

## FACTORS AFFECTING WHEEL SELECTION

The following factors and variables should be considered for selecting a proper Super Abrasive wheel.

### 1. ABRASIVE

Selecting the correct abrasive, type of diamond or CBN is a very important criteria for optimum wheel performance. The various factors to be considered for selection of diamond or CBN type are based on the material being ground, severity of operation, type of operation and geometry and quality of parts required.

The wheel manufacturer normally chooses the best possible diamond or CBN type based on wheel design and operation factors. Some diamond and CBN types used in Norton grinding wheels are given below.

#### a. DIAMOND TYPES

##### 1. Resin Bond Wheels

**SD** : This is a synthetic diamond used with Resin Bond Wheels for wet or dry grinding, when freeness of cut is desired. This is specially suitable for grinding with low Horse power machines and for operations with high heat generation.

**ASD** : A synthetic variety of Armoured Nickel Coated diamond. This is a natural first choice for grinding carbides where 1/3 or less the total area is steel.

**AMD & AMDC** : Blocky shaped Armoured diamond that prevents wear when a high percentage (greater than 35%) of the area is steel or brazing. This is a premium priced diamond type.

##### 2. Metal Bond Wheels

**M2D** : A blend of weak shaped diamond type for non-metallics.

**M4D** : Most commonly used diamond type for glass, ceramics, refractories.

##### 3. Vitrified Bond Wheels

**RMD** : Medium strength diamond for carbides

**D** : Micron sized diamond for finishing and lapping.

#### CBN TYPES

##### 1. Resin Bond Wheels

**CB** : A coated CBN crystal used mainly with resin bonds. The coating aids the bonds in crystal retention.

**B** : Uncoated CBN crystal used for wheels needing free cutting characteristics.

#### b. GRIT SIZE OF ABRASIVE

This is important as selection of the proper grit size of the Diamond and CBN in the grinding wheel affects the Material Removal Rate and the surface finish of the job being ground. Selection of the proper grit size is also important for profile wheels where corner radii are critical.

Coarser grits should be used for operations needing higher material removal rates and finer grits where finer surface finishes are required. The chart below indicates different surface finishes (RMS) which can be obtained with diamond on carbides and CBN on steels.

## EXPECTED SURFACE FINISH (RMS)

| Grit Size | Surface Finish |           | Depth of cut<br>per pass (max) mm |
|-----------|----------------|-----------|-----------------------------------|
|           | Micro Inch     | Microns   |                                   |
| 100       | 24 - 32        | 0.9 - 1.3 | -                                 |
| 105       | 18 - 30        | 0.7 - 1.2 | -                                 |
| 100S      | 16 - 26        | 0.6 - 1.0 | 0.025 - 0.050                     |
| 110       | -              | -         | -                                 |
| 120       | 16 - 18        | 0.6 - 0.7 | -                                 |
| 150       | 14 - 16        | 0.5 - 0.6 | -                                 |
| 180       | 12 - 14        | 0.5       | 0.002 - 0.0025                    |
| 220       | 10 - 12        | 0.4 - 0.5 | -                                 |
| 240       | 8 - 10         | 0.3 - 0.4 | 0.001 - 0.0015                    |
| 320       | 8              | 0.3       | 0.001 - 0.0015                    |
| 400       | 7 - 8          | 0.3       | -                                 |

## EXPECTED SURFACE FINISH FOR CBN ON STEEL (RMS)

| Grit Size | Surface Finish with Oscillation |           | Surface Finish with<br>Plunge Grinding |           |
|-----------|---------------------------------|-----------|--|-----------|
|           | Micro Inch                      | Microns   |  |           |
| 100       | 35 - 40                         | 1.4 - 1.6 | 40 - 45                                | 1.6 - 1.8 |
| 120       | 30 - 45                         | 1.2 - 1.4 | 35 - 40                                | 1.4 - 1.6 |
| 150       | 25 - 30                         | 1.0 - 1.2 | 30 - 35                                | 1.2 - 1.4 |
| 180       | 20 - 25                         | 0.8 - 1.0 | 25 - 30                                | 1.0 - 1.2 |
| 220       | 15 - 20                         | 0.6 - 0.8 | 20 - 25                                | 0.8 - 1.0 |
| 240       | 10 - 15                         | 0.4 - 0.6 | 15 - 20                                | 0.6 - 0.8 |
| 320       | 5 - 10                          | 0.2 - 0.4 | 10 - 15                                | 0.4 - 0.6 |

\* The grit size of the diamond & CBN grits indicated above are with Norton grit sizes.

