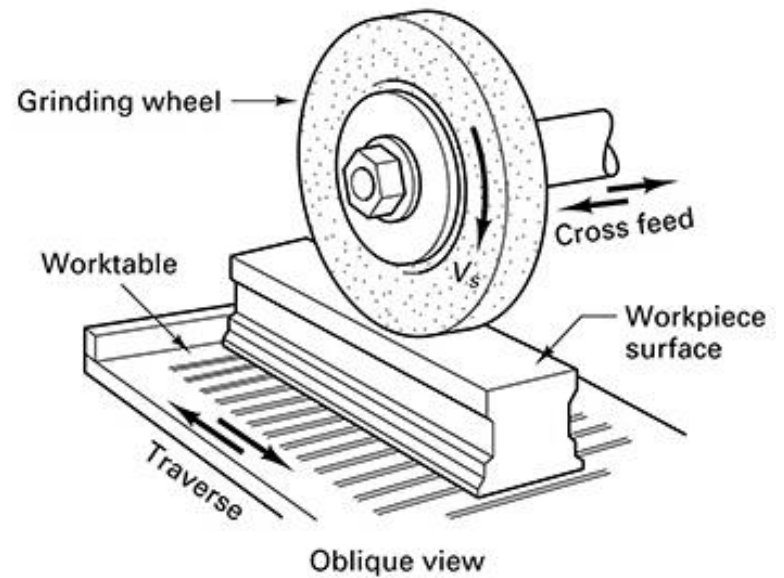
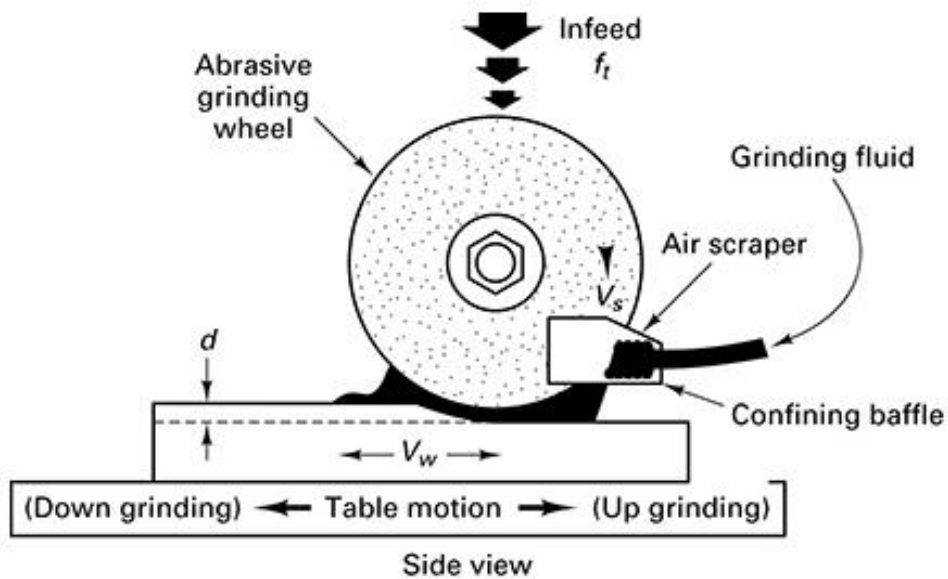


# Abrasive Machining

# **WORKPIECE SURFACE FINISH**

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# Surface Grinding

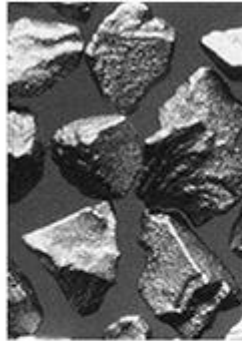
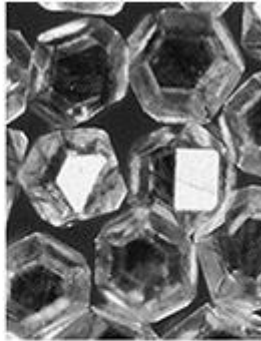
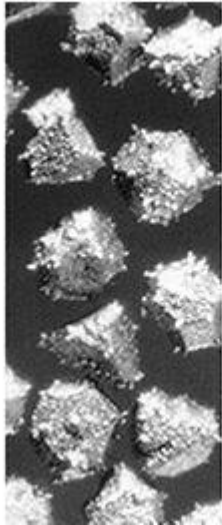
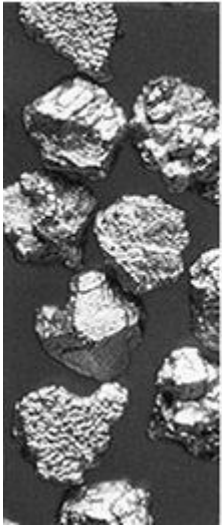


# **ABRASIVES AND GRINDING WHEELS**

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# Loose Abrasive Grains

## Irregular Cutting Edges

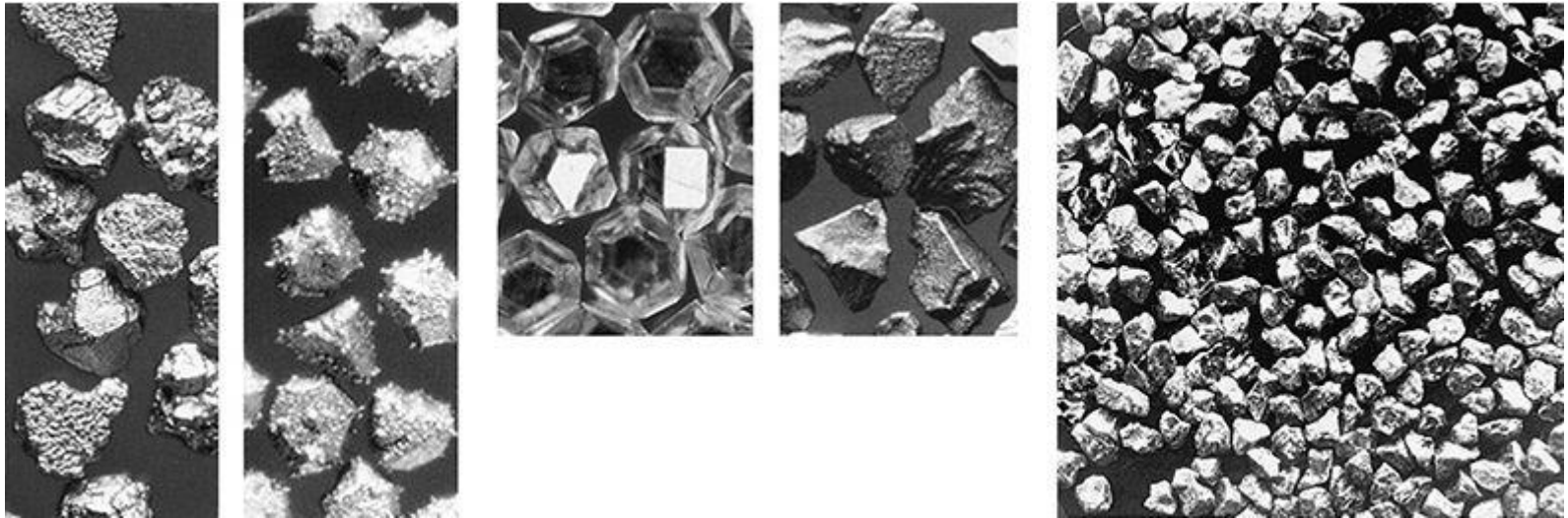


# Knoop Hardness of Grits

Knoop Hardness Values for Common Abrasives

Abrasive Material	Year of Discovery	Hardness (Knoop)	Temperature of Decomposition in Oxygen (°C)	Comments and Uses
Quartz	?	320		Sand blasting
Aluminum oxide	1893	1600–2100	1700–2400	Softer and tougher than silicon carbide; used on steel, iron, brass, silicon
Carbide	1891	2200–2800	1500–2000	Used for brass, bronze, aluminum, and stainless and cast iron
Borazon [cubic boron nitride stainless (CBN)]	1957	4200–5400	1200–1400	For grinding hard, tough tool steels, stainless steel, cobalt and nickel based, superalloys, and hard coatings
Diamond (synthetic)	1955	6000–9000	700–800	Used to grind nonferrous materials, tungsten carbide, and ceramics

