

CHB34 fuel tank replacement

Nick Fletcher, Dec 2021

INDEX

- 1 Problem Cause / History
- 2 Old tank removal
- 3 New tank options
- 4 Selection of tank option
- 5 Increasing tank insertion opening
- 6 Design of new tank
- 7 Fabrication of new tank
- 8 Installation of new tank
- 9 Considerations

Appendix A - Tank fabrication drawings - as built

Appendix B - Tank fabrication drawings - recommended design

1 Problem Cause / History

L'Attitude is a 1976 CHB34 built by Chung Hwa in Taiwan. I bought the boat knowing that the starboard fuel tank was "weeping". There was minimal evidence, but passing one's fingers, under the tank bottom it came back damp with a fuel smell. I was advised to sprinkle baking soda on the hull for a positive confirmation and, sure enough, after some days it turned brown near the forward end of the tank. The previous owner had removed the teak decks and there had been leakage above the stbd tank and the tank top had corroded through in the area of the filler pipe. The PO cut out a section of the tank top and patched it with a metal plate held by self-tapping screws. At that time a substantial amount of water was found inside the tank, but no further work was done.



2 Old tank removal

See separate report on tank removal

3 New tank options

I identified 6 major tank options as listed below:

3.1 Plastic off-the-shelf tank from Moeller

The Moeller Marine #032550 tank is 45" x 12" x 25" and will slide through the space between engine and side of hatch opening. At 50 US gal this means a reduction to 33% of current fuel capacity (total 100 USG). Tank price is about US\$400 each. Not possible to line up filler directly below deck fitting, so cannot dip tank but tank comes with a level gage sender. Note - it is not possible to request any custom connections, as these have to be part of the original mould. There does not appear to be any other Moeller tank size that is of interest. Using multiple Moeller tanks each side does not appear to be an option because the tanks only have top connections, so they would have to each have their own deck filler.

As regards corrosion, plastic is the best material available. It is possible to have a welded custom plastic tank made but I am not comfortable with its reliability. Also it appears expensive.

This Moeller #03255 option was used on a CHB34 in Brentwood Bay, BC. That owner has since sold the boat and current location is not known.

3.2 Put fuel in the water tank(s).

A couple of boats have done this and then added water tankage around midships. Personally I do not favour this option.

3.3 Two cube shaped aluminum tanks each side

A tank about 24" cube can be lowered down through the forward hatch, then slid outboard and then aft along the side of the engine. Each tank holds about 1/3 of original one-side capacity. Install 2 tanks each side, interconnected top and bottom, which will give approx 66% original capacity. In theory, 3 tanks could be installed each side. The 2 tank option increases available engine room space for other equipment.

Tanks would be fabricated from aluminum. The filler in the forward tank can be located to line up with the existing deck filler and so allow dipping.

A number of boats have used this method (2 in BC and the Monk36 in US, that I know of). One of them has top connections only and has to have separate deck fillers for each tank and separate pick-ups with isolation valves. Interconnecting the tanks at the bottom to avoid this.

Here is a link to a good article showing this method on a very similar boat (Monk36).

<https://gilwellbear.wordpress.com/category/boat-technical-topics/maintenance-topics/fuel-tank-replacement/>





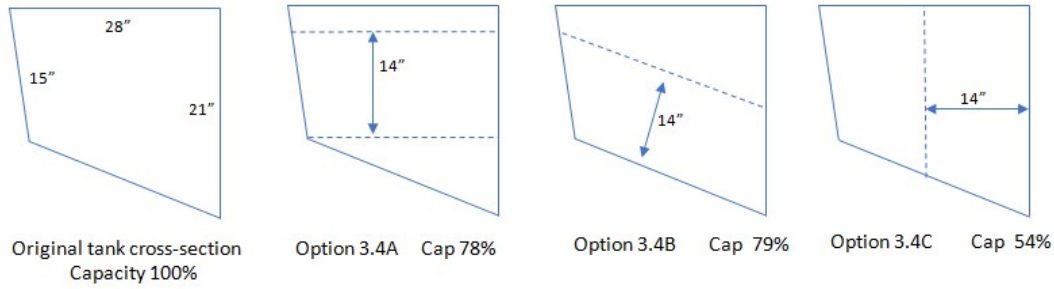
3.4 One full-length shallow aluminum tank each side

Fabricate a full length (72") tank which will slide through the space between engine and side of hatch opening (similar to Option 3.1 except that the tank dimensions will be optimised to get most possible capacity).

Maximum dimension for sliding past the engine is approx 14" (will probably require removing manifold on port side). The sketch below shows 3 possible tank shape options.

I personally favour option B, giving 79% of original capacity. Option B would have the same interface with the hull ribs and would offer some useable storage space on tank top.

Note: as described later, it was not possible to install the complete 72" length, so the 79% capacity was not achieved.



3.5 Two full-length shallow aluminum tanks each side

This option is a combination of 3.3 and 3.4. Full original fuel capacity is maintained by sliding shallow tanks down the side of the engine and stacking one above the other. I saw that this had been done on a CHB34 in San Diego for sale on YachtWorld - photo below copied from the ad.



3.6 Pull engine and install aluminum tanks identical to the tanks

I have spoken to two (ex) owners who did this as a DIY and one ex owner who had it done.

One owner moved the engine to over the starboard bench seat and the other moved the engine up and forward and then took it out of the boat through the side door with a truck mounted Hiab crane (see photo).

One big advantage of this is the ability to clean up the boat's bilge.



Table of pros and cons

Option	Capacity (% orig)	Cut up old tanks?	Pull engine?	Pros	Cons
3.1	33%	Yes	No	Plastic tank, off shelf	Low capacity
3.2	40%	Optional	No	Quick fix.	Low capacity Poor access to new fuel tank.
3.3	66%	Yes	No	No internal baffles needed. Easy to handle smaller tanks. Permits bottom tank fuel pickup. Allows dipping.	Requires bottom interconnecting piping
3.4	79%	Yes	No	Maintain original tank mounting onto hull. Permits bottom tank fuel pickup. Allows dipping.	Requires engine manifold removal
3.5	100%	Yes	No	Full capacity Permits bottom tank fuel pickup.	Requires tank interconnecting piping Increased cost
3.6	100%	No	Yes	Full capacity Maintains boat original configuration. Permits bottom tank fuel pickup. Allows bilge cleanup. Allows dipping.	Engine lift

4 Selection of tank option

I chose Option 3.4B, the "flat, one-piece tank". I had managed to see two other boats which had the two cube shaped tanks (Option 3.3) and decided that I preferred the flat tank option for the following reasons:

- (a) my battery box, just forward of the engine, is higher than some boats and would have to be removed to allow insertion of the cube-shaped tanks
- (b) to eliminate the need for interconnecting piping between the tanks
- (c) to be able to support the tank directly on the boat's ribs, same as the old tank

5 Increasing tank insertion opening

The next job was to open up the gap for inserting the new tank. This involved removing some major protrusions on the engine and increasing the hatchway opening. The raw water strainer was also removed.