Grit Size of Abrasives depends on the average particle size of the abrasives. Different grading systems are prevalent and manufacturers generally use the US Standard Mesh Size or the European FEPA Size.

The Norton grit size is similar to the US Standard Mesh. In India, the FEPA system is preferred. A comparison of the different grading system of abrasives along with the average particle size is given below.

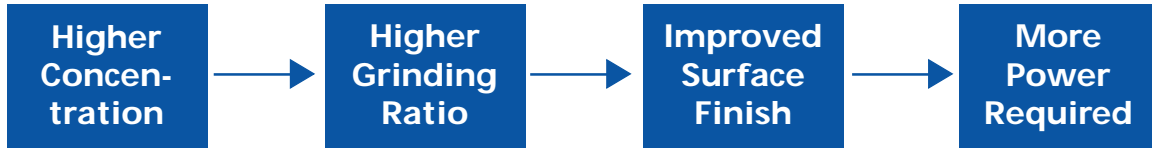
| Norton Grit Size |      | U.S. Standard Mesh | European (FEPA) Size | Japanese (JIS) Size | Average Particle Size (Inches) |
|------------------|------|--------------------|----------------------|---------------------|--------------------------------|
| Diamond          | CBN  |                    |                      |                     |                                |
| 16               | -    | 16/20              | 1182                 | -                   | 0.046                          |
| 24               | 24   | 20/30              | 892                  | 20                  | 0.033                          |
| 36               | 36   | 30/40              | 602                  | 30                  | 0.023                          |
| -                | -    | 35/40              | 501                  | 35                  |                                |
| 46               | 46   | 40/50              | 427                  | 40                  | 0.017                          |
| 60               | 60   | 50/60              | 301                  | 50                  | 0.012                          |
| 80               | 80C  | 50/80              | -                    | -                   |                                |
| 100              | 80   | 60/80              | 252                  | 60                  | 0.0098                         |
| 105              | 100  | 80/100             | 181                  | 80                  | 0.007                          |
| 100S             | 120C | 80/120             | -                    | -                   | 0.0064                         |
| 110              | 120  | 100/120            | 151                  | 100                 | 0.006                          |
| 120              | 150  | 120/140            | 126                  | 120                 | 0.005                          |
| 150              | 180  | 140/170            | 107                  | 140                 | 0.004                          |
| 180              | 220  | 170/200            | 91                   | 170                 | 0.0035                         |
| 220              | 230  | 200/230            | 76                   | 200                 | 0.003                          |
| 240              | 240  | 230/270            | 64                   | 230                 | 0.0025                         |
| 320              | 320  | 270/325            | 54                   | 270                 | 0.0018                         |
| 400              | 400  | 325/400            | 46                   | 325                 | 0.0018                         |

## MICRON SIZE COMPARISON

| Nominal Micron Size | Norton Grit Size* | Approximate European (FEPA) Size | Japanese (JIS) Grit Size | Average Particle Size (Inches) |
|---------------------|-------------------|----------------------------------|--------------------------|--------------------------------|
| 40/60               | -                 | M63                              | -                        | 0.0018                         |
| 30/40               | 500               | M40                              | 500                      | 0.0012                         |
| 23/30               | -                 | M25                              | 700                      | 0.00087                        |
| 15/25               | -                 | -                                | 800                      | 0.0006                         |
| 10/20               | 600               | M16                              | 1000                     | 0.00049                        |
| 8/16                | -                 | -                                | 1500                     | 0.00037                        |
| 6/12                | 800               | M10                              | 2000                     | 0.0003                         |
| 4/8                 | -                 | M6.3                             | 2500                     | 0.0002                         |
| 3/6                 | -                 | -                                | 4000                     | 0.00018                        |
| 2/4                 | -                 | M4.0                             | 5000                     | 0.00011                        |
| 0/2                 | -                 | M1.0                             | 15000                    | 0.000039                       |

