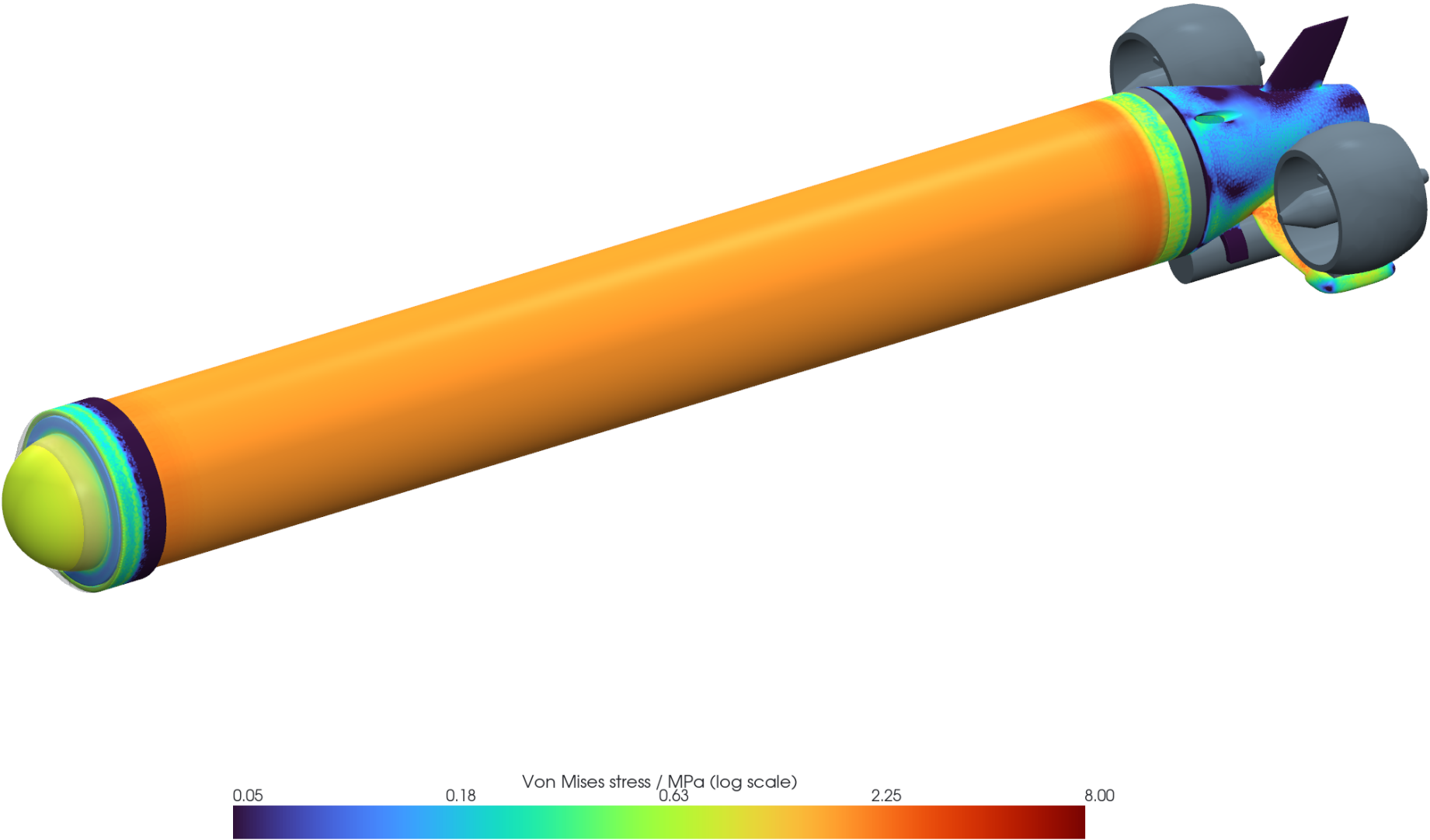


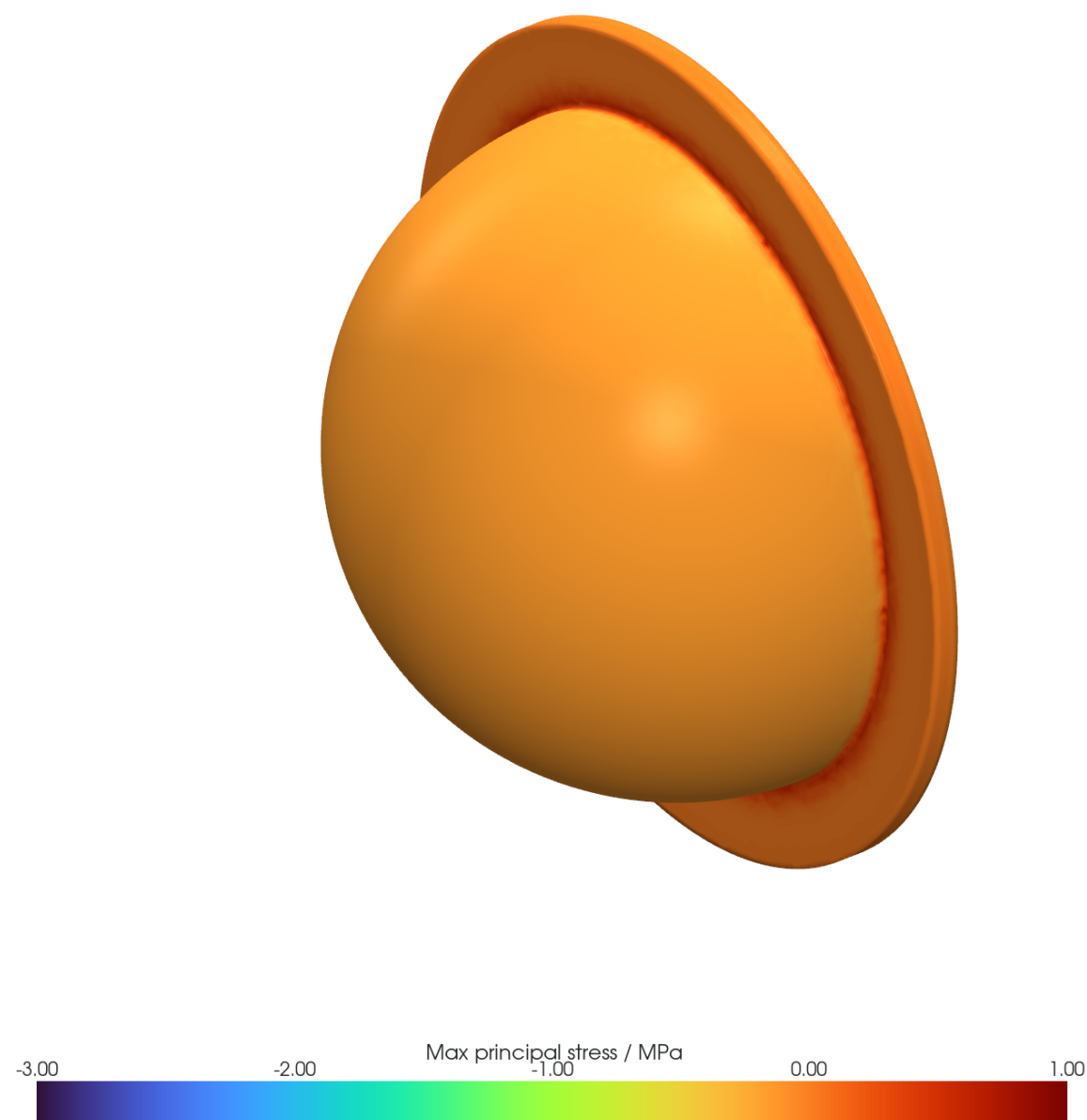