5.1 Protrusions on the starboard side of the engine

The following were removed:

- Stop solenoid and throttle cable bracket
- Coolant header tank
- Secondary fuel filters
- Oil filter (not disconnected - just hung loose)

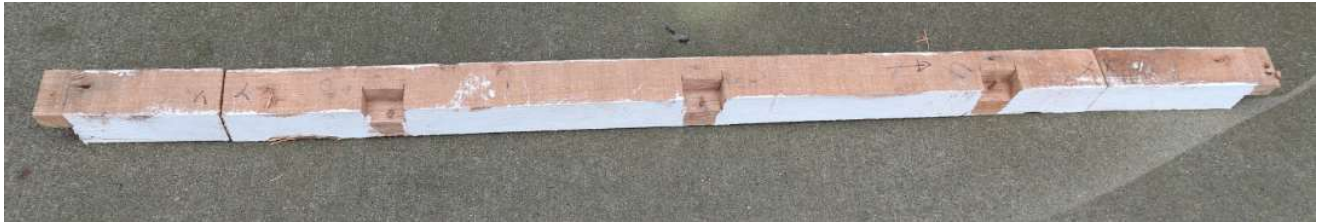


5.2 Increasing the hatchway opening

First the hatchway trim piece and the hatch support piece (see diagram below) were removed from the starboard and aft hatchway sides. The trim pieces were held with small nails and glue and the support pieces with screws under plugs and glue. Removal was not too difficult.

This was the easy part and, in retrospect, I should have stopped here but I also removed the main fore-aft beam on the starboard side of the hatchway. Getting this out was like solving one of those wooden interlocking brainteaser puzzles - except that I ended up having to cut the piece to get it out (and then replacing it with a new beam).

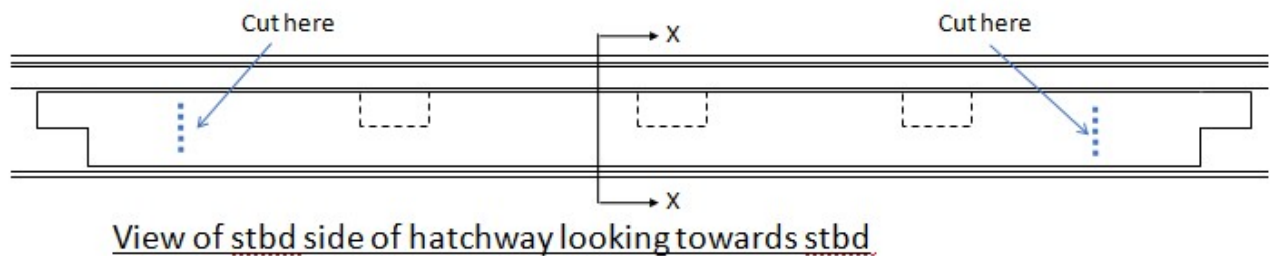
As can be seen from the drawings and photo below, the fore and aft ends of the beam have tongues which engage with the transverse beams just ahead and aft of the hatchway, so it was necessary to cut the ends off the beam to get it out (see photo). First a 4" strip of the underside 1/4" ply liner was removed. Then the beam was cut and the three parts were pried out, overcoming screws in the five connections.

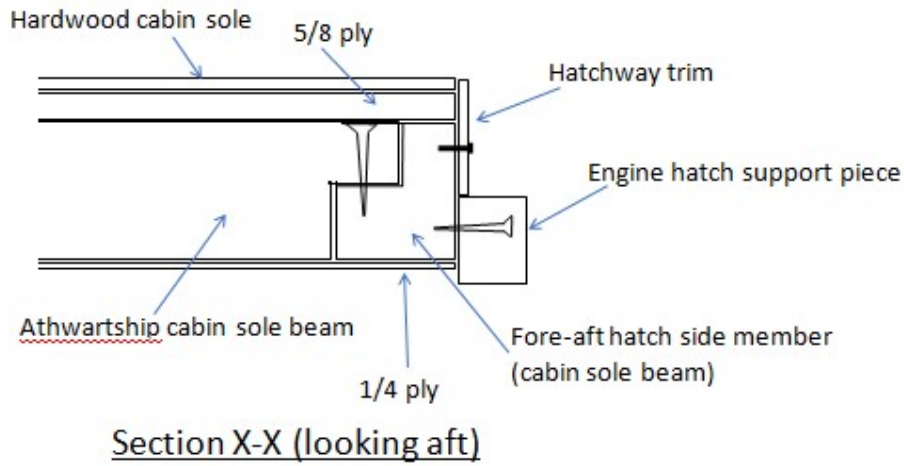


The old beam after removal (the two cuts can be seen).



View of starboard side of engine hatchway after beam removal (looking forward).





The replacement beam was made without the end tongues and held in place by many screws (vertical into the 5/8"ply, horizontal into the transverse beams, and 45° through the ends). The hatchway trim and the hatch support pieces were reinstalled with screws only (more screws than originally used, but no glue).

6 Design of new tank

6.1 Mockup

Next task was to build a mockup of the proposed new tank and to try inserting it. Various versions were tried and it quickly became apparent that the 72" length of the original tank could not be maintained. At 72" the aft end of the mockup hit the aftmost rib (just visible in photo 3/3 below - see arrow) and would not allow the forward end of the mockup to go down.



Simple first mockup



I reduced the length to 60" and it could then be inserted. The tightest point was now the filler fitting - a 2"NPT female coupling which had to be fitted at an angle into the tank top in order for it to end up vertical.

The original simple mockup was then finalised by lining the underside with thin ply and adding protrusions to simulate the tank filler, vent and pickup connections. Insertion was confirmed and tank fabrication sketches made (see appendix).