# Abrasive Grain Size and Geometry

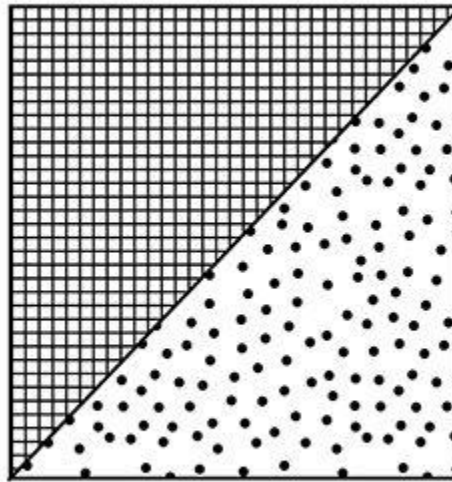


# Typical Screens for Sorting Abrasives

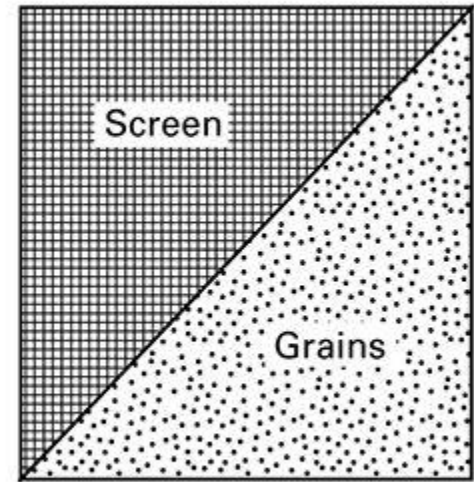
← 1" →



Screen no. 8  
Grain size 8



Screen no. 24  
Grain size 24



Screen no. 60  
Grain size 60



# Grain Sizes

- Coarse – 4-24
- Medium – 30-60
- Fine – 70-600

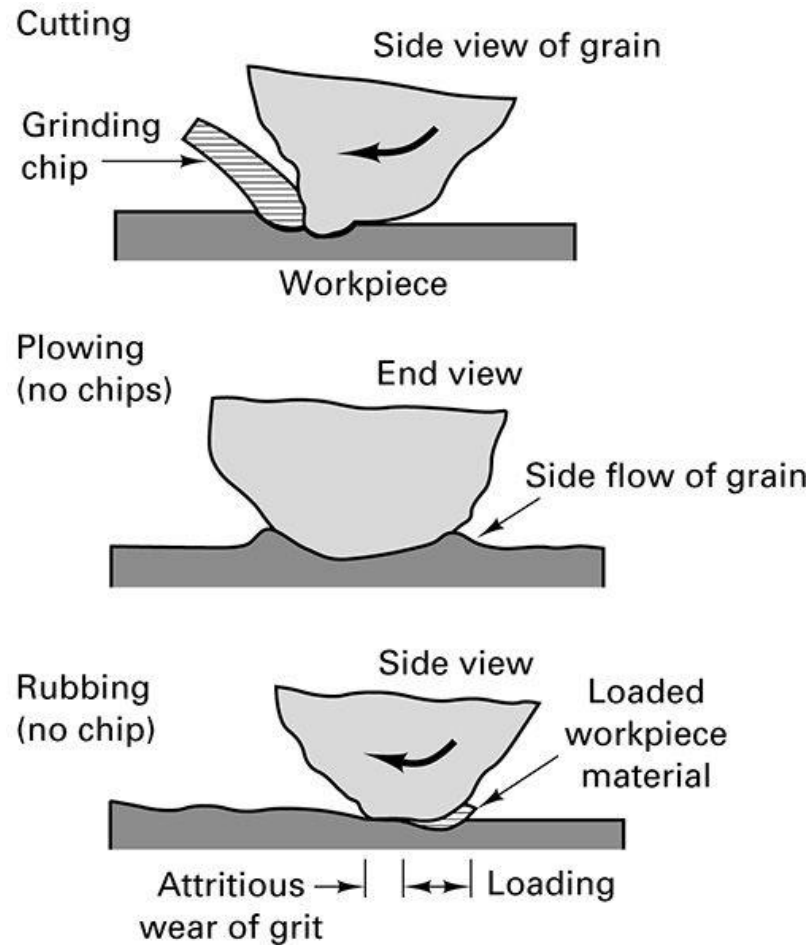
# Common Grit Sizes

- Aluminum oxide 4 – 240 grit
- Silicon carbide 2 – 240 grit
- Diamond and CBN 120 – 400 grit
- Lapping/fine honing (flour sizes) 240 – 600 grit

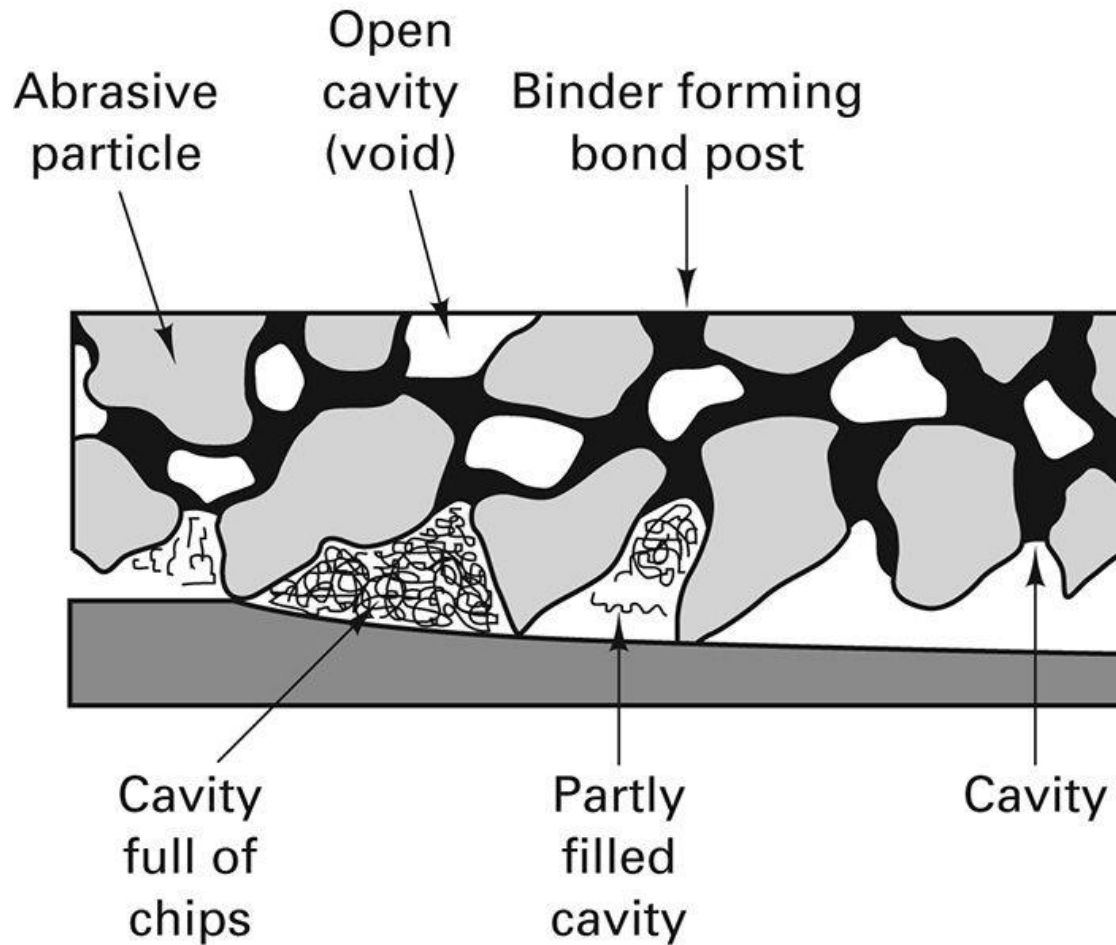
# Grain Diameter vs. Openings

- Grain diameter,  $D \cong 0.7/S$
- Screen size (number of openings/inch),  $S$
- Grain size is smaller than the opening size

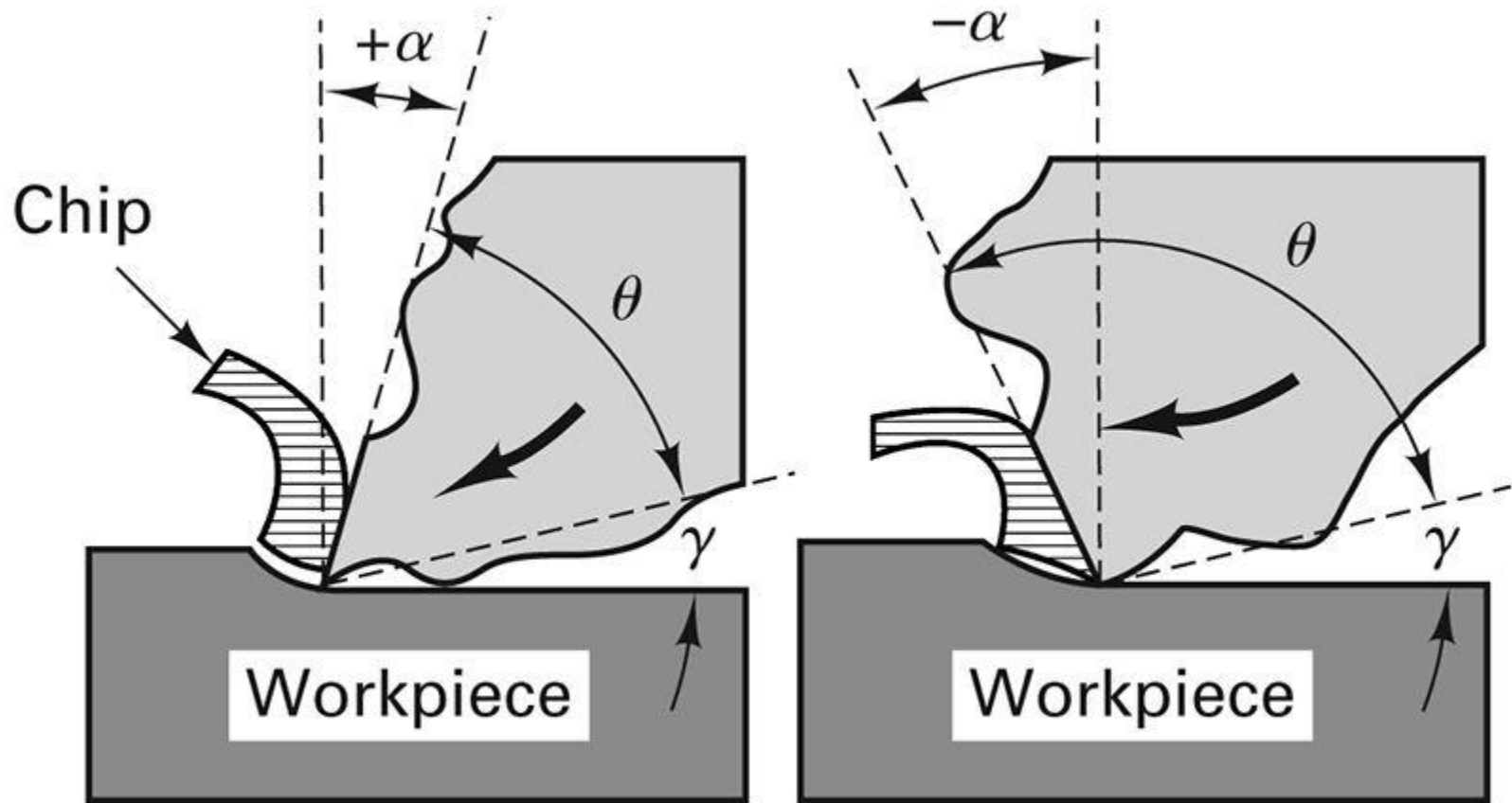
# Grits Interact: Cutting, Plowing, Rubbing



