Subject Name & Code:

MANUFACTURING PROCESSES-BE04000191

ASSIGNMENT-8: Grinding Machines and Abrasives (CO-2,3,4)

Q1. Explain grinding wheel designation system.

Grinding Wheel Designation System (IS: 551 / ANSI B74.13):

A standard grinding wheel is specified by a **sequence of symbols** in the following order:

Format: Prefix - Abrasive Type - Grain Size - Grade - Structure - Bond Type - Manufacturer's Code

Example: A 60 K 5 V 10

Position	Symbol	Meaning	Example Value
1	Prefix	Manufacturer's symbol (optional)	—
2	**Abrasive Type**	A = Aluminium Oxide, C = Silicon Carbide	A
3	**Grain Size**	Grit number (coarse: 10-24, medium: 30-60, fine: 70-600)	60
4	**Grade**	Hardness of bond (A-Z; A-soft, Z-hard)	K (Medium)
5	**Structure**	Spacing between grains (1-dense to 16-open)	5 (Medium)
6	**Bond Type**	V = Vitrified, B = Resinoid, R = Rubber, E = Shellac, S = Silicate	V

Position	Symbol	Meaning	Example Value
7	Suffix	Manufacturer's private marking	10

Detailed Explanation:

1. Abrasive Type:

- **A:** Aluminium Oxide (for steel, malleable iron, tough materials)
- **C:** Silicon Carbide (for cast iron, non-ferrous metals, carbide)
- **D:** Diamond
- **B:** Cubic Boron Nitride (CBN)

2. Grain Size (Grit Number):

- Coarse (10-24): Fast stock removal, rough finish.
- Medium (30-60): General purpose.
- Fine (70-180): Precision grinding, good finish.
- Very Fine (220-600): Lapping, honing, superfinishing.

3. Grade (Hardness):

- A-H: Soft grade (grains release easily)
- I-P: Medium grade
- Q-Z: Hard grade (strong bond, grains held firmly)

4. Structure (Porosity):

- 1-4: Dense structure (for hard, brittle materials)
- 5-8: Medium structure (general purpose)
- 9-16: Open structure (for soft, ductile materials; better coolant flow)

5. Bond Type:

- **V (Vitrified):** Most common; brittle, porous; not affected by coolant; used for precision grinding.
- **B (Resinoid):** Strong, elastic; used for high-speed, rough grinding, cut-off wheels.
- **R (Rubber):** Flexible; used for thin wheels, cut-off wheels.
- **E (Shellac):** Elastic; good finish; used for camshaft grinding.
- **S (Silicate):** Mild action; used for tool grinding.

Q2. Explain truing and dressing of grinding wheels.

Parameter	Dressing	Truing
Definition	Process of **restoring cutting action** by removing dull grains and exposing fresh sharp grains	Process of **restoring wheel geometry** (shape, concentricity, face squareness)
Purpose	Unclogs wheel face; removes loaded material; breaks dull grains	Makes wheel run true; corrects out-of-roundness; restores profile
Effect on Wheel	Opens wheel face; improves cutting efficiency	Corrects wheel shape and runout
Tool Used	Diamond dresser, star dresser, abrasive stick	Diamond dresser (single or cluster), crushing roll
When Performed	Frequently during grinding operation	After mounting new wheel; periodically to correct shape
Depth of Cut	Very light (0.01-0.02 mm)	Can be deeper to correct shape
Combined Operation	Often dressing and truing are done **simultaneously** using diamond dresser	—

Dressing Tools:

1. **Single Point Diamond Dresser:** Most common; for precision dressing/truing.
2. **Multi-Point Diamond Dresser:** Diamond clusters; faster stock removal.
3. **Star Dresser:** Star-shaped hardened steel wheels; for rough dressing.
4. **Abrasive Stick:** Silicon carbide stick; hand dressing for small wheels.

Procedure for Diamond Dressing:

1. Wheel rotated at normal speed.
2. Diamond dresser mounted on machine table or special fixture.
3. Dresser traversed across wheel face at controlled feed rate.
4. Light depth of cut (0.01-0.02 mm per pass).
5. Coolant used to prevent thermal shock.

Importance:

- Maintains cutting efficiency.
- Ensures dimensional accuracy and surface finish.
- Prevents wheel glazing and loading.
- Extends wheel life.

Q3. How grinding wheel is specified? Explain in details.

Grinding Wheel Specification (Same as Q1 - Expanded):

A grinding wheel is completely specified by a **standard marking system** that describes its composition and characteristics.

