

Conditions under which fracture, breakage and abnormal wear are likely to occur

Factor	Condition	Possibility of damage to tip			Possibility of large wear			Possibility of thin punch breakage			
		Large	Medium	Small	Large	Medium	Small	Large	Medium	Small	
Tool material	Heat-treatment hardness too high	○				○				○	
	Material not uniform (ex.: internal defect)	○			○					○	
	Materially similar tool and workpiece materials	○			○					○	
Workpiece material	Presence of oxide film on surface			○	○					○	
	High hardness		○		○					○	
	Large elongation and high viscosity	○			○					○	
Working conditions	Tool contour	Too long relative to diameter			○					○	
		Small punch shoulder roundness			○					○	
		Sharp corners on punch tip	○			○					○
		Rough surface finish	○				○				○
	Clearance	Extremely small	○			○					○
		Uneven	○			○					○
	Lubrication	Not lubricated	○			○					○
		Incorrect lubricant		○		○					○
	Bridge width	Uneven	○			○					○
	Punch guide	No punch guide			○	○					○
		Poor accuracy of punch guide			○	○					○
	Holding of workpiece	No plateretainer (when fixed stripper is used)			○	○					○
Insufficient plate holding force				○	○					○	
Abnormal punching	Double shot or two-sheet shot	○			○					○	
Press, die set	Low press rigidity			○	○					○	
	Poor press accuracy			○	○					○	
	Poor die set accuracy			○	○					○	

(Press Working Data Book, 1980, The Nikkan Kogyo Shimibun Ltd.)

Comparison table of carbide tools for wear resistance

Application	Application category code	Tungaloy	Sumitomo Electric Hardmetal	Mitsubishi Materials	Dijet	Hitachi Tool Engineering	Fuji Die	Nippon Tungsten	Sanalloy	EVERLOY	Silver Alloy	
For general wear-resistant, impact-resistant tools	V10	D10	D1	GT105	D1	WH10 WH20	D10 D20	G1	DA10 DA20 DA25	H1 G1 KD05	G1 G2	
	V20	D20 D25	D2	GT110 GT115	D2	WH30	D40 D50 C50 G55	G2	DA30 VA30	G2 KD10 A10W	G3	
	V30	D30	D3 ED30	GT120	D3 NC2 NC6 NC8	WH40	D60	G3 G20	DA50 VA40	G3 G4 KD20 MC30	G4	
	V40 *	D40	G5 ED50	GT130	G5 NC10 GD195	WH50	G60 G65	G30 G40	DA60 VA50 EA50	G5 TB6 KD40	G5 6F	
	V50 *	D50	G6	GT135 GT130S GT140	MH4 GD174 GD201	WH60	C70 C84 G70 G85	G50 G60	VA60 VA70 EA60 EA70	TB7	G6 F65 G65	
	V60 *	D60 D70	G7 G8	GT140S GT150S	MH5 MH7 GD206	WB60	C95	G80 SD1	VA80 EA80 EA90	G8	G7 G8 7F 8F	
Ultrafine grain carbide	For cutting tools	Z01	F MD08F	F0	ZH104 SF10 MF10	FZ05 FB10	NM08	F08				
		Z10	M MD10 MD05F	XF1 F1 AFU	HT10 MF20	FZ10 FZ15 FB15	NM15	F10 M10	FN10 FN20		EF05	
		Z20	MD15 MD20 EM10	AF0 SF2 AF1	TF15 UF30	FZ20 FB20	BRM20 EF20N	F20	FN30 SF30	FD25	EF10	
		Z30	UM	A1 CC		FZ25	NM25		FN40 SF50		EF20	
	For wear and impact resistance	V10	F	F0 SF1 ED10 AFU	UF20	FB15 FZ15 FZ10		F08 F10 F20 M10	FN10 FN20		EF05 EF10	
		V20	EM10	AF0 AF1	UF30	FB20 FZ20			FN30 SF30	FD25	EF20	SF20 SF05
		V30		A1 CC		FZ25	NM25		FN40	FD15		SF25 SF30
		V40 *					NM40		SF50			

\*: Standard of the Japan Cemented Carbide Tool Manufacturers' Association

Carbide application category

Unit: Wt%

Application category code	Hardness HRA	Transverse rupture force N/mm <sup>2</sup> (kgf/mm <sup>2</sup> )	Metal component		Hard phase component	
			Co	W-based hard phase		
V10	89 or more	1170 or more {120 or more}	3~6	88~91		
V20	88 or more	1275 or more {130 or more}	5~9	88~90		
V30	87 or more	1471 or more {150 or more}	8~16	78~87		
V40	85 or more	1864 or more {190 or more}	11~20	73~85		
V50	83 or more	2060 or more {210 or more}	14~25	70~82		
V60	78 or more	2256 or more {230 or more}	17~30	65~78		

(Standard of the Japan Cemented Carbide Tool Manufacturers' Association CIS 019C—1990)

Notes 1. The application category codes from V10 to V30 and the corresponding values are in accordance with JIS B 4053.

2. The application category codes must not be used as material type codes.

3. Some carbide manufacturers have multiple material type codes that correspond to the same application category code.

Ultrafine grain carbide

Application category code	Hardness HRA	Transverse rupture force N/mm <sup>2</sup> (kgf/mm <sup>2</sup> )
Z01	92 or more	1177 or more {120 or more}
Z10	91 or more	1275 or more {130 or more}
Z20	89.5 or more	1471 or more {150 or more}
Z30	88.5 or more	1668 or more {170 or more}

(JIS B 4053—1989)

Standards for carbide selection

Major category	Product name		Application category code					
	Part name and type		High←Wear resistance→Low Low←Impact resistance→High					
			V10	V20	V30	V40	V50	V60
Trimming die	Die	When load is small						
		When load is large						
	Punch	When load is small						
When load is large								
Drawing die	Drawing die	When load is small						
		When load is large						
	Drawing punch	When load is small						
		When load is large						
Powdered metal forming die	Die body	Round						
		Irregular						
	Punch							
Other wear-resistant, impact-resistant tools and components	When impact is small	Gauge, valve, nozzle, seal ring, precision ball, etc.						
	When impact is medium	Bending die, crusher, spike, etc.						
	When impact is large	Engraving punch, coining die, coining punch, impact die, swaging die, nail-making tool, hot extrusion die, polishing disks, etc.						

(Standard of the Japan Cemented Carbide Tool Manufacturers' Association CIS 019C—1990)