# Voids between grains collect chips



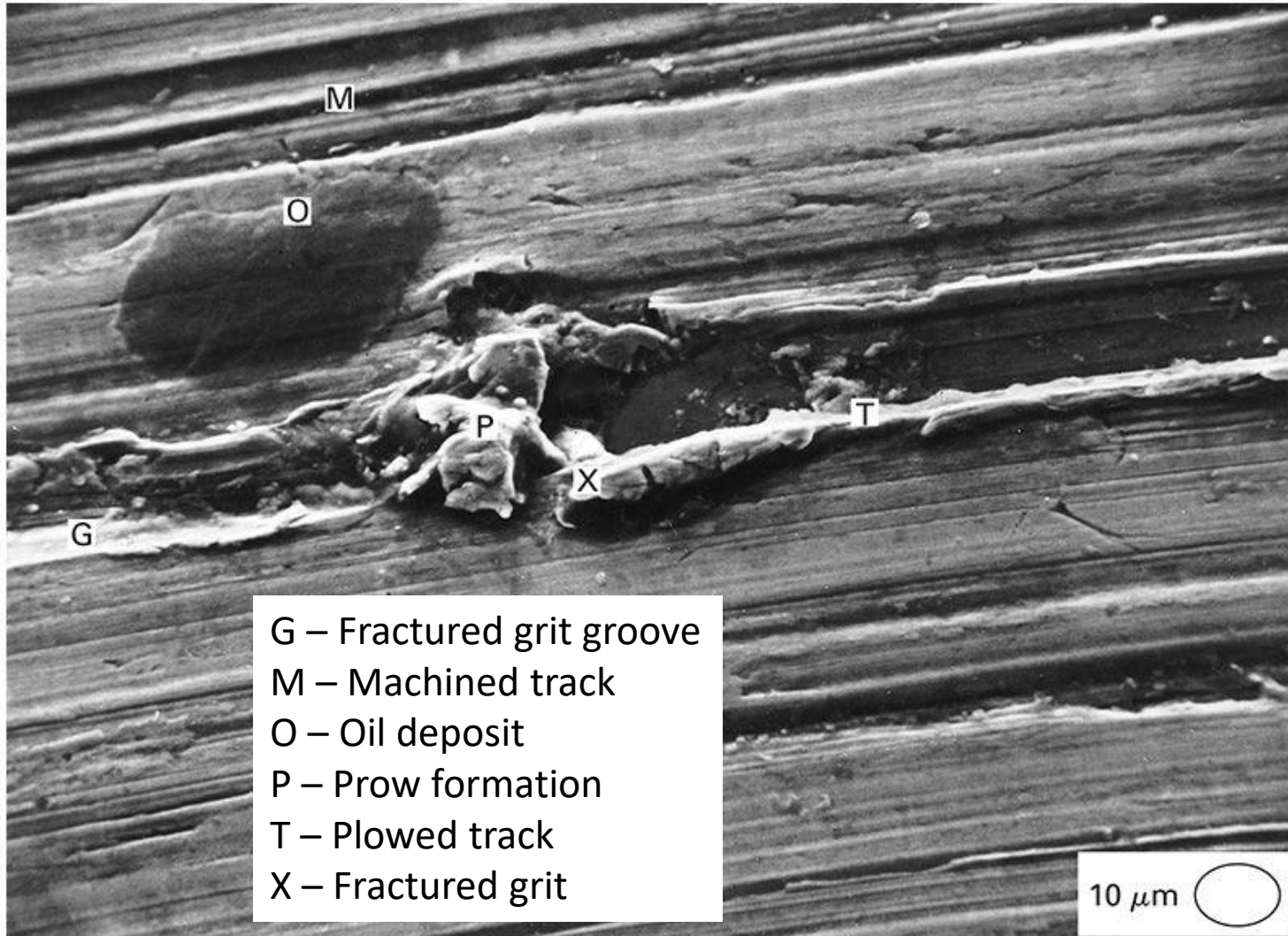
# Positive or Negative Rake Angle



# Heat Transfer in Abrasive Machining

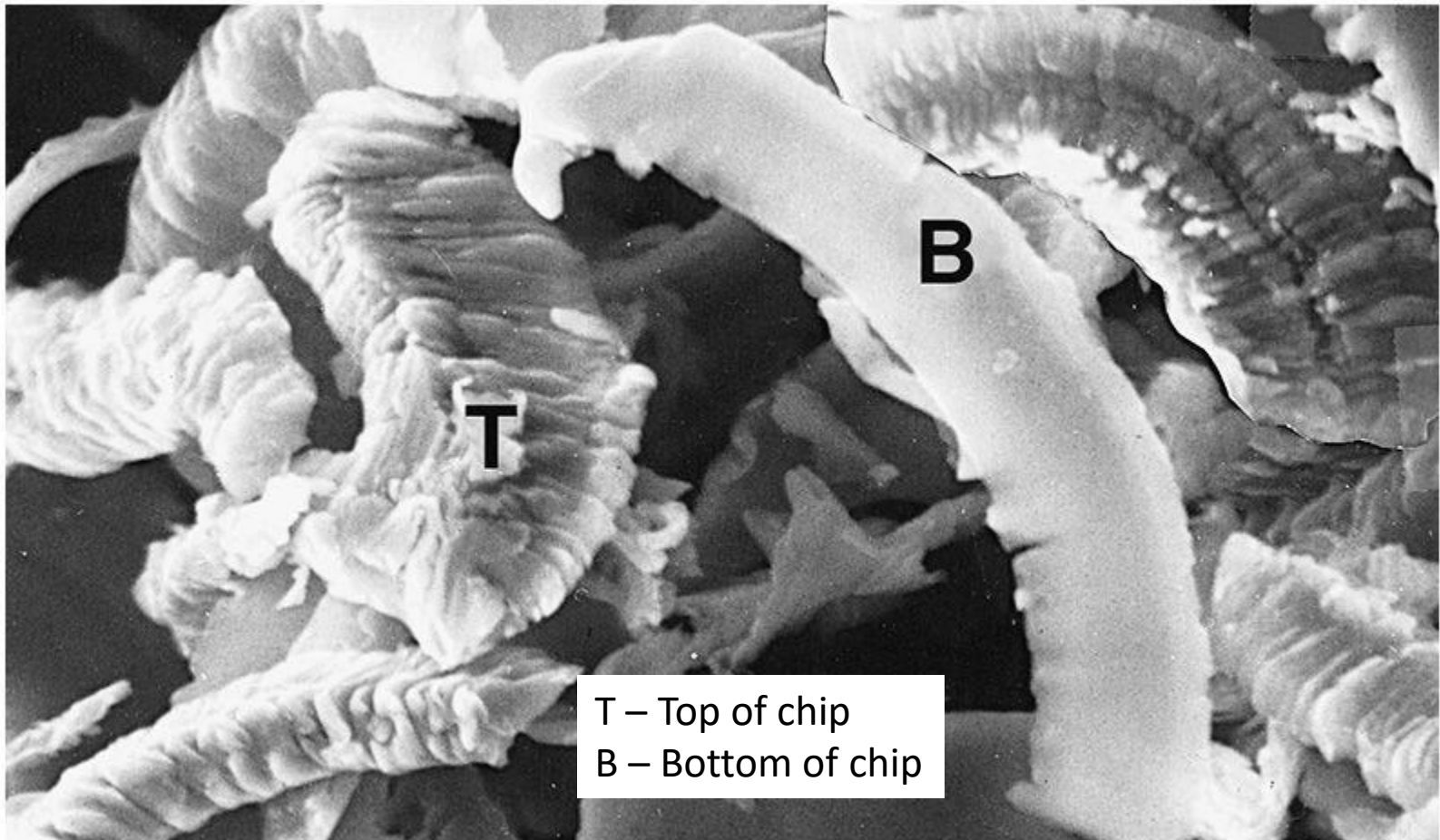
- Plowing and Rubbing: energy goes into workpiece
- Cutting: 95 – 98% of energy (heat) goes into chips to makes sparks – chips burn