6.2 Tank connections and other details

Tank top:

- Filler connection - 2" NPT female coupling
- Vent - 3/4" NPT female half coupling
- Fuel return from engine - 3/4" NPT female half coupling (chosen to be the same size as the vent, so as to be interchangeable)

Tank bottom:

- Fuel pick-up - 1/2" NPT female half coupling (I chose to have 3 of these to allow flexibility for the final fuel piping in the engine room)
- Water drain - 1"NPT coupling welded onto the bottom inboard seam with hole drilled through bottom corner (this was an attempt at a type of sump, where any water would find its way and be able to be drained off).

Baffles - 2 baffles, located to coincide with the boat's ribs. Baffles welded on all 4 edges.

Threaded bosses - a total of 22 threaded pads were welded onto the tank outer faces as follows:

- 8 on inboard face for mounting equipment
- 8 on top face for mounting equipment
- 2 on each end for mounting handles for tank installation (one of these for later use for grounding strap)

Inspection openings - I chose not to install access hatches, partly because of cost. Because of the baffles, 3 accesses would have been required. Accesses can always be installed later.

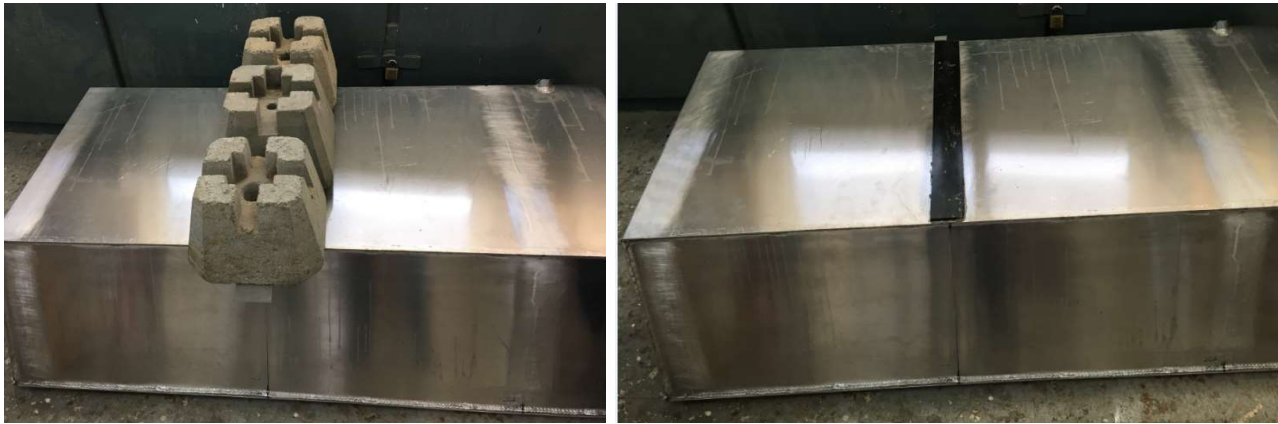
7 Fabrication of new tank

Fabrication was straightforward. I found a small aluminum shop which had done tanks before and was able to discuss the exact details with the fabricator himself. He also suggested minor changes which made it easier to be fabricated. Unfortunately, it would not quite come out of a 4'x 8' sheet and a 5'x 10' sheet had to be ordered, which increased the price a bit. I had thought that both the long bottom seams could be bent, rather than welded, but the fabricator did not want to bend beyond 90° for fear of cracking. Also he did not want to change his 90° bend setup and then spend hours resetting it. Since I was going to support the tank with 3/8" thick rubber strips, I agreed to let the fabricator weld the seams with "overhangs" so that he could use fillet welds (stronger and faster) instead of butt welds.



8 Installation of new tank

First, strips of 3/8" rubber (solid 80 durometer neoprene sheet, purchased from a gasket supply company) were sealed onto the bearing areas. The tank surface was roughened with 50 grit paper, cleaned with acetone and then polyurethane caulking compound used to completely seal the rubber.



Insertion was straightforward and took less than 10 minutes. The salon doorway was lined with protective material and a sheet of 1/8"ply was placed against the engine. Two younger (much younger than me) helpers carried the tank in and passed it down.





Left hand photo showing inboard restraints. Right hand photo shows fuel return and vent connections with stainless bushings to avoid brass/aluminum contact.



Photo showing plywood equipment panel in place and fuel pickup valve installed (note use of stainless fitting in contact with the aluminum).

9 Considerations

Overall, I was happy with the process. If I do the port tank it will be much quicker because I will have a clear roadmap right from the start.

The final tank length of 60" gives 66% of original volume. If the top 2" and the bottom 3" are considered unusable then the final usable capacity is around 73% of original. I am delighted with the increased space just aft of the tank. Previously it was almost impossible to access the thru-hulls located in this area.

The port tank will require removing the manifold from the engine, but this should open up a bigger gap than achieved for the starboard side. With the confidence now gained I would have the tank fabricated before starting the work in the boat.

As regards the tank design, the only change I would make would be to have a horizontal area on the tank top (outboard side - see Appendix B). This would allow installing the filler connection straight (instead of at a 16° angle) and the filler connection will protrude less. It may be possible to not disturb any of the hatchway wood - certainly the beam should not need to be removed.

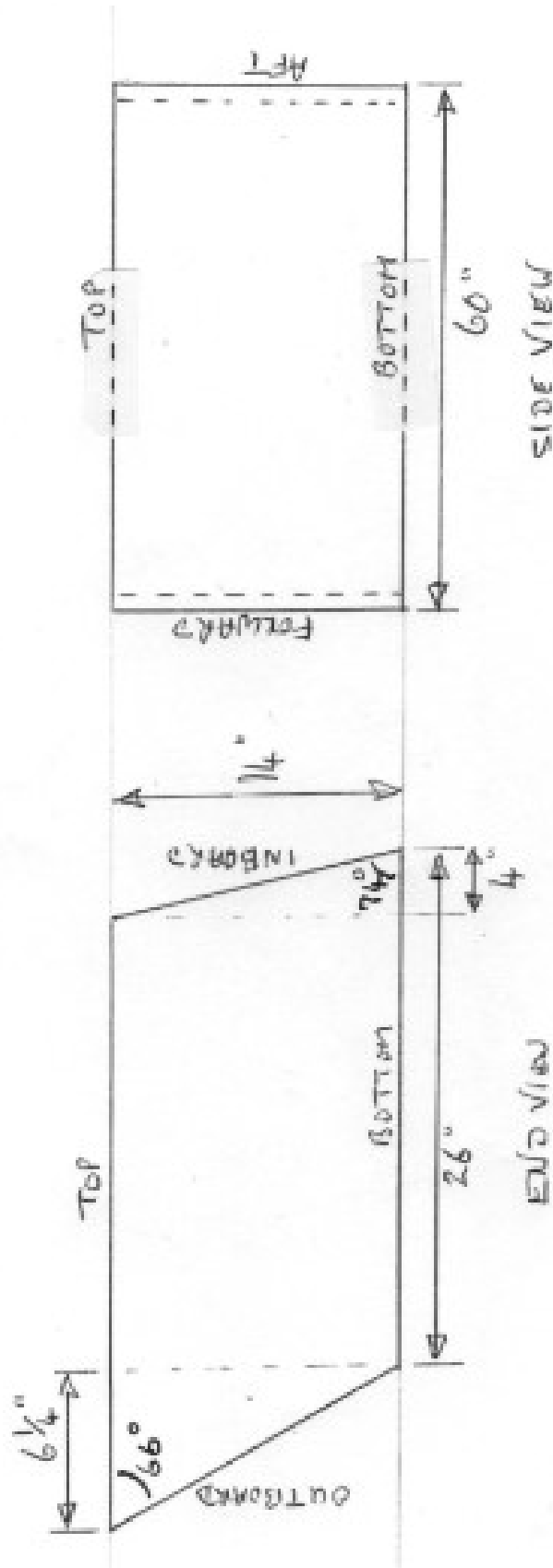
The handles on the ends of the tank were invaluable during the installation and the other threaded bosses appear to be very practical.

