

## *Ud500*

ii i

(OC) (EVC) (VC) Ud500 CNC  
EVC EVC EVC  
Ud500 (EVC) (VC) :

### *One-Directional and Elliptical Ultrasonic Vibration Assisted Turning of Ud500 Work-pieces*

S. Amini and M. J. Nategh

#### **ABSTRACT**

Vibration cutting (VC), elliptical vibration cutting (EVC) and conventional cutting (OC) of Ud500 work-pieces have been experimentally investigated in the present research. The experiments were carried out by using single crystal diamond tool and ultra-precision CNC lathe. The influence of various cutting parameters including cutting speed, feed-rate, vibration amplitude and phase angle on the cutting force, surface roughness and tool life have been studied and the results obtained in the aforementioned processes have been compared. The results indicate that the cutting force in EVC is much less than the two other processes. The surface roughness in both the cutting and feed directions was also less than those in other processes. In addition, far longer tool life was observed in EVC compared with the two other processes.

**KEYWORDS :** Vibration cutting (VC), elliptical vibration cutting (EVC), super-alloy Ud500

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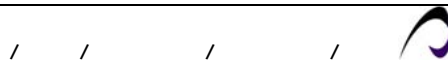
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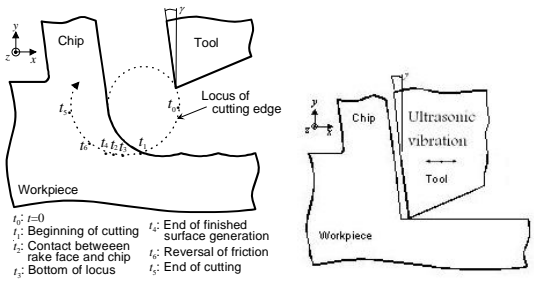
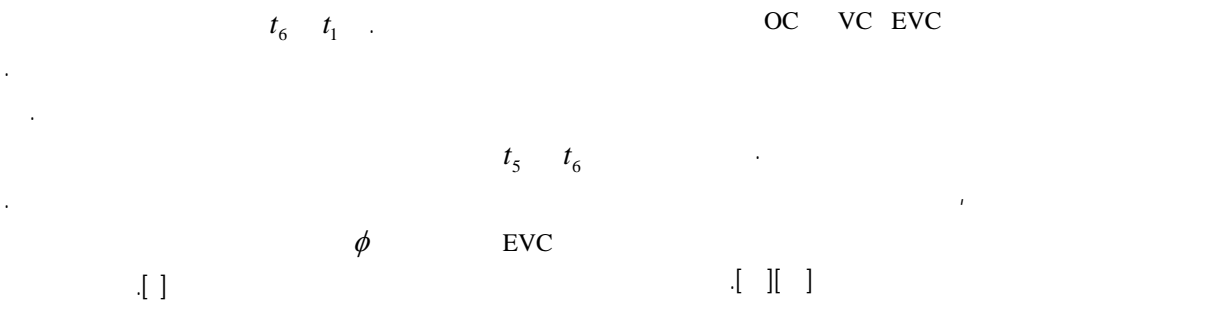
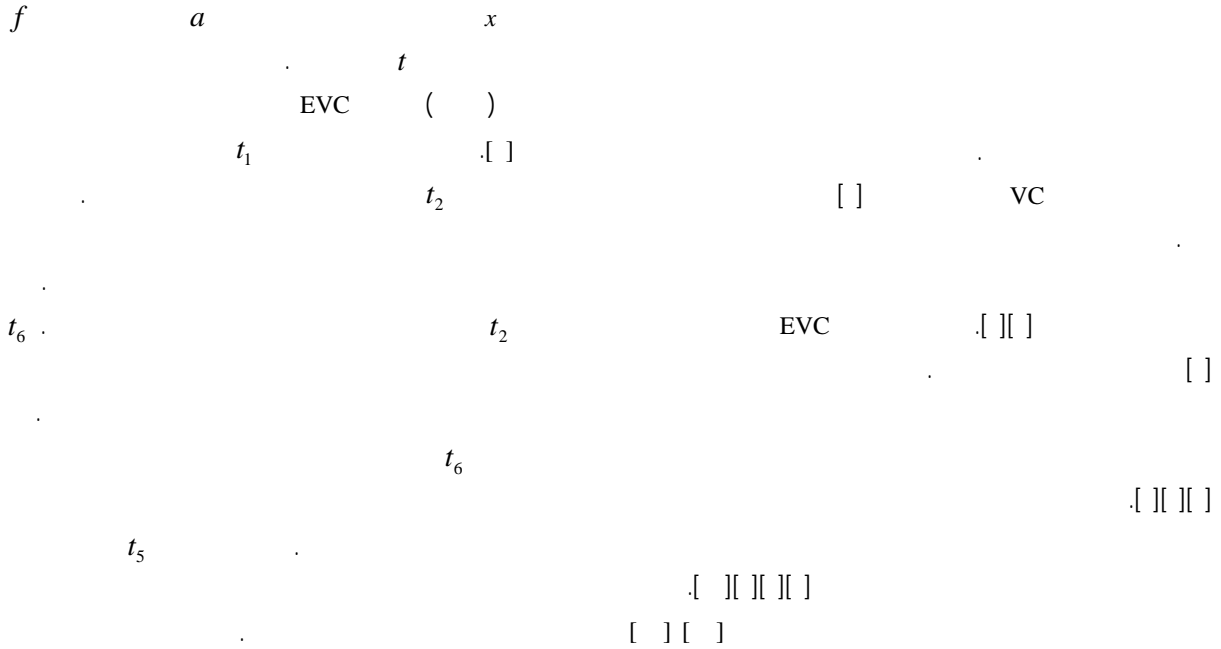
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$$x = a \sin(2\pi ft), \text{Vibration Speed} = 2\pi fa \cos(2\pi ft) \quad (1)$$



