WALTER

_ EXPERTISE IN MACHINING

Machining composites intelligently.

Industry-specific

Composites

HIGH-TECH MACHINING.

Carbon-fibre reinforced plastic (CFRP) is the most well-known of composite materials. CFRP is a key technology material used in situations that call for a high level of weight-specific tensile strength and rigidity: For example in Automotive, in the manufacture of sporting equipment or in the aerospace industry. The particular properties of CFRP used in Aircraft manufacture enables longer range flights together with lower energy consumption. Greater rigidity also allows for higher cabin pressures. CFRP's excellent corrosion resistance permits a higher level of cabin air humidity, which passengers really appreciate especially on long-haul flights. CFRP is also undemanding in terms of maintenance and care.

But the same does not apply when it comes to machining CFRP. What is required in this case is the elimination of fibre breakouts and uncut fibres. The abrasive fibres rule out the possibility of using conventional cutting tools for machining Composites and stack materials. Stacks such as CFRP/Titanium are very difficult to machine due to the different material properties.

As a full-service provider with many years of experience, we can provide you with the right machining solutions for CFRP and other similar materials. To show you what we have to offer, this brochure contains a selection of our high-tech drilling tools for composites, as used in the aerospace industry. Our specialists look forward to hearing about your particular task. Please contact us for more information.

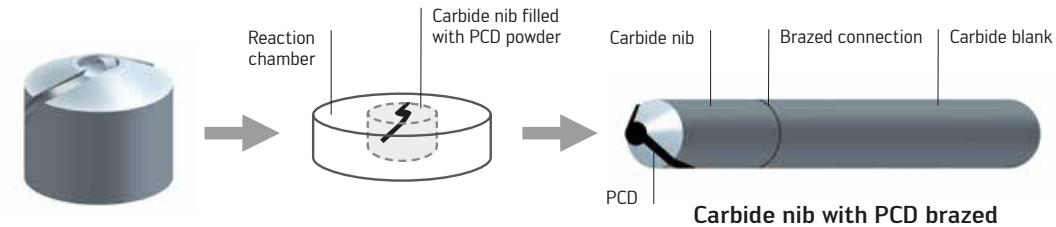
WALTER WALTER TITEX WALTER PROTOTYP

PCD VEIN TECHNOLOGY

When drilling CFRP and titanium, the Walter PCD Vein tools enable high cutting speeds and excellent dimensional accuracy with minimal wear.

The innovative production technology for PCD Vein tools is state of the art. Including a special designed carbide nib in which the PCD is sintered. The nib is brazed onto the shank before precision grinded and final geometry eroded.

Walter Titex PCD Vein rivet drill
The PCD Vein is sintered at 1500 °C and 60,000 bar, which turns this rivet drill into a special high-tech tool for excellent machining with no fraying and low burr formation in titanium.



Carbide nib | **Sintering process** | **Carbide nib with PCD brazed onto blank**

AFT1P 130° point angle
Geometry for stacks made of fibre composite materials and metal. Cutting edge geometry optimised for titanium materials with integrated coolant channels for emulsions and MQL machining.

Reconditioning: 2 to 3 times

AF3P 125°/90° point angle
Geometry specially designed for unidirectional fibres and other fibre materials with a high risk of fibre breakouts. Also suitable for use with multi-directional respectively woven fibres.

Reconditioning: 2 to 4 times

AFE1P E-point
Geometry for curved CFRP components, thin materials and aramid fibres. The tool can alternatively be used for AF3P geometry.

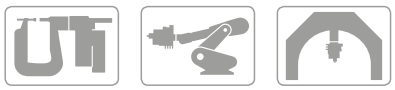
Reconditioning: 1 to 2 times

CFRP AIRCRAFT FUSELAGE

CNC-controlled fuselage riveting machines, flextracks and robots, as well as automatic drilling units and hand-held drilling machines, are used for machining CFRP fuselage panels and their attachment parts. Walter has the right cutting tool for each of these applications, whether machining is performed with MQL, dry or with emulsion. For CFRP machining, we have decided in favour of using PCD Vein and diamond-coated solid

Walter Titex step rivet drill AF1D for window frames

The pre-drilling step allows the automatic drilling unit with C-clamping to be easily positioned. The countersink is created directly in a "one-shot-drilling procedure", thereby saving time. The diamond coating increases tool life significantly.