As regards cutting up the old tank, I would like to pay someone next time but the problem is to find someone who is skilled enough not to hurt themselves or to damage the boat, who has workplace insurance and who is prepared to do only this part of the job.

My thanks to those fellow owners who helped me with their experiences and let me see their upgraded tank arrangements. I hope this record helps some others who are faced with ageing tanks.

Nick Fletcher, 27 Dec 2021

Appendix A - Tank fabrication drawings - as built



MATERIAL: 5052 ALUM (OR 5083 OR 5086)

3/16" THICK

DIMENSIONS: +/- 1/4"

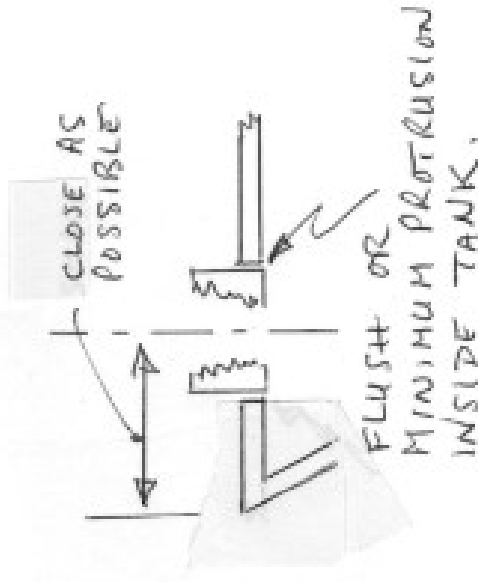
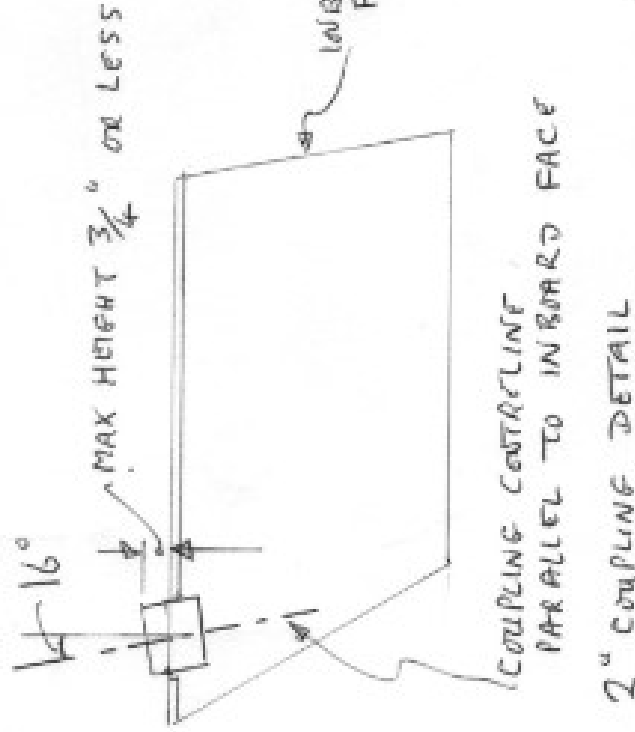
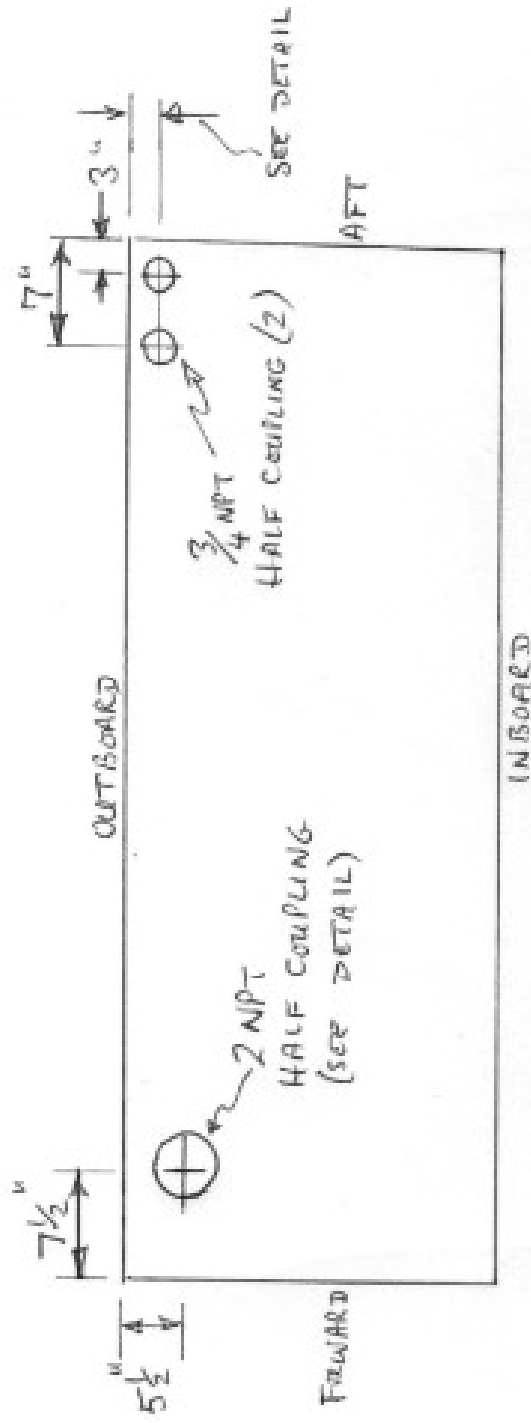
CHR 34 FUEL TANK - GENERAL VIEW

SHEET 1 of 5

REV A.

