Machining

Grinding Wheel Basics – What's in a Wheel?

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Many manufacturers today use abrasives somewhere in their process. In fact, without abrasives our planes wouldn't fly, our cars wouldn't drive, and the list goes on. Whether making precision bearings, knocking down welds on a construction site, grinding crankshafts, or polishing an injection mold used to make household appliances, abrasives are everywhere, and one of the most commonly used abrasive products is the grinding wheel!

ABRASIVES: A HISTORICAL PERSPECTIVE

Abrasives, even in their most rudimentary form, have been around as long as man has been making things!

- Using one stone to shape another dates back to the Stone Age
- 7,000 years ago, the Chinese used crushed sea shells glued to parchment for polishing
- Using mill stones to crush food grains dates back to 200 B.C.
- In the 10th century, grinding stones were used for making swords, shields, plows, and tools

Today, modern abrasives have evolved into highly sophisticated technical products, used to manufacture very complex components made from some of the toughest alloys and known materials.

But what do we really know about them?

WHAT'S IN A WHEEL?

Grinding wheels, regardless of their manufacturer, are made up of three main components:

An Abrasive Grain

- Aluminum oxide, silicon carbide, zirconia, ceramic alumina, cBN, or diamond are the most common

A Bonding Agent

- Vitrified – glass-like bond
- Organic – resin or other agent

Air/Empty Space

- Voids or porosity (natural or induced)

If the wheel is a superabrasive, the actual abrasive segment (Diamond or cBN) will be mounted on a hub or core to form the wheel.

Wheel Hub Materials

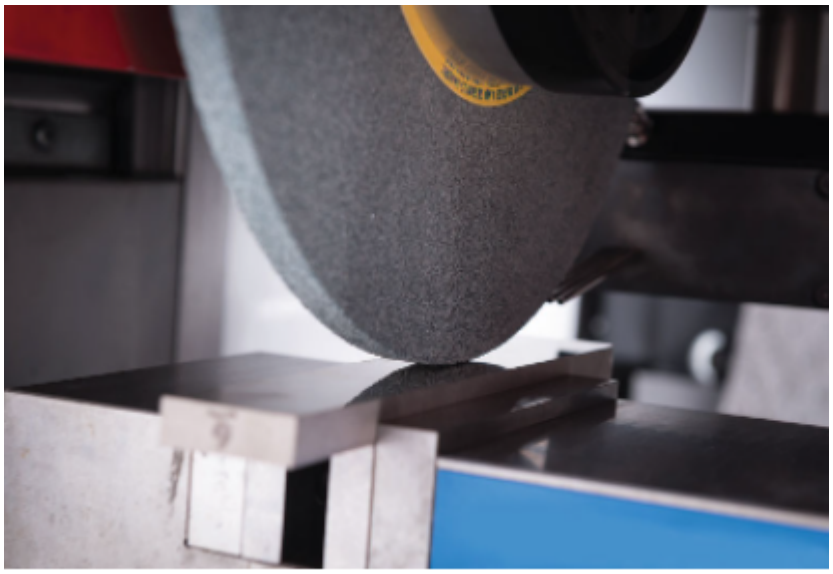
- Steel, aluminum, carbon fiber, bakelite, etc.

HOW ARE GRINDING WHEELS MADE?

When talking to a grinding wheel manufacturer, many use the analogy that making a grinding wheel is like baking a cake, and in its simplest form, that is exactly how it's made.

When a baker receives an order for a cake, they look at the recipe and measure out the ingredients. The wet and dry ingredients are blended together to make the batter, and once mixed, they pour the mixture into a mold and put the mold into the oven to bake. Once the batter is cooked, they remove the cake from the mold, clean it up, finish it, and send it to the customer.

When a grinding wheel manufacturer receives an order for wheels, whether they are making it for stock or made-to-order for a particular customer, they follow a nearly identical – although much more industrialized – process. The manufacturing process begins with an order for a particular wheel. The specification calls out which abrasive grain and bonding chemicals go into the wheels, and the size tells them how much of each is required. These raw materials are then mixed in a large industrial mixer, very similar to mixing mortar or cement. Once it meets the required consistency, the mixture moves to the molding presses were it is measured out, molded, and pressed into wheels in a very raw or green state. These green wheels are then loaded into an oven and fired to bake or cure the wheel into a rough, but usable, grinding product. When the wheels cool, they are moved to a finishing area where they are cleaned, inspected for quality and safety, balanced, stenciled, packaged, and finally shipped to the end user.



BREAKING THE CODE: HOW TO DECIPHER A GRINDING WHEEL SPEC

Many who work with grinding wheels every day don’t often think about the specification and what is stenciled on the side of the wheel, only ensuring that what’s on the wheel matches what the operation requires so the wrong wheel is not accidentally mounted and/or used.

For those who make grinding wheels and are tasked to optimize them, there is a lot of information provided in a wheel specification. If you know how to break the code and decipher what the spec info means, nearly everything there is to know about that particular wheel can be determined.

Although every grinding wheel manufacturer has their own list of abrasive grains and bonds, and there is no set industrial standard or requirement to follow a set format, the “Marking System” as we know it

has been established by convention. Let's take a look at a grinding wheel specification and decipher what each part means.

32A46-I8VBE

32A46-I8VBE – The first part of the specification identifies what the abrasive grain is. Every manufacturer has their own list of abrasives, but in general, an 'A' is aluminum oxide, a 'B' calls out cBN, a 'C' indicates silicon carbide, a 'D' is for diamond, and a 'Z' denotes a zirconia abrasive grain. Where things get tricky is when a ceramic or ceramic blend is called out. This is where each manufacturer can sometimes get a little creative.

32A**46**-I8VBE – The second part of the specification identifies the abrasive grit size. In general terms, the abrasive grit size range for grinding wheels runs between 12 grit for rough grinding operations, such as those found in steel mills, and 220 grit for very fine/precision grinding operations.

Again, there is no industry standard, but in general terms:

- Coarse grits run 12 to 24
- Medium grits run 30 to 70
- Fine grits run 80 to 220 (and finer)

32A46-**I**8VBE – The third part of the marking system identifies the grade or hardness of the wheel. The marking system uses letters between A and Z or ZZ to indicate how hard the wheel is. Each manufacturer may use the same marking system, but this does not mean that each manufacturer's particular grade is the same. Norton may have a mid-range wheel marked as a 'J' grade, and another manufacturer may also mark their wheel as a 'J' grade, but it doesn't mean that they will be the same hardness or act the same. Generally, it just means that they are both mid-range wheels.

For reference:

- Soft grades range from D through H
- Medium grades range from I through P
- Hard grades range from Q through Z

32A46-I**8**VBE – This number, the fourth item in the marking system, is sometimes omitted. This number represents the structure of the wheel. Structure is a measure of the relative grain spacing or porosity of the wheel. The larger this number is, the more open or porous the wheel. The smaller this number, the more densely packed the grains are in the wheel. In the event that this number is omitted, we consider it to be an '8' structure, which is considered the "normal" or standard value.

32A46-I8**VBE** – The final part of the specification identifies what type of bond is used in the wheel and what, if any, modifiers have been added. The most common values are 'B' for resinoid bonds, 'R' for rubber, and 'V' for vitrified bonds. In the event that there are multiple bonds available for a given type, as is often the case in the Vitrified bond group, this part of the marking system will indicate which particular bond is used from the group.

For many people, grinding wheels are a mystery. But as with most things, when you break them down to their components and look at what they really are, you can pull back the curtain and see grinding wheels for what they are: multi-point cutting tools used in precision manufacturing.

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