

Appendices

A. Comparison between surface defects machining and vibration assisted machining

Vibration assisted machining (VAM) and surface defects machining (SDM)	Similarities	Differences
Cutting forces on tool	Reduced cutting forces provide better surface finish and tool longevity.	Not applicable
Overall cutting load on tool	Not applicable	In VAM, periodic reduction in cutting load occurs at specified amplitude whereas in SDM cutting load reduces where dislocations in the form of holes are encountered.
Volume of material removal	Not applicable	Although, tool is periodically rotated to reduce the cutting load, the total material to be removed during VAM process remains unchanged. In SDM, due to the vacancies made in the form of holes, some of the volume of the material to be removed reduces.
Tool contact with chips	Not applicable	In VAM cutting tool loses contact with the chips on specified amplitude whereas in SDM cutting chips remains in continuous contact with the tool.
Operational time	Not applicable	No cutting action took place

		while the tool is disengaged in VAM whereas in SDM continuous cutting takes place.
Requirement of machine tool	Not applicable	Separate machine tool required to execute VAM whereas with an addition of independent process, conventional machine tool is good enough for SDM process.

B. CNC G code program used in the experiments

%		G18U0.W0.	G50S1000	G01X17.	
O2321(WALEED	TEST	N1(BAR-FINISH CBN TOOL)	G00T808	G00U0.2	G00X33.
SAMPLES)		G30U0.W0.	G97S300M3	G01X16.	M74
G80		G80	X33.0Z2.	G00U0.2	M9
G40		M320	Z-22.5	G01X15.	G30U0.W0.
M69		M46	F0.04M08	G00U0.2	G80
G113		M9	G01X32.	G01X14.	M5
G107C0.		G50S1000	G00U0.2	G00U0.2	M320
G18U0.W0.		G00G96G99G40S250T707M3	G01X31.	G00U0.2	M46
N1(BAR-ROUGHING)		G80	G00U0.2	G01X13.	G97
G30U0.W0.		X32.Z2.0	G01X30.	G00U0.2	G23
M320		G01G42X29.4F0.15	G00U0.2	G01X12.	M30
M46		Z-20.0	G01X29.	G00U0.2	%
M9		G40X33.0	G01X28.	G01X11.	
G50S1200		G00Z2.0	G00U0.2	G00U0.2	
G00G96G99G40S90T606M3		G30U0.W0.	G01X27.	G01X10.	
G80		G97	G00U0.2	G00U0.2	
X32.Z3.0		G80	G01X26.	G01X9.	
G01G42X29.6F0.14		M5	G00U0.2	G00U0.2	
Z-20.5		M320	G01X25.	G01X8.	
G40X33.0		M46	G00U0.2	G00U0.2	
G00Z1.		G23	G01X24.	G01X7.	
G30U0.W0.		M00	G00U0.2	G00U0.2	
G97		N2(PART OFF 2.5MM WIDE	G01X23.	G01X6.	
G80		BLADE)	G00U0.2	G00U0.2	
M5		G80	G01X22.	G01X5.	
M320		G40	G00U0.2	G00U0.2	
M46		M69	G01X21.	G01X4.	
G97		G113	G00U0.2	G00U0.2	
G23		G107C0.	G01X20.	G01X3.	
M00		G18U0.W0.	G00U0.2	G00U0.2	
G40		G99	G01X19.	M73	
M69		G30U0.W0.	G00U0.2	G97S300	
G113		M320	G01X18.	G01X-	
G107C0.		M46	G00U0.2	0.2F0.03	

C. Materials properties (Hardness and Composition)

Region United States (US)	Ultimate Tensile Strength 814 MPa Yield Strength Hardness: 144 Bhn																												
Workpiece Material Steel	<table border="1"> <thead> <tr> <th>Component</th> <th>Weight %</th> </tr> </thead> <tbody> <tr><td>Al</td><td></td></tr> <tr><td>C</td><td>0.17</td></tr> <tr><td>Co</td><td></td></tr> <tr><td>Cr</td><td>0.5</td></tr> <tr><td>Cu</td><td></td></tr> <tr><td>Mn</td><td>0.8</td></tr> <tr><td>Mo</td><td>0.2</td></tr> <tr><td>Ni</td><td>0.55</td></tr> <tr><td>P</td><td>0.035</td></tr> <tr><td>S</td><td>0.04</td></tr> <tr><td>Si</td><td>0.225</td></tr> <tr><td>Ti</td><td></td></tr> <tr><td>V</td><td></td></tr> </tbody> </table>	Component	Weight %	Al		C	0.17	Co		Cr	0.5	Cu		Mn	0.8	Mo	0.2	Ni	0.55	P	0.035	S	0.04	Si	0.225	Ti		V	
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AISI-4130 AISI-4140 AISI-4140 (200Bhn) AISI-4150 AISI-4340 AISI-4340M AISI-50B35 AISI-5160 (Q&T) AISI-5160 (Norm) AISI-52100 AISI-8617H (78HRb) AISI-8617H (46HRc)																													
<input checked="" type="radio"/> Standard <input type="radio"/> Custom																													

