Optical window for PEPS

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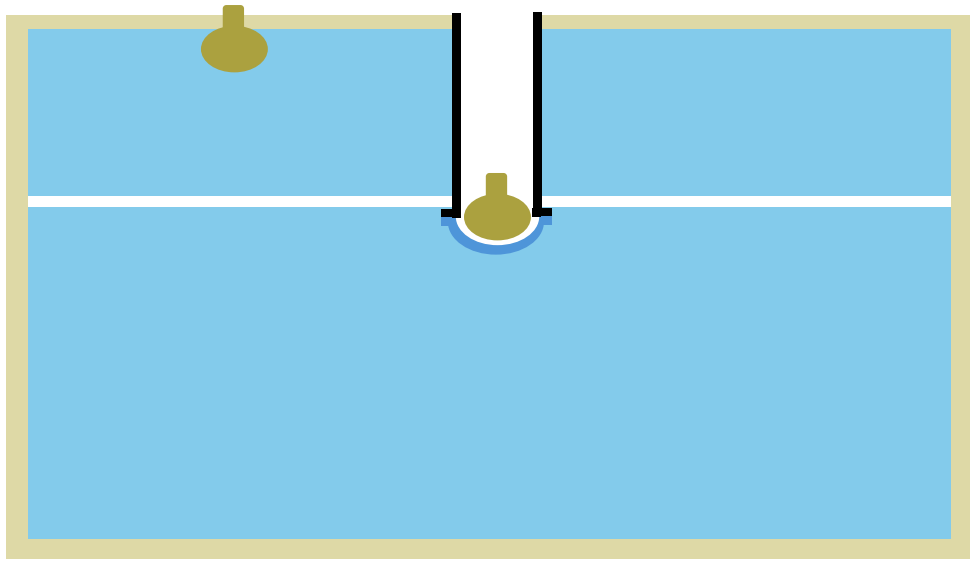
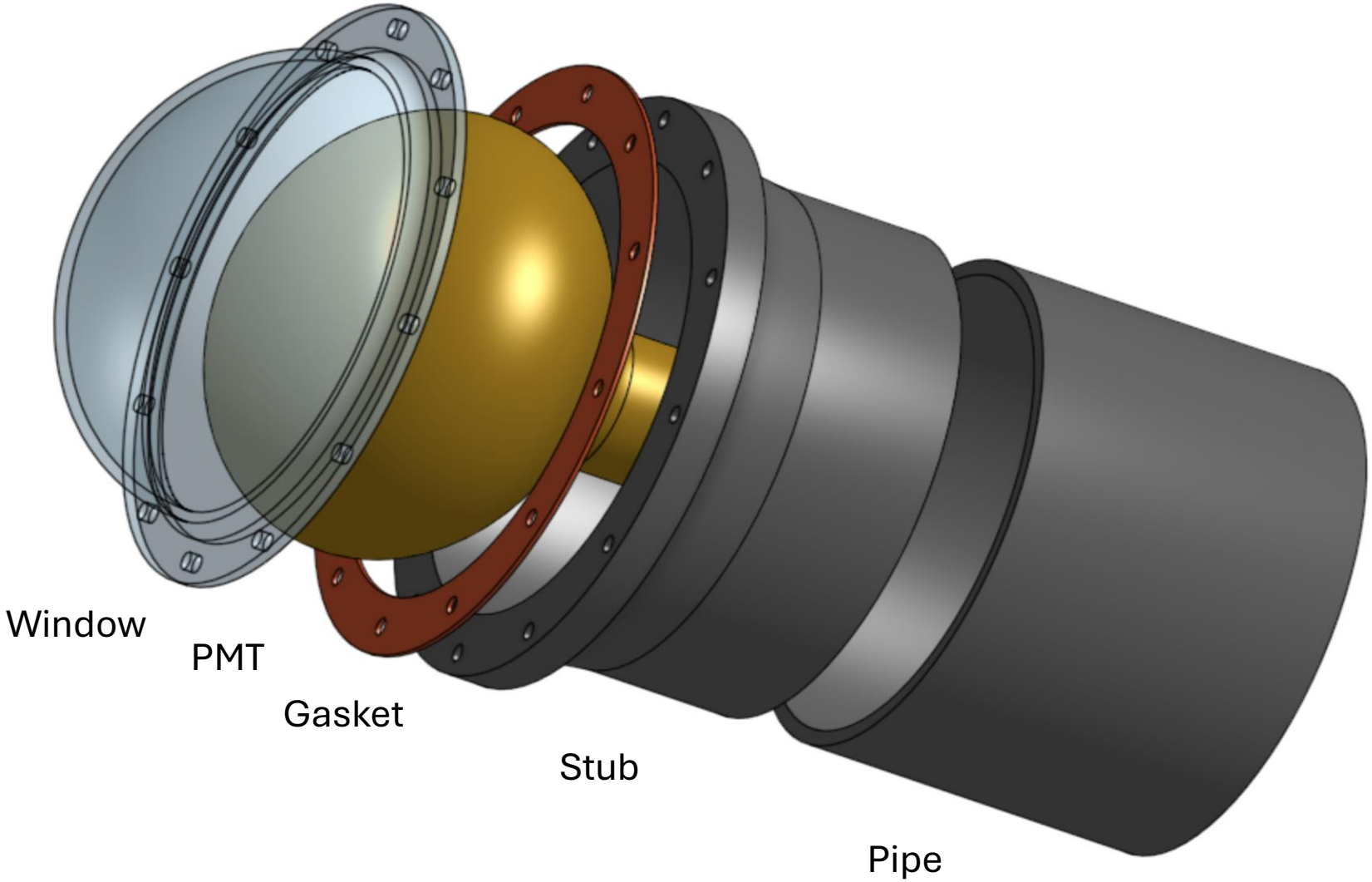
Mounting the lower PMT in the PEPS tank