DRAWN BY: NICK FLETCHER

2021-10-25

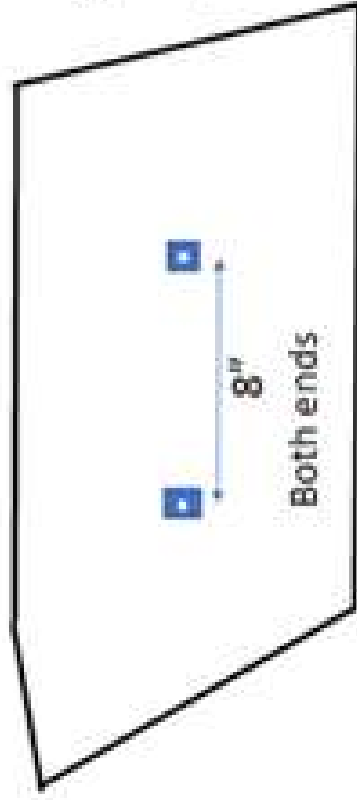


$\frac{3}{4}"$ COUPLING DETAIL

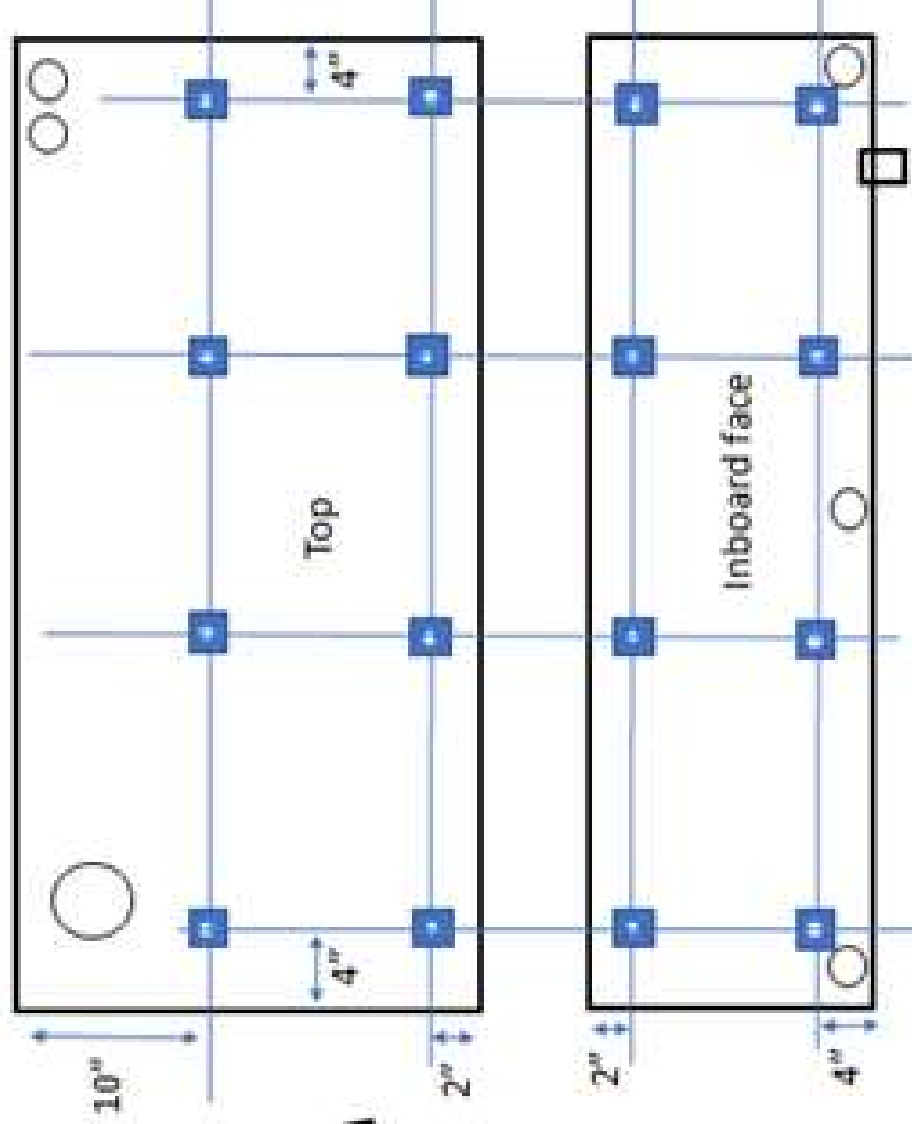
TANK TOP

(STBD TANK)