AUV structural study

15 m pressure closures / 20 N per thruster mounting case



Front dome

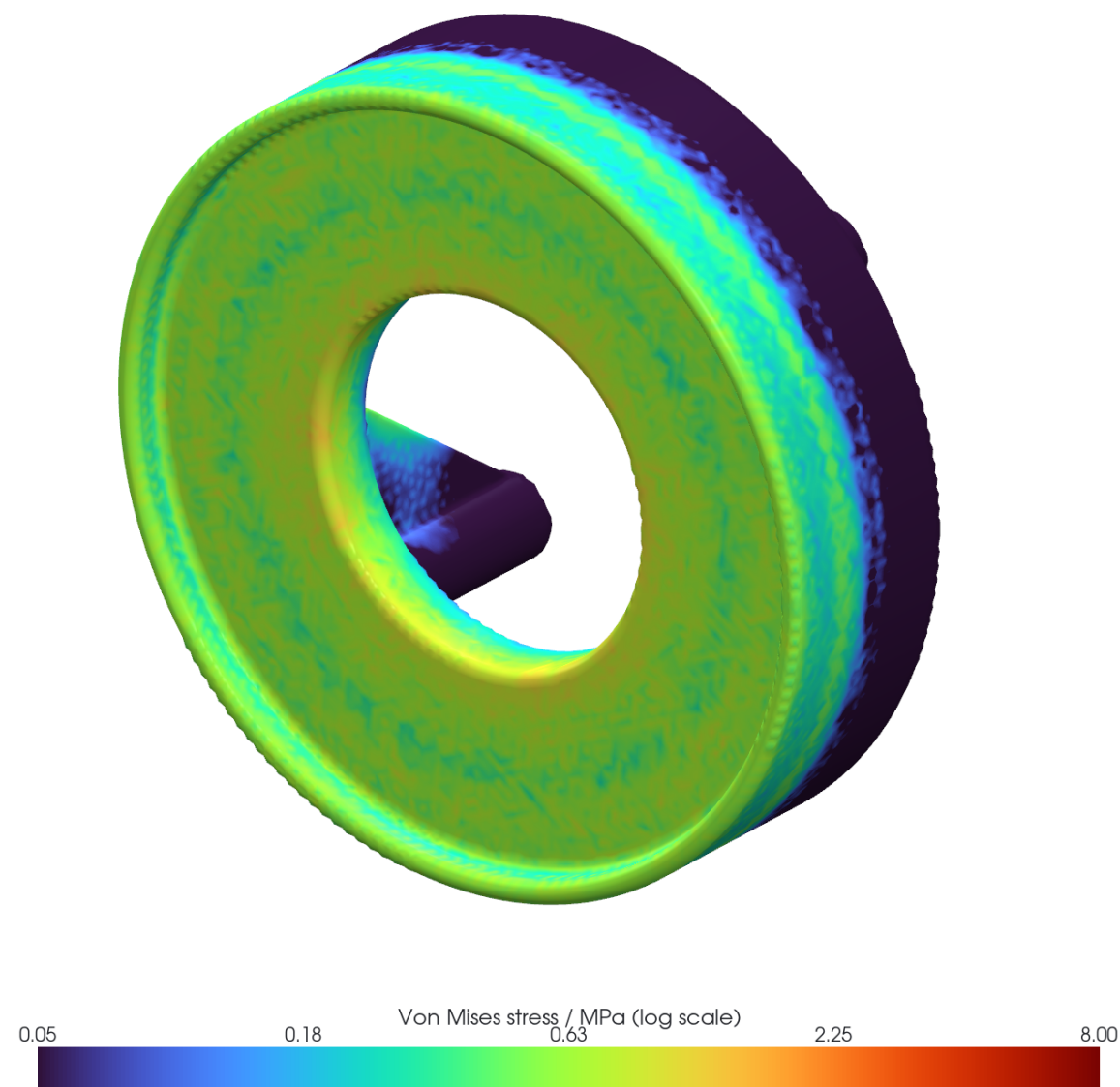
15 m external pressure / confirmed 3 mm acrylic