## 2. CONCENTRATION

This is defined as the percentage by weight of the abrasive (Diamond or CBN) per cubic unit of the abrasive layer. It is normally expressed as a number which indicates the number of carats (1 carat = 0.2 gms) of abrasive per unit volume of the abrasive layer.



$$\text{Grinding Ratio} = \frac{\text{Vol. of Material Removed}}{\text{Vol. of Wheel Wear}}$$

### SELECTION OF CONCENTRATION

#### Resin Bond - Diamond

- 125 - Used mainly for profile wheels where form retention is critical with hard bonds
- 100 - Used for high production operations for high stock removals. Used only on high horse power machines with flood coolant
- 75 - For dry grinding on medium horse power machines for tool regrinding
- 50 - For low horse power machines and for off-hand grinding where broad surface areas of contact of grinding are there.
- 25 - For polishing operations with micron grits

### GRADES

The grade of a grinding wheel is normally specified along with the Concentration. Grade indicates the hardness of the bond of the grinding wheel. The bond has to have adequate strength to hold the grits and soft enough to shed the dulled grains after use. This is fine tuned based on how the wheel is grinding.

The grade of the wheel is represented by an alphabet.

|               | Bond Type      | Abrasvie | Grade |
|---------------|----------------|----------|-------|
| Most Durable  | Resin Bond     | Diamond  | R     |
| Least Durable |                |          | H     |
| Most Durable  | Resin Bond     | CBN      | Z     |
|               |                |          | W     |
| Least Durable |                |          | Q     |
| Most Durable  | Vitrified Bond | Diamond  | R     |
| Least Durable |                |          | N     |
| Most Durable  | Vitrified Bond | CBN      | N     |
| Least Durable |                |          | F     |
| Most Durable  | Metal Bond     | Diamond  | Q     |
|               |                |          | P     |
| Least Durable |                |          | L     |
| Most Durable  | Metal Bond     | CBN      | W     |
| Least Durable |                |          | Q     |

## RESIN BOND WHEELS

Resin bond wheels are made by bonding the Diamond and CBN grits in a Phenolic or Polyimide matrix. This bond system is extremely soft acting and resilient and is the most commonly used bond system for grinding carbides and HSS tools.

Resin bond wheels are cool cutting and not sensitive to vibrations and can be used in a variety of operations. They are not much suitable for form retention or profiling applications and on applications requiring close tolerances to be maintained. These wheels can be designed to grind with or without coolant and can be made in a variety of shapes. The bonds can be hardened with metal fillers (called Resimet bonds) for creep-feed grinding and some form retention applications. For Diamond and CBN wheels 5 Bonds are available.

B1, B2, B3, B4 and B5.

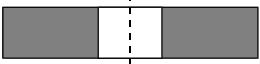



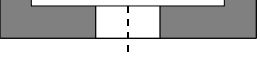
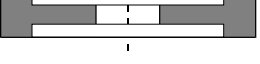
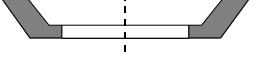
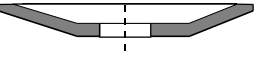
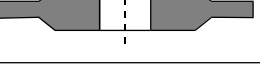
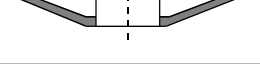
## TYPE OF BONDS WITH RESIN BOND WHEELS






























- B1 - Bond used on high power machines for grinding carbides without steel portions. Wheels can be used wet or dry.
- B2 - Used for Carbide & Steel grinding applications and for large contact area jobs.
- B3 - Dry grinding bond suitable for low horse power machines and tool regrinding jobs.
- B4 - Made with Metal fillers (Resimet) for creep-feed and form retention applications.
- B5 - Made with Metal fillers with cool cutting characteristics.