Hand-held drilling machine
Manual drilling

ADU (automatic drilling unit)
Drilling with constant cutting parameters

Robot
CNC drilling with moderate stability of the machine, clamping system and workpiece

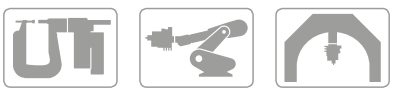
Fuselage riveting machine/machining centre
CNC drilling

Walter Titex PCD Vein rivet drill AF3P for longitudinal and transverse seams

Walter PCD Vein technology represents long tool life and multiple 100% reconditioning, while the same hole quality is maintained. The advantages of the PCD cutting material are a more even and slow progressive wear.

Walter Titex rivet drill AF1D for longitudinal and transverse seams

The Walter Titex rivet drill AF1D with diamond coating and without pilot, provides the same performance as a rivet drill with pilot, but reduces the machining time thanks to shorter approach to contact and drill depth.

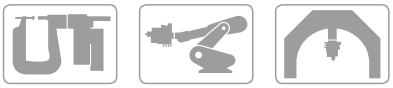


carbide tools. These cutting materials provide long tool life and excellent hole quality. Carbide substrate and diamond coating are perfectly matched in order to achieve optimum coating adhesion. For Walter a long tool life and, especially, process reliability have the highest priorities.

The ratio between hole quality, machining speed and cost efficiency is individually adjusted for each particular operation.

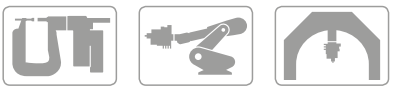
Walter Titex drill AF1D All-round CFRP drilling tool

The AF1D geometry with diamond coating is designed to drill uni- and multi-directional carbon fibre composite materials. Even with the automatic drilling unit, the geometry delivers excellent roundness and dimensional accuracy thanks to its self-centering characteristic.



Walter Titex drill AFF1D for moderate machining conditions

The Walter Titex drill AFF1D with four cutting edges and diamond coating was especially developed for unstable clamping arrangements and is exceptionally suitable for robot applications. In spite of the drill's long tool life, no rework is required where copper mesh is at the hole exit.



Walter Titex drill MFF1 for manual pre-drilling and drilling

This Titex drill with E-point geometry produces clean holes without uncut fibres. The centring point allows the tool to be precisely positioned. An ideal tool for hand-held drilling machines.

Walter Titex drill MFA1 for manual counterboring

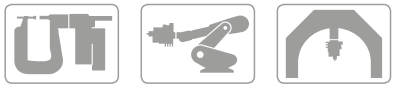
The MFA1 with three cutting edges is particularly suitable for manual counterboring. Due to three optimally positioned lands, the drill produces dimensionally accurate holes even under difficult technical conditions.

STACK AIRCRAFT FUSELAGE

Stacks consist of at least two materials which may each have different properties. Commonly used composite-to-metal combinations are CFRP and titanium or CFRP and aluminium. In spite of the difference in the material properties, dimensionally accurate holes have to be guaranteed throughout a long tool life. That is the challenge for tool development. CFRP is a very abrasive material and quickly leads to rounded cutting edges. Titanium, on the other hand, is a tough material with very low heat conductance. When a CFRP/Ti stack is drilled,

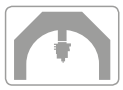
Walter Titex step drill AFT4A
for spar-clip holes

This tool was especially developed for use with automatic drilling units. Polished flutes and a smooth, heat-resistant ACN coating (aluminium chromium nitride layer) ensure optimal chip evacuation.



Walter Titex PCD Vein rivet drill AFT1P
for skin-spar holes

Internal coolant channels and a protective chamber on the PCD Vein cutting edge ensure excellent cutting values in CFRP/titanium stacks. High cutting speed, practically no fraying in CFRP and low burr formation on titanium make this tool the number one choice.

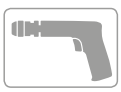


Walter Titex counterboring MFT2 tool
for holes in CFRP/Ti stacks

This counterboring tool is helically left-handed and pushes the chips forward through the pre-drilled hole. If the drilling sequence is CFRP→titanium, the titanium chips cannot damage the CFRP. If the drilling sequence is the other way round, the helically right-handed version of this tool is recommended.

