What are our manufacturing options for the spherical ends of our tank?

**Machining with CNC mill**

**Potential Vendors**

* <http://www.ppmfg.com/>
* PSU melt
* PSU physics machine shop
* <https://www.protolabs.com/>
* <http://usherprecision.com/>

**Pros**

* No machine/labor cost to machine the part in-house (if the part only requires a 3-axis CNC mill).
* Lower lead time.
* Reproducible for future PSAS teams

**Cons**

* More material relative to other manufacturing processes.
* The end-product might be thicker, heavier.

**Questions**

* How do we fix a round part so we can machine both sides of the dome?

**Manufacturing videos**

* 3 axis milling for the outer part of the dome: <https://www.youtube.com/watch?v=uh9xZiqeF04>
* 5 axis milling for the inner part of the dome: <https://www.youtube.com/watch?v=NUoIzkCSpag>

**Hydroforming**

**Potential vendors**

<http://usherprecision.com/>

<http://www.amalco.com/hydroforming-oregon.html>

**Pros**

* Amalco will give parts for free if you want a small number of units (you must pay for set up)
* Less expensive than other metal forming methods, such as deep drawing when producing small quantities.
* Dome cross section is thinner.
* Can scale up to larger diameters.

**Cons**

* Potentially long lead time.
* Cost for set-up fee.

**Questions**

* Do they have standard sizes that fit our needs?
* Can we machine threaded holes in the part?
* How does this constrain the geometry of the part?

**Manufacturing videos**

* <https://www.youtube.com/watch?v=n-ht_5Ysurc>