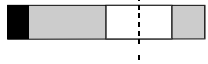
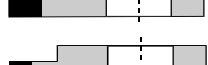
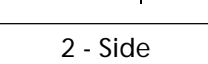
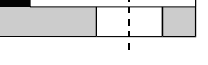
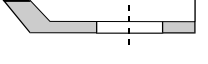
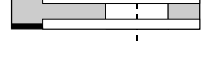
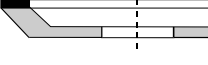


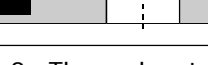

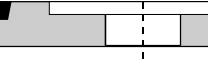
## TYPE OF WHEEL

The size, geometry and dimensions are selected based on the operation to be done the machine used and the accessibility of the abrasive section to the work piece. The basic dimensions and physical characteristics of wheels are given below. Normally, the FEPA standard is used to designate the wheel fully.

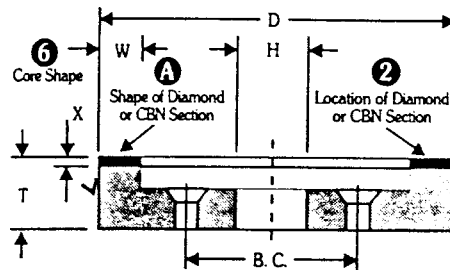
**Type of Wheel :** This indicates the shape of the wheel and is typified by 4 digits.

| <b>1st Digit</b>  |    |
|---|----|
| Indicates Core Shape which can be<br>1, 2, 3, 4, 6, 9, 11,<br>12, 14, 15.           |    |
|    | 1  |
|    | 2  |
|    | 3  |
|   | 4  |
|  | 6  |
|  | 9  |
|  | 11 |
|  | 12 |
|  | 14 |
|  | 15 |

| <b>2nd Digit</b>  |    |
|---|----|
| Indicates Shape of the Abrasive Section and is indicated by 1 or 2 alphabets and chosen from chart. |    |
|                    | A  |
|                    | GN |
|                    | AH |
|                    | H  |
|                    | B  |
|                    | J  |
|                    | BT |
|                    | K  |
|                    | C  |
|                    | L  |
|                   | CH |
|                   | LL |
|                  | D  |
|                  | M  |
|                  | DD |
|                  | P  |
|                  | E  |
|                  | Q  |
|                  | EE |
|                  | QQ |
|                  | ER |
|                  | S  |
|                  | ET |
|                  | U  |
|                  | F  |
|                  | V  |
|                  | FF |
|                  | Y  |
|                  | G  |

| <b>3rd Digit</b>  |
|---|
| Indicates the location of the Abrasive Section.                                       |
| <b>1 - Periphery</b>  |
|    |
|    |
|    |
| <b>2 - Side</b>   |
|    |
|   |
| <b>3 - Both Sides</b>   |
|  |
| <b>4 - Inside Bevel or Arc</b>  |
|  |
| <b>5 - Outside Bevel or Arc</b>   |
|  |
| <b>6 - Part of Periphery</b>  |
|  |
|  |
| <b>8 - Throughout</b>   |
|  |
| <b>9 - Corner</b>   |
|  |

The wheel shown below is a 6A2 wheel such as **Type 6A2**



### WHEEL DIMENSIONS

The important wheel dimensions to be specified are

- 1 - Diameter of the wheel 'D'
- 2 - Width of the Abrasive Section W or V
- 3 - Depth of Abrasive X
- 4 - Overall thickness of wheel T
- 5 - Bore of the wheel H

### HOW TO ORDER A FULL WHEEL

To completely order or specify a wheel the following has to be given :

| Wheel Type        | Abrasive                   | Mesh Size                | Grade               | Conc                       | Bond             |
|-------------------|----------------------------|--------------------------|---------------------|----------------------------|------------------|
| <b>6A2</b>        | <b>ASD</b>                 | <b>126</b>               | <b>R</b>            | <b>75</b>                  | <b>B2</b>        |
| Choose from chart | Choose diamond or CBN type | Choose mesh size in FEPA | Choose proper grade | Choose right concentration | Choose bond type |

Specify Dimension **D, W/U, X, T, H**

For special profile wheels include wheel drawing.