- one assembly containing
  - vertical tube
  - optical window
  - gasket
  - PMT
  - optical coupling gel
  - (spacer to center the PMT base)
- ease of replacement in the field

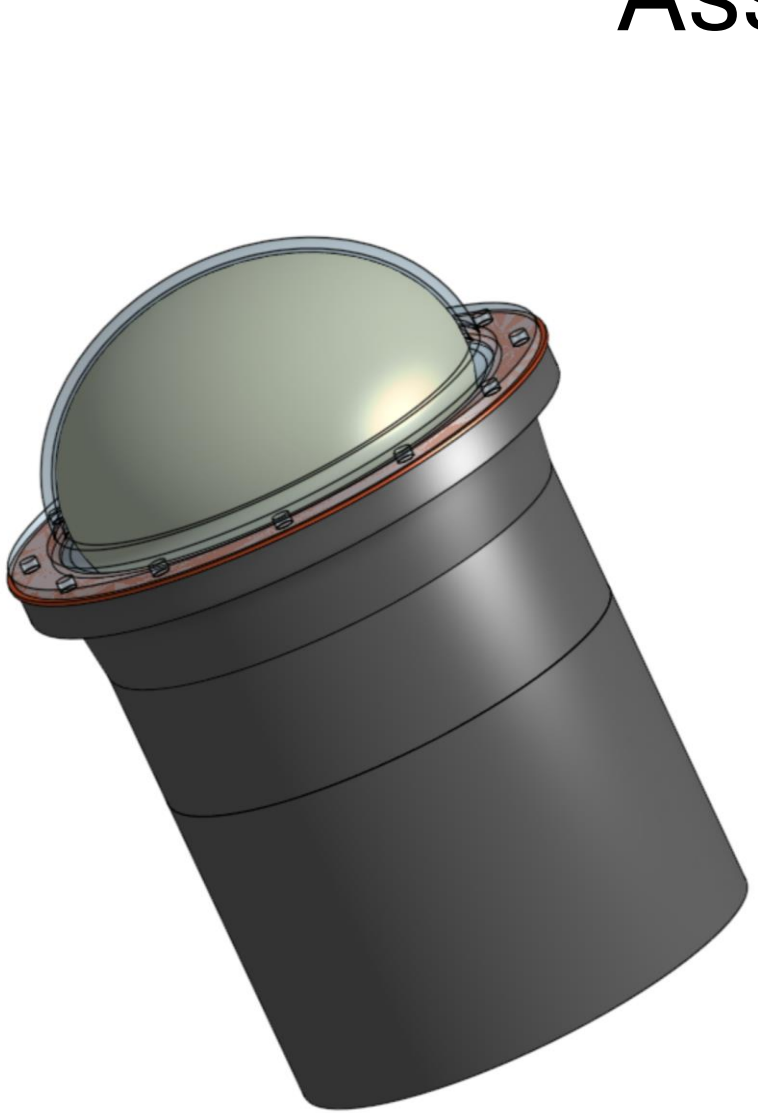


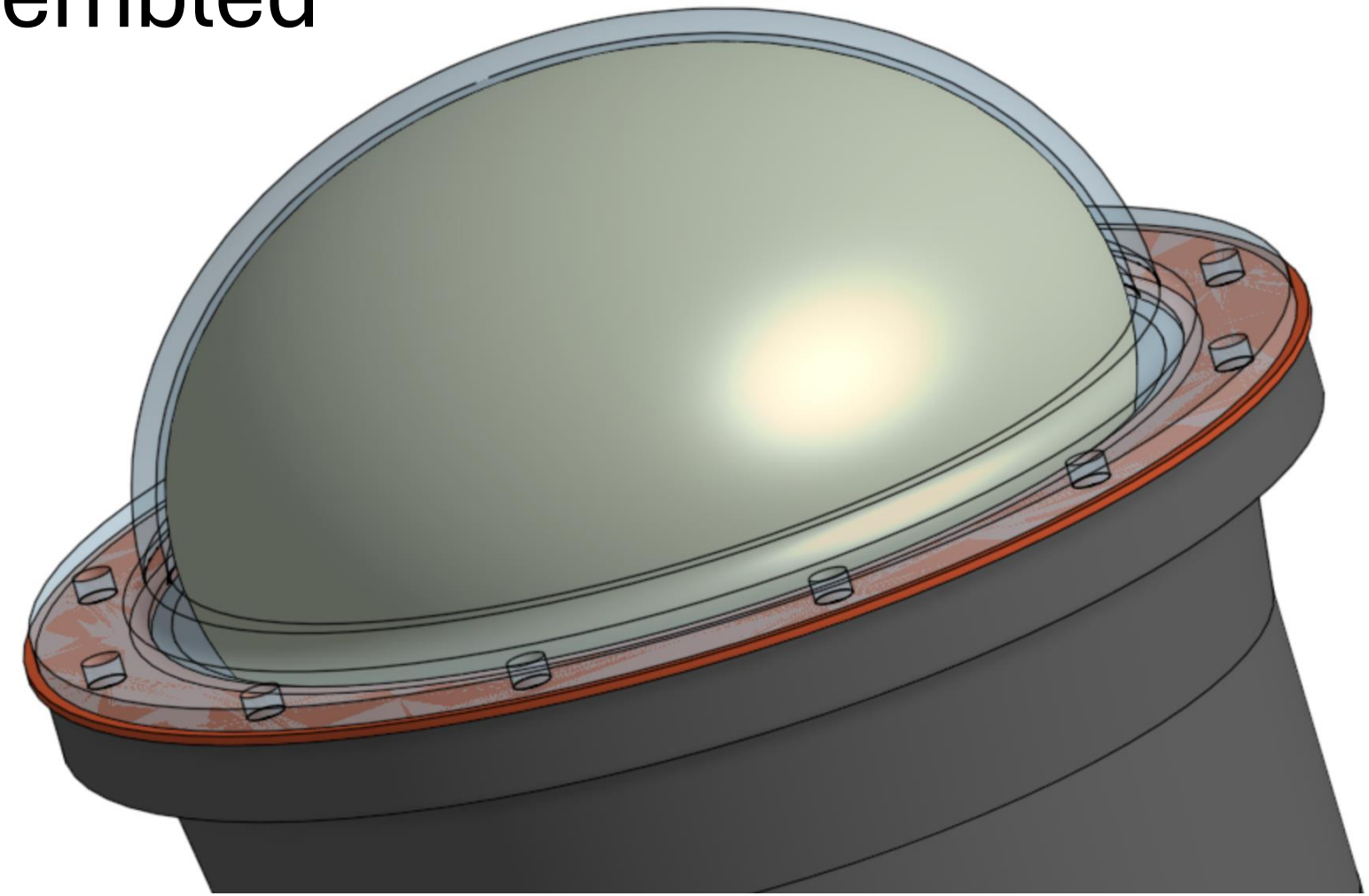
PEPS tank

Exploded view of assembly



Assembled