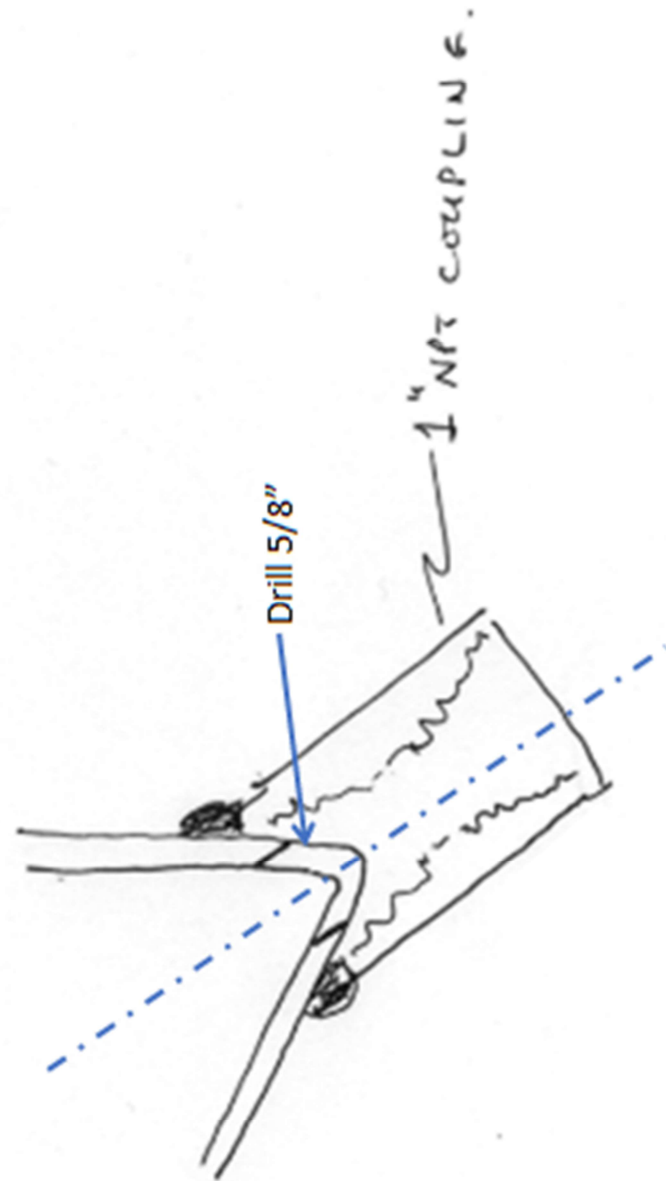
SHEET 2 OF 5



Boss detail: $\frac{3}{4}" \times \frac{3}{8}" \times \frac{3}{8}"$,
tapped 5/16NC



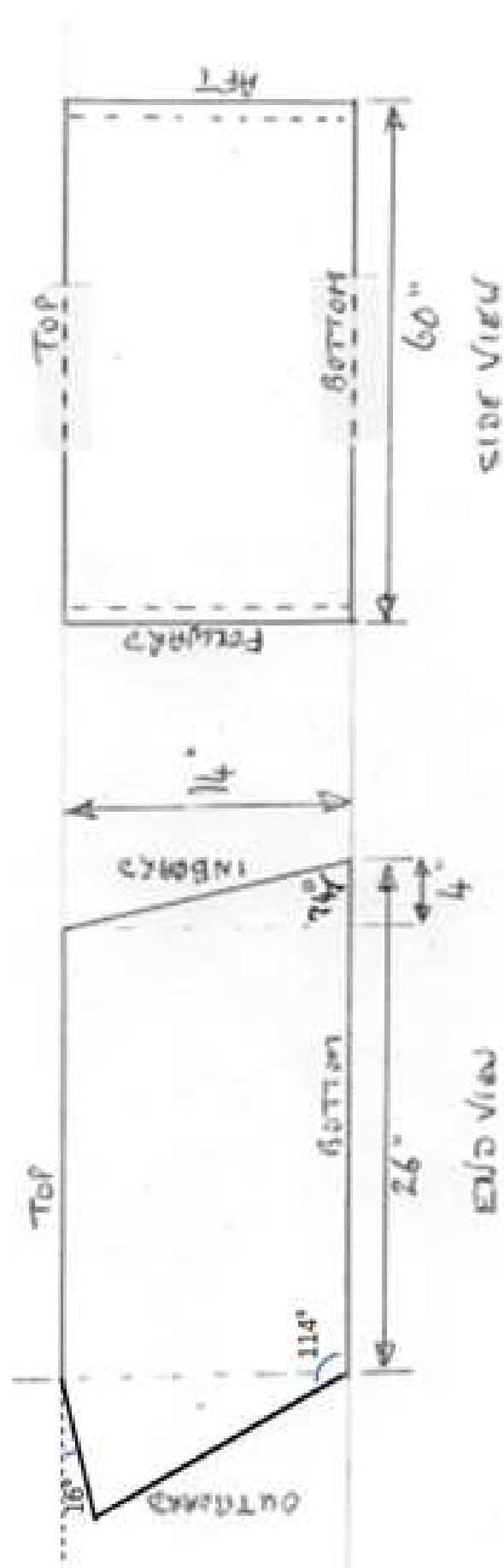
Threaded boss locations ($\pm \frac{1}{2}"$)



"SUMP" DETAIL

Sheet 5 of 5

Appendix B - Tank fabrication drawings - recommended design



MATERIAL: 5052 ALUM (OR 5083 OR 5086)

$\frac{3}{16}$ " THICK

DIMENSIONS: $\pm \frac{1}{4}$ "

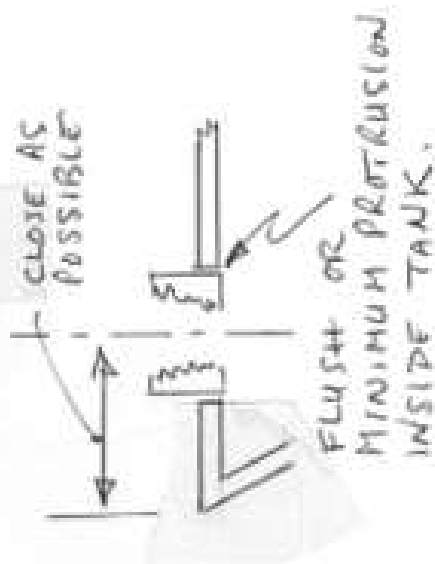
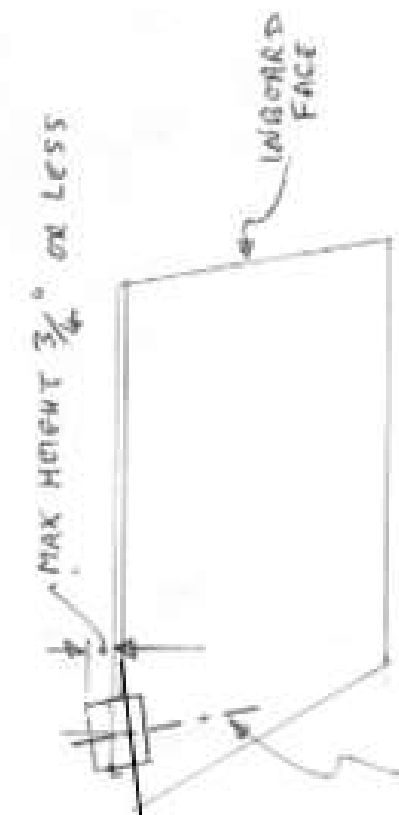
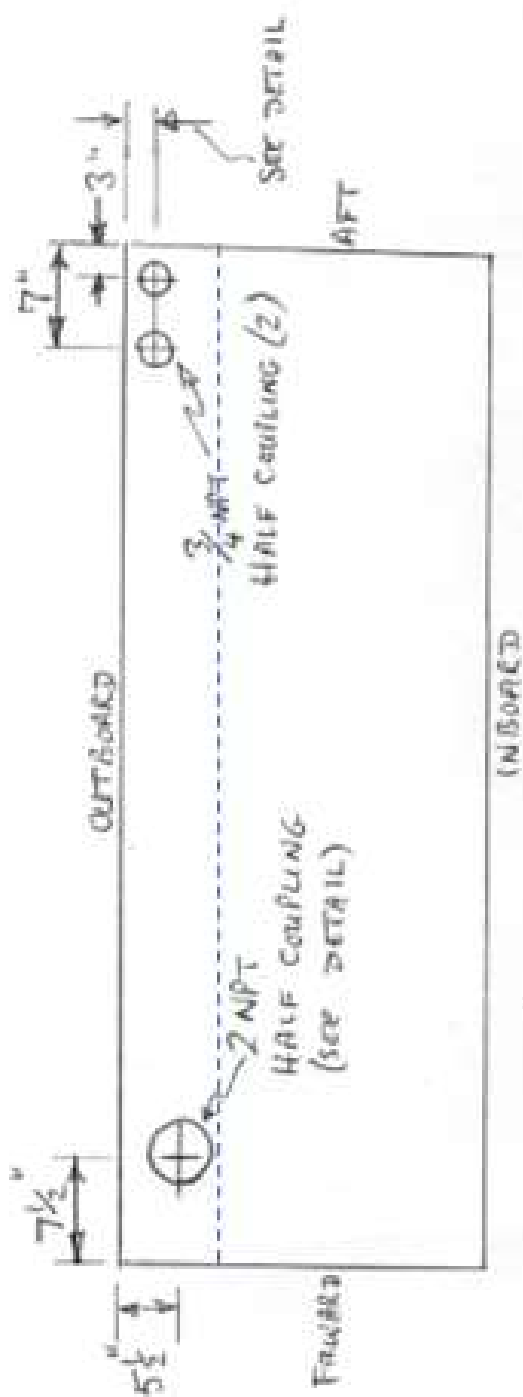
CHR 34 FUEL TANK - GENERAL VIEW