Exploratory elastic response Ideal support Not a measured failure load

Front closure

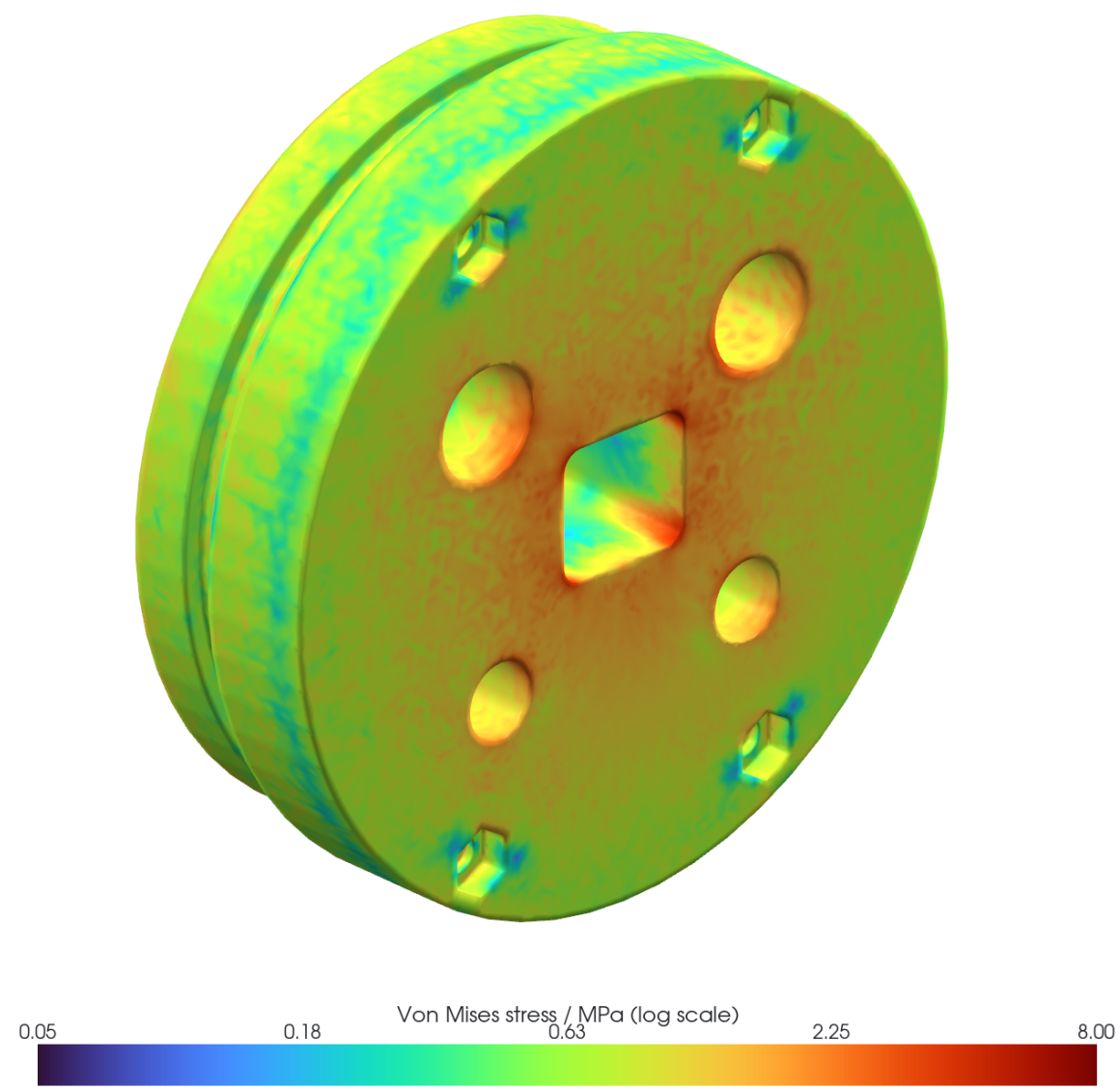
Dome load transferred to the printed hull socket