# SEM Micrograph of Ground Steel Surface

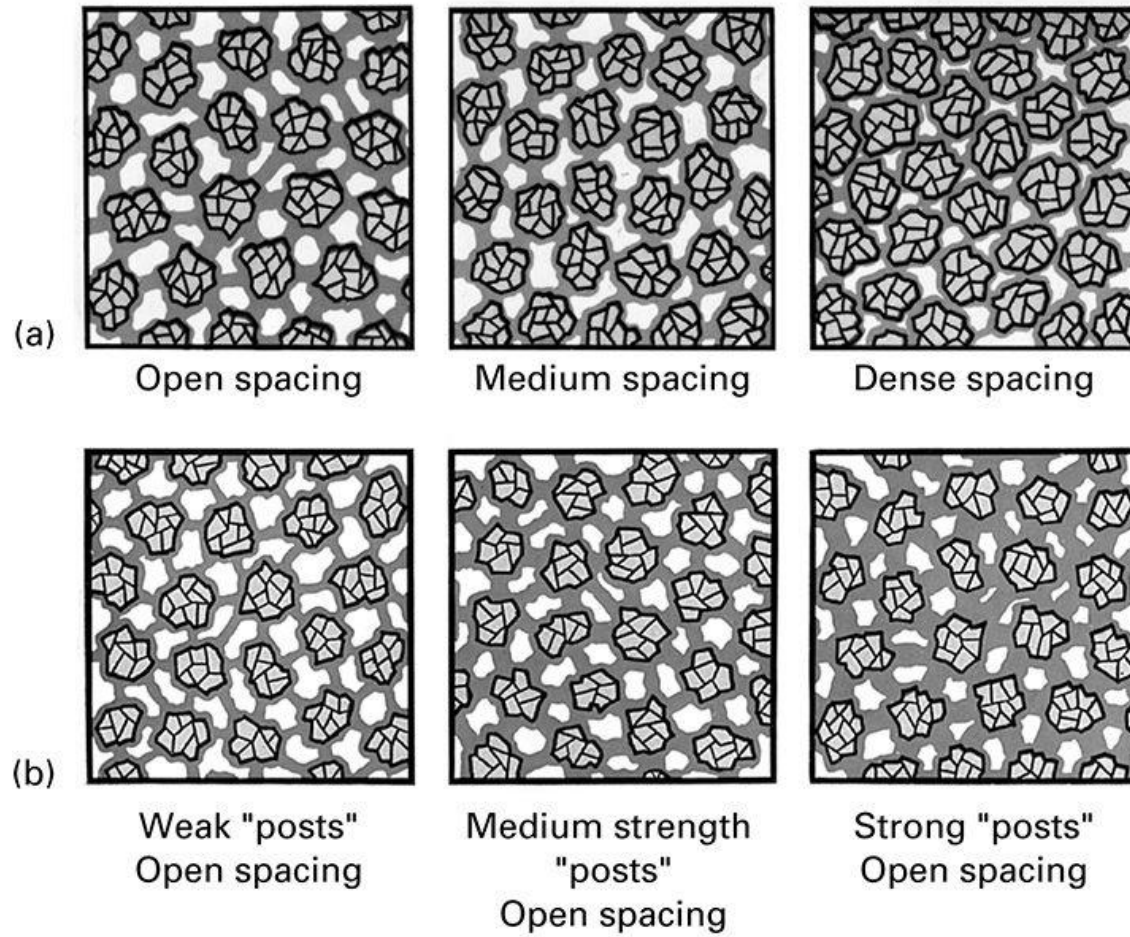




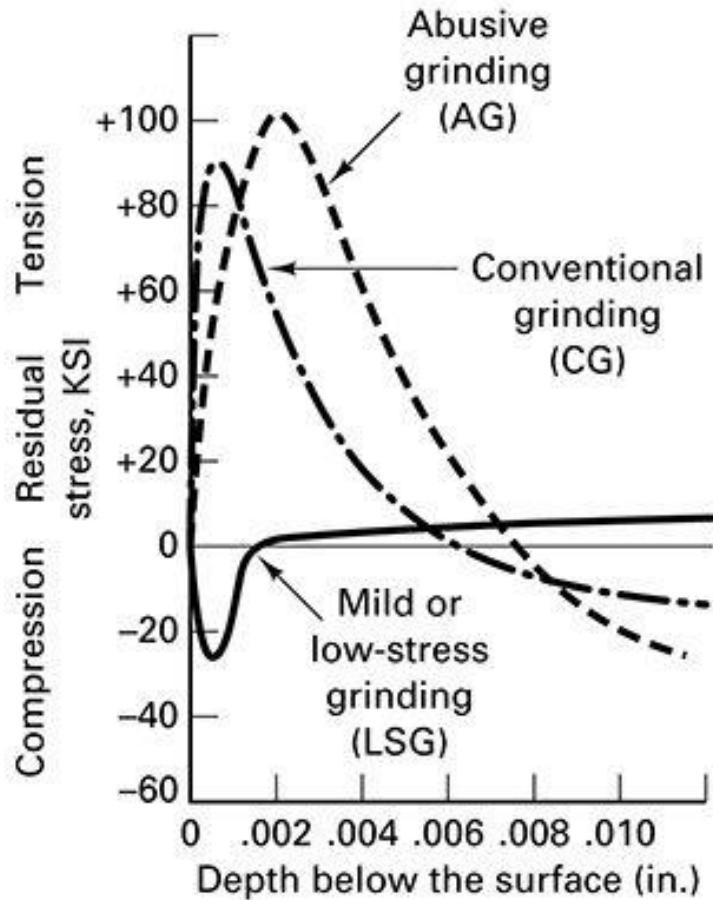
# SEM Micrograph of Stainless-Steel Chips



# Wheel Structure and Grade



# Residual Stress Distributions

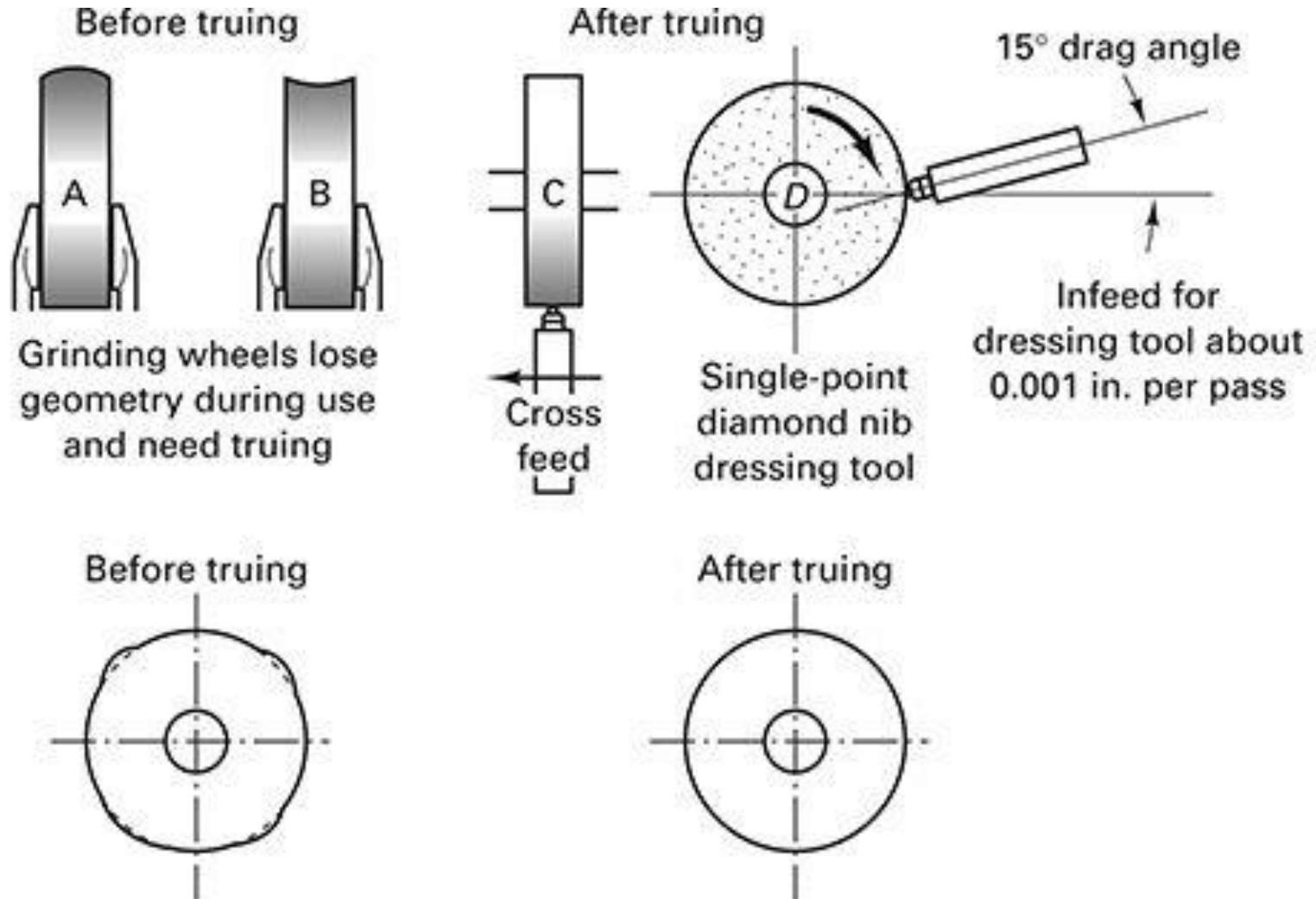


	Grinding conditions		
	Abusive AG	Conventional CG	Low-stress LSG
Wheel	A46MV	A46KV	A46HV or A60IV
Wheel speed ft/min	6,000–18,000	4,500–6,500	2500–3000
Down feed in./pass	.002–.004	.001–.003	.0002–.005
Cross feed in./pass	.040–.060	.040–.060	.040–.060
Table speed ft/min	40–100	40–100	40–100
Fluid	Dry	Sol oil (1:20)	Sulfurized oil

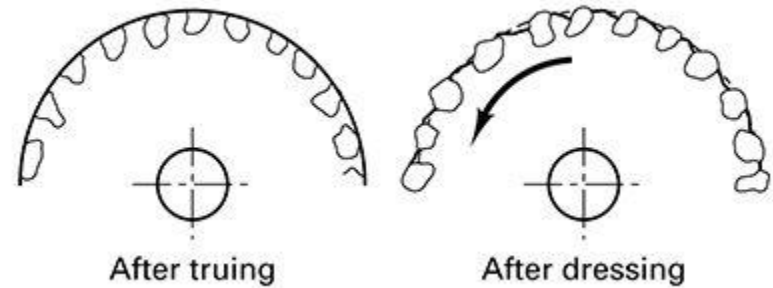
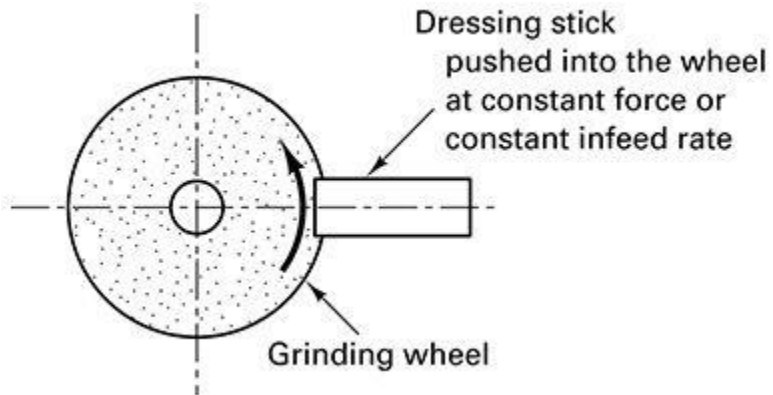
# **BALANCING, TRUING AND DRESSING**