Walter Titex step drill MFA4 for holes
in CFRP-Al stacks

The tool can be used for manual drilling or counterboring. Four lands stabilise the tool and the secondary flutes prevent cold welding when dry drilling aluminium.



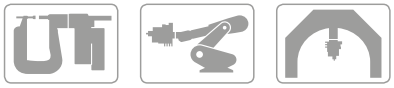
the rounded cutting edge has negative effects on CFRP like fibre breakouts and uncut fibres, while in titanium, it generates additional frictional heat. For that reason, Walter has decided in favour of low-wear PCD Vein tools and solid carbide, as well as coated solid carbide, depending on the task at hand. In addition, optimised cutting edge geometries are developed and offered for the best possible result.

Walter Titex drill AFT3A for stack material

The proven geometry of the Walter Titex A3366 drill has been perfected for stack machining with internal coolant channels, polished flutes and ACN coating, and is designed for high feed rates.

Walter Titex step drill AFT1N for spar-clip holes

The NHC coating (ta-C carbon layer) with a hardness of 5000 HV restricts wear. The smooth layer reduces built-up edges. The drill's four cutting edges also significantly increase tool life.



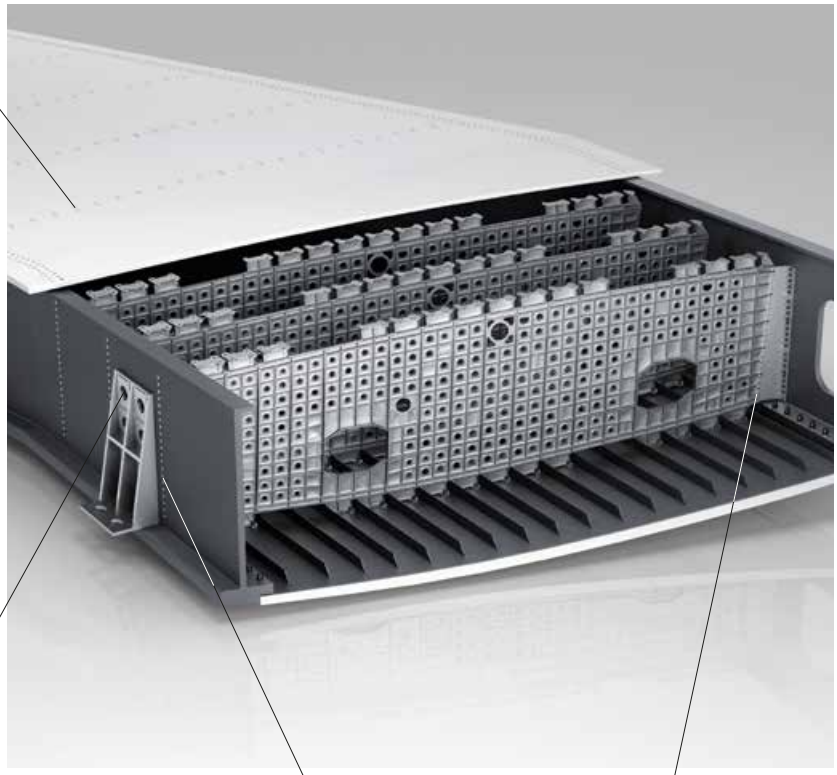
Walter Titex drill MFT1 for manual pre-drilling

A reliable Walter tool for pre-drilling stacks with a hand-held drilling machine. Suitable for small diameters in CFRP, titanium and aluminium stacks.

STACK AIRCRAFT WINGS

Aircraft wings contain stacks made of CFRP, titanium, aluminium and stainless steel, as well as sandwich materials such as honeycomb aluminium. The material thickness of the different stacks also varies considerably. From hole sizes of a few millimetres for the leading edge outer skin through to 15 x d holes towards the centre wing box.

The diameters of the holes also vary more sharply than in the fuselage segment and reach diameters of more than 30 mm.



Walter Titex PCD Vein rivet drill AFA1P for wing skin to ribs

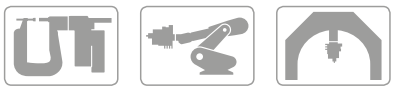
The cutting edge geometry of the AFA1P is specially designed for CFRP/Al stacks. A sharp cutting edge and the internal cooling channels for MQL or wet machining reduce burr formation to a minimum even for platinised pure aluminium.