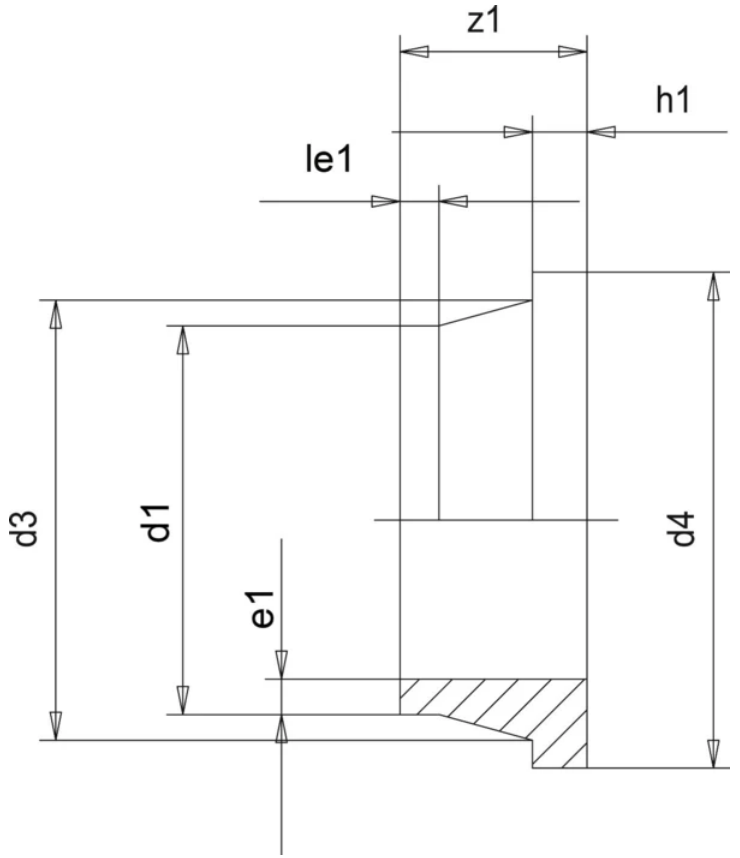
Vertical tube

- use available industrial parts and methods
- anti-static (conductive) polyethylene PE-EL, black
- SDR33 PN1.5 thin wall pipe rated for 1.5 bar
- outer diameter 225 mm (wall thickness 6.9 mm)
- use standard stub and pipe
- HDPE butt welding or fusion welding

PE-EL Stub and Pipe

Stub PE-EL SDR33 225 mm
(myvink.be art. 477532)

Pipe PE-EL SDR33 225 mm
(myvink.be art. 408799)



d1: 225 mm
e1: 6.9 mm
d3: 235 mm
d4: 268 mm
z1: 121 mm
h1: 18 mm
le1: 65 mm

(source: simona.de
product 01060038)

gasket contact surface needs to be machined flat and holes for bolts need to be drilled