SHEET 1 of 5

REV B

DESIGN BY: NICK FLETCHER

2021-10-25



2" COUPLING DETAIL

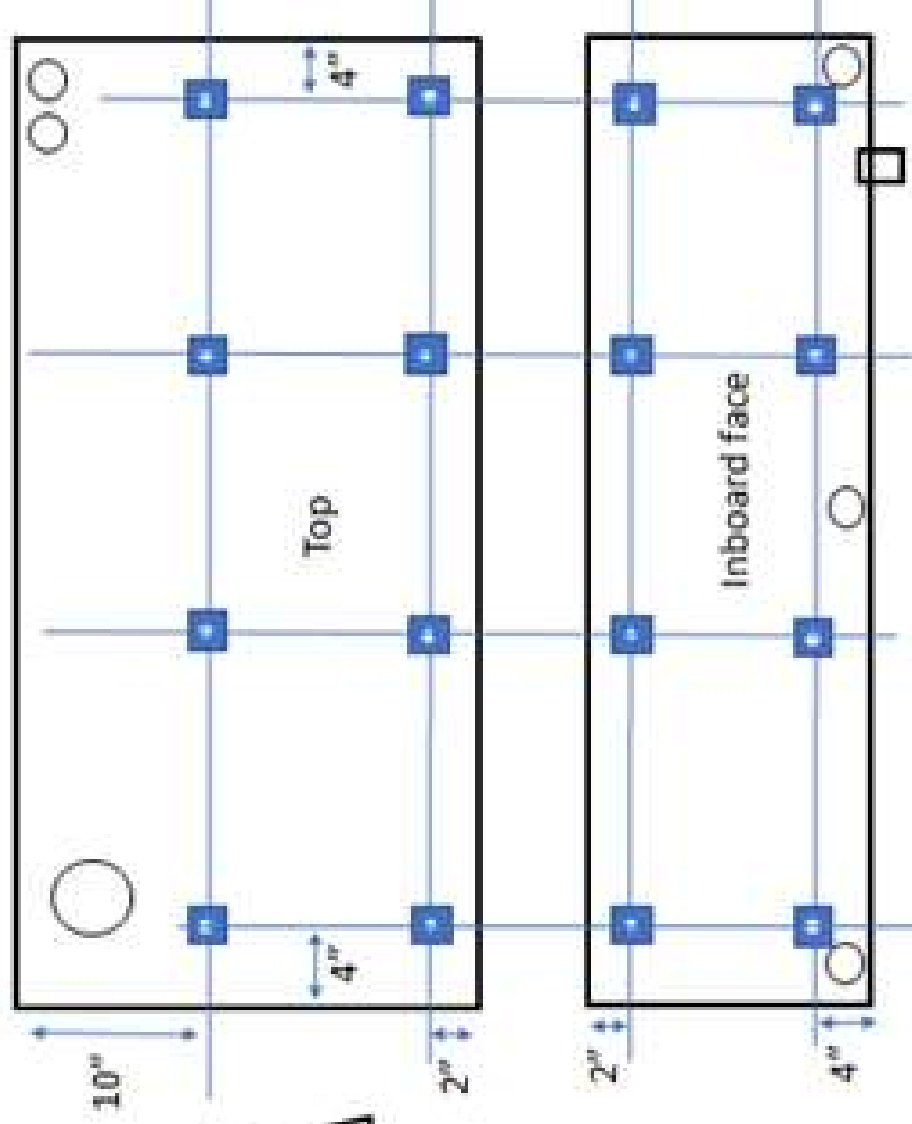
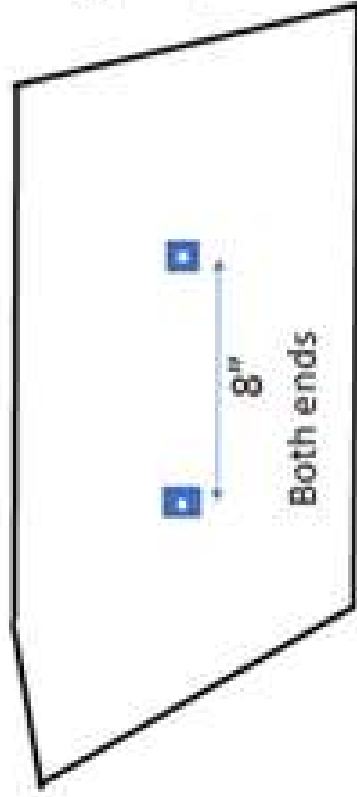
$3\frac{3}{4}"$ COUPLING DETAIL