Walter B4017 Point Drill for drilling

Ideal for CFRP/aluminium one-shot-drilling. Cost-effective solution for hole diameters of 12 to 38 mm. Maximum process reliability thanks to the optimised drill insert in the well-proven Xtra·tec® Point Drill body and low hole tolerance due to additional lands.

Walter Titex drill AFA1N for wing spar to ribs

The four cutting edges of the AFA1N enable long tool life in metal-to-composite material combinations as well as fewer uncut fibres. The non-metallic NHC coating (ta-C carbon layer) also reduces built-up edge formation.



Walter Titex step drill MFA5 for manual counterboring

The Walter Titex MFA5 is designed for manual counterboring CFRP/Al and Al/Al stacks. The low twist of the tool reduces the speed when the drill exits the hole.

STACK VERTICAL STABILISER

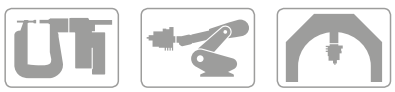
The construction of the vertical stabiliser has similarities to the structure of the wing, in terms of both materials and drilled hole diameter. The vertical stabiliser as well as the wing and the fuselage segments are dynamically stressed, safety-related components. Therefore the tolerances for drilled hole quality result in being very small and the process reliability of machining and component quality are of primary importance.

Walter Titex drill AFT2:16 x D_C drill for CFRP/Ti

The Titex AFT2 drill is a 16 x D_C tool and is suitable for deep pre-drilling holes. The materials CFRP and titanium, and even stainless steel, can be machined with this tool.

Walter Titex step drill AFT1A forTi/steel stacks

This tool was especially developed for use with automatic drilling units. Polished flutes and a smooth, heat-resistant ACN coating ensure optimal chip evacuation.



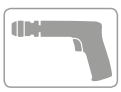
Walter Prototyp ConeFit* countersinker for Ti, steel and Al

The countersinker's pilot aids tool positioning and maintenance of concentricity of the hole in relation to the countersink. The tool is available as Z = 2 or Z = 3 and is suitable for countersinks from 10 mm, and also for cost reductions.

* Can be combined with the entire ConeFit holder range.

Walter Titex step drill MFA4 for CFRP/Al

The tool can be used for manual drilling or counterboring. Four lands stabilise the tool and the secondary flutes prevent cold welding when dry drilling aluminium.



CUTTING DATA AND TOOL DIMENSIONS

The cutting data table contains starting values for composite machining. Many of these applications are non-recurring and require adapted cutting parameters and tools. In order to improve hole quality, cutting speed can be increased and feed rate reduced. Low feed rate and high cutting speed, however, shorten tool life. A gradual approach to find optimal cutting parameters is recommended, which allow the correct balance between hole quality and tool life.

