PCB Machining Check List

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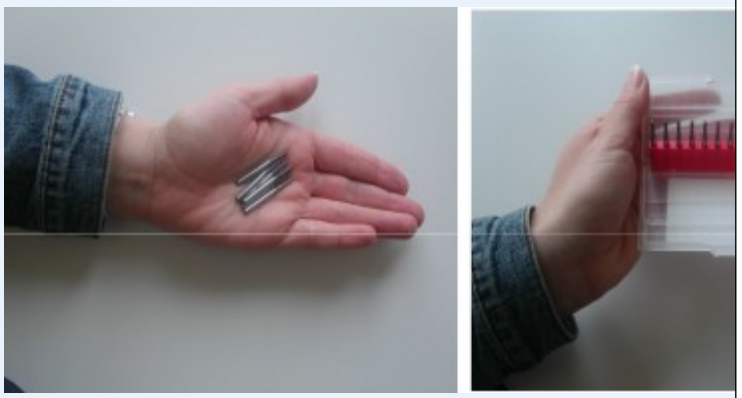
Impact	Description	GLOBAL TECHNOLOGY's recommendation
Base material	In most cases the base material is already specified and offers little room for change. The best balance between quality and cost comes from choosing the right tool and fine-tuning the machining parameters for each specific application.	**⇒ GLOBAL TECHNOLOGY parameter recommendations for different applications are available on our website:** www.global-technology.ch
Drilling	PCB machining typically relies on straight-flute drills with varying helix angles, and in some cases undercut drills. A helix angle of 38° or more brings a clear benefit for chip evacuation and surface finish.	**⇒ GLOBAL TECHNOLOGY products for different applications are available on our website:** www.global-technology.ch
Routing	Inner and outer PCB contours are machined with spiral- or diamond-cut routers. Spiral-cut routers offer a clear edge in dimensional accuracy and surface finish. Depth routing, and machining of IMS and non-ferrous metals, calls for two-flute end mills.	⇒ GLOBAL TECHNOLOGY recommends ordering routers with set rings from your supplier, where required.
Handling	How tools are handled has a major effect on dimensional accuracy, and cutting edges are easily damaged. For this reason, tools should be moved straight from the manufacturer's packaging into the tool cassette, without any intermediate handling.	**Wrong vs. correct handling:**  Left: wrong — tools loose in the hand. Right: correct — tool moved directly from packaging into the tool cassette.
Machine	Machines need to meet the required quality standards. Servicing them regularly according to the manufacturer's specifications keeps the process stable and the quality consistent, which in turn extends the life of spindles, collets and tools. Collet run-out should be checked on a regular basis. PCBs are held on the machine table with pressure feet: small, rigid pressure-foot	**⇒ GLOBAL TECHNOLOGY recommends:** • drilling spindle run-out: ≤ 10 µm • routing spindle run-out: ≤ 25 µm • daily cleaning of collets on routing machines

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	inserts work best for drilling, while brush inserts with short, stiff plastic bristles are the right choice for routing.	• routing spindle speed ≥ 80,000 rpm • 1.00–2.00 mm gap between the tool tip and the pressure foot
Extraction	Extraction performance strongly affects both quality and tool life. Suction values are only meaningful when measured directly at the pressure foot, and a central extraction system is the preferred setup.	**⇒ GLOBAL TECHNOLOGY recommends:** ≥ 50 mbar, measured at the pressure foot

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Parameter	Spindle speed, feed rate and return stroke are the key variables here, and all of them depend on tool diameter and base material.	**⇒ GLOBAL TECHNOLOGY parameter recommendations for different applications are available on our website:** www.global-technology.ch
Pre-drilling	For standard-geometry drills larger than the shank diameter, pre-drilling is recommended. With GLOBAL TECHNOLOGY drills larger than the shank diameter, pre-drilling is generally unnecessary (depending on the spindle) — their tapered diameter and thinned web cut Z-axis forces to under 50% of what standard-geometry drills require. On routing paths, pre-drilling at the start and end point improves accuracy, cleanliness and router tool life, and lets infeed be increased up to fourfold.	**⇒ GLOBAL TECHNOLOGY recommends:** • type 1534 when drill-Ø > shank-Ø • for drilling: pre-drill at 15–20% of the drill diameter, where needed • for routing: pre-drill with drill-Ø = router-Ø
Routing direction	The direction of routing has a direct impact on surface quality, dimensional accuracy and router tool life.	⇒ GLOBAL TECHNOLOGY recommends routing outer contours counter-clockwise and inner contours clockwise.
Working length / Stack height	Working length and stack height affect productivity, dimensional accuracy and the machining parameters alike. The unused flute length needs to be factored in for chip removal and for how far the tool penetrates the backup material: working length equals stack height plus entry material plus penetration depth into the backup material.	**⇒ GLOBAL TECHNOLOGY parameter recommendations for different applications are available on our website:** www.global-technology.ch
Tool life	Tool life depends on a combination of factors: base material, tool, diameter, flute length, parameters, stack height, surrounding machinery, extraction, and quality requirements.	**⇒ GLOBAL TECHNOLOGY recommends:** • diamond-coated drills: tool life increases by a factor of 20 • diamond-coated routers: tool life increases by a factor of 12 • drilling and routing IMS and non-ferrous metals: feed rate increases by a factor of 3–4 compared to uncoated tools

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Entry material / Backup material	Entry materials improve drilling accuracy, cut down on burr formation and protect the PCBs during machining. For drill diameters below 0.30 mm and other demanding applications, using a lubricated entry material further improves process capability. Backup materials also help reduce burrs and are typically applied on both sides of the panel.	**⇒ GLOBAL TECHNOLOGY recommends:** • a hard, thin entry material free of surface defects • a coated backup material with a hard, flat surface and minimal thickness tolerance
Tool deflection / Diameter compensation	Some dimensional deviation between the top and bottom of the panel is unavoidable, and depends on tool diameter, flute length, parameters, base material, entry material and stack height. When routing outer contours, the router is drawn into the material, so the bottom panel comes out slightly smaller than the top. Diameter compensation corrects for these effects on the routing process — including router run-out, wear and other system influences — bringing top and bottom back into alignment.	