



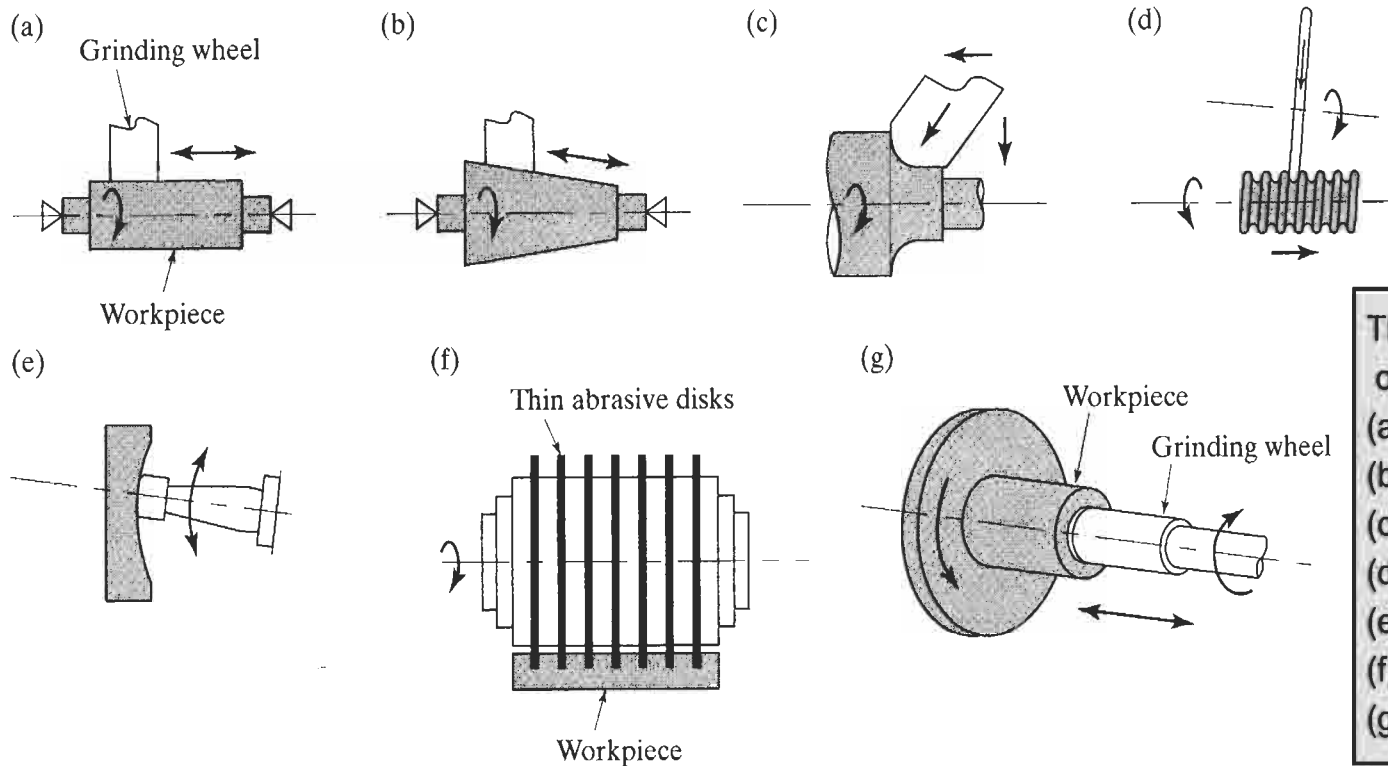
FREDERICK INSTITUTE OF TECHNOLOGY
Mechanical Engineering Department

5.4. GRINDING PROCESSES

General Characteristics of Abrasive Machining Processes and Machines

Process	Characteristics	Maximum dimension (m)*
Surface	Flat surfaces on most materials; production rate depends on table size and automation; labor skill depends on part; production rate is high on vertical-spindle rotary-table type.	Reciprocating table L : 6 Rotary table D : 3
Cylindrical	Round workpieces with stepped diameters; low production rate unless automated; labor skill depends on part shape.	Workpiece D : 0.8 Roll grinders D : 1.8 Universal grinders D : 2.5
Centerless	Round workpieces; high production rate; low to medium labor skill.	Workpiece D : 0.8
Internal	Bores in workpiece; low production rate; low to medium labor skill.	Hole D : 2
Honing	Bores and holes in workpiece; low production rate; low labor skill.	Spindle D : 1.2
Lapping	Flat surfaces; high production rate; low labor skill.	Table D : 3.7
Ultrasonic machining	Holes and cavities of various shapes, particularly in hard and brittle nonconducting materials.	—

*Larger capacities are available for special applications. L = length; D = diameter.