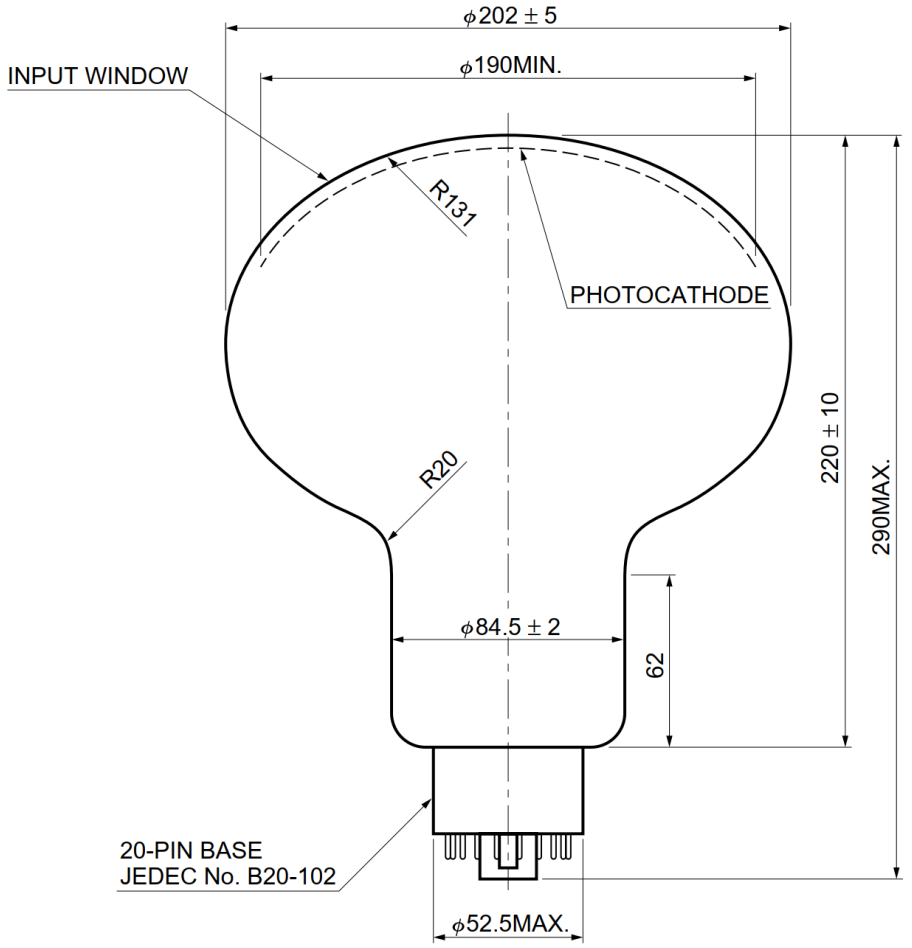
Gasket

- EPDM (Ethylene Propylene Diene Monomer) rubber ring gasket
- EPDM PN10/16 DN200 2mm (273x220x2) EN 1514-1 IBC
- holes need to be made (water jet cutter, laser cutter)

eriks.be
art. 11023934

PMT Hamamatsu R5912 dimensions unclear

- official datasheet has large tolerances
  - diameter 202 mm +/- 5 mm
  - length 220 mm +/- 10 mm
  - curvature of the cathode is spherical with radius 131 mm, no tolerance given

