Macor Machining FAQ — 30 Questions (Engineer Edition)

This document contains 30 concise frequently asked questions and answers about machining Macor machinable glass-ceramic, along with a First Article Inspection (FAI) checklist template for use in quality control. Use the Excel template provided alongside this PDF to record measurements and FAI data.

Q: What tooling is best for machining Macor?

A: Carbide tooling with polished flutes is recommended. Use sharp carbide end mills or micro-drills to minimize chipping and cracking; HSS is not preferred for finishing.

Q: What tools and process are recommended for Macor micro-holes (0.1 mm)?

A: Use specialized micro-drills, low feed rates, peck-drill cycles, and air blow for chip evacuation. High spindle rigidity and minimal vibration are critical.

Q: How to manage tool life to maintain tolerances?

A: Implement a tool-life log, replace tools by lifecycle, and verify critical dimensions on sample parts to detect drift. Record tool IDs in the program and FAI.

Q: What tooling and post-processing for optical support surfaces?

A: Use ultra-fine carbide for finish passes, then wet polishing and ultra-fine grinding. Final ultrasonic cleaning is recommended for optical-grade Ra targets.

Q: How to reduce tool-induced microcracks?

A: Use shallow depth of cut, low radial engagement, high spindle speed, and uniform support. Avoid impact cooling and use sharp tooling.

Q: Are coated tools suitable for Macor?

A: Some coatings can extend life but may affect edge behavior. Test coated tools in trial cuts and compare surface finish and forces before full use.

Q: What cutting strategy (rough/semifinish/finish) is recommended?

A: Use three-stage strategy: roughing to remove bulk, semi-finish to refine geometry, and finish with shallow passes to achieve final tolerance and surface quality.

Q: Dry machining or minimal lubrication — which is better?

A: For high surface quality, dry or minimal lubrication is preferred. Spray cooling can be used for heavy removal but avoid thermal shock to the part.

Q: How to prevent chipping and burrs?

A: Reduce depth and feed, use support fixtures, add chamfers, and apply multi-pass finishing. Replace worn cutters promptly to avoid increased chipping.

Q: What fixturing strategy works for long thin walls?

A: Use vacuum fixtures, soft jaws, distributed soft-pads, and temporary supports. Avoid point clamping that concentrates stresses.

Q: Typical parameter ranges (speed/feed/depth)?

A: Parameters depend on machine/tool. Example micro-milling ranges: high spindle (tens of thousands RPM), very small feed per tooth, cut depths 0.05–0.2 mm. Always validate on test coupons.

Q: How to control thermal stress during machining?

A: Avoid rapid local cooling, use steady cutting conditions, consider micro-lubrication, and maintain stable ambient temperature to minimize thermal-induced cracking.

Q: Is Macor suitable for UHV and how to ensure low outgassing?

A: Yes — with validated cleaning and controlled bake-out. Document cleaning steps and bake-out profile to demonstrate low outgassing for UHV use.

Q: Typical bake-out procedure and temperatures?

A: A common starting point is 150–200°C for several hours, but final conditions must match the assembly, adhesives, and system requirements.

Q: How to clean Macor parts to remove organics?

A: Use ultrasonic cleaning with isopropyl alcohol or ethanol, followed by DI water rinse and controlled drying before bake-out.

Q: Which adhesives or sealants to avoid in vacuum assemblies?

A: Avoid high-volatile organics and uncured adhesives. Use vacuum-rated, low-outgassing epoxies or metallic/ceramic joining methods when possible.

Q: How dimensionally stable is Macor under high-temperature vacuum?

A: Macor has predictable thermal expansion; allow for small dimensional shifts in design and verify with FEA or test parts for critical fits.

Q: Common vacuum failure modes for Macor components?

A: Surface contamination, assembly-induced microcracks, and incompatible adhesives. Strict IQC, cleaning and bake-out protocols reduce risk.

Q: What to consider when joining Macor to metal?

A: Match thermal expansion, avoid concentrated stresses, use compliant transition pieces or low-temperature metallization/brazing methods validated by testing.

Q: How to design inspectable assembly datums?

A: Include dedicated datum faces or shoulders for CMM fixturing, and clearly call out datum references on drawings for repeatable inspection.

Q: Do bolted joints cause cracking and how to avoid?

A: Point clamping can induce cracks. Use distributed clamping, soft pads, or metal bushings to spread load and reduce local stress.

Q: Recommendations for hermetic sealing or glass-frit bonding?

A: Ensure CTE matching and validate frit or braze process in controlled atmosphere. Consider low-temperature alternatives if assemblies are heat-sensitive.

Q: How to provide shielding/grounding when using Macor insulators?

A: Apply metalized layers or integrate metal shields; validate adhesion and thermal cycling stability of metalization.

Q: How to record and trace QC after assembly?

A: Use an FAI report that includes drawing revision, material lot, cleaning and bake-out records, measurement results, photos, and sign-offs.

Q: When to choose Macor over alumina?

A: Choose Macor for complex geometry, ease of machining, and prototyping where high mechanical load is not required; choose alumina for higher strength/wear.

Q: Differences between Macor, AIN and Shapal?

A: Macor is machinable but lower thermal conductivity and strength; AIN offers high thermal conductivity; Shapal is a machinable AIN-like composite with better mechanical properties.

Q: Are there lower-cost prototype alternatives to Macor?

A: Engineering plastics may be cheaper for non-vacuum prototypes but lack Macor's thermal stability and vacuum compatibility; assess function before substituting.

Q: Is Macor suitable for medical device parts?

A: Macor can be machined to precise shapes, but biocompatibility and sterilization compatibility must be verified per application and regulations.

Q: How to decide between Macor and metal for a given application?

A: Assess electrical, thermal, mechanical requirements. Use Macor for insulation, vacuum compatibility and complex geometry; use metal for load-bearing or conductive needs.

FAI / Inspection Checklist (Quick Reference)

Part Number	
Drawing Revision	
Quantity	
Material	Macor (Corning)
Material Lot/Batch	
Customer	
Production Date	
Inspector	
Machine ID	
Program ID	
Fixture ID	
Tool IDs	
FAI Sample ID	Sample-001
Bake-out Temp (C)	
Bake-out Duration (hr)	
Vacuum Level (mbar/torr)	
Cleaning Method	Ultrasonic IPA + DI rinse
Surface Finish (Ra)	Ra0.01 μm

Measurement Points Template

Point ID	Feature	Nominal (mm)	Tol (+/- mm)	Measured	P/F
P1					
P2					
P3					
P4					
P5					
P6					
P7					
P8					
P9					
P10					

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