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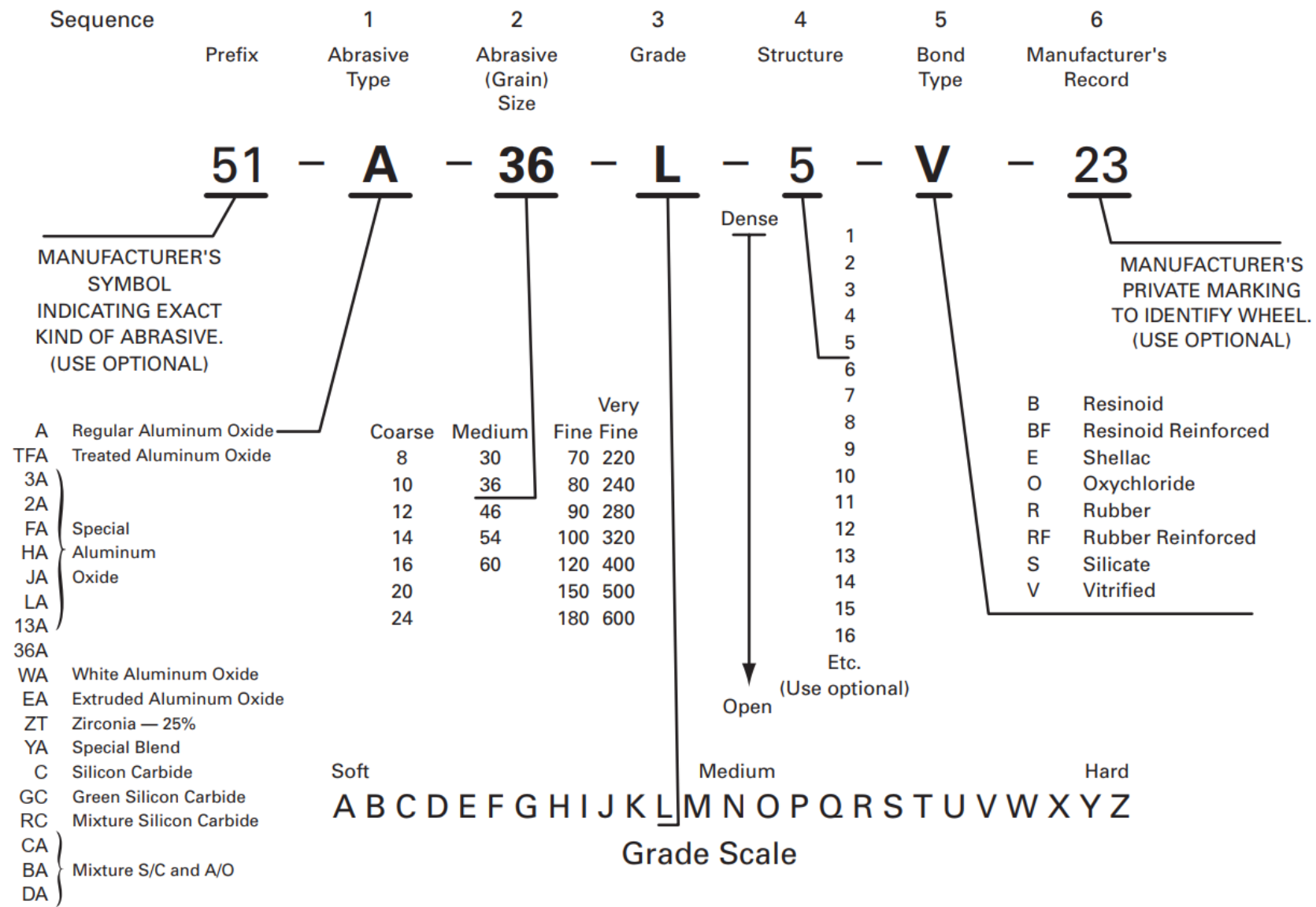
# Truing a Wheel



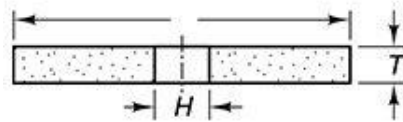
# Stick Dressing vs. Truing



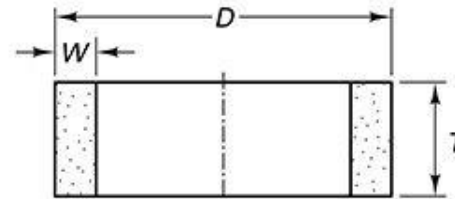
# Standard Markings for Grinding Wheels



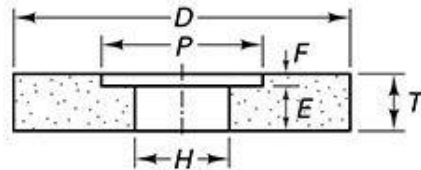
# Standard Grinding Wheel Geometry



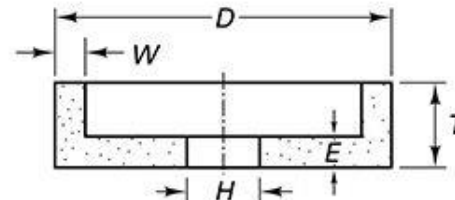
1. Straight



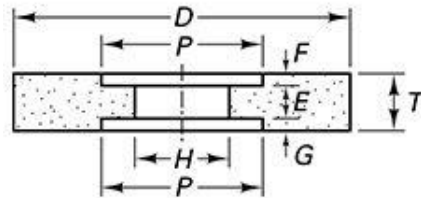
5. Cylinder



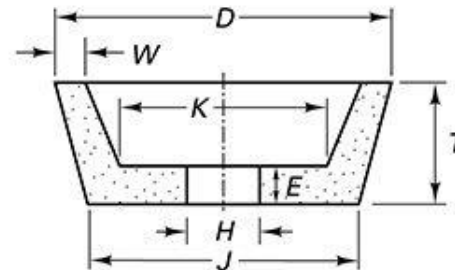
2. Recessed one side



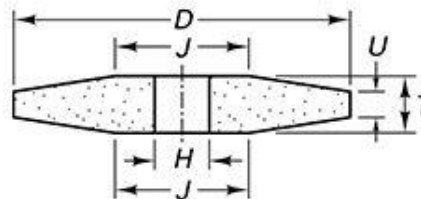
6. Straight cup



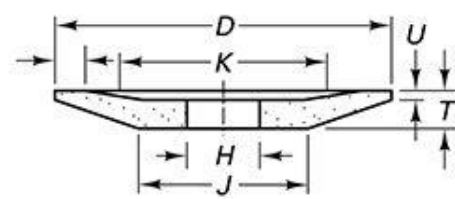
3. Recessed two sides



7. Flaring cup



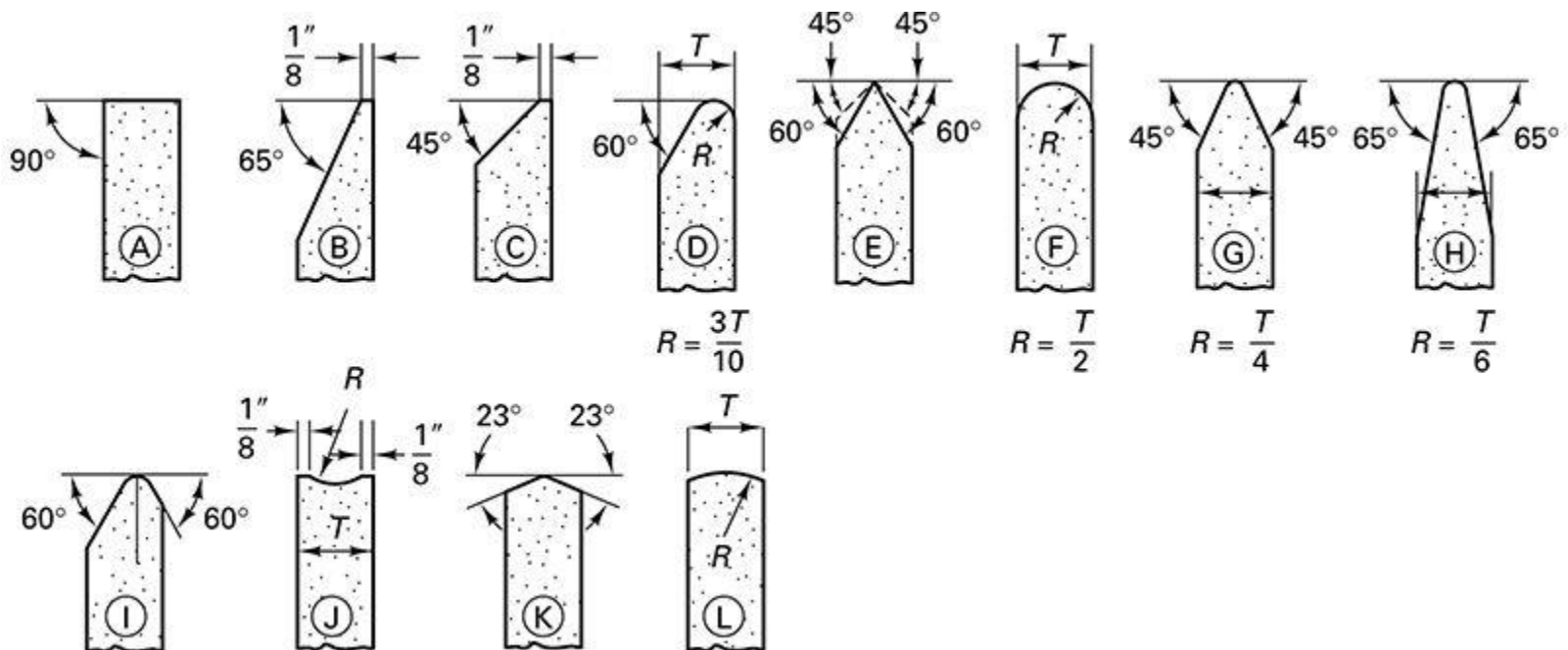
4. Tapered



8. Dish



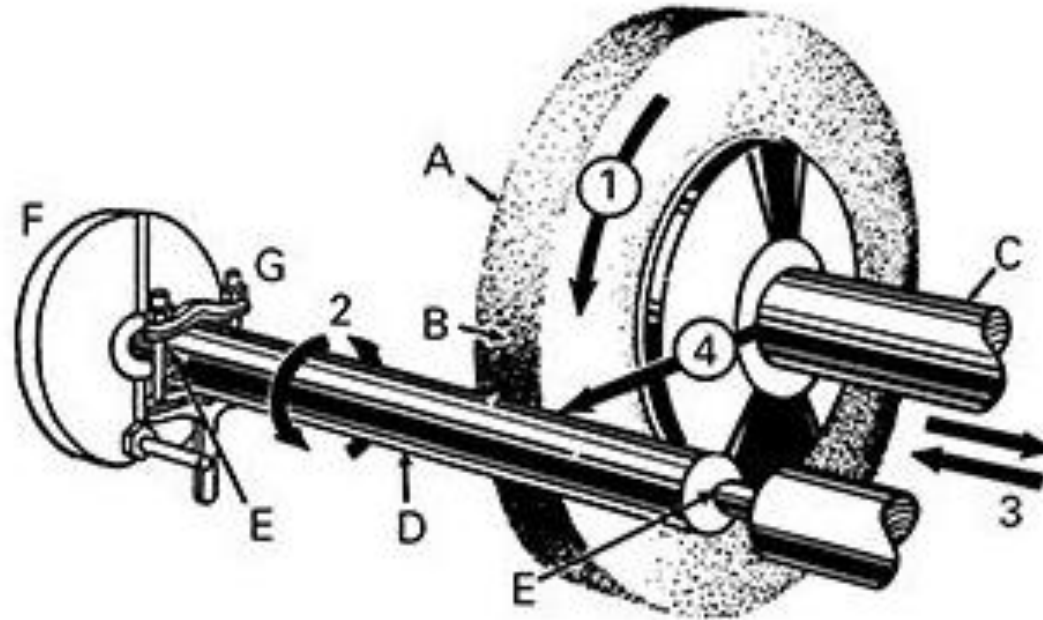
# Standard Face Contours



# **GRINDING SAFETY**

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# Cylindrical Grinding Between Centers