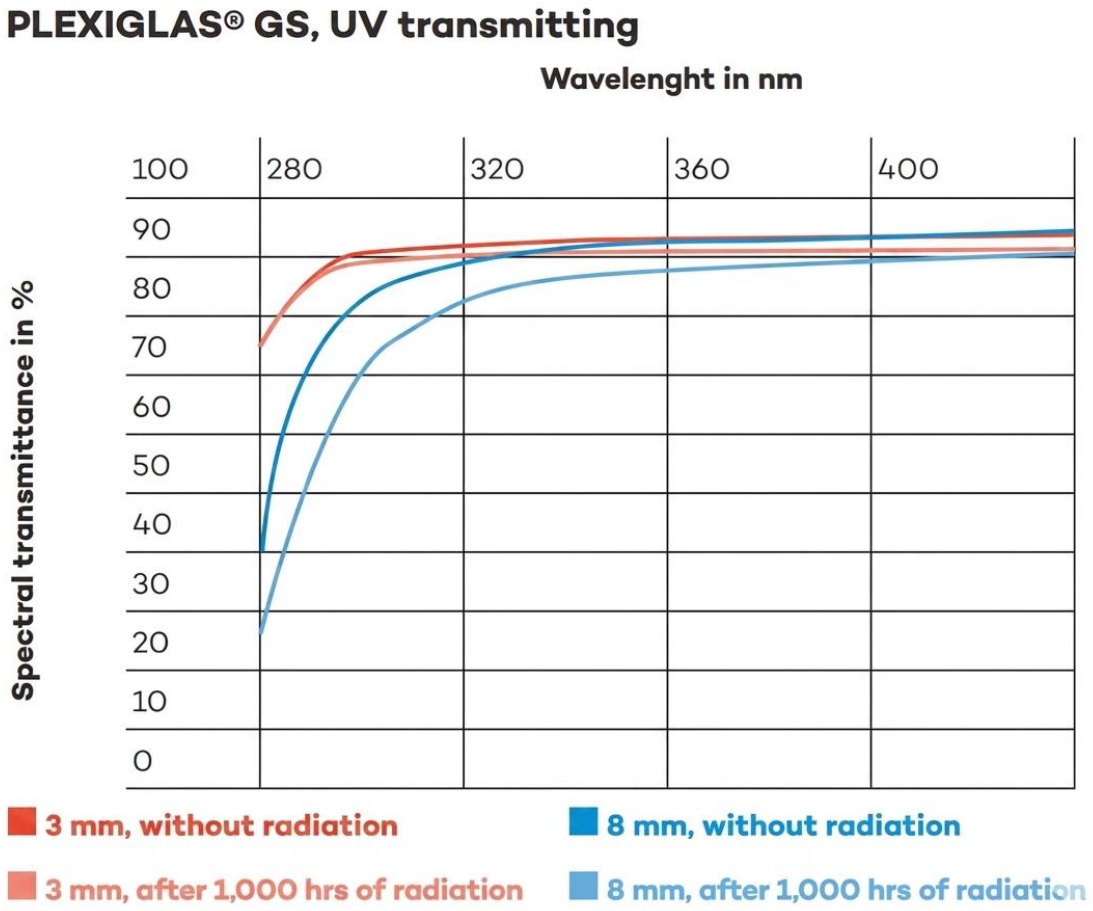


PMT R5912 measured dimensions

- measured 6 PMTs (N = 6)
- curvature is not spherical, it is elliptical
- large axis is 202 mm, small axis 150 mm (R101 x R75)
- all 6 PMTs are within 1 mm of this curvature
- let’s hope they are all within these limits…
- can be checked easily with 3D printed gauge