Standard Marking Sequence (IS: 551):

W - A - 60 - K - 5 - V - 17

Position	Parameter	Symbol	Meaning
1	Manufacturer's Prefix	W	(Optional) Manufacturer code
2	Abrasive Type	A	Aluminium Oxide
3	Grain Size	60	Medium grit
4	Grade	K	Medium hard bond
5	Structure	5	Medium porosity
6	Bond Type	V	Vitrified bond

Position	Parameter	Symbol	Meaning
7	Manufacturer's Suffix	17	Private code

Detailed Explanation of Each Element:

1. Abrasive Type:

- **Aluminium Oxide (A):** For grinding steel, malleable iron, tough bronzes. Types: Regular (A), White (WA), Pink (PA).
- **Silicon Carbide (C):** For cast iron, non-ferrous metals, cemented carbides. Types: Black (C), Green (GC).
- **Diamond (D):** For carbide, glass, ceramics.
- **CBN (B):** For hardened steels, superalloys.

2. Grain Size (Grit Number):

- Determines surface finish and stock removal rate.
- **Coarse (10-24):** Rough grinding, snagging.
- **Medium (30-60):** General purpose, cylindrical grinding.
- **Fine (70-180):** Precision grinding, tool sharpening.
- **Very Fine (220-600):** Lapping, superfinishing.

3. Grade (Bond Hardness):

- Indicates strength of bond holding abrasive grains.
- **Soft (A-H):** For hard materials (grains dull slowly, need to release easily).
- **Medium (I-P):** For general applications.
- **Hard (Q-Z):** For soft materials (grains dull quickly, need to hold longer).

4. Structure (Porosity):

- Spacing between grains; affects chip clearance and coolant flow.
- **Dense (1-4):** For hard, brittle materials; better surface finish.
- **Open (9-16):** For soft, ductile materials; prevents loading.

5. Bond Type:

- **Vitrified (V):** Clay/ceramic bond; porous, rigid, unaffected by coolant; most common.
- **Resinoid (B):** Synthetic resin; strong, elastic; for high-speed wheels, cut-off wheels.

- **Rubber (R):** Flexible; for thin wheels, regulating wheels.
- **Shellac (E):** Elastic; high finish; cam grinding.
- **Metal (M):** For diamond/CBN wheels.

Selection Criteria:

- Workpiece material determines abrasive type.
- Stock removal vs. finish determines grain size.
- Material hardness determines wheel grade.
- Coolant and chip clearance needs determine structure.

Q4. Explain how grinding wheels are classified.

Classification of Grinding Wheels:

1. Based on Abrasive Type:

- **Conventional Abrasives:**
  - Aluminium Oxide (A) wheels
  - Silicon Carbide (C) wheels
- **Superabrasives:**
  - Diamond (D) wheels
  - Cubic Boron Nitride (B) wheels

2. Based on Shape (IS: 2324 / ISO 525):

Type	Shape	Application
Type 1	Straight wheel	Cylindrical, surface, tool grinding
Type 2	Cylinder wheel	Surface grinding (horizontal spindle)
Type 4	Tapered wheel	Thread grinding, gear grinding
Type 5	Recessed wheel	Surface grinding with mounting flange
Type 6	Straight cup wheel	Tool and cutter grinding

Type	Shape	Application
Type 7	Recessed double cup	Cylindrical grinding
Type 11	Flaring cup wheel	Tool grinding, snagging
Type 12	Dish wheel	Saw sharpening, cutter grinding
Type 13	Saucer wheel	Saw gumming

3. Based on Bond Type:

- Vitrified Bond Wheels (most common)
- Resinoid Bond Wheels
- Rubber Bond Wheels
- Shellac Bond Wheels
- Silicate Bond Wheels
- Metal Bond Wheels (for superabrasives)

4. Based on Grade (Hardness):

- Soft Grade Wheels (A-H)
- Medium Grade Wheels (I-P)
- Hard Grade Wheels (Q-Z)

5. Based on Grain Size:

- Coarse Grit Wheels (10-24)
- Medium Grit Wheels (30-60)
- Fine Grit Wheels (70-180)
- Very Fine Grit Wheels (220-600)

6. Based on Structure:

- Dense Structure (1-4)
- Medium Structure (5-8)
- Open Structure (9-16)

7. Based on Application:

- **Rough Grinding Wheels:** Snagging, cut-off, portable grinding.

- **Precision Grinding Wheels:** Cylindrical, surface, tool & cutter, thread grinding.
- **Mounted Wheels/Points:** Small wheels on mandrels for internal grinding and deburring.
- **Cut-off Wheels:** Thin wheels for parting operations.

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