## Movements

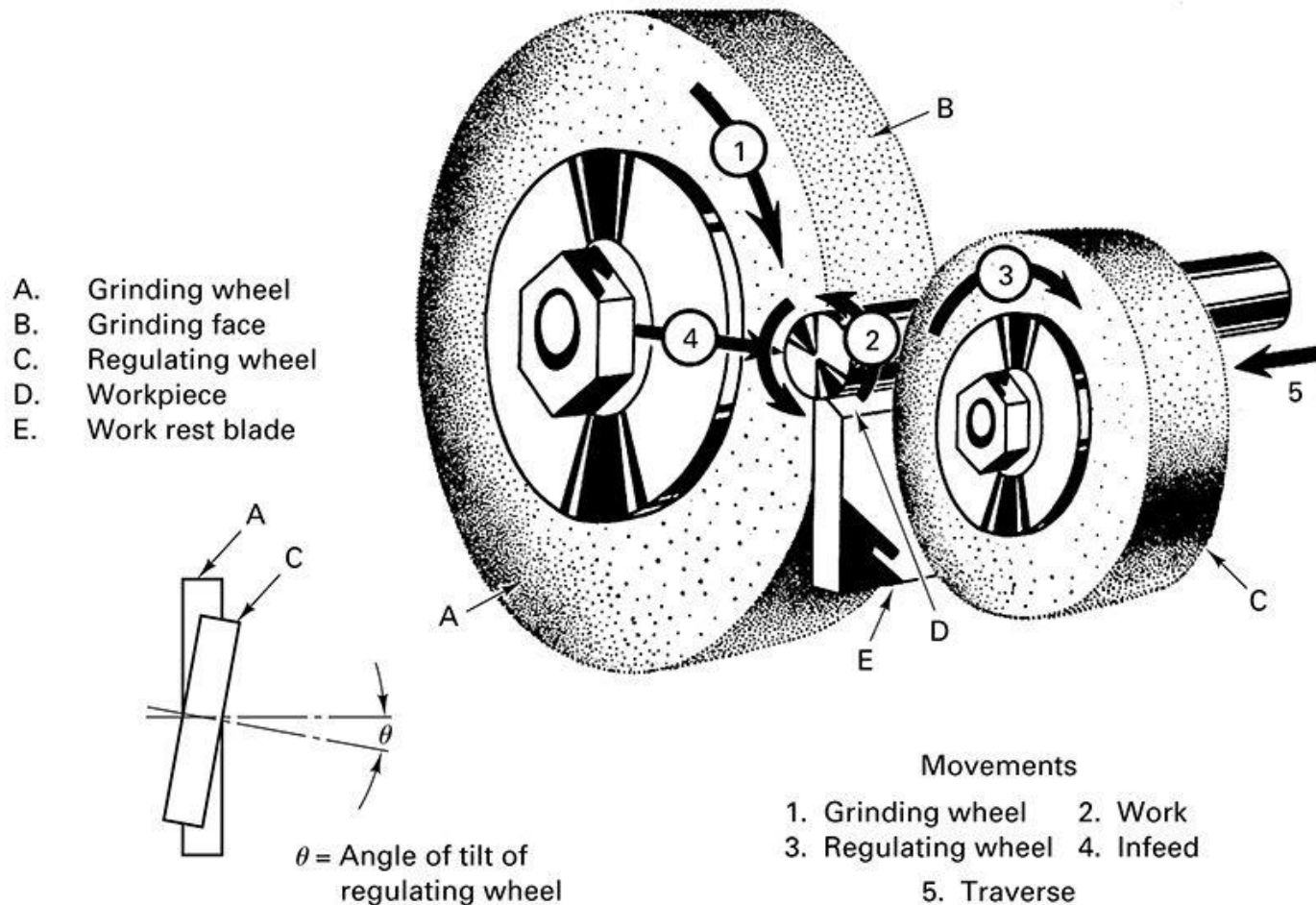
1. Wheel
2. Work (rotates)
3. Traverse
4. Infeed

# CENTERLESS GRINDING

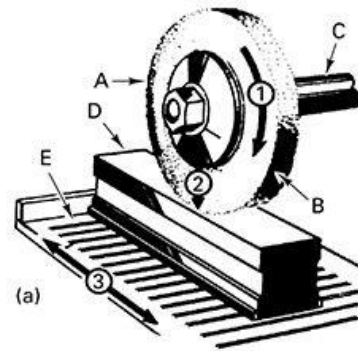
A close-up photograph of a centerless grinding operation. The image shows a cylindrical workpiece being ground between two abrasive wheels. The grinding wheel on the right is in motion, creating a bright, sparks-filled contact point with the workpiece. The machine's structure is painted blue, and various mechanical components like guides and supports are visible.

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# Centerless Grinding

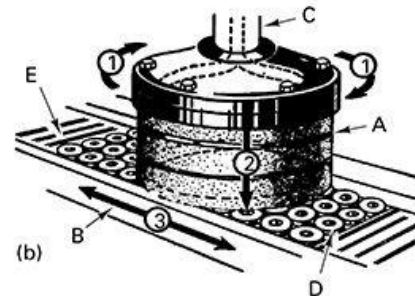


# Surface Grinding

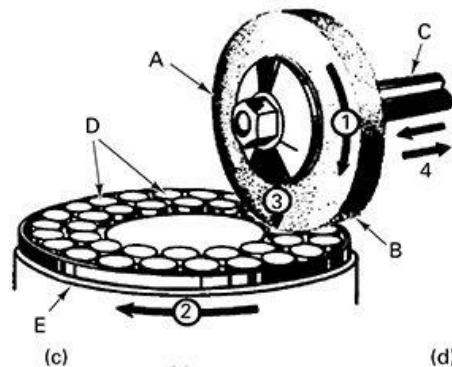


Movements

1. Wheel
2. Infeed
3. Work table traverse

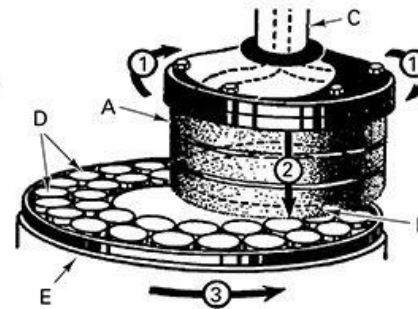


- A. Grinding wheel
- B. Grinding face
- C. Shaft
- D. Workpiece
- E. Magnetic chuck on table



Movements

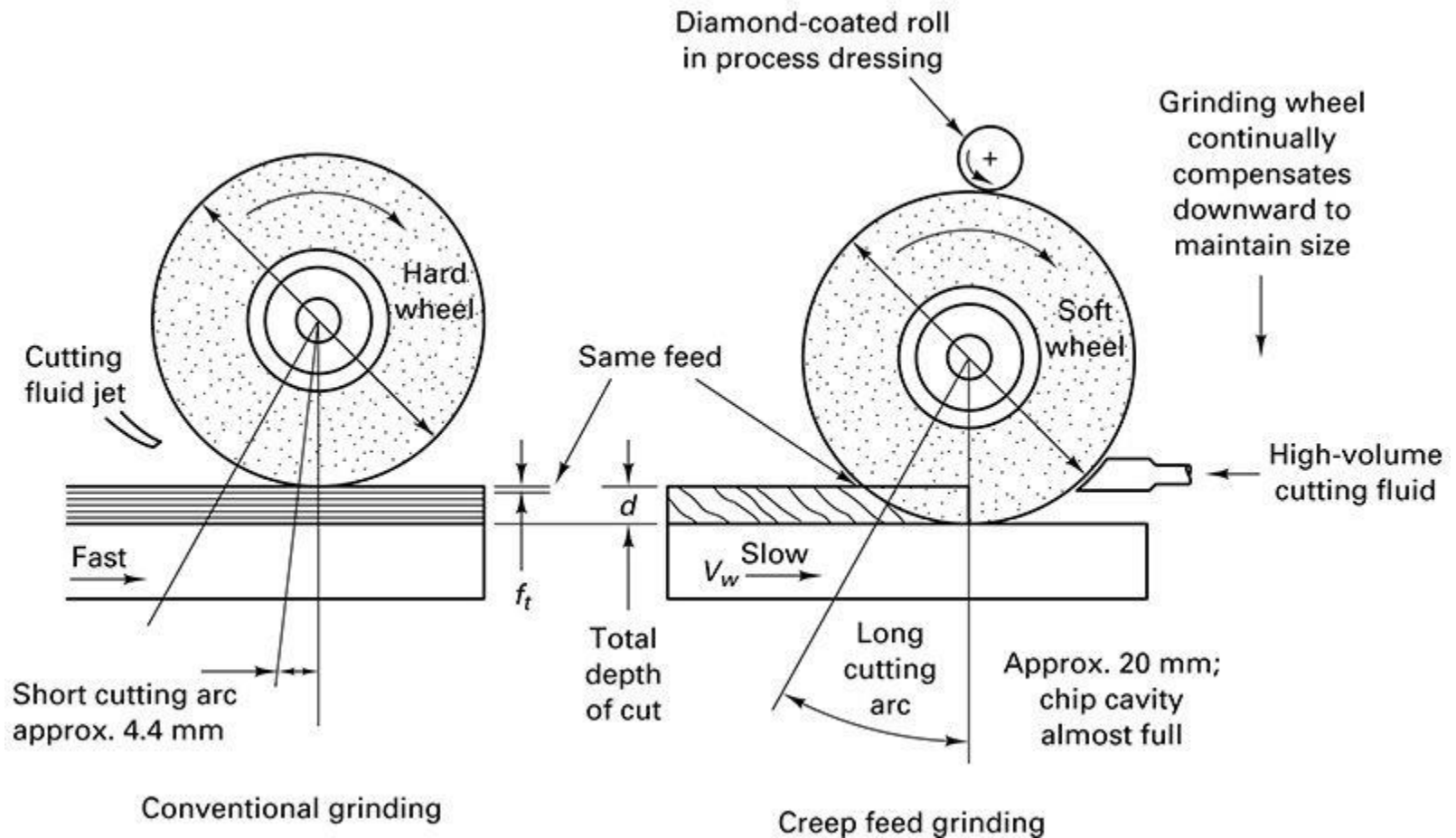
1. Wheel
2. Work table rotation
3. Infeed
4. Cross feed