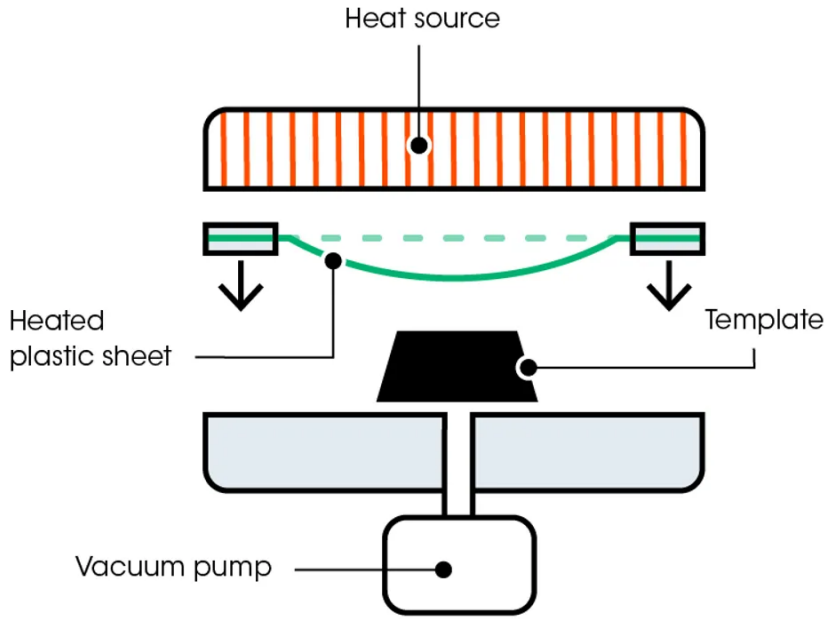
UV transparent acrylic

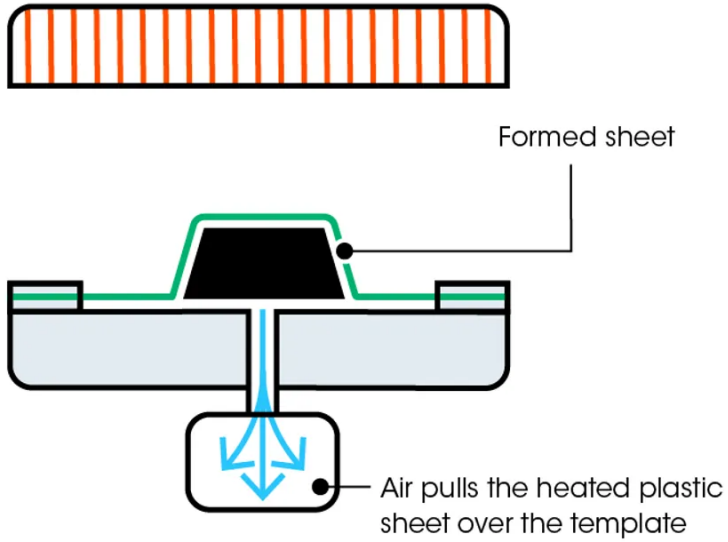
- acrylic (= PMMA, polymethylmethacrylate)
- PLEXIGLAS® GS Clear 2458
- high UV (ultraviolet) transmission
- main application: tanning beds
- 4 – 5 mm should have 90% transmittance to 300 nm (depending on internal reflections)



Vacuum Thermoforming

Centroform EZFORM SV 1217 V2





temperature for acrylic: 140ºC - 160ºC

template made of aluminium (expensive) or for small runs, MDF (Medium-Density Fibreboard, low cost) covered with heat resistant epoxy paint

Thermoforming effects on PMMA (acrylic)