$t_0: t=0$        $t_4$ : End of finished surface generation  
 $t_1$ : Beginning of cutting       $t_5$ : End of cutting  
 $t_2$ : Contact between rake face and chip       $t_6$ : Reversal of friction  
 $t_3$ : Bottom of locus       $t_6$ : End of cutting

$$x = a \sin(2\pi ft), y = b \sin(2\pi ft + \varphi)$$

$$\text{Horizontal vibration Speed} = 2\pi fa \cos(2\pi ft) \quad (2)$$



VC EVC

/ KHz

$$2\pi fa > v_w \quad (3)$$

ET4000A)

$v_w$

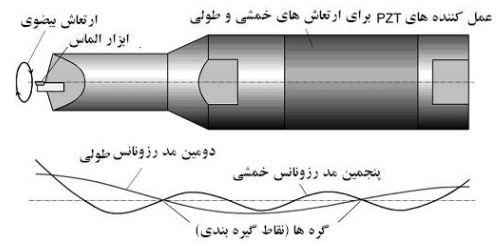
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S-3600N)

PF

Ud500



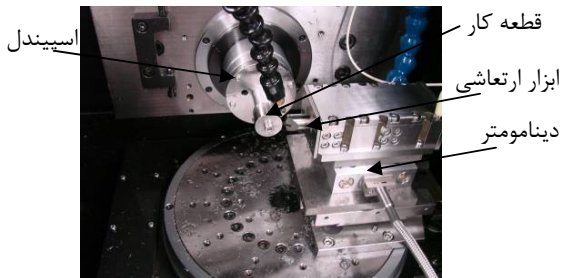
[ ] : ( )

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/ KHz

CNC

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B

AHN05-Toyoda ) CNC

(Co.

OC EVC VC

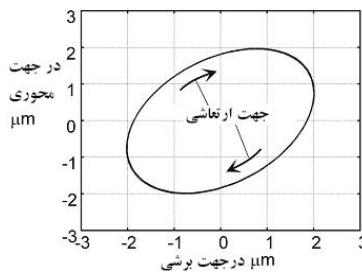
EVC : ( )

$\mu m$	( )	$\mu m$	$\mu m / rev$	m/min
				/
				/

) ( ) ( )

VC : ( )

$\mu m$	$\mu m$	$\mu m / rev$	m/min
			/
			/



: ( )

: ( )

$\mu m$	$\mu m / rev$	m/min
	20	

VC

m/min  $2\pi f a$  EVC

OC

OC

OC

EVC VC

( )

