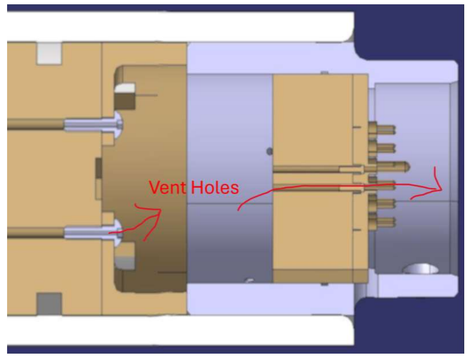
Designing a Probe Head for Extreme Environments

Turbulence Probe Design Considerations

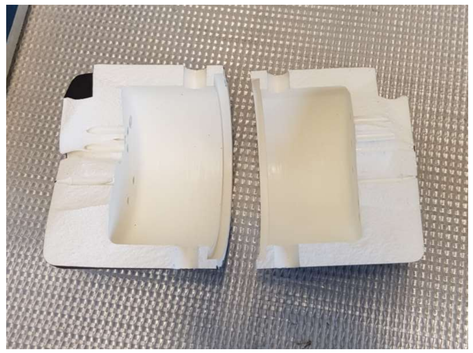
Material Choices:

- Graphite – Probes
- Boron Nitride – Ceramic Shell
- Polyether Ether Ketone – Internals
- Stainless Steel – Plug Housing, Screws



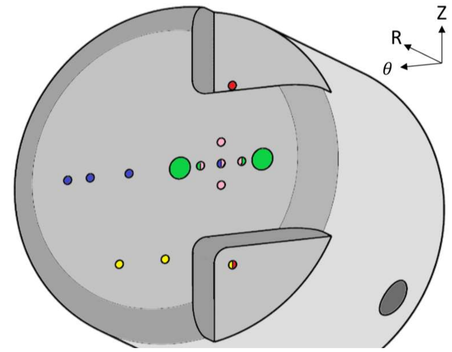
Vacuum Considerations:

- Void Breaking
- Vent Holes
- Pumping Pathways



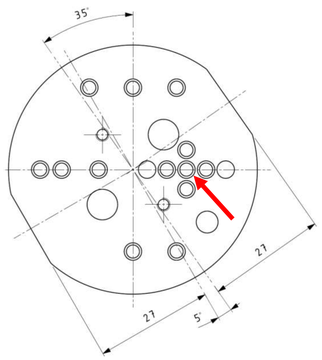
Thermal Expansion:

- Clearance of 0.4mm
- PEEK expanded by 0.7mm
- Clearance of 1.4mm for new design

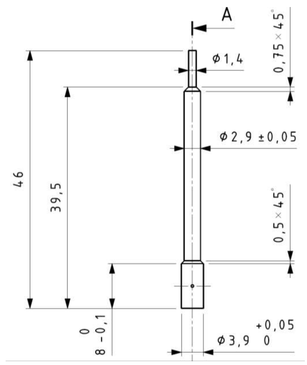


Multifunctional Probe Arrays:

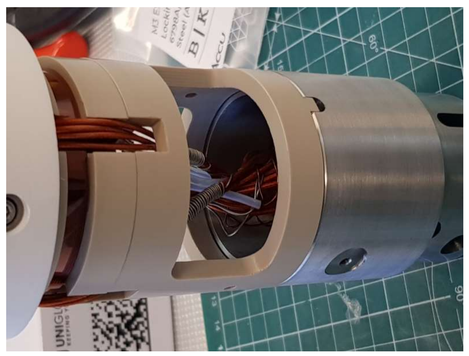
- Blue – Log-spaced for cross-correlations
- Green – Ball-Pen Probes $\Phi_{\mathrm{Plasma}}, T_{\mathrm{e}}$
- Pink – 5-pin balanced probe $n_{\mathrm{e}}, T_{\mathrm{e}}$
- Yellow – Linear array filament stats
- Red – Parallel Mach number



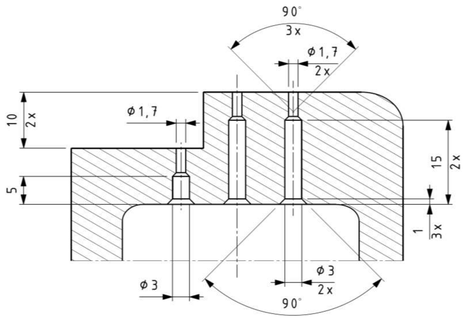
- Asymmetric con-flats ensure one way to fit the shell cap
- Middle space raised for central pin
  - Needs to peak above the rest of the array
  - Allows for same pin dimensions reducing unique parts



- Thick probe until near the tip
- increase strength
- reduce breakages
- Vent hole



- Cabling routed in coil winding channels
- Kapton insulation between coils and cables
- Common earthed shield for cables
- Spacer gives room for wiring



- Wide countersink for centring pins
- Stepped to match pins prevent plasma leakage