.com/webapp/wcs/stores/servlet/ProductDisplay?productId=13140625&storeId=10701&langId=-1&catalogId=10051>)