CNC

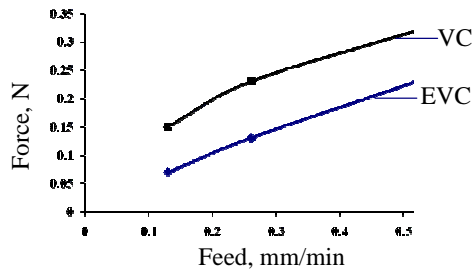
( ) CNC

VC EVC

/  
CNC



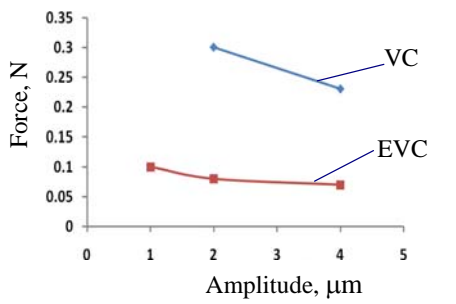
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( ) VC EVC / m/min

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VC EVC  $\mu\text{m}/\text{rev}$  m/min

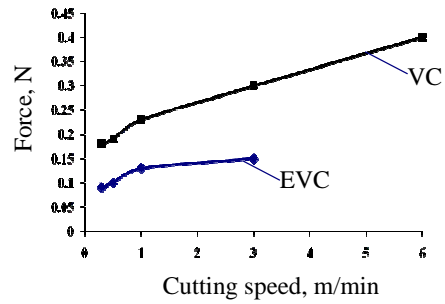


( ) VC EVC m/min

(  $\mu\text{m}/\text{rev}$  )

( )

( ) VC EVC  $\mu\text{m}/\text{rev}$



VC EVC ( )

( )

( ) VC EVC

OC

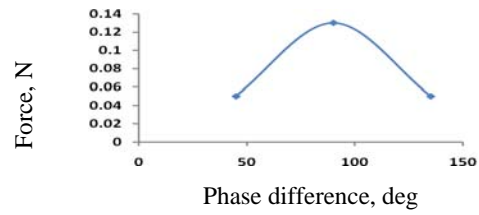
m/min  $\mu\text{m}/\text{rev}$

VC EVC

( )

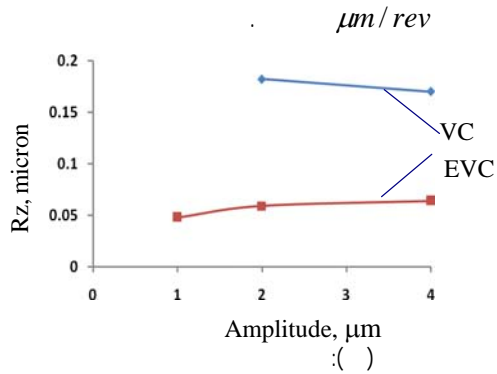
VC EVC / m/min

( )  
VC EVC



( )  
m/min

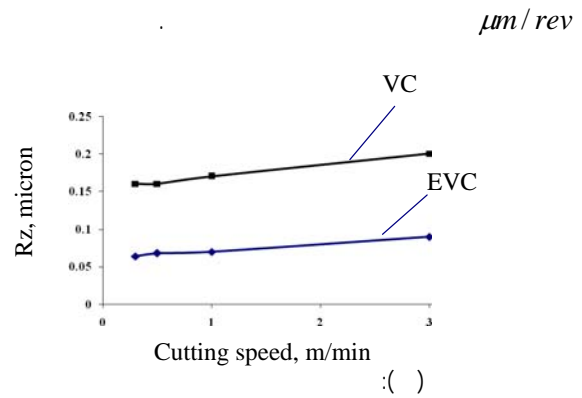
( )  
m/min



OC VC EVC

( ) ( )

( μm/rev m/min )  
EVC ( )



VC

( μm/rev )