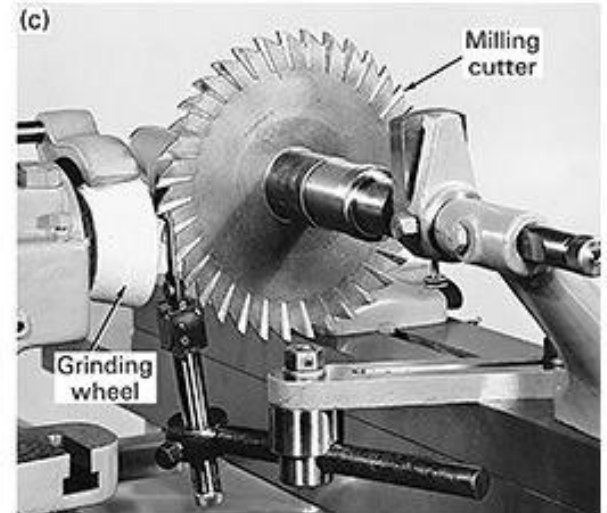
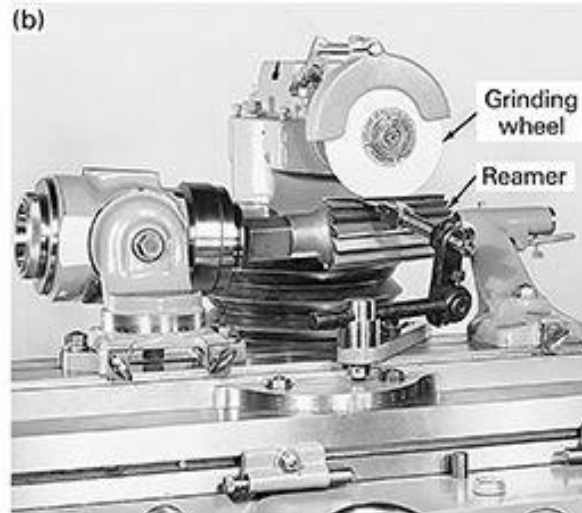
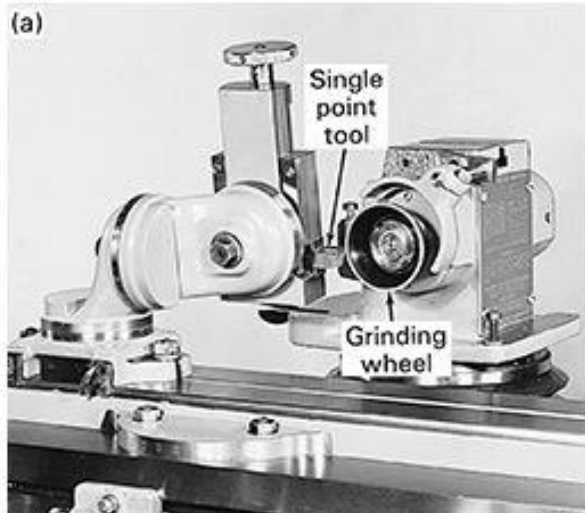
Movements