The types of workpieces and operations typical of grinding:

- (a) cylindrical surfaces
- (b) conical surfaces
- (c) fillets on a shaft
- (d) helical profiles
- (e) concave shape
- (f) cutting off or slotting with thin wheels
- (g) internal grinding

The following are abrasives commonly used in manufacturing processes:

Conventional abrasives

- a. Aluminum oxide (Al_2O_3)
- b. Silicon carbide (SiC)

Superabrasives

- c. Cubic boron nitride (cBN)
- d. Diamond

Knoop Hardness for Various Materials and Abrasives

Common glass	350–500	Titanium nitride	2000
Flint, quartz	800–1100	Titanium carbide	1800–3200
Zirconium oxide	1000	Silicon carbide	2100–3000
Hardened steels	700–1300	Boron carbide	2800
Tungsten carbide	1800–2400	Cubic boron nitride	4000–5000
Aluminum oxide	2000–3000	Diamond	7000–8000

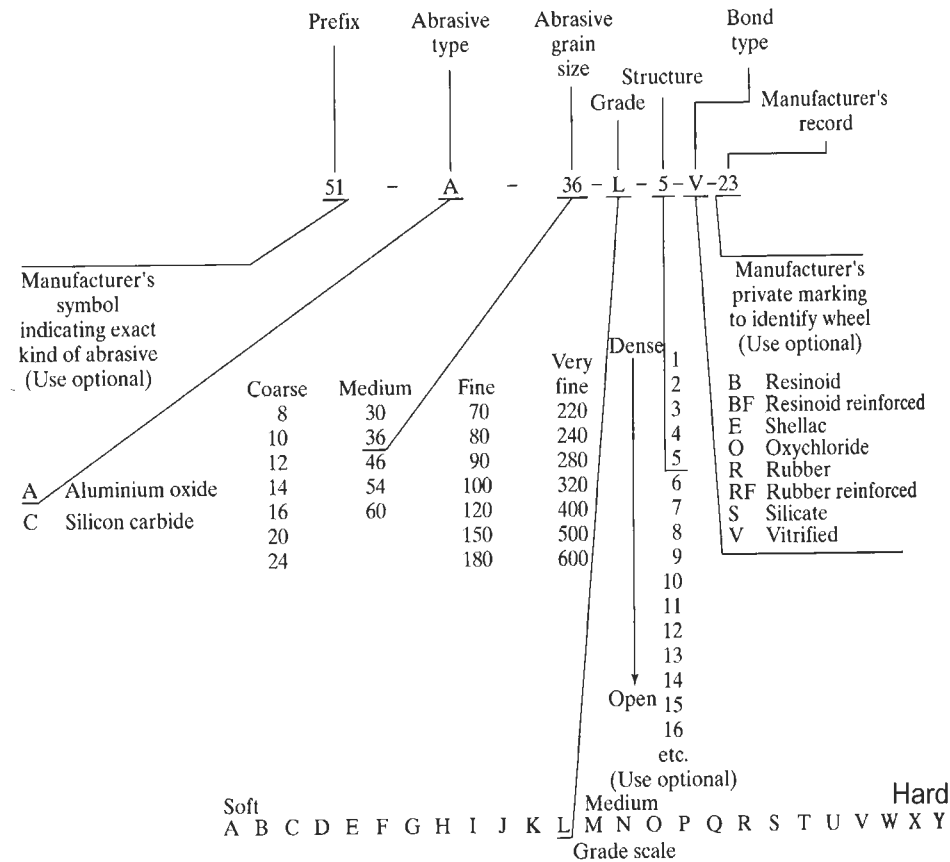
M D 100 — P 100 — B 1/8

Prefix	Abrasive type	Grit size	Grade	Diamond concentration	Bond	Bond modification	Diamond depth (in.)
B	Cubic boron nitride	20	A (soft)	25 (low)	B	Resinoid	1/16
D	Diamond	24	to	50	M	Metal	1/8
		30		75	V	Vitrified	1/4
		36		100 (high)	Absence of depth symbol indicates solid diamond		
		46					
		54					
		60					Z (hard)
		80					
		90					
		100					
		120					
		150					
		180					
220							
240							
280							
320							
400							
500							
600							
800							
1000							