EVC

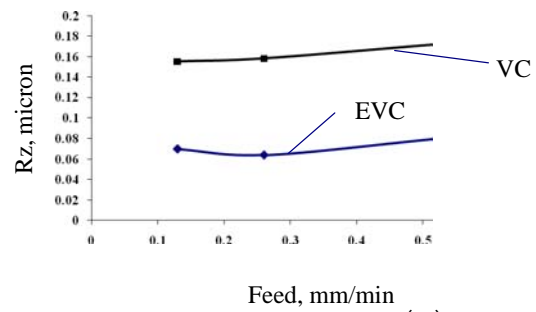
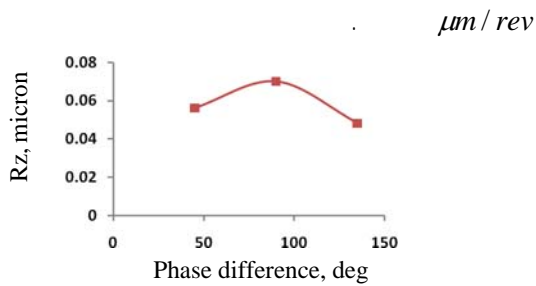
/ μm OC  
VC EVC ( )

OC

EVC

( )  
m/min

( ) VC EVC  
m/min



( )  
m/min

( )  
m/min



OC EVC

( )

EVC

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EVC

(

( )

OC

EVC

( ) ( )



( ) ( ) ( )

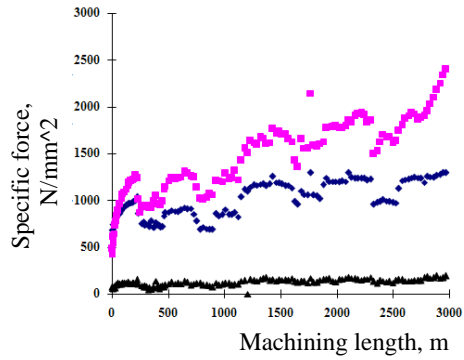
OC

CT( VC( EVC( ( )

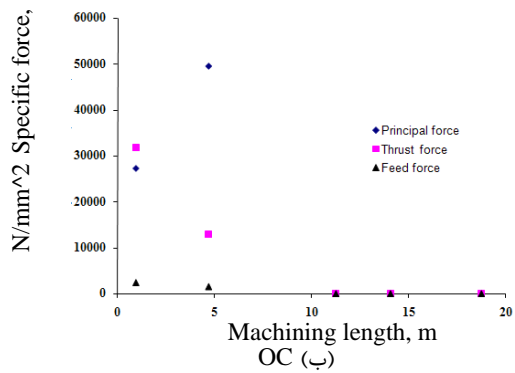
OC

( )

EVC



EVC(الف)



OC (ب)

( )

OC

( ) ( )

( ) ( )

EVC

( )

OC

VC

$\mu m$

$\mu m / rev$

m/min

( )

OC EVC

Ud500 OC VC EVC

EVC Ud500

OC  $\frac{1}{2}$  VC VC

EVC

OC  $\frac{1}{5}$  VC VC  $\frac{1}{3}$

VC EVC

VC EVC

VC Ud500 EVC

VC CT

EVC VC EVC

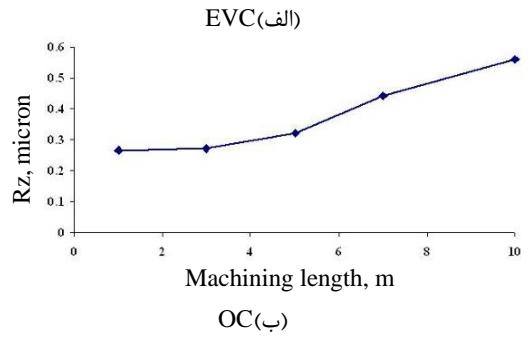
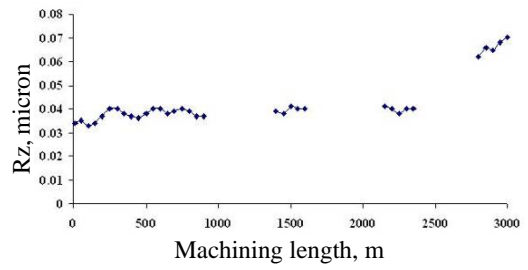
OC EVC

EVC

OC

OC

EVC



( ) :



(الف)



(ب)

EVC( ) ( ) :

OC (

Ud500  
CNC

EVC



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