Exploratory elastic response Ideal support Not a measured failure load

Rear pressure plug

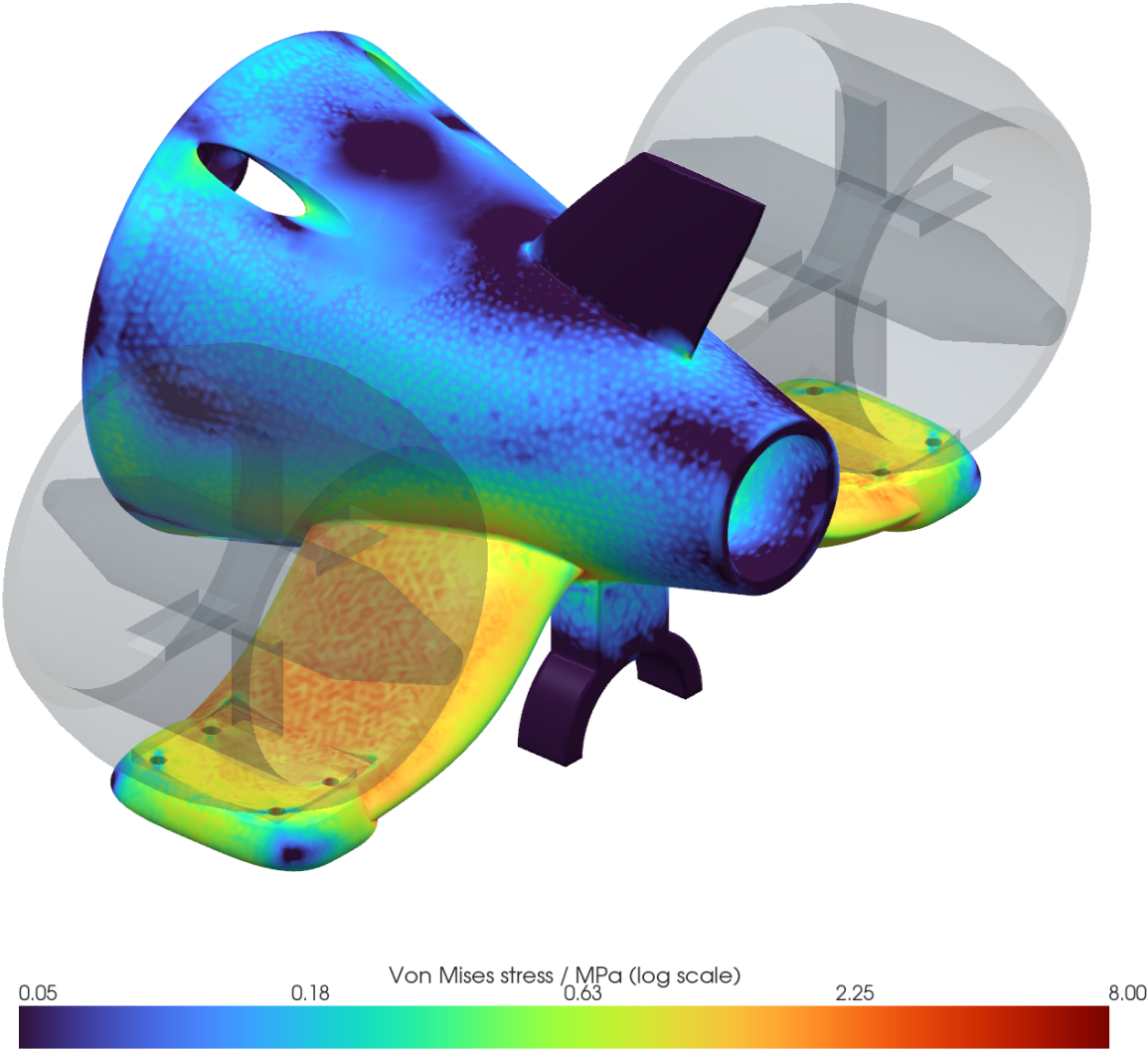
15 m equivalent closed-end load / sealed passages assumed



Exploratory elastic response Ideal support Not a measured failure load

Twin-thruster mounts

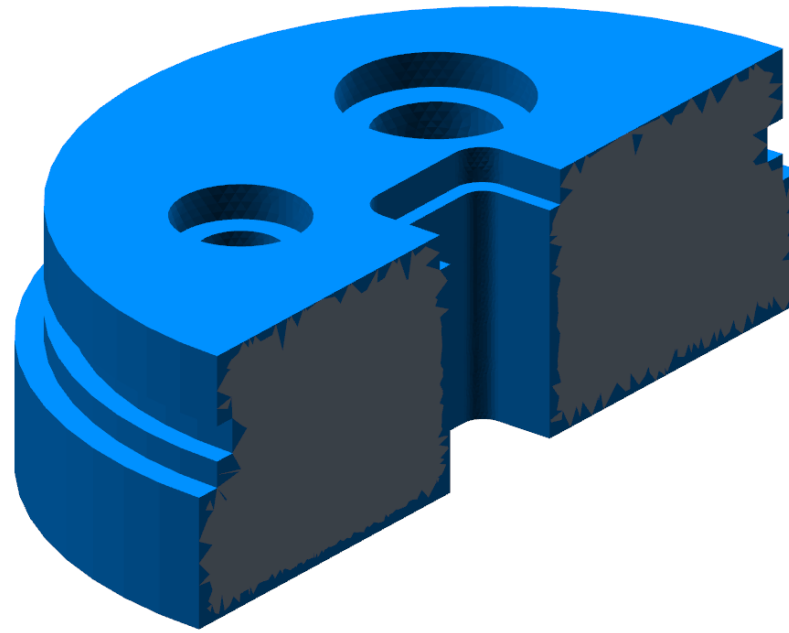
20 N per side / thrust-axis bending included