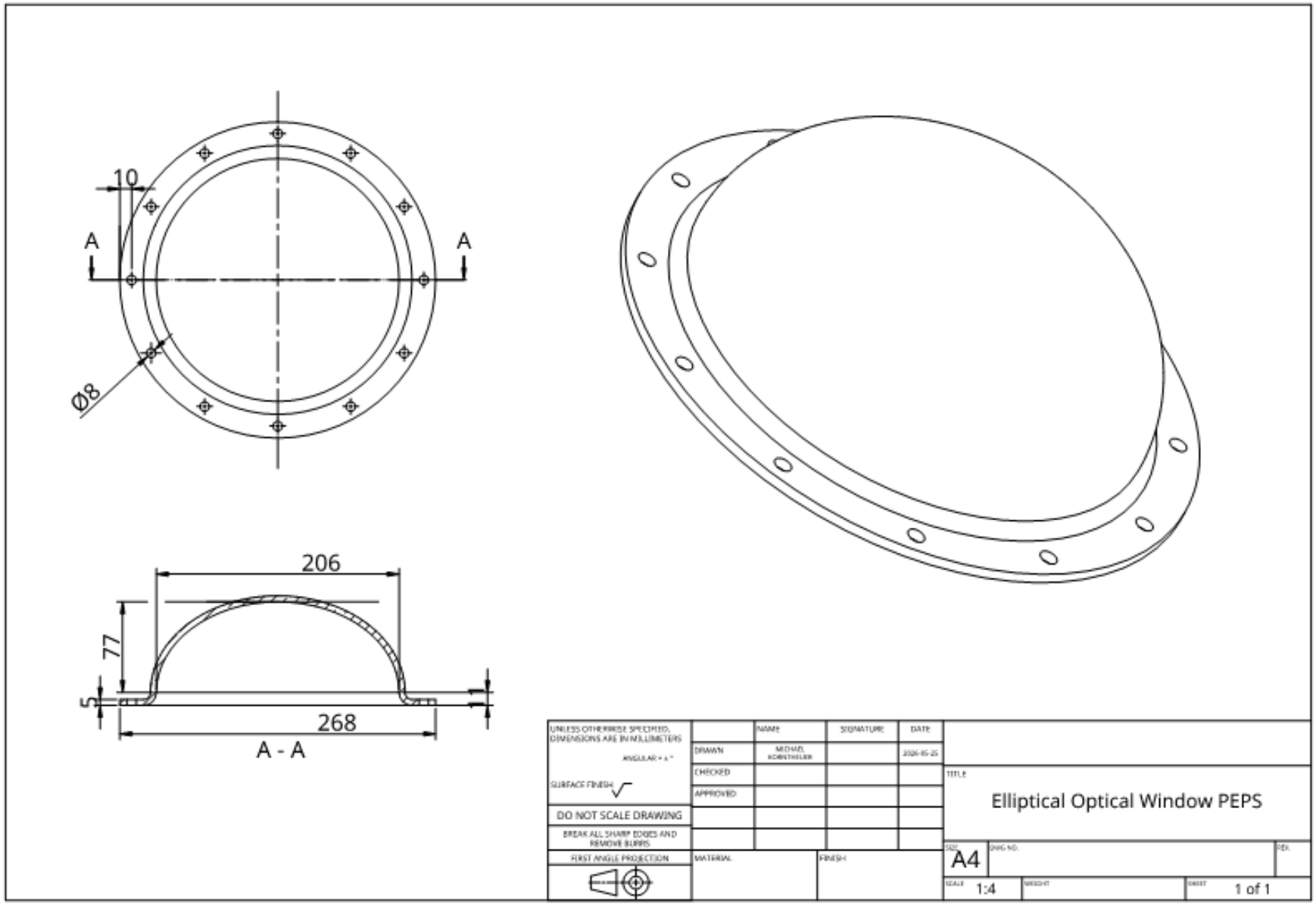
- internal stresses are created during thermoforming of acrylic
- internal stresses can slowly develop into crazing, cracking, or premature failure
- polymers are stretched which polarizes the light
- polarization is not important for our application, but it can be used to check internal stresses
- internal stresses in acrylic can be relieved by annealing: heating to 80°C, holding it for a few hours at 80°C, and then slowly cooling down

Water absorption of PMMA (acrylic)

- acrylic absorbs water until saturation, increasing weight 2%
- it takes 1 to 2 year to reach saturation
- at full saturation, acrylic expands about 0.4% (swelling)
- the optical window diameter (268 mm) increases with about 1 mm
- the stub material PE – EL has negligible water absorption and expansion
- the gasket (2-3 mm thick), the mounting bolts (spring loaded?), larger mounting holes in the window, and the (hydrophobic) non-curing optical coupling gel (20% extra?) must compensate for this difference in expansion
- How does Auger deal with this?

Optical coupling

- PMMA and borosilicate glass have almost the same refractive index (~1.49) so optical coupling is easy with a (hydrophobic) optical gel or even mineral oil
- the refractive index water is different (1.33)
- apply a broad spectrum anti-reflective coating/treatments on the water-PMMA interface (nanostructed coating, Sol-gel films…)?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