

Table 1

Experimental conditions

Order of tests			Spindle speed ($\text{rev}\cdot\text{s}^{-1}$)	Feedrate ($\text{mm}\cdot\text{s}^{-1}$)	Ultrasonic vibration power (%)
Tool 1	Tool 2	Tool 3			
1	1	1	66.7	0.06	40
2	2	2	33.4	0.06	40
3	3	9	100	0.06	40
4	4	10	50	0.06	40
5	5	11	66.7	0.06	40
6	6	12	66.7	0.25	40
7	7	3	66.7	0.14	40
8		4	66.7	0.19	40
9		5	66.7	0.06	60
10		6	66.7	0.06	40
11		7	66.7	0.06	30
12		8	66.7	0.06	50

Table 2

Properties of titanium alloy (Ti-6Al-4V)

Property	Unit	Value
Tensile strength	GPa	950
Thermal conductivity	$\text{W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$	21
Melting point	K	1941 ± 285
Density	$\text{Kg}\cdot\text{m}^{-3}$	4510
Heat of fusion	$\text{kJ}\cdot\text{kg}^{-1}$	440
Coefficient of thermal expansion	K^{-1}	8.64×10^{-6}

Table 3

Results on cutting force (N)

Spindle speed (rev·s ⁻¹)	Feedrate (mm·s ⁻¹)	Ultrasonic vibration power (%)	Tool 1	Tool 2	Tool 3
66.7	0.06	40	118	111	123
33.4	0.06	40	547	534	565
100	0.06	40	98	102	97
50	0.06	40	298	264	244
66.7	0.06	40	118	119	134
66.7	0.25	40	680	750	695
66.7	0.14	40	390	385	402
66.7	0.19	40	448		468
66.7	0.06	60	145		138
66.7	0.06	40	118		106
66.7	0.06	30	161		172
66.7	0.06	50	109		101

Table 4

Results on MRR ($\text{mm}^3 \cdot \text{s}^{-1}$)

Spindle speed ($\text{rev} \cdot \text{s}^{-1}$)	Feedrate ($\text{mm} \cdot \text{s}^{-1}$)	Ultrasonic vibration power (%)	Tool 1	Tool 2	Tool 3
66.7	0.06	40	0.56	0.418	0.47
33.4	0.06	40	0.582	0.447	0.481
100	0.06	40	0.539	0.441	0.464
50	0.06	40	0.539	0.43	0.487
66.7	0.06	40	0.56	0.49	0.56
66.7	0.25	40	1.68	2.01	1.81
66.7	0.14	40	1.27	1.3	1.28
66.7	0.19	40	1.4		1.5
66.7	0.06	60	0.565		0.474
66.7	0.06	40	0.56		0.452
66.7	0.06	30	0.591		0.448
66.7	0.06	50	0.567		0.452

Table 5

Results on surface roughness (μm)

Spindle speed ($\text{rev}\cdot\text{s}^{-1}$)	Feedrate ($\text{mm}\cdot\text{s}^{-1}$)	Ultrasonic vibration power (%)	Tool 1		Tool 2		Tool 3	
			hole	rod	hole	rod	hole	rod
66.7	0.06	40	0.69	0.48	0.76	0.5	0.75	0.52
33.4	0.06	40	2.01	1.75	1.98	1.8	1.93	1.69
100	0.06	40	0.63	0.3	0.65	0.31	0.58	0.33
50	0.06	40	1.29	0.93	1.35	0.88	1.31	0.94
66.7	0.06	40	0.69	0.48	0.79	0.48	0.81	0.54
66.7	0.25	40	4.64	3.51	4.23	3.8	4.19	3.89
66.7	0.14	40	1.27	0.7	1.19	0.63	1.22	0.69
66.7	0.19	40	2.91	2.32			2.79	2.2
66.7	0.06	60	0.63	0.28			0.58	0.22
66.7	0.06	40	0.69	0.48			1.01	0.5
66.7	0.06	30	1.66	1.44			1.47	1.89
66.7	0.06	50	0.66	0.31			0.57	0.35

All tables published in: Churi, N.J., Pei, Z.J., and Treadwell, C., 2006, "Rotary ultrasonic machining of titanium alloy: effects of machining variables," *Machining Science and Technology*, Vol. 10, No. 3, pp. 301–321.