Exploratory elastic response Ideal support Not a measured failure load

Printed-part approximation

Blue: 1.25 mm skin envelope / gray: weak elastic core



Mesh-labelled continuum, not explicit infill or layer adhesion $E_{\text{skin}} = 2,000 \text{ MPa}$; $E_{\text{core}} = 200 \text{ MPa}$

Calculated response

Linear elastic component models, solved independently. The assembled view is a registered result montage, not one coupled contact model.

Component	Load case	Max movement	Stress field
PVC hull	15 m pressure	0.064 mm	2.19 MPa*
Dome	15 m pressure	0.012 mm	Principal stress
Front closure	1.155 kN axial resultant	0.052 mm	Von Mises
Rear plug	1.155 kN axial resultant	0.084 mm	Von Mises
Motor mounts	20 N per side + moment	0.470 mm	Von Mises

*Hull stress is the verified inner-wall midspan value, not the restraint-sensitive end peak. Component plots show nodal-extrapolated stresses; averaging across skin/core interfaces and ideal restraints affect local peaks.

Numerical checks

Applied forces balance support reactions to better than 0.001%.
All sampled quadratic-element Jacobians are positive. The hull matches the cylinder stress solution within 0.054%.

Maximum displacement changes between two meshes: dome: 0.0%; front: 11.8%; rear: 1.8%; tail: 3.9%. The front closure remains mesh-sensitive. Fracture stresses are not established.

Failure screening and assumptions

Pressure boundary

PVC: $E = 3,200$ MPa, Poisson ratio 0.40. Dome: user-confirmed acrylic and 3 mm wall, 80 mm diameter taken from the CAD. $E = 2,800$ MPa and Poisson ratio 0.35 remain representative material assumptions.

At 15 m, the nominal load on a 100 mm end closure is 1.16 kN. The generic unsupported-pipe buckling estimate is 225 kPa; an illustrative duration/ovality sensitivity reduces it to about 153 kPa, close to the applied 147 kPa.

Printed parts and joints

Approximate 1.25 mm PLA skin with $E = 2,000$ MPa and a weak core with $E = 200$ MPa; Poisson ratio 0.35. The core modulus is an assumed sensitivity value, not a measured property or an infill-percentage conversion.

The saved rear-plug profile has three walls and 10% infill. Toolpaths, voids, layer adhesion, creep and water aging are not explicitly modeled. Attachments are ideally fixed; the confirmed rubber sleeve and two hose clamps are not simulated as contact.

A break depth cannot be assigned from these elastic results

Dome cracking, printed-layer fracture, hull buckling, adhesive separation, cable-potting failure and O-ring leakage need different failure criteria. No calibrated strength/damage model or complete-assembly pressure validation is available. Seal leakage may occur before any visible structural failure.

15 m is an analysis load case, not an approved operating depth. The tail case is an illustrative mounting load, not a measured U2 thrust limit. Purchased motors, cosmetic fairing, spacer, clamps and seals are not strength-validated here.

Reproducibility

Geometry and solver

Existing front-plug, rear-plug v3 and straight-cone tail v8 release CAD. Assumed analytic dome matched to the portfolio assembly. CalculiX 2.22: quadratic C3D20R hull elements and C3D10 component elements. Gmsh 4.15.2 meshing. Independent component supports deliberately replace unresolved contacts.

Study files

Full-vehicle and component PNG/WebP images are provided for the portfolio. Input decks, calculated fields, geometry/force checks and scripts are retained in the local study directory. The original portfolio and CAD print releases are unchanged.

References

[CalculiX - solver documentation](#)

[Gmsh - quadratic elements and mesh API](#)

[Vinidex - PVC external-pressure buckling guidance](#)

[User-selected PERIPLAST drainage tube](#)

Material inputs are explicit modeling assumptions. No manufacturer material certificate or actual-build failure test was supplied.