1. Wheel
2. Infeed
3. Work table rotation

# Creep-feed Grinding

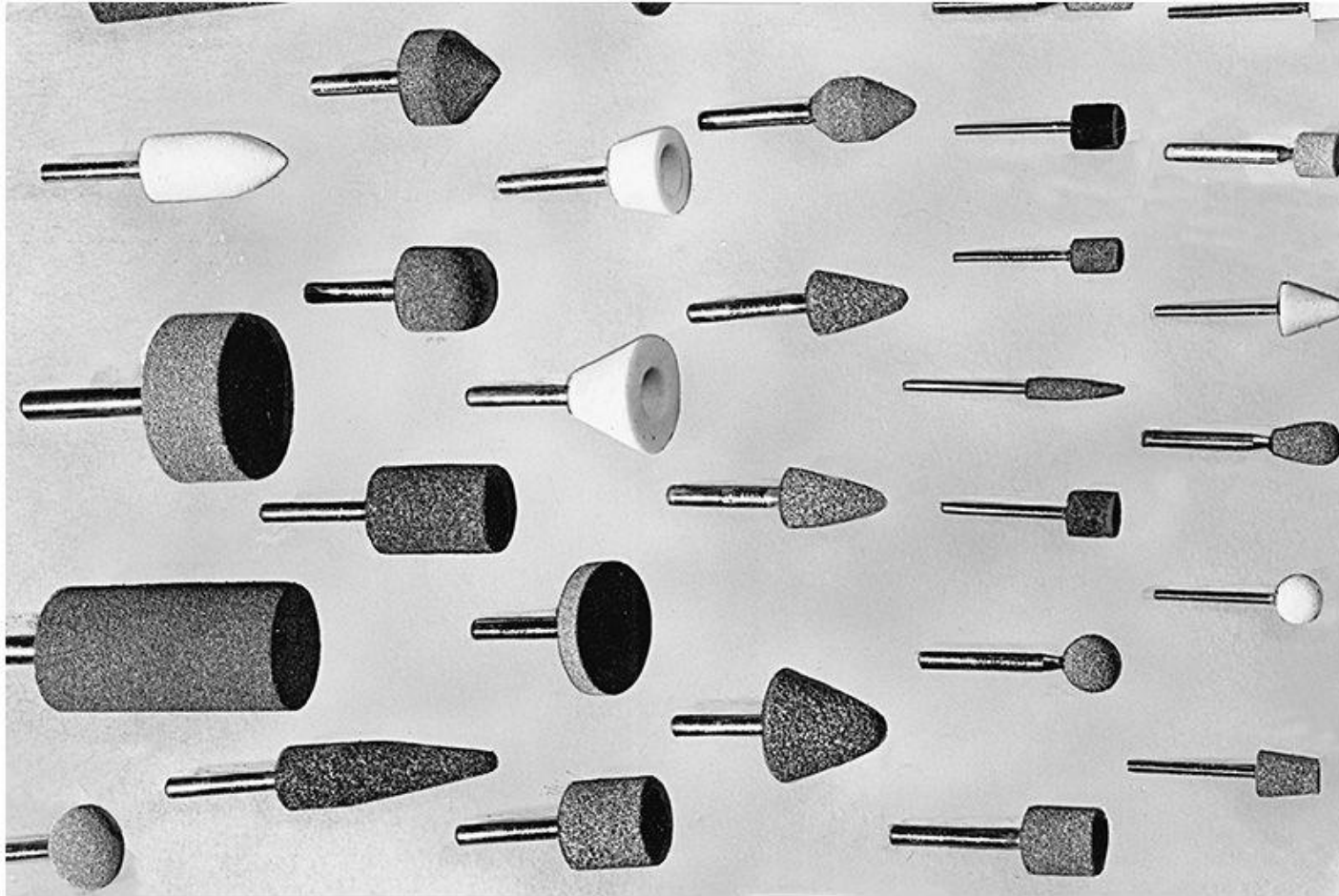


# Tool Grinding



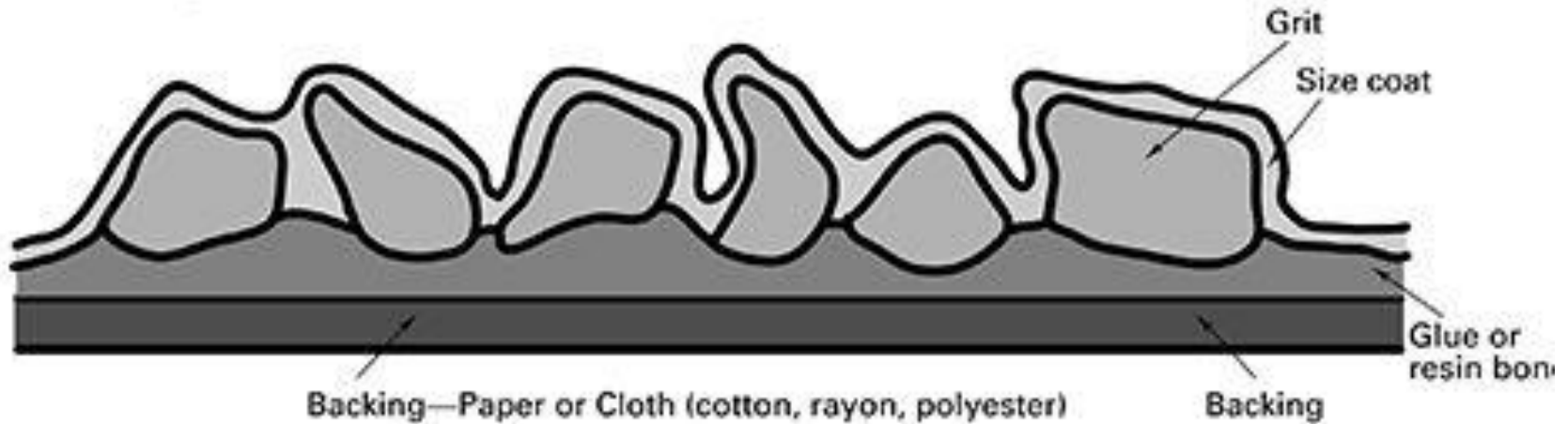


# Hand-held Grinding Wheels

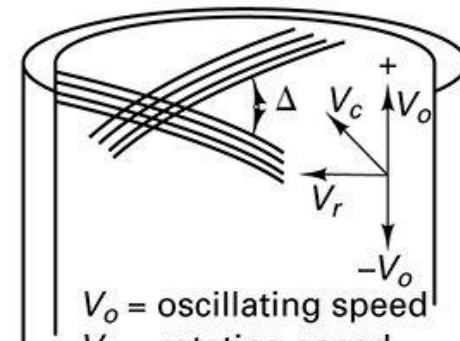
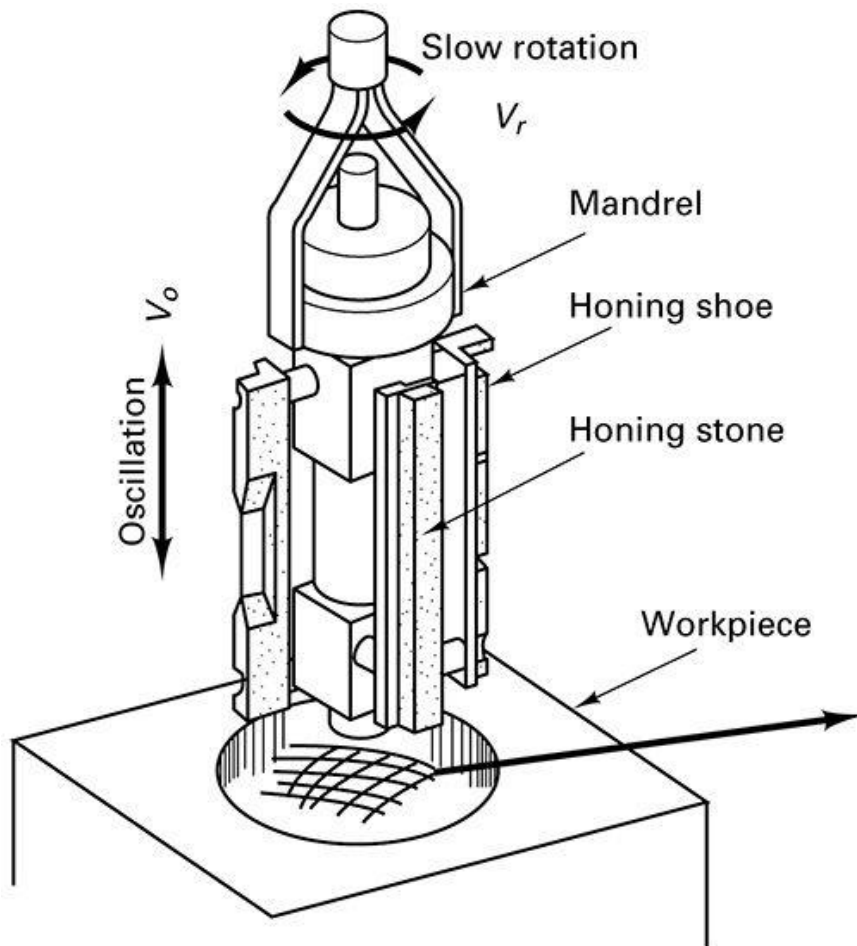


# Coated Abrasive Belt Composition

Belt composition

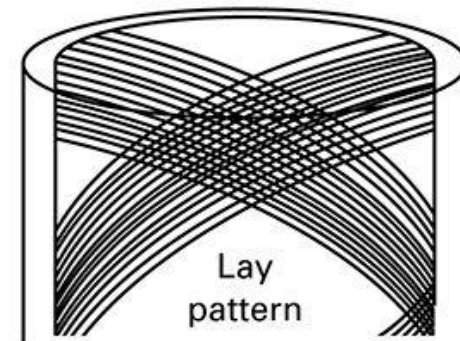


# Honing

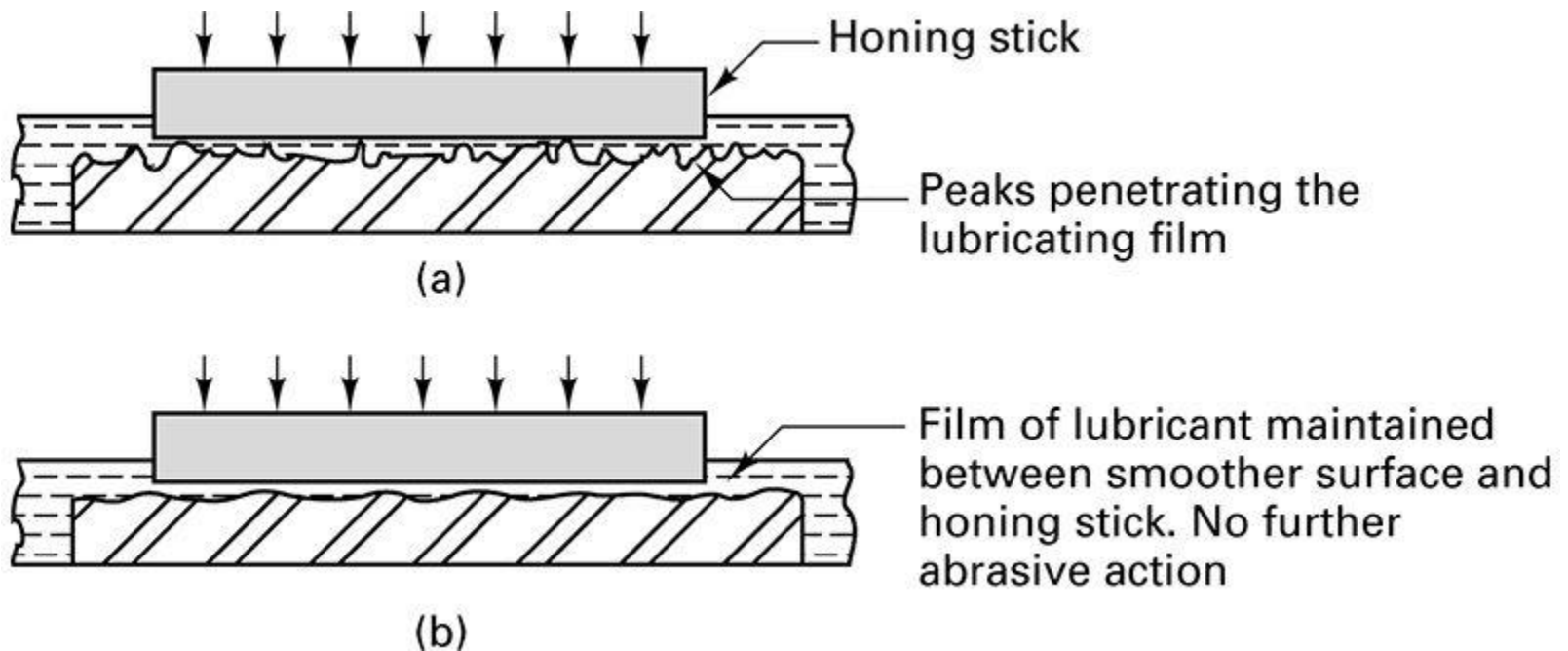


$V_o$  = oscillating speed  
 $V_r$  = rotating speed  
 $V_c$  = resulting cutting speed

$\Delta$  = inclined angle  
Inset



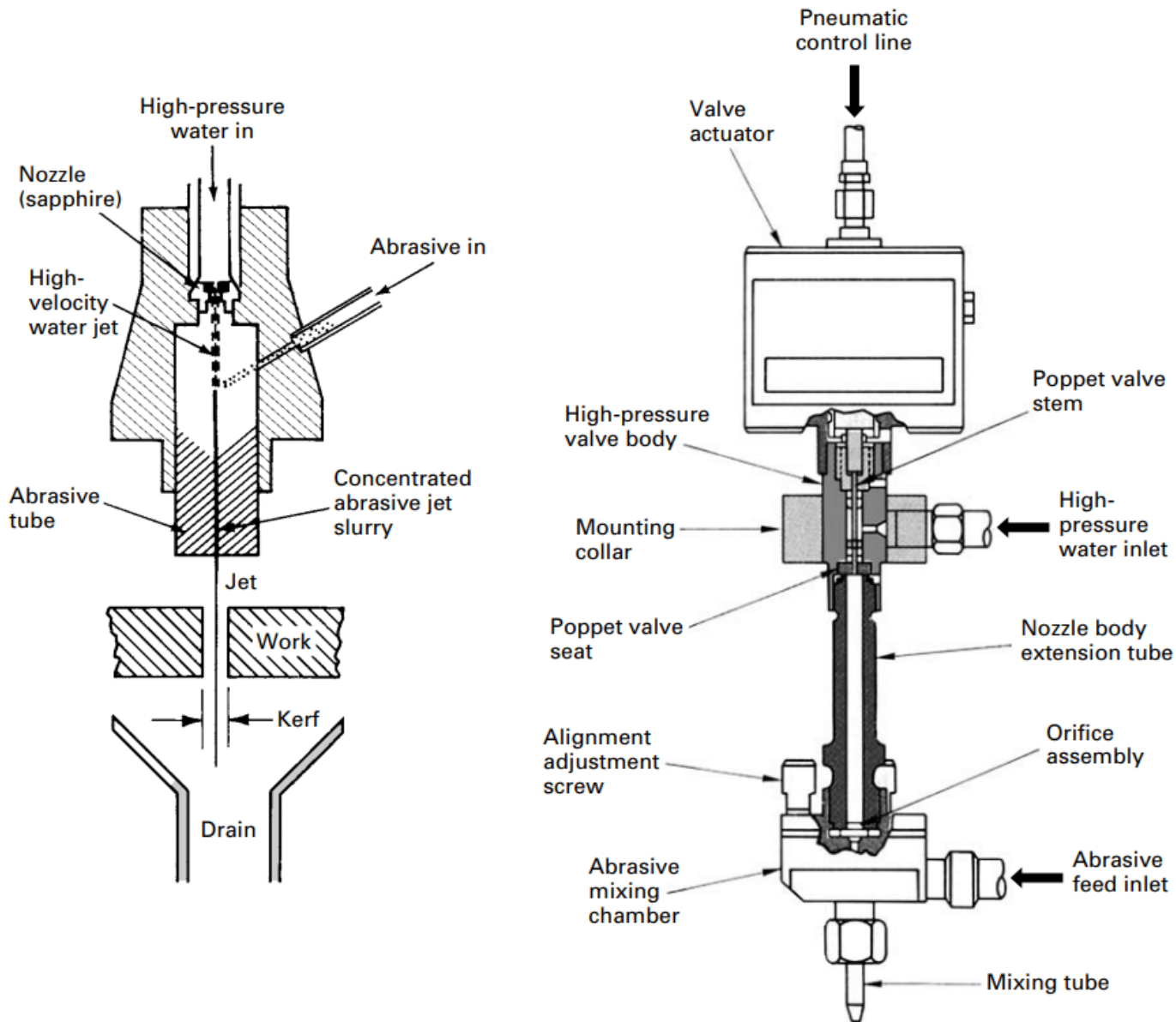
# Superfinishing



# ABRASIVE WATERJET CUTTING

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# Abrasive Waterjet Machining



# Materials cut by AWC

- Plastics
- Glass
- Ceramics
- Rubber
- Metals
- Composites
- Any material thru choice of abrasives