Permeability Model User Testing Form (FEniCSx)

1. Test Case ID
FVA-FENICSX-001

2. Model / Feature Being Tested
Permeability_Initialiser.py

3. Task Objective
The user is supposed to verify that the complete set of xdmf and h5 files is given correctly as an output.

4. Preconditions / Setup
Tetrahedron for 3D tetrahedral meshes
• Dirichlet and Neumann Boundary Conditions
• e_ref: reference vector normal to the surface; K1_form: [0, 0, 0, 0, 0, 0, 0, 0, 1]
• Installed packages FEniCSx
• HPC (Crescent2)

5. Testing Steps / Procedure
1. Load mesh from b0000/clustered. Xdmf
2. Define permeability field
3. Set up variational form and apply boundary conditions
4. Run `solve()`
5. Postprocess velocity and pressure fields

6. Expected Output / Behavior
K1_form.xdmf(written in XDMF + HDF5 format)

K2_form.h5(raw HDF5 format)

eloc.xdmf: local vessel orientation field

main_direction: main vessel direction field

7. Observed Output / Results
Visual results with good resolution

8. Pass / Fail
Pass

9. Logs / Screenshots / Code Snippets
Paraview screenshots are given as results with slices in the three axis

10. Issue Severity (if applicable)
☒ Low – Affects documentation or minor setup
☐ Medium – Output deviates from expected result, but simulation runs
☐ High – Wrong physics behavior or incorrect solver results
☐ Critical – Solver fails or outputs NaNs/infinite values

11. Observations
The code doesn’t run on MPI; it can only run on serial at Crescent2