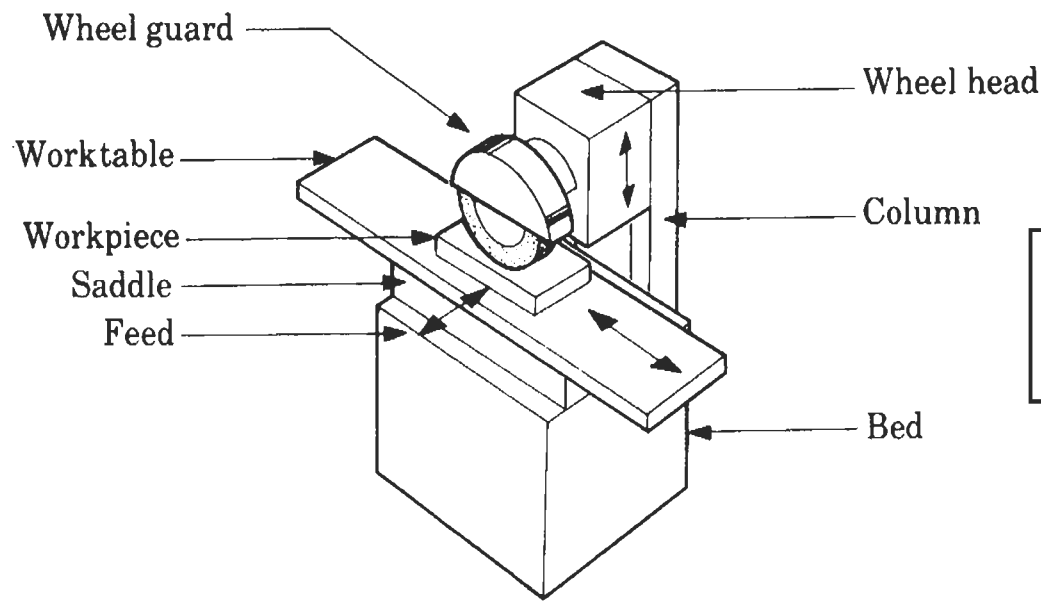
Manufacturer's symbol to indicate type of diamond

A letter or numeral or combination used here will indicate a variation from standard bond

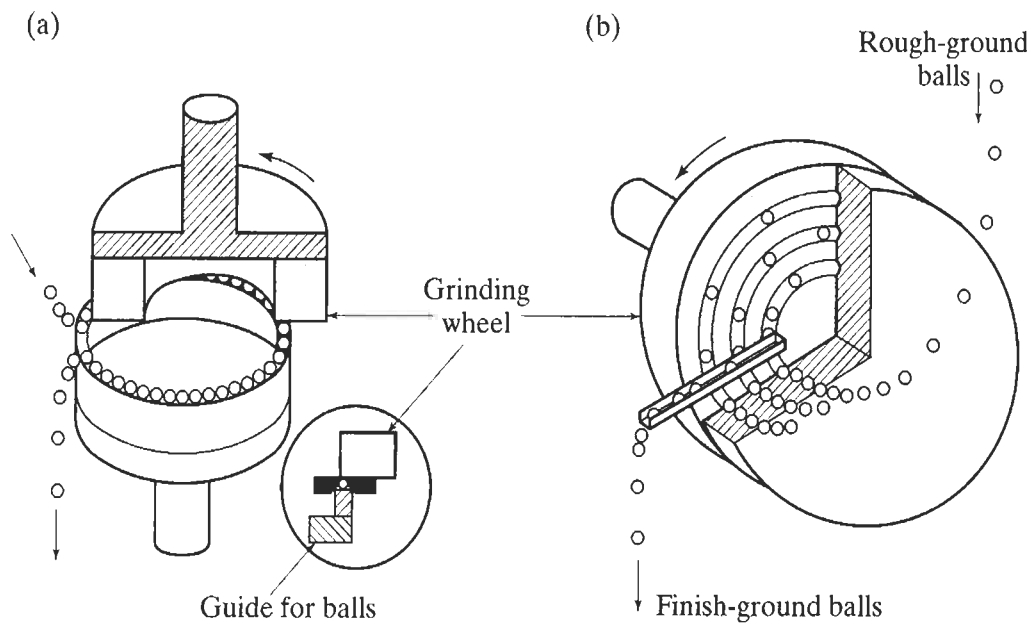
Standard marking system for cubic boron nitride and diamond bonded abrasive



Standard marking system for aluminum-oxide and silicon-carbide bonded abrasives



Schematic illustration of a horizontal-spindle surface grinder



(a) Rough grinding of steel balls on a vertical-spindle grinder; the balls are guided by a special rotary fixture
 (b) Finish grinding of balls in a multiple-groove fixture. The balls are ground to within 0.013 mm of their final size