Region United States (US)	Ultimate Tensile Strength Yield Strength Hardness: 680.2 Bhn																												
Workpiece Material Steel	<table border="1"> <thead> <tr> <th>Component</th> <th>Weight %</th> </tr> </thead> <tbody> <tr><td>Al</td><td></td></tr> <tr><td>C</td><td>1.5</td></tr> <tr><td>Co</td><td></td></tr> <tr><td>Cr</td><td>12.0</td></tr> <tr><td>Cu</td><td></td></tr> <tr><td>Mn</td><td>0.6</td></tr> <tr><td>Mo</td><td>0.8</td></tr> <tr><td>Ni</td><td></td></tr> <tr><td>P</td><td>0.03</td></tr> <tr><td>S</td><td>0.03</td></tr> <tr><td>Si</td><td>0.4</td></tr> <tr><td>Ti</td><td></td></tr> <tr><td>V</td><td>0.35</td></tr> </tbody> </table>	Component	Weight %	Al		C	1.5	Co		Cr	12.0	Cu		Mn	0.6	Mo	0.8	Ni		P	0.03	S	0.03	Si	0.4	Ti		V	0.35
Component	Weight %																												
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Ti																													
V	0.35																												
AISI-52100 AISI-8617H (78HRb) AISI-8617H (46HRc) AISI-8617H (59HRc) AISI-8620 Brico3010 CPM 9V D2 D2 (680Bhn) D3 H13 (44HRc) H13 (48HRc)																													
<input checked="" type="radio"/> Standard <input type="radio"/> Custom																													

Region United States (US)	Ultimate Tensile Strength 1970 MPa Yield Strength 1655 MPa Hardness: 550 Bhn																												
Workpiece Material Steel	<table border="1"> <thead> <tr> <th>Component</th> <th>Weight %</th> </tr> </thead> <tbody> <tr><td>Al</td><td></td></tr> <tr><td>C</td><td>0.43</td></tr> <tr><td>Co</td><td></td></tr> <tr><td>Cr</td><td>0.825</td></tr> <tr><td>Cu</td><td></td></tr> <tr><td>Mn</td><td>0.775</td></tr> <tr><td>Mo</td><td>0.375</td></tr> <tr><td>Ni</td><td>1.825</td></tr> <tr><td>P</td><td>0.035</td></tr> <tr><td>S</td><td>0.04</td></tr> <tr><td>Si</td><td>1.625</td></tr> <tr><td>Ti</td><td></td></tr> <tr><td>V</td><td>0.05</td></tr> </tbody> </table>	Component	Weight %	Al		C	0.43	Co		Cr	0.825	Cu		Mn	0.775	Mo	0.375	Ni	1.825	P	0.035	S	0.04	Si	1.625	Ti		V	0.05
Component	Weight %																												
Al																													
C	0.43																												
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V	0.05																												
300M Steel 300M Steel (550Bhn) 9310 AISI-1020 AISI-1040 AISI-1045 AISI-1045 (200Bhn) AISI-1050 (Q&T) AISI-1050 (Norm) AISI-1053 AISI-1060 AISI-1070																													
<input checked="" type="radio"/> Standard <input type="radio"/> Custom																													

Region
United States (US) ▼

Workpiece Material
Steel ▼

- AISI-50835
- AISI-5160 (Q&T)
- AISI-5160 (Norm)
- AISI-52100**
- AISI-8617H (78HRb)
- AISI-8617H (46HRc)
- AISI-8617H (59HRc)
- AISI-8620
- Brico3010
- CPM 9V
- D2
- D2 (680Bhn)

Standard Custom

Ultimate Tensile Strength

Yield Strength

Hardness: 614 Bhn

Component	Weight %
Al	
C	1.04
Co	
Cr	1.45
Cu	
Mn	0.35
Mo	
Ni	
P	0.025
S	0.025
Si	0.23
Ti	
V	

Region
United States (US) ▼

Workpiece Material
Steel ▼

- 300M Steel
- 300M Steel (550Bhn)
- 9310
- AISI-1020
- AISI-1040
- AISI-1045
- AISI-1045 (200Bhn)
- AISI-1050 (Q&T)
- AISI-1050 (Norm)
- AISI-1053**
- AISI-1060
- AISI-1070

Standard Custom

Ultimate Tensile Strength 2560 MPa

Yield Strength 2160 MPa

Hardness: 623 Bhn

Component	Weight %
Al	
C	0.53
Co	
Cr	
Cu	
Mn	0.75
Mo	
Ni	
P	0.04
S	0.05
Si	
Ti	
V	

Region
United States (US) ▼

Workpiece Material
Steel ▼

- AISI-1050 (Q&T)
- AISI-1050 (Norm)
- AISI-1053
- AISI-1060
- AISI-1070**
- AISI-1095
- AISI-1118
- AISI-1538
- AISI-15B32
- AISI-4120
- AISI-4130
- AISI-4140

Standard Custom

Ultimate Tensile Strength 2530 MPa

Yield Strength 2330 MPa

Hardness: 627 Bhn

Component	Weight %
Al	
C	0.7
Co	
Cr	
Cu	
Mn	0.75
Mo	
Ni	
P	0.04
S	0.05
Si	
Ti	
V	

Region
United States (US) ▼

Workpiece Material
Steel ▼

- AISI-8617H (78HRb)
- AISI-8617H (46HRc)
- AISI-8617H (59HRc)
- AISI-8620
- Brico3010
- CPM 9V
- D2**
- D2 (680Bhn)
- D3
- H13 (44HRc)
- H13 (48HRc)
- H13 (52HRc)

Standard Custom

Ultimate Tensile Strength

Yield Strength 486 MPa

Hardness: 615 Bhn

Component	Weight %
Al	
C	1.5
Co	1.0
Cr	12.0
Cu	
Mn	0.6
Mo	0.95
Ni	
P	0.03
S	0.03
Si	0.6
Ti	
V	1.1