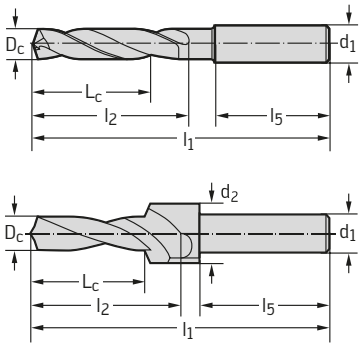
	Geometry	Material	CFRP UD (unidirectional)	CFRP MD (multi-directional)	Thermoplastic with carbon fibre	CFRP/Al	CFRP/Ti Al/Ti
		Machining	Dry	Dry	Dry	Minimum quantity lubrication	Minimum quantity lubrication
PCD Vein	AF3P	Vc [m/min] f [mm]	100 – 300 0.04 – 0.08	100 – 300 0.04 – 0.12	100 – 300 0.04 – 0.20	–	–
PCD Vein	AFE1P	Vc [m/min] f [mm]	80 – 200 0.04 – 0.08	80 – 200 0.04 – 0.10	80 – 200 0.04 – 0.15	–	–
PCD Vein	AFA1P	Vc [m/min] f [mm]	80 – 200 0.04 – 0.08	80 – 200 0.04 – 0.10	80 – 200 0.04 – 0.15	80 – 200 0.04 – 0.10	–
PCD Vein	AFT1P	Vc [m/min] f [mm]	80 – 180 0.04 – 0.08	80 – 180 0.04 – 0.10	80 – 180 0.04 – 0.15	–	10 – 25 0.05 – 0.06
Carbide with and without various coatings	AF1D / AFF1D	Vc [m/min] f [mm]	80 – 200 0.04 – 0.08	80 – 200 0.04 – 0.12	80 – 200 0.04 – 0.20	–	–
Carbide with and without various coatings	AFA1N	Vc [m/min] f [mm]	80 – 160 0.04 – 0.08	80 – 160 0.04 – 0.12	80 – 160 0.04 – 0.20	30 – 90 0.07	–
Carbide with and without various coatings	B4017 with P6004 indexable insert	Vc [m/min] f [mm]	60 – 100 0.03 – 0.05	60 – 100 0.03 – 0.06	60 – 100 0.04 – 0.10	10 – 100 0.04 – 0.30	–
Carbide with and without various coatings	AFT1N / AFT1A	Vc [m/min] f [mm]	60 – 140 0.04 – 0.08	60 – 140 0.04 – 0.10	60 – 140 0.04 – 0.20	–	10 – 20 0.07
Carbide with and without various coatings	AFT2	Vc [m/min] f [mm]	–	–	–	–	10 – 20 0.05 – 0.10
Carbide with and without various coatings	AFT3A	Vc [m/min] f [mm]	80 – 120 0.04 – 0.06	80 – 120 0.04 – 0.08	80 – 120 0.04 – 0.12	–	10 – 20 0.05 – 0.13
Carbide with and without various coatings	AFT4A	Vc [m/min] f [mm]	60 – 120 0.04 – 0.07	60 – 120 0.04 – 0.09	60 – 120 0.04 – 0.15	–	10 – 20 0.05 – 0.10
Carbide with and without various coatings	ConeFit countersinker	Vc [m/min] f [mm]	–	–	–	20 – 100 0.08 – 0.20	20 – 60 0.08 – 0.10
Carbide with and without various coatings	VFA1A / VFT1A	Vc [m/min] f [mm]	30 – 60 0.03 – 0.075	30 – 60 0.03 – 0.075	30 – 60 0.03 – 0.075	30 0.075	15 0.075
Carbide with and without various coatings	MFF1	Vc [m/min]	15 – 60	15 – 60	15 – 60	–	–
Carbide with and without various coatings	MFA1 / MFA4 / MFA5	Vc [m/min]	–	–	–	5 – 45	–
Carbide with and without various coatings	MFT1 / MFT2	Vc [m/min]	–	–	–	5 – 45	5 – 15

Note: When drilling stacks with one parameter, the CFRP/Al or CFRP/Ti, Al/Ti column is used. If the parameters are changed between the materials, the CFRP parameters are used for fibre materials, CFRP/Al values for aluminium and CFRP/Ti data for titanium.

Type		D_C [mm]	d_1 [mm]	d_2 [mm]	l_1 [mm]	l_2 [mm]
Carbide drill	without IC with IC	2.5 – 25 4.0 – 25	≤ 25 ≤ 25	– –	≤ 300 ≤ 300	≤ 15 x d / 150 ≤ 15 x d / 150
PCD Vein drill	without IC with IC	2.5 – 12.8 4.7 – 12.8	≤ 16 ≤ 16	– –	≤ 170 ≤ 170	≤ 10 x d / 100 ≤ 10 x d / 100
Carbide rivet drill	without IC with IC	2.5 – 21 4.0 – 21	≤ 25 ≤ 25	≤ 2.5 x d_1* ≤ 2.5 x d_1*	≤ 300 ≤ 300	≤ 15 x d / 250 ≤ 15 x d / 250
PCD Vein rivet drill	without IC with IC	4.0 – 10 4.7 – 10	≤ 16 ≤ 16	≤ 2.5 x d_1 ≤ 2.5 x d_1	≤ 170 ≤ 170	≤ 10 x d / 100 ≤ 10 x d / 100