TANK TOP

(STBD TANK)

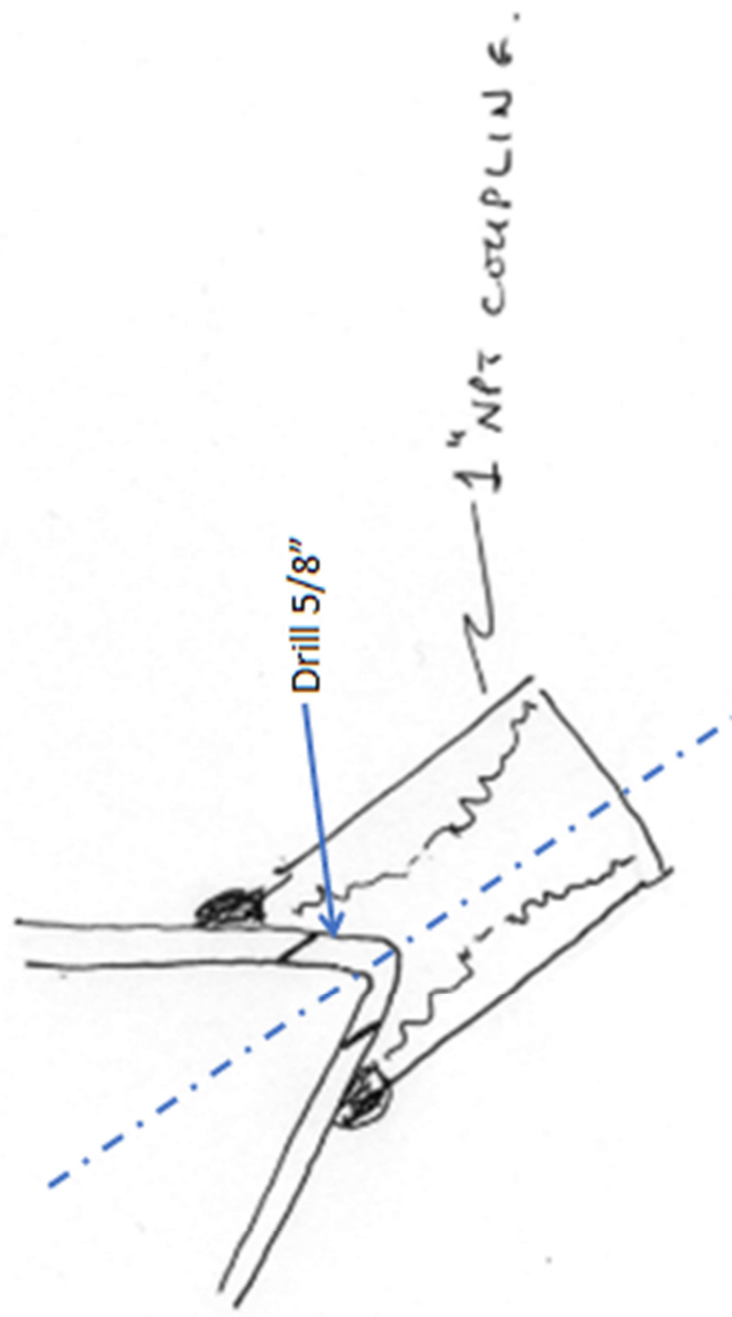
SHEET 2 OF 5

Note: Exact location of filler connection must be measured for each boat.



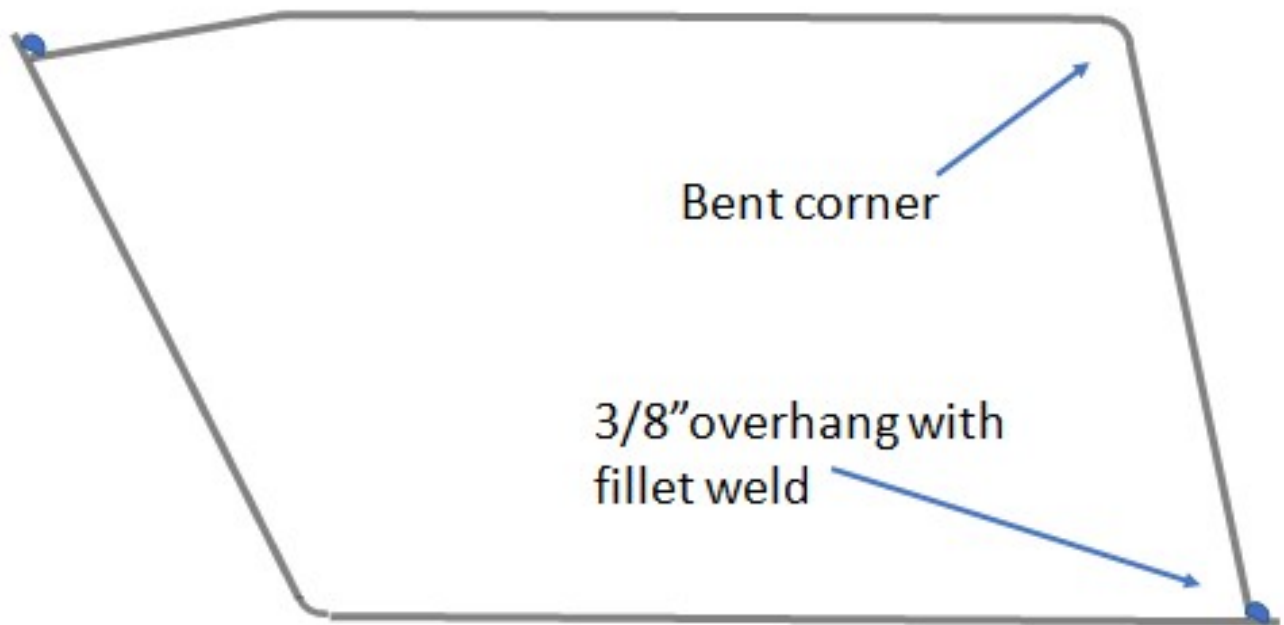
Boss detail: $\frac{3}{4}$ " x $\frac{3}{8}$ " x $\frac{3}{8}$ ",
tapped 5/16NC

Threaded bosses locations ($\pm \frac{1}{2}$ ")



"Sump" Detail

Sheet 5 of 5



Suggested fabrication detail
(ends inset 3/8" and fillet welded also)