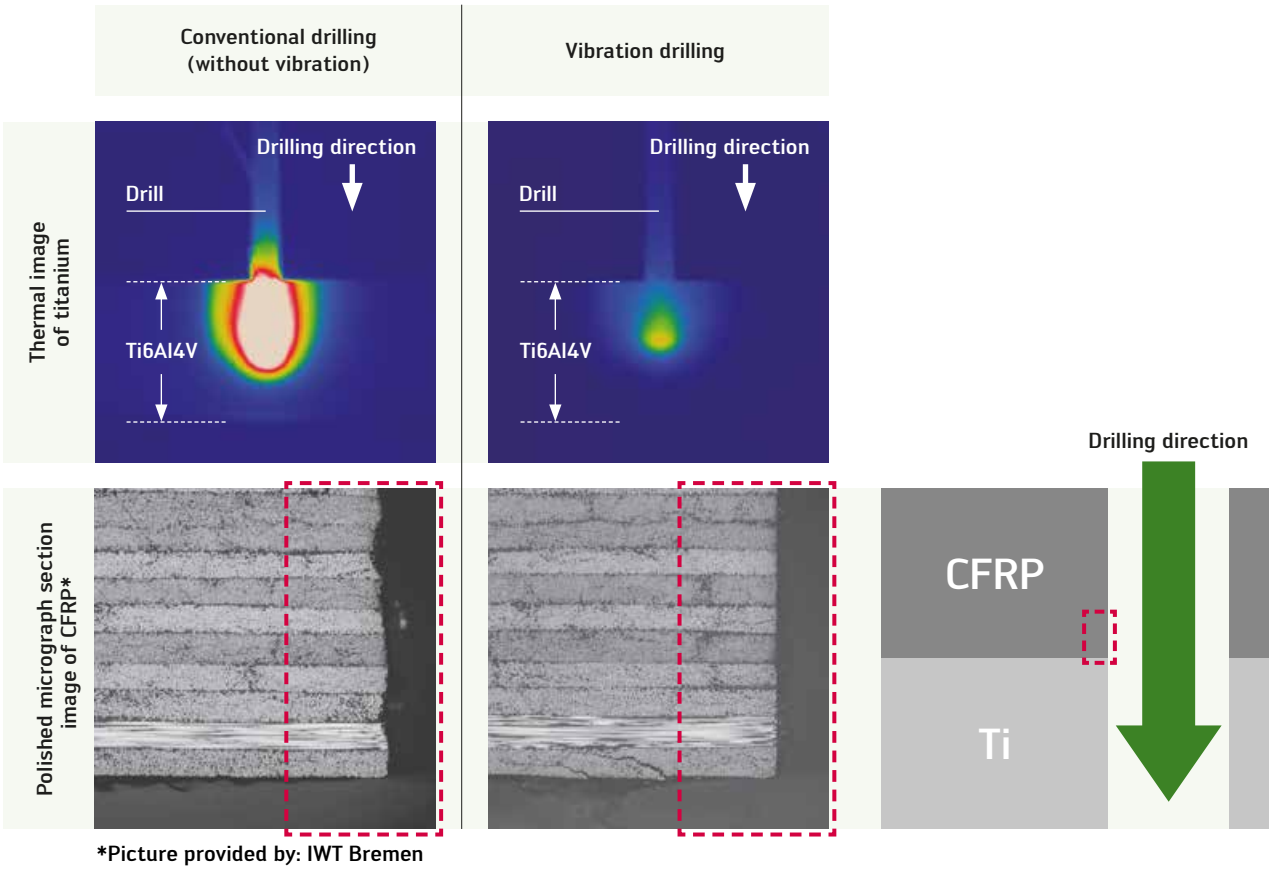
* Step difference factor for tools with three cutting edges only 1.4 x d_1 and no step possible for MFT2 and AFT2

l_5 > 20 mm; $L_C = l_2 - 5$ mm



VIBRATION DRILLING TECHNOLOGY

Vibration drilling is recommended for machining stack materials, especially CFRP/Ti stacks. Using this method, the drilling tool is additionally moved in the feed direction. The movement corresponds to a sine wave, whereby the tool cutting edges are constantly at work. In the sinus wave trough, controlled chip breaking is performed at the minimum feed rate. Short chips lower the process temperature and improve the surface quality and dimensional accuracy of the entire hole.



*Picture provided by: IWT Bremen

Walter Titex vibration step drill VFA1A

The vibration step drill is particularly suitable for C-clamping automatic drilling units. The cutting edge geometry and optional coating have been optimised for the vibration drilling process in order to achieve excellent results.

Walter Titex vibration drill VFT1A

The vibration drill for machining centres and fuselage riveting machines works process reliable. The tool is suitable for CFRP/Ti stacks with considerable material thickness and high tolerance requirements.

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